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APPROACHES FOR ENHANCING THE CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT STRATEGY IN JORDAN

PhD Research

Dedication

I dedicated this research to

Almighty God,

My great father and mother (Hussein Al-khraisha and Lana Al-Tarawneh), my beloved future wife (Sara Gharaibeh),

and other family members and friends…

for their patience, encouragement, and support.

Acknowledgments

Firstly, I owe everything to the almighty God for giving me the foresight, knowledge, health and wellness strength to complete this research successfully.

I am very grateful to the person who kept the research in right direction and lighted the way to achieve it through his guidance, encouragement and patience throughout the study, my first supervisor **Dr. Reuben Brambleby.** I also owe thanks to my second and third supervisors, **Dr. Maryam Imani**, **Dr. Yingang Du and Dr. Alan Coday.** Special thanks to the administration manager **Sam Wilson** for his help and support.

I am very thankful to all the keys of contact and the points of contact of this research for supporting and helping me on different aspects: **Eng. Baha AlNsour, Eng. Hanadi Raba'ayah, Eng. Kholoud Sa'dieh, Eng. Mohammad Salah and Eng. Tariq Hureini**. I also acknowledge all the sources of research information used in this study. I thank the following organisations and their officers for providing research information and making their resources accessible: **GAM, GIM, JEPC and CAA**.

I am very grateful to the members of my family and my beloved future wife. Special great thanks to all of them who remained all the time the source of inspiration, love, support and encouragement. I thank you all for your prayers, patience and waiting for me.

Abstract

Despite the globally recognized importance of construction and demolition waste management, Jordan employs an inadequate national construction and demolition waste management strategy that is confined to discarding of construction and demolition waste to landfill. This work has identified evidence of several significant impediments to successful construction and demolition waste management in the Jordanian construction industry. It is shown that most construction and demolition waste in Jordan is disposed of informally along roads or in open spaces between residential areas, with no environmental protection measures in place. Thus, this work aims to present proposals aimed at improving Jordan's strategy for managing construction and demolition waste in a manner that the Jordanian construction industry is likely to accept and adopt. Evidence is provided to demonstrate that construction and demolition waste recycling is both desirable and achievable in Jordan and that informal dumping of construction and demolition waste should be eliminated.

Several gaps in knowledge have been identified during the review of previous literature, the review reveals several questions that need further investigation. Thus, the research has employed a mixed methodology approach that entails undertaking material testing, archival data collection, closed and open-ended questionnaires and semi-structured interviews with practitioners and governmental bodies involved in construction and demolition waste management. The literature review was utilised to analyse both international best practices in waste management and peculiarities with Jordan's construction sector. The analysis of the literature reveals that current strategies for managing construction and demolition waste in Jordan are insufficiently developed and therefore hinder improvement of the current state of construction and demolition waste management in the country.

The main findings demonstrate that the construction sector has a significant impact on Jordan’s environment by manufacturing over 5 million m^3 of concrete and extracting around 4-4.25 million m^3 of aggregate per year (2019 data). In addition, generating around 6 million m^3 of construction and demolition waste, nearly 50% of which is informally dumped. The findings have identified that most problems relating to construction and demolition waste in the country are associated with governmental controls and construction and demolition contractors. Including a general lack of legislative control and its enforcement accompanied with poor oversight and contractors’ perspective and willingness. In addition, appropriate procurement methods are not adopted, particularly for demolition projects. Results have shown that the absence of recycled waste material design codes and poor waste disposal systems are strongly influential factors too.

The findings here identify the measures necessary to push the construction industry toward improved construction and demolition waste management. This can be achieved by raising awareness of the value of crushed concrete aggregates as a resource for new concrete construction in Jordan. In addition, establishing a set of proposals targeted at enhancing Jordan's construction and demolition waste management strategy that are effective, the likely effectiveness has been reviewed and confirmed by industry experts. Findings show that if crushed concrete aggregates is recycled, Jordan might save around 11.5-13% of the total cost of sourcing of raw materials in concrete manufacturing. Meanwhile, the key aspects of these proposals include improving the current government legislation and regulations, developing the industry and its workforce and improving planning and development strategies. The research not only makes proposals for enhancement in Jordan's construction sector, but they also lay the groundwork for future benchmarking studies for construction and demolition waste management.

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Notation

EthOS: Electronic Theses Online Service

GIZ: Deutsche Gesellschaft fur Internationale Zusammenarbeit

C&D waste: Construction and Demolition Waste

CCA: Crushed Concrete Aggregates

GDP: Gross Domestic Product

MT: Million Tons

GHG: Greenhouse Gases

BT: Billion Tons

DfD: Design for Deconstruction

DEFRA: Department for Environment, Food & Rural Affairs

WRAP: Waste and Resources Action Programme

MENA region: Middle East and North Africa Region

GAM: Greater Amman Municipality

AM: Aqaba Municipality

DOS: Jordanian Department of Statistics

NEAP: National Environmental Action Plan

MoE: Ministry of Environment

3 R's approach: Reduce, Reuse and Recycle

MPWH: Ministry of Public Works and Housing

JCCA: Jordanian Construction Contractors Association

JEA: Jordan Engineers Association

CAGR: Compound Annual Growth Rate

NA: Natural Aggregates

OA1:

PIS: Participant Information Sheet

PCF: Participant Consent Form

$\boldsymbol{m^3}$**:** Cubic Meter

KW: Kilo Watt

L: Litre

T: Tons

M$\boldsymbol{M^3}$**:** Million Cubic Meter

JOD: Jordanian Dinars (Currency)

JOD/$\mathbf{m^3}$**:** Jordanian Dinars per one Cubic Meter

MJOD: Million Jordanian Dinars

MLA: Ministry of Local Administration

JGBC: Jordan Green Building Council

EU: European Union

UK: United Kingdom

Supplementary Materials

According to the University's requirements for postgraduate students, applicants are expected to attend all mandatory sessions of the Doctoral School's Researcher Development Programme throughout the term of study. The following stages are listed:

1. Stage 1 compulsory sessions related to the Research Proposal application which includes Induction, Intellectual Property, Ethics 1 - Good Research Practice and Ethics 2 – Research with Humans in the Health and Social Sciences Introduction to Research Ethics and Integrity (in Human Research).

2. Stages 2a and 2b related to the application for Upgrade/Confirmation of Registration which includes Training – Presentations and Training – Academic Writing.

3. Stage 3 which is designed to help candidates prepare for their viva which includes Training – Thesis Production and Examination Preparation.

4. Another compulsory course for “candidates who are engaged in undertaking teaching on any Anglia Ruskin modules and who have not received approved training for that teaching must attend the Learning and Teaching in Practice programme”.

It is worth noting that the applicant has participated in an optional course given by the Doctoral school to identify the skills development requirements for research advancement, such as an Introduction to JISC Online Surveys Workshop.

Copyright Declaration

1 Introduction

This chapter informs the reader about the research's purpose, objectives and topic areas. The chapter starts with an overview of the research history, development and a description of the study's methodology. It presents earlier research demonstrating the importance and value of research in bridging knowledge gaps and contributing to the advancement of knowledge and society by several mixed methods research technique. Additionally, it discusses the research's limitations and its structure.

1.1 The History and Development of the Research

Numerous previous studies show that the bulk of C&D waste is disposed of informally, without consideration for environmental impact in roadside ditches or in open areas between residential neighbourhoods (GIZ, 2014). According to the main analysis, this issue is the result of inadequate management. This has prompted the researcher to obtain a PhD study in Jordanian C&D waste management. Concentrating on the issues inherent in C&D waste management and solutions for optimizing the present management.

Selecting a PhD subject requires extensive study to ascertain the research area, research question, purpose and contribution to knowledge by achieving the following:

1. Desk-top Review:

   Desk-top research was needed to identify a particular C&D waste problem. After a thorough examination of earlier literature, research and novels, it was established that waste management is Jordan's most compelling current topic.

   Jordan, as the data reveal, has a substantial C&D waste issue. As Jain S. et al. (2018) notes, several governments have set a range of goals and aims under a variety of legislation, management systems, programs and policies. To limit the sector's consequences, especially C&D waste, to promote economic growth while conserving the environment. Jordan, however, has made no steps towards such an issue.

   Thus, a key issue was raised with no satisfactory answer was discovered which is **"How can the current issue of C&D waste be effectively enhanced in Jordan and to what extent could recycling be beneficial for the country?".**

2. Interviewing several academics:
   These interviews addressed a broad variety of critical topics with C&D waste in Jordan. The majority of which were related to management concerns, as well as the actors who may be productively engaged in the study.

3. Formulating the PhD topic:
   The study's emphasis was determined upon the previous desktop assessment and interviews. Focusing on the Jordanian construction industry's C&D waste management by establishing a foundation for a more comprehensive investigation.

   Regrettably, Jordan's construction sector lacks established practices for managing C&D waste. Consequently, Jordan's strategy for controlling C&D waste is in desperate need of reform and improvement. Therefore, the study's primary purpose is to provide proposals aimed at improving Jordan's national strategy for managing C&D waste. Intending to garner acceptance from Jordan's construction industry actors that recycling C&D waste is both desired and feasible, as well as informal dumping of C&D waste should be abolished.

4. Identifying the scope of the research:
   Regarding the type of construction waste material, Grifa M. (2006) pointed out in his study that “It is observed throughout the visual and the empirical survey that cement, steel, sand, aggregate and water are the most important construction materials in the Arab construction projects”. Thus, the researcher aims to concentrate on concrete which gathers all these components as the study's primary case.

   Following the debate outlined above, the primary title, purpose and objectives of the study, as well as its originality, were agreed upon. However, the study title has been slightly adjusted from “The Benefits of Using Recycled Construction Material in Building New Structures in Jordan” to "Approaches to Enhancing the Use of Recycled Construction Materials for New Structures in Jordan." As mentioned in the next section, the study's purpose and objectives have been modified during the research process.

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1.2 Research Question and Purpose

Based on the initial investigation, the primary question and objective of the study are crystallised as follows:

A. The Research Question:

“How can Jordan effectively enhance the current problem with C&D waste management and to what extent could recycling be beneficial for the country, focusing primarily on crushed concrete aggregates?”.

B. The Research Purpose:

To develop a set of proposals targeted at enhancing Jordan's national strategy for managing C&D waste. While also recognizing and accepting the proposals of C&D waste recycling that is both desired and feasible and that informal dumping of C&D waste should be eradicated by the industry actors.

C. The Research Aim and Objectives:

The purpose of this study is to tackle various objectives, which are outlined briefly below (**section 3.5.5**):

I. Review of global construction industries and C&D waste management to identify current best practice and effective methodologies.
II. Review of solid waste management in Jordan.
III. Review and investigate C&D waste management in Jordan.
IV. Establish proposals aimed at improving the national C&D waste management strategy in Jordan.

1.3 Research Methods Adopted

An eclectic approach was used to meet the study objectives. The mixed method research technique comprises completing a literature review, , gathering archival data and conducting questionnaires and interviews.

Table 1-1 details how mixed methods research is done and how each technique contributes to the study's objectives being met. Additional information is available in **chapter 10-appendix I** and **chapter 3**.

Research Objectives	L.R	Collection of Archived Data	Questionnaires	Interviews
Review of global construction industries and C&D waste management to identify current best practice and effective methodologies.	X			
Review of solid waste management in Jordan.	X		X	X
Review and investigate C&D waste management in Jordan.	X	X	X	X
Assessing the technical viability of using Jordanian CCA by conducting material tests of both UK and Jordanian CCA.	X			
Establish proposals aimed at improving the national C&D waste management strategy in Jordan.			X	X

Table 1-1: The Mechanism of Using the Research Mixed Methods to Achieve its Objectives

1.3.1 Literature Review Scope

A critical review of secondary data on international best practices in C&D waste management is conducted. As well as the unique characteristics of the Jordanian construction industry, with a particular emphasis that very little waste is currently recycled. Thereby achieving the research's first four objectives. All aspects of environmental, social and economic consequences of the construction industry, as well as the hurdles and solutions related with the adoption of C&D waste management, material extraction, manufacture and transportation, as well as design, construction and demolition, are studied (**chapter 2**). Although, as per the scarcity of trustworthy data on C&D waste management in Jordan, the study has focused on solid waste management to acquire a better understanding of the attitudes toward waste management in the local context.

1.3.2 The Main Investigation

The main investigation was designed to address gaps in the preceding literature highlighted by the research objectives and to accomplish the research output using the following methods:

A. Collection of Archival Data:

   To accomplish the second and third objectives, this technique was used to cover many significant gaps in Jordan's construction sector. **Chapter 5** of archival data includes information on the manufacture of concrete and the extraction of its constituents, the rate and composition of C&D waste landfilling and the energy consumption of concrete manufacturing. It additionally assesses the economic value of recycling CCA.

B. Questionnaires and Interviews:

   These two approaches were employed to supplement the material cited in objectives 2 and 3. To ascertain the constraints in the Jordanian context that impeded the existing C&D waste management strategy's efficacy. **Chapters 5** and **6** contain results from surveys and interviews with several actors in the construction industry, including government organisations, contractors, designers and suppliers (**chapter 3** and **chapter 10-appendix I**).

   The surveys chapter comprises participant answers and analyses demonstrating informal C&D waste dumping, its causes, responsible parties and effective suggestions for its reduction. It also assesses the contractual arrangements for construction and demolition, current approaches to C&D waste management, waste minimization in projects, encouragements, perspectives of local actors and their compliance with and adherence to legislation.

The interviews chapter provides a comprehensive insight and narrative account of the construction industry's present state. Identifies the obstacles to developing a national strategy for C&D waste management and alternative ways of promotion, as well as the local context's perspective (willingness), the causes of informal dumping and potential solutions.

1.4 The Significance and Contribution to Knowledge

The significance of the research emerges from its contribution to bridging the gaps that can be found in previous literatures. Based on an in-depth analysis of past studies and a critical examination of them, particularly those on Jordan, one may appreciate the magnitude of this research and its crucial addition to knowledge.

The relevance of a research may be outlined in terms of the addition it can make to knowledge; hence, this study's contribution can be summarised as follows:

1. As shown by the literature analysis, there is an urgent need to undertake further studies in the Jordanian construction sector to provide a foundation for future research. While there are occasional allusions to the construction industry, they are still somewhat confined to a few specific elements of the industry. Therefore, important gaps in the literature about the re-use of C&D waste in the Jordanian construction sector were identified. As so, it represents a significant addition to knowledge.

2. Based on the interviews performed in Jordan, it is determined that no such research exists that focuses only on C&D waste management in Jordan. In light of this, it is worth noting that this research is the first of its type in the country and benefits the society. This is especially true when the research outcome is tailored to the Jordanian construction industry. Thus, providing a contribution to knowledge and society.

3. In terms of the practical advantages that may be realised for a variety of actors in the Jordanian construction sector, the study established the potential economic values of recycling CCA. Consequently, it contributes to the advancement of knowledge and society.

4. Developing a set of proposals for Jordan's present national strategy for managing C&D waste. Which gained the Jordanian construction industry's recognition and acceptance that recycling is both desirable and feasible, as well as the elimination of informal dumping. Thus, a contribution to society and knowledge.

1.5 Limitations of the Research

The researcher has encountered several limitations and challenges during conducting research study which are as follows:

1. The unpredicted Covid-19 Epidemic and its consequences.
2. Due to a lack of resources, the study was limited to the Jordanian construction industry, which made it difficult to access the data required and support the research, particularly given the time constraints.
3. The cultural competency of the Jordanian society to effectively communicate, interact and participate in the research study.
4. The complexity involved in managing various forms of C&D waste material. To prevent this, despite the fact that concrete is a prevalent material in the industry, the waste material employed in this study was just concrete.

1.6 Structure of the Thesis

This study is arranged into nine chapters, followed by a bibliography and appendices. The research chapters are listed as follows:

- Chapter 1: Introduction
- Chapter 2: Literature Review
- Chapter 3: Methodology
- Chapter 4: Collection of Archival Data
- Chapter 5: Questionnaire Surveys
- Chapter 6: Interviews Analysis
- Chapter 7: Discussion of the Main Findings
- Chapter 8: Overview and Proposals for Future Research
- Bibliography
- Appendices (Appendix I, II, III, IV and V)

The following chapter discusses data gathered from secondary sources regarding international best practices in waste management and the peculiarities of the Jordanian construction industry. Particularly the management of C&D waste and with a particular emphasis on reinforced concrete as the country's primary construction material.

2 Literature Review

2.1 Impacts of Construction Worldwide Industry

Since the turn of the century, the world's cities have increased from 16 to around 400, with over 70% of them located in developing countries (United Nations , 2019). This is astounding evidence of global urbanisation and human development in recent decades to improve people's quality of life (Chen M. et al, 2014). Since it has always been a critical role in urbanisation by meeting the large and expanding need for buildings, this urbanisation has generated around 13% of global GDP (Kabirifar K. et al., 2020; WBCSD, 2015; Kusuma G.H. et al, 2015; Orr J. et al., 2019; Mckinsy and Company, 2017).

This rising urbanisation has resulted in the construction industry to virtually extracts about half of the global natural resources annually (Cheng K. et al., 2018; Augiseau V. and Barles S., 2017; Pacheco-Torgal F. et al., 2017). Nearly 60% of raw material deplete natural resources, resulting in resource depletion (Cheng K. et al., 2018; Augiseau V. and Barles S., 2017; Pacheco-Torgal F. et al., 2017). This industry accounts for more than a third of world greenhouse gas emissions and more than a third of global energy consumption (Iacovidou E. and Purnell P., 2016; Ness D. et al., 2015). According to Zea Escamilla E. et al. (2016), it contributes for around 35% of global CO_2 emissions. The construction industry produces around 30% of global greenhouse gas emissions via construction operations, while transporting and processing construction material contributes another 18% (Zea Escamilla E. et al., 2016).

The amount of C&D waste generated by this industry raises environmental, social and economic problems (Wu H. et al., 2016). These findings are consistent with those reported by Llatas C. (2011), Faleschini F. et al. (2016), Coelho A. and de Brito J. (2013), Marzouk M. and Azab S. (2014), Ram V.G. et al. (2020) and Zheng L. et al. (2017), indicating that this industry generates one of the most voluminous global waste flow streams and is currently consuming an excessive amount of landfill space since most of them are dumped (formally and informally).

According to research by Chau CK et al. (2017) and Huang B et al. (2018), landfilling is the most often used management practice globally. Landfilling depletes landfill space and resources by consuming construction material, results in economic losses, degrades soil productivity and generates noise pollution waves (Faleschini F. et al., 2016; Llatas C., 2011; Coelho A. and de Brito J., 2013; Marzouk M. and Azab S., 2014; Ram V.G. et al., 2020; Zheng L. et al., 2017; Ye G. et al., 2012; Ding Z. et al., 2016; Akanbi L.A. et al., 2018). Additionally to using energy and non-energy resources via manufacturing, material transportation and waste disposal, associated with releasing greenhouse gas emissions, increasing the ecological footprint of the construction industry that adds to the phenomena of global warming such as worsening quality of air and heat waves (Faleschini F. et al., 2016; Llatas C., 2011; Coelho A. and de Brito J. , 2013; Marzouk M. and Azab S. , 2014; Ram V.G. et al., 2020; Zheng L. et al., 2017; Ye G. et al., 2012; Ding Z. et al., 2016; Akanbi L.A. et al., 2018). Additionally, economic losses come from transporting and disposing of C&D waste to licensed landfill sites through disposal pricing systems (Akanbi L.A. et al., 2018 and Ding Z. et al., 2016). According to Akanbi L.A. et al. (2018) and Ding Z. et al. (2016), this might be a key factor for informal C&D waste disposal in Jordan.

2.1.1 Types and Volume of Construction and Demolition Waste

Prior to providing the types and volume of C&D waste, it is necessary to define C&D waste. C&D waste is defined by Lu. W. et al. (2011) as residual material generated during construction, restoration, or demolition. While Lu. W. et al. (2011) failed to adequately define C&D waste, Zhao W. et al. (2010) did.

This waste is classified into two taxonomies as seen below (Zheng L. et al., 2017). Inert waste that has no direct economic value and must be processed which includes concrete, bricks, mortars and ceramics (Wu H. et al., 2016). Non-inert waste is waste that is commercially valuable and has direct economic value by re-selling, such as steel and timber (Wu H. et al., 2016). Unlike the UK, which has classified C&D waste according to its type, as detailed in AlZohbi M. (2015) study:

1. Inert Waste:
    a. Soft material such as soil.
    b. Hard material such as concrete and mortars.
2. Non-inert Waste:
    a. Residual material.
    b. Other material such as metals and timber.

Numerous studies have discovered that renovation and demolition activities present the biggest proportion of C&D waste composition, around 70% of which is inert waste such as concrete and aggregates (Ding Z. et al., 2016; Wu H. et al., 2016; Abreu P.F. et al., 2015). Below are detailed data.

The following are global data on the types and volume of C&D waste. According to Wu Z. et al. (2019), the annual total amount of C&D waste generated globally exceeds 10 billion tons, only 35% of this is currently landfilled (Duan H. et al., 2016; Kabirifar K. et al., 2020). According to estimates, the US landfill 33% of C&D waste generated, Hong Kong 65%, Canada 35%, UK 50% and Australia 20–30% (Polat G. et al., 2017). The discrepancy between Llatas C. (2011); Faleschini F. et al. (2016); Coelho A. and de Brito J. (2013); Marzouk M. and Azab S. (2014); Ram V.G. et al. (2020); Zheng L. et al. (2017); Chau C.K. et al. (2017); Huang B. et al. (2018) studies and Wu Z. et al. (2019) study may be due to the informal dumping of C&D waste that is not quantified.

Charts 2-1 and **2-2** compare the mix of solid waste and C&D waste generation volume in various regions around the world (Eurostat Waste Statistics, 2018). Estimates from several studies quantified that C&D waste accounts for 30% - 40% of solid waste composition (Shen L.Y. and Tam W.Y., 2002; Akhtar A. and Sarmah K., 2018; Jin R. et al., 2017; Solís-Guzmán J. et al., 2009). C&D waste accounted for 36% of total EU solid waste (924 MT) in 2016 (Eurostat Waste Statistics, 2018). Another interpretation of the composition of solid waste can be found in Zheng L. et al. (2017) and Wang J. et al. (2018) studies, estimating that around 800 MT of C&D waste is generated in European countries accounting for roughly 25–30% of solid waste composition.

France, UK and the Netherlands generate approximately 74% of the EU's C&D waste (Eurostat Waste Statistics, 2018). As evidenced by C&D waste levels in France (about 69% of total solid waste composition) and the UK (approximately 49% of total solid waste composition), where critics assert that nearly 13 MT of material are unused (López Ruiz L.A. et al., 2020; DEFRA, 2013; Liu Z. et al, 2015). Other countries, such as Germany, USA and China, generate approximately 200, 534 and 2036–3500 MT of C&D waste, respectively, accounting for 30–67% of total solid waste composition (López Ruiz L.A. et al., 2020; DEFRA, 2013; Liu Z et al., 2015; EPA, 2016; Huang B. et al., 2018; Zheng L. et al., 2017). According to additional research by Wu H. et al. (2019) and Wang J. et al. (2018), USA generates annually 700 MT of C&D waste. Along with Brazil, Hong Kong and Canada which C&D waste accounts for nearly 40%, 25% and 27%, respectively (Lu W. and Tam W.Y., 2013; Oyedele O. et al., 2014).

In comparison, Europe's aggregate estimates of C&D waste are significantly lower than those in China and that criticizes the ways in which C&D waste is managed which is mostly attributed to mature systems and long-term implementation of C&D waste management. This could be a result of Jordan's inability to handle C&D waste.

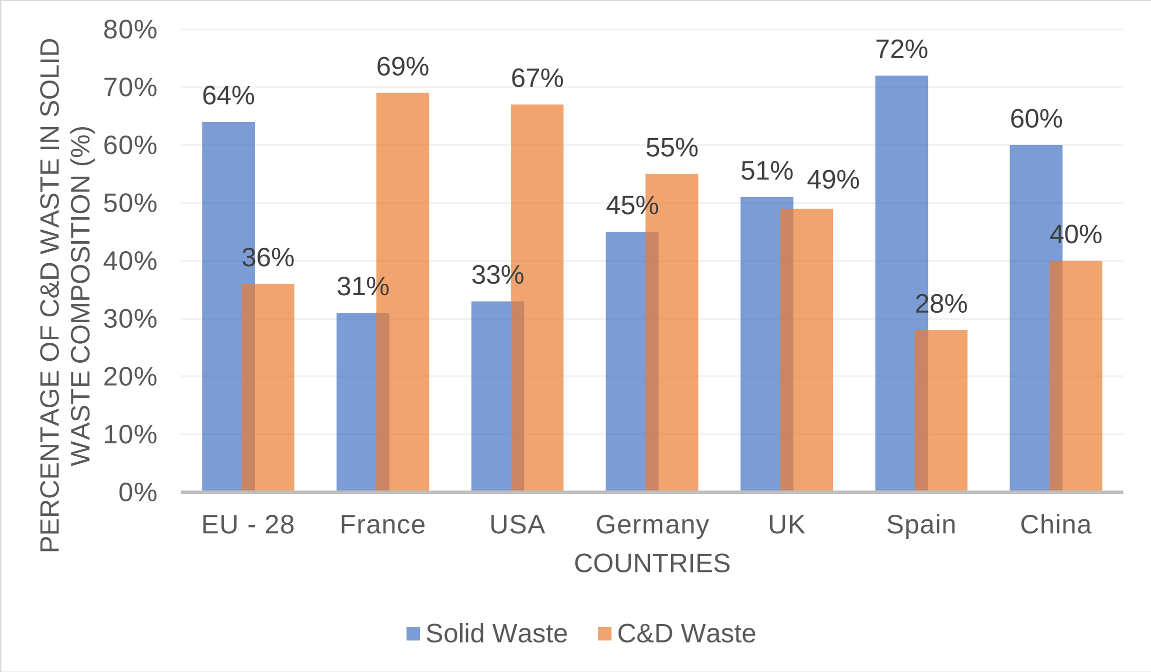

Chart 2-1: Composition of Solid Waste in Different Countries (Eurostat Waste Statistics, 2018)

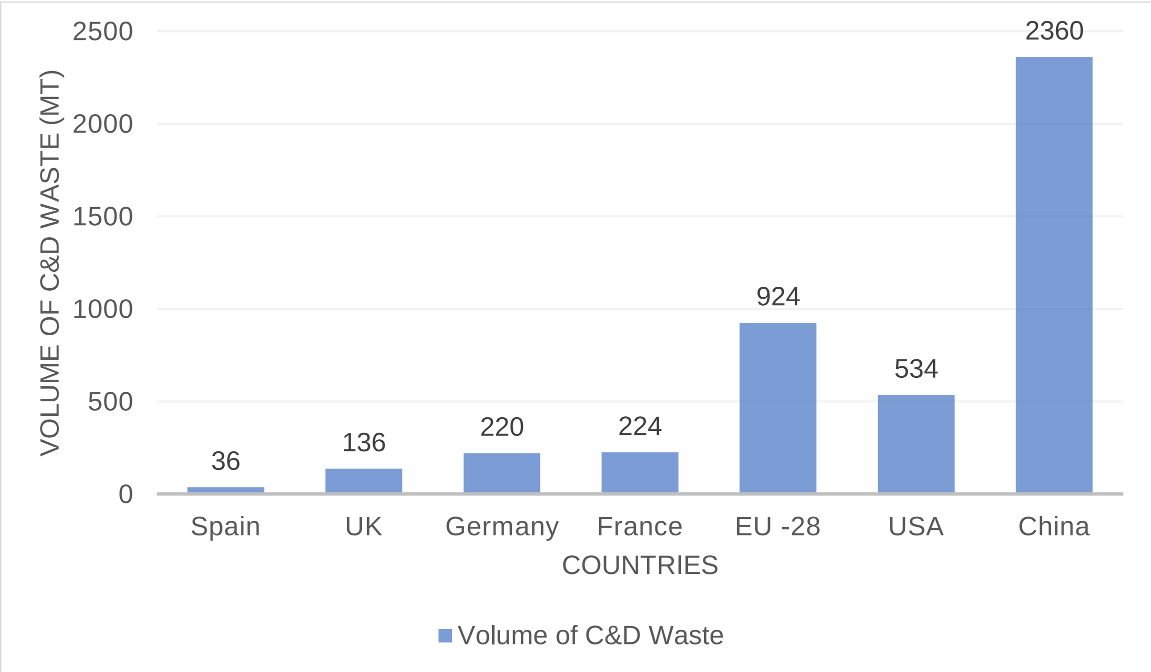

Chart 2-2: Annual Generation of C&D Waste in Different Countries (López Ruiz L.A. et al., 2020; DEFRA, 2013; Liu Z. et al, 2015; EPA, 2016; Huang B. et al., 2018; Zheng L. et al., 2017)

The types and quantities of C&D waste vary according to type of site, usage, culture, building designs, weather conditions and job activities (Gálvez-Martos et al., 2018; Sormunen P. and Kärki T, 2019). These distinctions reflect the diversity of building material and structures used throughout the world (Islam R. et al., 2019). Thus, the type of construction material used influences the composition of C&D waste.

Table 2-1 presents the composition of C&D waste with percentages excluding excavation material (BioIS, 2016; Gálvez-Martos et al., 2018). The highest compositions are found for masonry and concrete ranging from 8% to 54% and 12 to 40%, respectively (BioIS, 2016). These two waste streams account for between 40% and 80% of C&D waste. Also Asphalt accounts for 4% to 24%, metal waste accounts between 0.2% and 0.4%, plastics accounts between 0.1% - 2% and timber accounts between 2% and 4% (BioIS, 2016).

The substantial share of concrete could be attributed to the construction industry's extensive use of concrete. As the recent functionalism of buildings towards modernization have inclined the use of concrete (Swensen G., 2012; Islam R. et al., 2019). Thus, concrete would be considered as part of a more comprehensive waste investigation in Jordan.

Waste Category	Min–Max Range %
Concrete and Masonry	40–84
Concrete	12–40
Masonry	8–54
Asphalt	4–26
Others (mineral)	2–9
Timber	2–4
Metal	0.2–4
Gypsum	0.2–0.4
Plastics	0.1–2
Miscellaneous	2–36

Table 2-1: Global C&D Waste Composition (BioIS, 2016)

Ignoring the management of C&D waste has a negative impact on the world environment, social and economic systems (Marzouk M. and Azab S., 2014; Akanbi L.A. et al., 2018; Ding Z. et al., 2016). Concrete and masonry wastes account for a sizable portion of total C&D waste, thus, inert waste plays a vital role in bringing about those impacts. However, a mixture of different types of non-inert C&D wastes such as gypsum, plastics and metals may drain heavy metals and toxic organic elements posing environmental hazards (Islam R. et al., 2019). To describe the environmental consequences of C&D waste, **table 2-2** compiles numerous researches conducted worldwide identifying C&D waste environmental impacts. It should be noted that non-energy resource consumption signifies the energy consumed of building raw material.

Studies	Country	Environmental Impacts of C&D waste						
		Land Depletion	Energy consumption	Non-energy resource consumption	Soil pollution	Air pollution	Noise pollution	Water pollution
(Seror N. et al., 2014)	Israel				✓			✓
(Marzouk M. and Azab S. , 2014)	Egypt	✓	✓			✓		
(Shen L.Y. et al., 2004)	Hong Kong					✓	✓	✓
(Zhang X. et al., 2012)	Hong Kong	✓						
(Vitale P. et al., 2017)	Italy	✓	✓	✓		✓		✓
(Ding Z. et al., 2016)	China	✓	✓			✓		✓
(Yeheyis M. et al., 2012)	Canada		✓			✓		✓
(Lockrey S. et al., 2018)	Vietnam		✓		✓	✓		✓
(Zambrana-Vasquez D. et al., 2016)	Spain	✓				✓		
(Coelho A. and de Brito J., 2013)	Portugal		✓			✓		
(Diyamandoglu V. and Fortuna L., 2015)	United States		✓			✓		
(Marrero M. et al., 2017)	Spain		✓	✓				
(Borghi G. et al., 2018)	Italy	✓	✓	✓		✓		✓

Table 2-2: Several Literatures of Environmental Impacts of C&D Waste (Seror N. et al., 2014; Marzouk M. and Azab S. , 2014; Shen L.Y. et al., 2004; Zhang X. et al., 2012; Vitale P. et al., 2017; Ding Z. et al., 2016; Yeheyis M. et al., 2012; Lockrey S. et al., 2018; Zambrana-Vasquez D. et al., 2016; Coelho A. and de Brito J., 2013; Diyamandoglu V. and Fortuna L., 2015; Marrero M. et al., 2017; Borghi G. et al., 2018)

According to Wang J.Y. et al. (2010), social impacts are frequently associated with increased disturbance of construction sites, low skilled job opportunities, particularly in developing countries. Additionally, C&D waste resulting in health problems and eyesores whether formally or informally disposed (Wang J.Y. et al., 2010). Nevertheless, according to Wang J.Y (2010) study these environmental and social impacts have been given as much lower attention. As several literatures related to C&D waste management to date shown that the construction industry's principal objective remains for economic performance or profit maximization, not the environmental and social aspects (Wang J.Y. et al., 2010).

2.1.2 Causes of Construction Waste

Numerous works of literature have debated the causes of C&D waste generation (Polat G. et al., 2017). Domingo N. and Luo H. (2017) discovered that ineffective project communication and coordination among project stakeholders, poorly defined responsibilities, a lack of supervision and regulations, low-quality construction material, a lack of contractor awareness and a low budget for construction projects all contribute to the generation of C&D waste. Additional factors can be found clarified in other studies such as Innes S. (2004), Osmani M. et al. (2008), Osmani M. et al. (2009), Chowdhury M. et al. (2016) and Islam R. et al. (2019).

The research details in the next section the design, construction and demolition methods through describing their stages and construction material used by the industry.

2.2 Design, Construction and Demolition Methods

Plans, reports and contracts for design, construction and demolition all contribute to the supply chain's exceptional performance (Naoum S. and Egbu C., 2015). Ineffective industry procurement processes, however, might occasionally result in worse results, as could be the case in Jordan. A thorough secondary source review of the UK construction industry was done, encompassing design, construction and demolition phases.

As stated by Naoum S. and Egbu C. (2015), construction procurement entails functional and contractual coordination of the involved members through roles, authority and power, as well as responsibilities and risks. Prior to these stages, contractors and construction firms organise themselves to win on biddings before these stages (Naoum S. and Egbu C., 2015).

Historically, project bids were inadequate since they were only based on lowest price selection. Although, this has changed significantly in recent years towards competitive procurement systems by multiple and best-value one and framework, particularly in developed countries such as the UK and China (Naoum S. and Egbu C., 2015). That pushed construction actors to compete on price, timeliness and quality to win on biddings (Naoum S. and Egbu C., 2015; Wibowo M.A. et al., 2015).

2.2.1 Design and Construction Methods

Several taxonomies for design and construction have been developed by Kagioglou K. et al. (2000) listed briefly as follows and could be provided in greater detail in his study:

1. Pre-project stage:
   This stage entails determining the client's requirements and financial situation via developers and consultants to proceed to the next level of preconstruction (Kagioglou M. et al., 2000). According to Kagioglou M. et al. (2000) and O'Reilly, J. J. N. (1987), this stage is frequently neglected, if not entirely removed.

2. Pre-construction stage:
   This stage corresponds to financial approval and attempts to financially secure the project to create and plan the subsequent stage's course (Kagioglou M. et al., 2000). However, in today's shifting market, the construction industry must demonstrate greater adaptability to influence customer decisions (Kagioglou M. et al., 2000).

This stage optimizes future construction waste planning, control and management to minimize waste and maximize material efficiency (Kagioglou M. et al., 2000). It also encompasses the development of policies and strategy frameworks, design, as well as the creation and implementation of C&D waste management strategies (López Ruiz L.A. et al., 2020).

3. Construction stage:
   This is the stage during which the project is successfully completed on time (Kagioglou M. et al., 2000). It necessitates the procurement of construction material and structures (Kagioglou M. et al., 2000). Bear in mind that changes made at this stage should be kept to a minimum as they add to the project's cost (Kagioglou M. et al., 2000).

4. Post construction stage:
   This last stage aims specifically to monitor and manage any maintenance needed to the structure (Kagioglou M. et al., 2000).

Naoum S. and Egbu C. (2015) discovered that these stages can be influenced by communication, coordination, client’s changes, the environment, the complexity of the project and economic changes (recessions). Providing the construction sector with a variety of strategies with different methods of construction procurements. Such as management contracting and construction project management, would aid to deliver projects that meet the objectives and fulfil client’s criteria and expectations (Naoum S. and Egbu C., 2015). Another possibility is to transmit knowledge and practices cautiously between the construction and industrial sectors (Kagioglou M. et al., 2000).

These findings highlight the critical need of management involvement at all stages of the process to make activities less challenging (Kagioglou M. et al., 2000). Additionally, this technique enables to comprehend how early management may assist reduce C&D waste generation (Wu H. et al., 2016; Zheng L. et al., 2017). That is why the research concentrated on those two concerns in Jordan. Since they may be significant impediments to the effectiveness of the present C&D waste management.

Having defined the taxonomies of design and construction methods, the research moves on now to represent the production of construction material that are needed to construct structures.

2.2.1.1 Production of Construction Materials

Materials in construction have different classifications that vary in their production and processing according to different authors viewpoints, one example is the taxonomy employed by Chandler I.E. (1978) as seen below. Although other examples of this are the studies carried out by Perdomo-Rivera J.L. (2004), Al-Haddad, E.E (2006) and Stukhart G. and Kirby D. (1995).

Chandler's I.E. (1978) taxonomy is used to describe and classify various types of construction materials based on their manufacturing and handling as follows:

1. Bulk materials that are delivered in mass such as sand, gravel, cement and concrete.
2. Bagged materials that are delivered in bags such as cement.
3. Palleted materials that are piled up and placed in pallets to be delivered such as cement bags, prefabricated concrete and doors.
4. Packaged material that are packaged such as pipes and tiles.
5. Loose material that are partially fabricated such as paving slabs and timber.

The extraction and manufacturing of construction material contribute significantly to the progress of the construction industry by supplying building material to meet the demands of global rapid urbanisation and industrialisation (Cheng K. et al., 2018).

It has been criticised that the construction industry environmentally impacts the earth extensively. By extremely demanding on extraction of raw material used for production of material for building of residential, commercial and industrial structures, bridges and roads, dams, etc. (Wu H. et al., 2019; Augiseau V. and Barles S., 2017; Pacheco-Torgal F. et al., 2017). Thus, consuming resources resulting in resource depletion (Pacheco-Torgal F. et al., 2017; Wu H. et al., 2019; Augiseau V. and Barles S., 2017). Previous published studies on the effect of the construction industry are consistent as it depletes raw material and water supplies, emits greenhouse gases (GHG) and consumes energy (Blankendaal T. et al., 2014; de Medeiros G. and Kripka M., 2014; Cabeza L.F. et al., 2021; Iacovidou E. and Purnell P., 2016; Ness D. et al., 2015).

The research concentrated on global extraction, manufacturing and consumption of two primary construction material: steel and concrete along with its main component (aggregate). Meanwhile, studies on masonry could be found in Mimi Das Saikia, Bhargab Mohan Das and Madan Mohan Das (2012), Zhang L. (2013;) Weyant C. et al. (2014) and DEFRA (2015), timber O'Brien M. and Bringezu S. (2018) and cement Mimi Das Saikia, Bhargab Mohan Das and Madan Mohan Das (2012), Nidheesh P.V. and Kumar M.S. (2019), WBCSD (2015), Kusuma G.H. et al (2015), Hanein T. et al. (2018), Hasanbeigi A. et al. (2010), Chen W. et al. (2015), Pal A. (2018), World Business Council for Sustainable Development and International Energy Agency (2013), Crow M.J. (2008), EMIS (2014), Kajaste R. and Hurme M. (2016;) and Surinder Singh Virdi (2012).

2.2.1.1.1.1 Steel

This section demonstrates how heavily the construction industry relies on steel to address expanding urbanisation. Steel manufacturing, in all its forms, has a significant environmental impact, consuming 18% of global energy, 15% of total industrial energy consumption and releasing 4% - 5% of global carbon emissions (Yellishetty M. et al., 2011; Mao C. et al., 2013). Huang L. et al. and Zhang Q. et al. (2018) shed additional light on the consequences of steel manufacture.

As illustrated in **chart 2-3**, approximately half of 2015 steel production was used in building and infrastructure (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016). This rate as based on 2015 data, steel production may have increased since then. **Chart 2-4** illustrates the construction industry's progressive increase in steel consumption between 2010 and 2015, from 1.3 to 1.5 billion metric tons (BT) (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016).

As illustrated in **chart 2-5**, Asia and Oceania had the highest rates of steel production and usage, at 69% and 66%, respectively (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016). China produced about 803 MT of steel in 2015, as illustrated in **chart 2-6** (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016). More statistics of steel production and usage in regional areas in the continent such as Japan with 105.4 MT and India with 89.2 MT (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016). By comparison, the EU and South America produced and used 10% and 3% of steel, respectively (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016).

The EU's statistics are comparable to those of North America, with 7% production and 9% utilisation (U.S. Department of Commerce and International Trade Administration , 2016; World Steel Association, 2016). Finally, the Middle East and Africa had the lowest rates of production and consumption, accounting for less than 5% of total production and utilisation (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016).

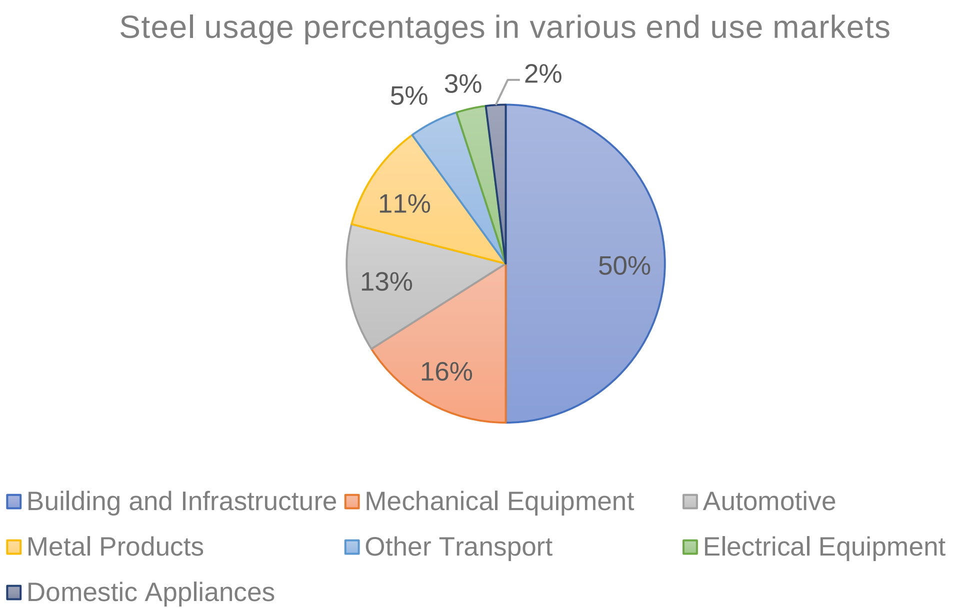

Chart 2-3: The Usage of Steel by the Construction Industry (U.S. Department of Commerce and International Trade Administration, 2016); (World Steel Association, 2016)

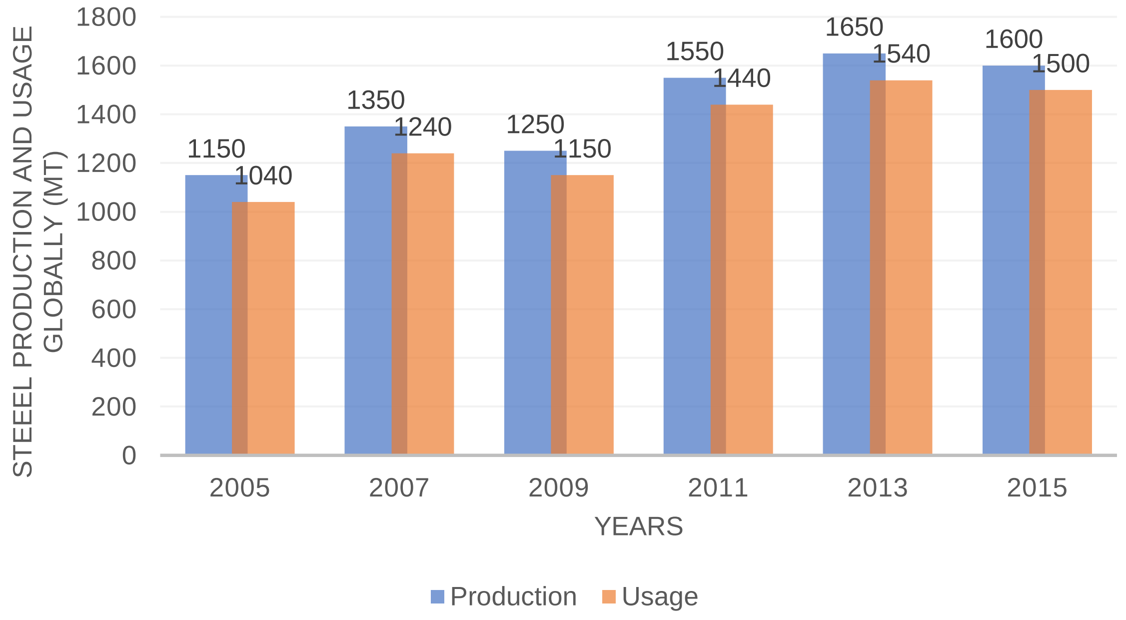

Chart 2-4: Global Steel Production and Usage (U.S. Department of Commerce and International Trade Administration, 2016); (World Steel Association, 2016)

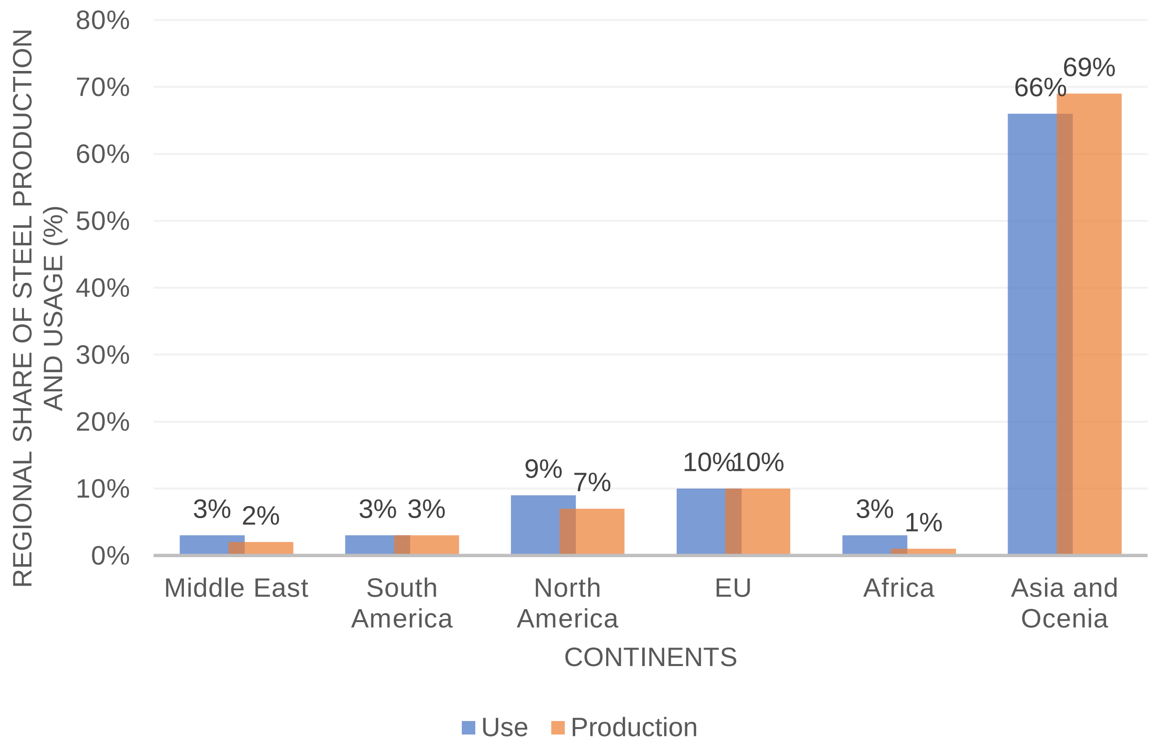

Chart 2-5: The Regional Share of Steel in terms of Production and Usage (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016)

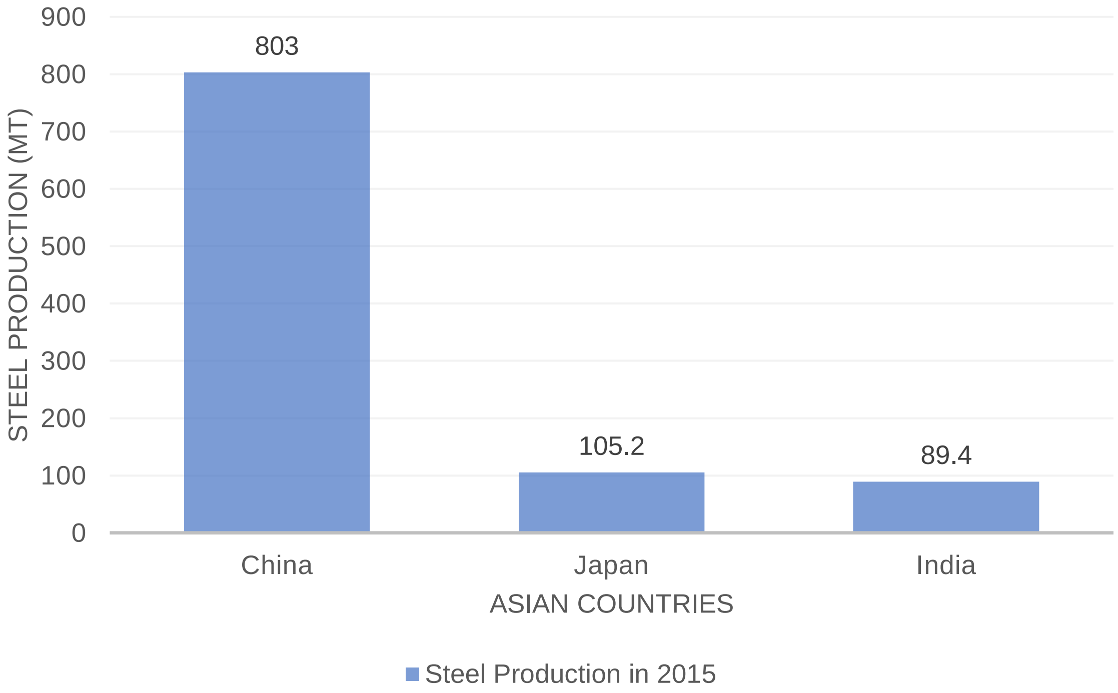

Chart 2-6: Steel Production in Asian Countries in 2015 (U.S. Department of Commerce and International Trade Administration, 2016; World Steel Association, 2016)

2.2.1.1.1.2 Concrete and Aggregates

Concrete mix is the second most widely used material on a global scale, after water (Balaji M., 2017; Sakai K., 2009). Aïtcin P.C. and Mindess S. (2011) and WBCSD (2009) estimate annual worldwide concrete production between 13 and 21 BT, or 3.8 tonnes per capita.

Concrete is a composite material composed of aggregates and cement (Gursel A. et al., 2014). Thus, the components of concrete contribute to environmental degradation by consuming resources and energy (Blankendaal T. et al., 2014). According to Miller S. et al. (2015), the global consumption of concrete in 2015 was approximately 23 BT. That consequently consumes more sand and gravel by 4.5% annually (Miatto A. et al., 2016). In another study, the industry utilises around 20 BT of its components: 90% sand and aggregates (since aggregates comprise 65-80% of the volume of concrete), 6% cement and 4% water (Domone P. and Illston J., 2010; Ali M.R. et al., 2018; Güçlüer K., 2020; Jin R. and Chen Q., 2015).

According to Gonzalez-Corominas A. and Etxeberria M. (2016), Ali M.R. et al. (2018) and Güçlüer K. (2020), a high aggregate content in concrete mixes increases aggregate demand, which results in increased aggregate extraction. With 160 MT of aggregate consumed annually in the UK, 96% generated in over 970 quarries throughout the country and 4% imported, aggregate production is the largest extractive industry in the country (Brown T. et al., 2011). In 2013, construction alone consumed over 53 MT of aggregates (DEFRA, 2015). In 2014, the construction industry in the UK consumed 58 million m^3 of concrete, accounting for 41% of aggregate consumption, followed by construction and fill (30%), asphalt (22%), mortar (6%) and rail ballast (1%) demonstrated in **chart 2-7** below (Brown T. et al., 2011).

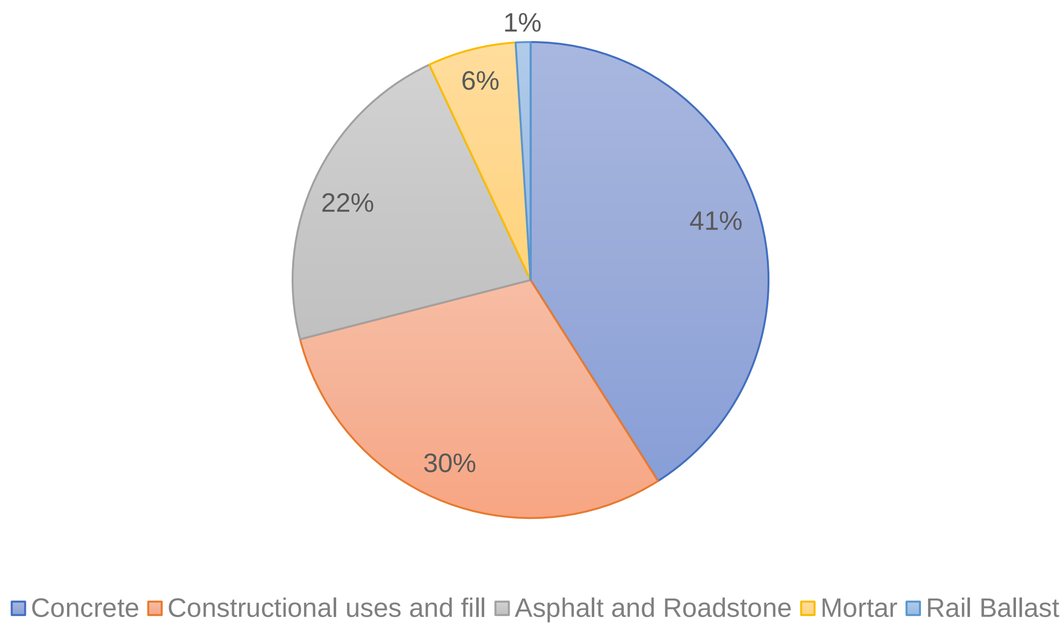

Chart 2-7: Aggregates Usage in the UK via Different Utilisations (Brown T. et al., 2011)

2.2.2 Demolition Methods

This section discusses the demolition process in the construction industry. Demolition is defined by HKBD (2004) as the dismantling or destroying of a whole or part of a structure by different controlled manual or machine methods like hydraulic crusher or implosion.

Demolition of buildings, regardless of their function and purpose, is a widely adopted method globally as demolition rates have increased. In 2014, Shanghai recorded 1.1 million m^2 of demolition floor space (SSB, 2015). Additionally, the number of demolition enterprises in the UK has increased by 40% over the last two decades, to reach 1,164 in 2007 (WRAP, 2009). This has resulted in an increase in the amount of waste generated during demolition projects, which accounts for around 30% of the annual C&D waste generation of approximately 32.7 MT (DEFRA, 2015; WRAP, 2009).

One criticism levelled at this waste is that more than half of that amount is being sent to landfill (Chinda T., 2016; Menegaki M. and Damigos D., 2018). Further statistics on the demolition activity and its waste could be provided in (Statistics Norway, 2015; NDRC, 2014; Lu W. et al., 2016; Yu B. et al., 2020; SSB, 2015; Poon C.S. et al., 2001; Lu W. et al., 2016).

Spisakova M. and Kozlovska M. (2013) listed the application of this method according to the structure and its components via several techniques as follows:

1. Manually.
2. Machinery.
3. Explosion.
4. Deconstruction or complete selective demolition.

According to Spisakova M. and Kozlovska M. (2013), the fourth approach is the most acceptable and suitable method of demolition, as it results in considerable environmental and economic benefits. Since it concerns a dismantling process of construction components to be furtherly re-used in old or new constructions, as recycling and disposal approaches for C&D waste are highly dependent on the approach of demolition used (Spisakova M. and Kozlovska M., 2013). Thus, further research might be conducted to analyse Jordan's demolition plan.

To aid with comprehension, Laefer F. and Manke P. (2008) classified the application of demolition into three fundamental methods:

1. Conventionally, by converting the whole building into waste.
2. Complete selective demolition or deconstruction which comprises the recovery of material.
3. Partial selective demolition which is a combination of both conventional demolition and complete selective demolition (Kourmpanis B. et al., 2008).

According to a study conducted in Portugal by Coelho A. and de Brito J. (2012), full deconstruction combined with recovery practices such as re-use and recycling reduces environmental impacts associated with climate change by around 77% when compared to conventional demolition.

According to Chau C.K. et al. (2017), selective deconstruction saves money in comparison to demolition due to lower total costs associated with landfilling fees. This may not be the case in Jordan, owing to the low cost of C&D disposal. Taxation of landfill fees is critical in determining which demolition or deconstruction practices to use (Chau C.K. et al., 2017).

Nonetheless, according to Schultmann F. and Sunke N. (2007), the construction industry is confronted with a growing number of issues that impact the deployment of recovery methods, one of which is selective destruction (Nußholz L.K. et al., 2019).

According to Wu H. et al. (2016), demolition waste is classified as inert or non-inert as defined above. However, most C&D waste is composed of concrete (inert) and yet ends up usually dumped (Huang B. et al., 2018). According to Wang S. et al. (2019), without waste management knowledge when demolition, all building material will degrade and end up in landfill or open spaces, resulting in both direct and indirect environmental impacts. This is consistent with a study on demolition waste management conducted by Blaisi N.I. (2019).

As a result, the world demands a strategy that takes environmental, social and economic problems into account. This strategy is necessary for urbanization, economic development and environmental protection. Especially when Yu B. et al. (2020) has stated that all demolition wastes can be recycled. As nearly 75% of concrete waste can be recycled and used like aggregates in new concrete (Jain S. et al. , 2018). Additionally, steel could be recycled to be used as a metal product and timber to be used in incineration facilities for energy recovery (Huang B. et al., 2018; Wang S. et al., 2019; Akhtar A. and Sarmah K., 2018; Galán B. et al., 2019; Lockrey S. et al., 2018; Santos S. et al., 2019; Silva R.V. et al., 2016). Although Kucukvar et al. (2014) and Rosado et al. (2019) discovered that non-inert C&D waste has a greater recycling potential than inert C&D waste.

This section has thus far concentrated on demolition but will now turn its attention to deconstruction. The deconstruction method generates construction components that can be used directly in existing or new structures without further processing (secondary components) or that can be utilised indirectly and processed in a recycling facility (sorting and crushing) to create recycled material (Spisakova M. and Kozlovska M., 2013).

The study's findings of Spisakova M. and Kozlovska M. (2013) suggested that the initial phase of demolition should be to design and plan the selected structure in advance taking into consideration the surroundings known as design for disassembly or deconstruction (DfD). These data demonstrate the critical role of DFD in minimizing construction, renovation, demolition and deconstruction waste (Ghisellini P. et al., 2018; Jaillon L. and Poon C.S., 2014). Because it is the ultimate method for delivering sustainable buildings through closed-loop construction material systems (López Ruiz L.A. et al., 2020), greatly reducing waste and facilitating waste recovery (Jaillon L. and Poon C.S., 2014). Additionally, it enforces measurements for delivering a reduction in waste generation from end-of-life activities (Jiménez Rivero A. et al., 2016). As it enables planning and implementation of sufficient waste management strategies contributing to optimize the volume, quality and potential saving costs of recovered material (Jiménez Rivero A. et al., 2016). A more detailed account of deconstruction can offer several benefits which could be provided in Eckelman M.J. et al.

(2018); Chini A.R. (2005); Kibert C.J. and Chini A.R. (2000); Bovea M.D. and Powell J.C. (2016); Brambilla G. et al. (2019); Coelho A. and de Brito J. (2013); Jung J. et al. (2015); Martínez E. et al. (2013) and Spisakova M. and Kozlovska M. (2013) studies.

However, according to Hübner F. et al. (2017), deconstruction is just as complex as construction, especially when the condition of the building is unclear or undocumented, creating uncertainty throughout the process. To meet project objectives and influence project outcomes, deconstruction operations must be organised or planned (Hübner F. et al., 2017). DFD is also constrained by communication, coordination, client changes, the environment, project complexity, limited time periods and economic changes (recessions) (Naoum S. and Egbu C., 2015). Jordan may have these grave defects. Another well-known shortcoming of this method is the absence of tools and design building codes for material reuse (Kibert C.J. and Chini A.R., 2000).

Therefore, Gorgolewski M. (2008) advocates examining deconstructed material to document their characteristics, allowing for improved demand and supply coordination and management in terms of time, quantity, cost and quality. To shift the manufacturing industry to manufacture more easily dismantlable and repairable products (Rios F.C. et al., 2015). Another major influence on deconstruction is time, as it takes between three and eight times as long as conventional demolition, although DFD can significantly reduce this time (U.S. Department of Defence, 2002). According to the US Environmental Protection Agency (EPA) (2008), applying DFD concepts is challenging since construction professionals do not have complete control over project schedules and costs. These concerns may develop in Jordan if DFD is not adopted. With Rios F.C. et al. (2015) work, he adds that the importance of modifying these habits to achieve proper deconstruction, which, if disseminated and implemented, will result in noticeable improvements. These findings contribute to a better understanding of the role of design and planning in deconstruction by considering the building's age, material types and quantities, health and safety precautions and risks (Hübner F. et al., 2017).

The following section discusses the collection, sorting, recycling and landfilling of C&D waste, as well as the regulations and legislation governing these activities. It also discusses the techniques, applications and benefits of using recycled aggregates in new concrete mixes.

2.3 Construction and Demolition Waste Management

Until the early 1980's, global construction industries dismissed environmental concerns in favour of sustainability (Assi L. et al., 2018). Since then, the industry has evolved significantly because of environmental and economic concerns, including new design strategies, production and material utilisation and material recovery (Hodge M. et al., 2010; Sieffert Y. et al., 2014). Over the last two decades, the flow of C&D waste into landfill has compelled governments to develop sustainable programs, schemes, strategies, initiatives, regulations and studies aimed at driving down environmental impacts and achieving economic benefits by attaining circular economy via replacing material's end of life stage with reuse, recycle and recovery (Ajayi S.O. and Oyedele L.O., 2017; Hodge M. et al., 2010; Sieffert Y. et al., 2014; Kirchherr J. et al., 2017).

This section discusses the life cycle of C&D waste material generated during construction, demolition, or renovation projects, including collection, sorting and disposal or recycling, C&D waste management strategies, as well as the outcomes, benefits and repercussions of recycling.

2.3.1 Waste Material Recovery

It is vital to understand the lifecycle of construction material before tackling waste material recovery. Standards (ISO 14040:2006) defined LCA as a "quantitative method that accounts for resource use, emissions and potential environmental and health impacts over the life cycle of a building, including extraction of raw material, manufacturing and assembly of building assemblies, transportation, construction, building operation, maintenance and eventual deconstruction or demolition". Another definition to LCA could be found in de Medeiros G.F. and Kripka M. (2014) study.

In terms of C&D waste, urbanization, economic growth and environmental protection all demand solutions such as C&D waste management. Despite these benefits, a recent study by Huang B. et al. (2018) recommends exercising caution when interpreting the findings. As they would be obtained if waste reduction or sorting processes have taken place, considering the distribution or transportation process throughout the life cycle of material (Ghisellini P. et al., 2018). This has been drawn from numerous studies revealing that most C&D waste generated on construction and demolition sites is mixed due to lack in sorting, lowering the potential and effectiveness of waste recovery processes for secondary resource recovery and vice versa (Huang B. et al., 2018; Ghisellini P. et al., 2018; Nußholz L.K. et al., 2019). Some material, such as steel, doors and windows, can be deconstructed on-site, most C&D waste, such as concrete, is typically discarded (Huang B. et al., 2018).

Thus, separation of C&D waste is crucial to preparing for waste recovery alternatives, resulting in higher material recovery efficiency, decrease contamination levels and providing better quality of waste (Ghisellini P. et al., 2018). Thus, decrease C&D waste disposal volume and environmental impacts and obtain economic benefits for contractors (Ghisellini P. et al., 2018). Another consistent study by Spisakova M. and Kozlovska M. (2013) established the vital importance of waste separation during all demolition methods.

Numerous studies indicate that if site conditions permit, on-site sorting is better than off-site sorting (Dahlbo H. et al., 2015; Ghisellini P. et al., 2018; Jiménez-Rivero A. and García-Navarro J., 2017). As on-site sorting can have profound optimum production of recycled material and reduces the transportation distances to recycling facilities (Bovea M.D. and Powell J.C., 2016). Another study by Zhang C. et al. (2019) discovered considerable net environmental benefits via deconstruction and on-site sorting. The study of Spisakova M. and Kozlovska M. (2013) demonstrated that on-site separation is an extremely cost-effective solution in terms of repurposing and convenience. Furthermore, due to energy consumption and gas emissions from transportation distance, off-site sorting may be more detrimental than landfilling (Vossberg C. et al., 2014). Although, Zhang C. et al. (2019) discovered that the cost of C&D waste disposal has a significant impact on on-site sorting adoption. In addition to the time and space constrain that might stand upon on-site sorting (DEFRA, 2015).

Waste material can be utilised in reusing or refurbishment and recycling through open, semi and closed loops (Huysman S. et al., 2017; Chau C.K. et al., 2017; Huang B. et al., 2018). Which promotes the use of salvaged material as a partial replacement in material manufacturing and standard material, or as a complete replacement of standard material (Huysman S. et al., 2017; Chau C.K. et al., 2017; Huang B. et al., 2018). Additionally, it can be used for energy recovery or backfilling purposes prior the least preferable management alternative in terms of environmental impacts which is landfilling as seen in **figure 2-1** (Huysman S. et al., 2017; Chau C.K. et al., 2017; Huang B. et al., 2018).

According to Wang J. et al. (2018), there are two forms of recycling: on-site and off-site in a recycling plant outside the construction or demolition site. According to critics, the technique is chosen based on the amount of C&D waste generated (Wang J. et al., 2018). As discussed in sections below, the application of recycling is another fundamental approach in C&D waste management as per its environmental benefits over the extraction and the demand of natural resources, reducing C&D waste disposal and energy consumption of material manufacturing etc (Bovea M.D. and Powell J.C., 2016; Chau C.K. et al., 2017; Huang B. et al., 2018). This application is preferred over landfilling because it reduces environmental, human health and landfilling costs (Marzouk M. and Azab S. , 2014).

Despite the benefits of recycling, research by Bovea M.D. and Powell J.C. (2016) and Minunno R. et al. (2018) indicates that recycling is not always appropriate for all C&D waste typologies. As the percentage of energy saved varies by material type (Ng W.Y. and Chau C.K., 2015). Recycling is the greatest option for concrete elements, whereas reuse is the best option for metal elements, according to Ng W.Y. and Chau C.K. (2015) research. This has been evidenced by Ng W.Y. and Chau C.K. (2015) that discovered that recycling C&D waste saved approximately 55% of energy in the construction value chain of a commercial building in Hong Kong. Whereas Christmann P. (2017) discovered that recycling metal products such as steel saved 62–74% of energy. While Christmann P. (2017) asserts that reuse is the most advantageous strategy in terms of economic and environmental benefits, its adoption is contingent on the amount of waste generated. Nonetheless, economic and environmental aspects should be considered while selecting the most appropriate alternative (Christmann P., 2017). Inability to reuse, recycle, recover energy, or backfill may result in unvalued C&D waste being disposed of in landfill (Christmann P., 2017).

López Ruiz L.A. et al. (2020) proposed as seen in **figure 2-1** a theoretical framework approach for adopting circular economy based on his literature investigation. This approach has covered the value of building material through 14 strategies organised into five stages for construction and demolition operations encompassing the entire value chain of building material. Further information related to these five stages could be provided in (López Ruiz L.A. et al., 2020) study.

1. Preconstruction entails three fundamental steps:

   Government policies and strategies establish the legislations and obligations for construction and demolition companies for further construction projects using economic instruments such as waste disposal fees, taxation on standard material and incentives for C&D waste management companies. By the help of designers and contractors' guidance to prioritise waste recovery practices and use secondary material by three main strategies listed as follows:

   a. Design for waste prevention.
   b. Design for waste deconstruction.
   c. Use of prefabricated elements.

2. Construction and renovation:

   The volume of waste generated at this stage varies according to the waste management technology chosen. Hence, inadequate C&D waste management practices in this stage result in substantial volume of C&D waste (Esa M.R. et al., 2016; Minunno R. et al., 2018).

   The application of design and C&D waste management can be applied in any construction or renovation activity to increase the recovery rates of waste material. Since they help in identifying and estimating the generated waste and consequently offering a detailed information and plan for waste management procedures, responsibilities and potential savings (Gálvez-Martos J.L. et al., 2018; Jiménez-Rivero A. and García-Navarro J., 2017).

3. Collection and distribution:

   This stage is applicable to waste generated to improve the recovery of C&D waste (López Ruiz L.A. et al., 2020). According to Nußholz L.K. et al. (2019), proper collection of waste at source results in cleaner waste fractions. According to Gálvez-Martos J.L. et al. (2018), proper collection includes having waste collection bins, defining waste stream and size, labelling and creating collection locations near sites, while hazardous waste collection bins should be situated with protection measures.

   The transportation distance is generally seen as a factor strongly related to effectiveness of C&D waste management (Bovea M.D. and Powell J.C., 2016; Brambilla G. et al., 2019; Coelho A. and de Brito J., 2013; Jung J. et al., 2015; Martínez E. et al., 2013). According to Bovea M.D. and Powell J.C. (2016), Brambilla G. et al. (2019), Coelho A. and de Brito J. (2012), Jung J. et al. (2015) and Martínez E. et al. (2013) this process is strongly related factor to environmental impacts, condition the application of recovery practices and conventional and selective demolition. Additionally, the studies of Estanqueiro B. (2016) and Bovea M.D. and Powell J.C. (2016) demonstrate the critical role of mode of transport and distance in influencing the environmental benefits of recycling vs landfilling. López Ruiz L.A. et al. (2020) classifies transport processes into seven categories:

a. Transportation of C&D waste from sites to storage.
b. Transportation of C&D waste from sites to treatment facilities.
c. Transportation of recovered C&D waste to storage.
d. Transportation of recovered C&D waste to manufacturing facilities.
e. Transportation of recovered C&D waste to sites.
f. Transportation of waste to backfilling embankments and sites.
g. Transportation of residual waste to landfill.

4. End-of-life:

   In this stage, to enhance waste recovery through proper collection and sorting, selective deconstruction over standard destruction may be recommended (López Ruiz L.A. et al., 2020). Notably, the method's application is contingent upon material type and operational considerations (López Ruiz L.A. et al., 2020). The application of charges of C&D waste landfilling plays a vital role in the selection of deconstruction practices.

5. Waste material recovery and production:

   This includes four main recovery alternatives that can be applied on C&D waste listed as follows:

   a. Reuse:

      It entails repurposing harvested construction material such as bricks, tiles, concrete slabs, beams, wood frames etc. in their original or different function (Huang B. et al., 2018; Gálvez-Martos J.L. et al., 2018). According to Schultmann F. and Sunke N. (2007), this material can be promptly reused or reprocessed via one of the applications as follows:

      1. Repair, by returning the used material to working conditions that is limited to assembly and reassembly of fixed parts.
      2. Refurbishment, by enhancing the quality of used material that is limited to disassembling, inspection and components replacement.
      3. Re-manufacture, by providing quality for used material based on specific standards.

   b. Recycling as explained above.

c. Energy recovery:

This can be utilised to reintroduce high-caloric resources such as wood into power plants and heat distribution or delivery systems for the purpose of energy production (Chau C.K. et al., 2017; Huysman S. et al., 2017; Schultmann F. and Sunke N., 2007). The recovery in incinerators has been seen by Hossain Md. and Poon C.S. (2018) as the optimal strategy in the alternative. The most obvious finding to emerge from Lai L.W.C. et al. (2018) and Ortiz O. et al. (2010) studies that these incinerators can significantly reduce energy usage by creating enormous volume of electrical and thermal energy. Although, it is unfortunate that they might produce poisonous gases, incombustibles, noxious compounds and fly ash etc. resulting to health issues such as cancer (Lai L.W.C. et al., 2018; Ortiz O. et al., 2010).

d. Backfilling:

For decades, the practice of utilising C&D waste in down cycling method and less lucrative uses such as road foundations and backfilling has been widespread (Allwood J.M. , 2014; Vandecasteele C. et al., 2013). This can be applied according to Coudray C. et al. (2017) to substitute natural resources for filling open sky cavities by crushing and using C&D waste. Gálvez-Martos J.L. et al. (2018) and Coudray C. et al. (2017) studies have gone some way towards enhancing our understanding that backfilling is a common method for reusing waste material and is now the most common application for recovered aggregates.

Figures 2-2 and **2-3** illustrate the procedure used to assess the recycling potential of massive amounts of demolition debris (inert waste) in Shenzhen (Yu B. et al., 2020). Both techniques of recycling C&D waste from demolition sites are depicted in the figures. Both scenarios entail 5 major stages encompassing waste generation, on-site treatment, transportation, recycling and product regeneration (Yu B. et al., 2020). The first four phases are consistent with research findings from Wang J. et al. (2018) and Wu H. et al. (2016) that excluded product regeneration stage.

Both types of recycling start with the waste generation of different types of C&D waste through specific demolition methods (Wu H. et al., 2016; Al-Bayati H.K.A et al., 2018; Sim J. et al., 2011). Prior to transportation stage in off-site recycling method, on-site treatment is performed (Wu H. et al., 2016; Al-Bayati H.K.A et al., 2018; Sim J. et al., 2011). This includes collection, sorting and pre-treating of waste after generation as seen in **figure 2-3** (Wu H. et al., 2016; Al-Bayati H.K.A et al., 2018; Sim J. et al., 2011). This is the third stage of on-site recycling, in which non-inert waste is separated from inert waste mechanically and manually (Yu B. et al., 2020). Due to the proximity of sites to pre-treatment facilities, this stage is usually requested as the second stage of on-site recycling (Yu B. et al., 2020). Unlike on-site recycling, this stage is numbered as the third stage in off-site recycling which transports waste from locations to recycling facilities. According to Yu B. et al. (2020), pre-treating waste prior to transportation has a positive effect on the environment. Following that, inert waste is crushed using a jaw or hammer in both methods of recycling to produce recycled aggregates with the desired particle size (Yu B. et al., 2020). This procedure is consistent with the findings of Wu H. et al. (2016). To avoid doping, inert waste must be magnetically separated from non-inert waste throughout this process (Yu B. et al., 2020). Following that, sieving is used to obtain aggregates of varying sizes and finally, air separation is used to remove lightweight components (Yu B. et al., 2020). Both methods of recycling ultimately undergo product regeneration, which results in recyclable aggregates and recycled products (Yu B. et al., 2020).

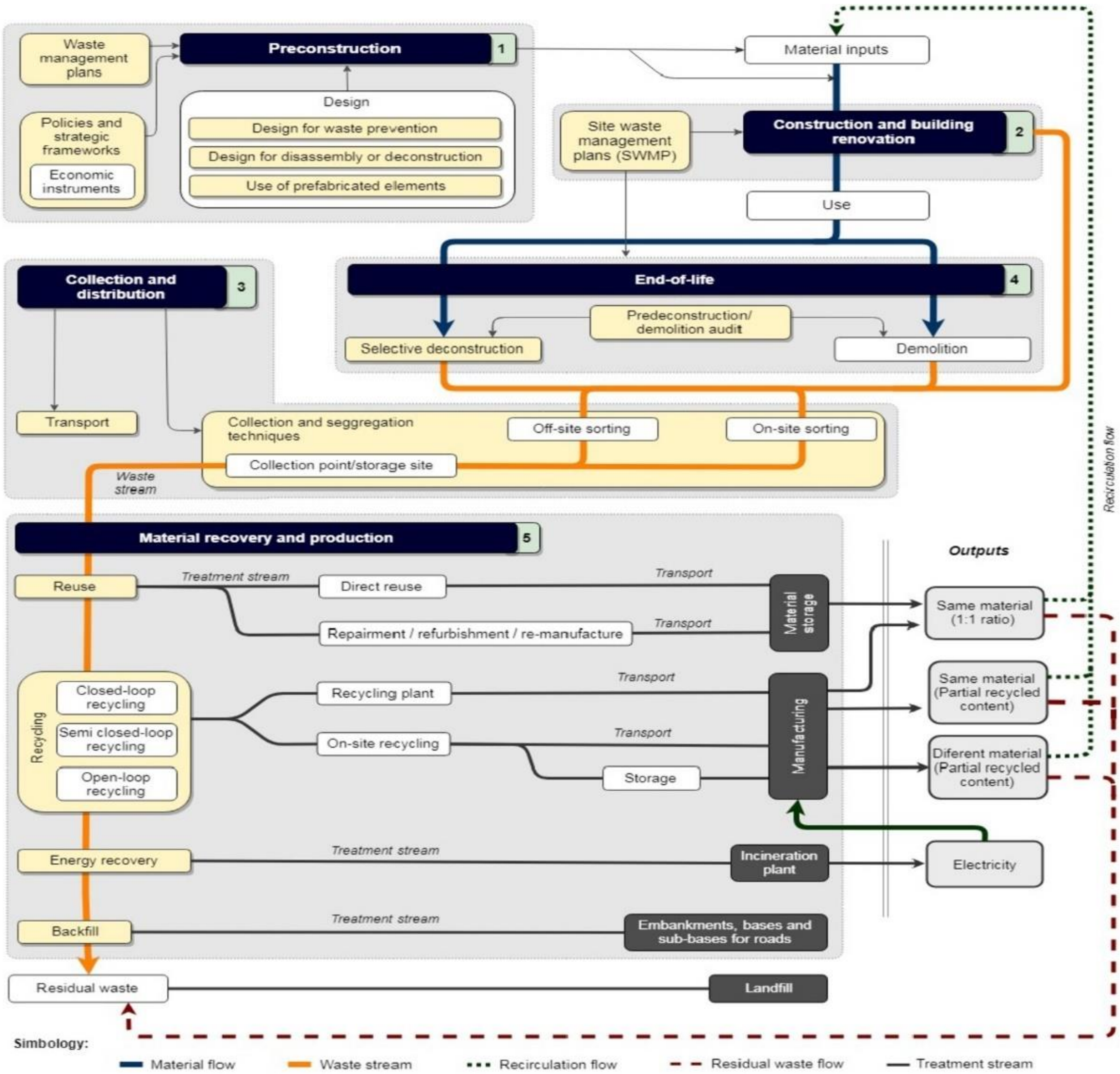

Figure 2-1: The Life Cycle of C&D Waste through Construction Activities (López Ruiz L.A. et al., 2020)

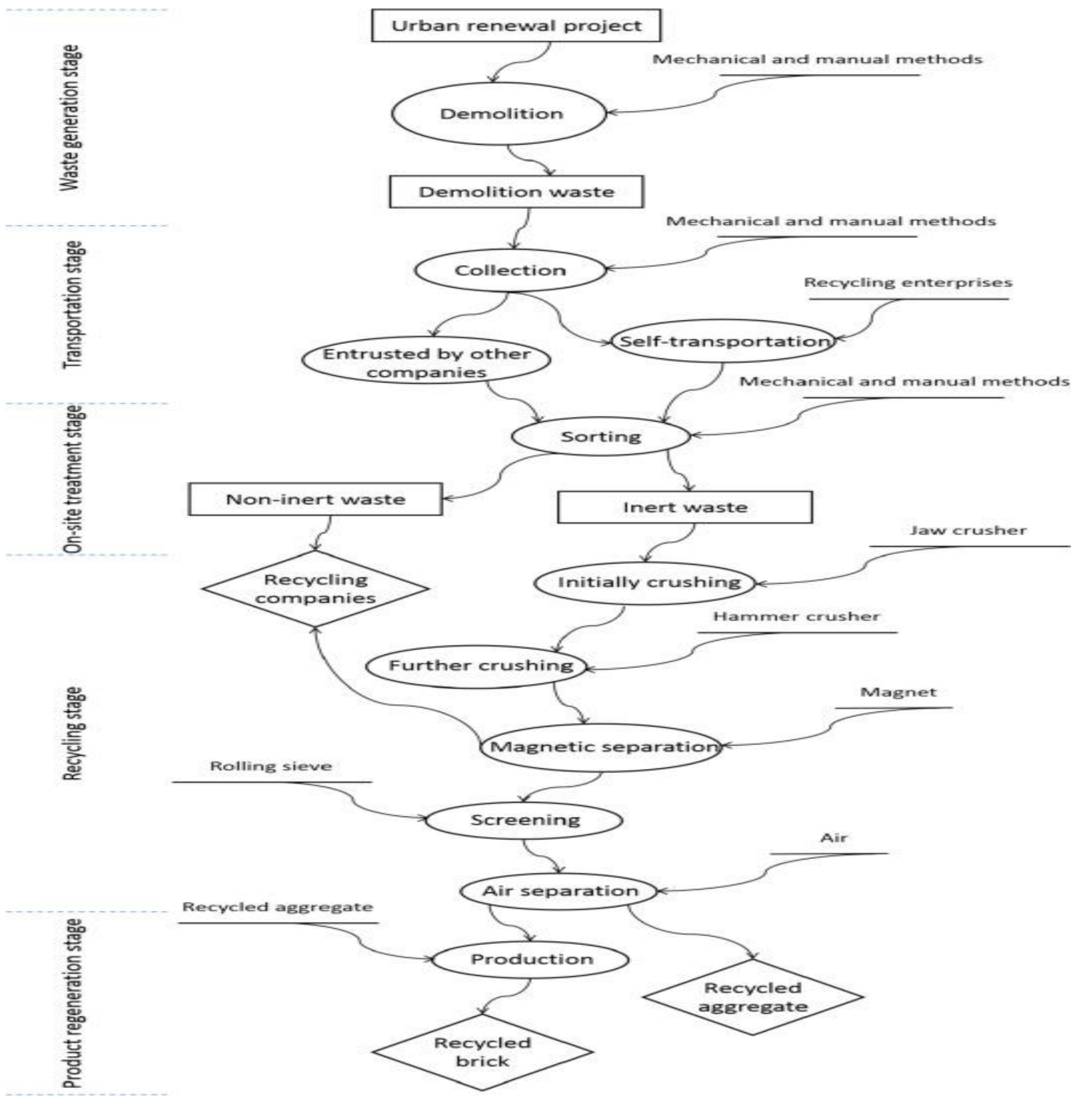

Figure 2-2: Onsite Recycling Process of Demolition Waste (Yu B. et al., 2020)

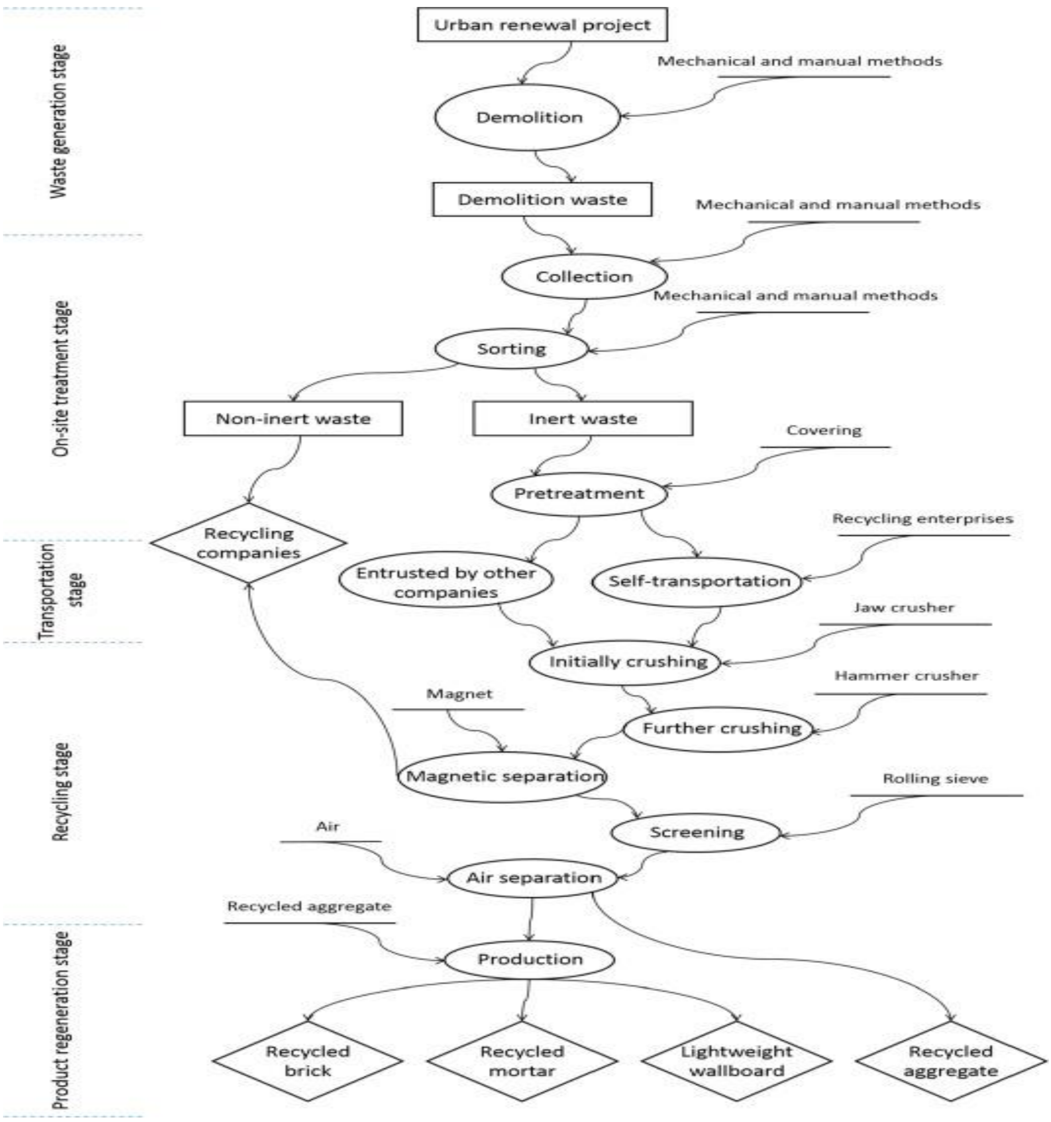

Figure 2-3: Offsite Recycling Process of Demolition Waste (Yu B. et al., 2020)

2.3.2 Waste Management Practice

As comprehensively reviewed, the construction industry is encountering many noteworthy impacts on several aspects, one of the most significant consequences is C&D waste. This has compelled governments to develop sustainable programs, strategies and policies aimed at mitigating the effects of C&D waste and achieving a circular economy (WRAP, 2013; WRAP, 2011; Infrastructure and Projects Authority, 2016; European Commission, 2014; European Commission, 2015; European Commission, 2016; Jain S. et al. , 2018).

2.3.2.1 Best Management Practice

López Ruiz L.A. et al. (2020) has proposed an integration of the best environment management practices based on his review of the literature. Utilising economic instruments and designing waste out through reduction, prevention, or deconstruction and applying C&D waste strategic managements should begin in the preconstruction stage as seen in **figure 2-4** (López Ruiz L.A. et al., 2020). This promotes early reuse and recycling strategies to minimize waste generation (López Ruiz L.A. et al., 2020). Then, while building is underway, it should utilise waste prevention, logistics (transportation), material use effectiveness and reuse of material (López Ruiz L.A. et al., 2020). By deconstructing, harvesting, sorting and processing C&D waste, excellent material recovery rates can be achieved in the demolition stage (López Ruiz L.A. et al., 2020). Then, quality control and reusability of recycled waste material are determined (López Ruiz L.A. et al., 2020).

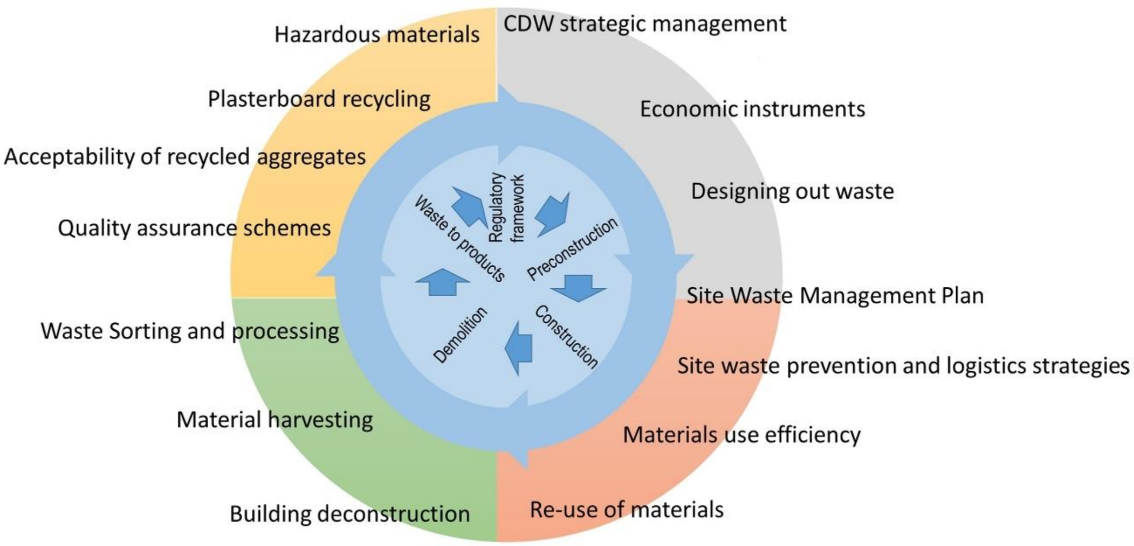

Figure 2-4: Integration of the Identified Best Environmental Management Practices (López Ruiz L.A. et al., 2020)

The development of C&D waste management plans is a common practice in Europe. As according to Gálvez-Martos et al. (2018), it is a necessity for all construction projects in Europe. They include a design report and a strategy for managing construction waste in construction planning stage (Jiménez-Rivero A. and García-Navarro J., 2017). To get satisfying results, these approaches for managing C&D waste should be developed throughout the design process (Yeheyis M. et al., 2012). For instance, the European protocol of C&D waste management requires a management model that should include several requirements as listed below complying with the requirements of assessment models such as BREEAM that promotes the application of CE strategies in terms of C&D waste prevention and minimization (Douglas I., 2016):

1. Demolition/deconstruction procedures.
2. Types of waste expected to be generated.
3. Preventive methods to reduce the generation of C&D waste.
4. Transport procedures.
5. Recognition of final treatment for generated hazardous and non-hazardous C&D waste that could reuse, recovery or disposal.
6. Procedures for mandatory on-site segregation.
7. Blueprints of C&D waste treatment facilities.
8. Description of safety issues and procedures.

2.3.3 Regulations, strategies and Initiatives

Numerous governments have established a variety of aims, objectives and targets for the purposes of mitigating the industry's environmental and economic impacts through various regulations, managements, programs and strategies (Jain S. et al. , 2018). To manage C&D waste by enabling them not only to meet but significantly surpass their targets and goals. In comparison to other countries that have not yet achieved their targets but have seen considerable reductions in C&D waste (**section 2.3.4**). Regrettably, some countries, particularly developing ones, continue to disregard C&D waste and its consequences. The high level of C&D waste in some countries was because there was no management that deals with C&D waste for a long time (Jain S. et al. , 2018). However, other countries have devised additional solutions, such as waste recovery (reuse and recycling), to limit the amount of C&D waste discarded in landfill (Jain S. et al. , 2018).

Europe had the greatest impact on C&D waste, owing to its strict and effective regulatory structures and legislation. In 2008, the European Commission adopted an effective waste framework legislation (2008/98/EC), with the goal of recycling 70% of non-hazardous C&D waste by 2020. The UK has adopted a combination of regulations, policies, programs, initiatives and incentives to meet targets for sustainable procurement, design and operation of all built assets, including DEFRA 2013 and WRAP (DEFRA, 2015; DEFRA, 2013; Ajayi S.O. and Oyedele L.O., 2017).

The EU directive now comprises five stages, as illustrated below: prevention, preparation for reuse, recycling, alternative recovery and disposal (Gharfalkar M. et al., 2016):

1. Waste prevention:

   This includes material recovery or directing to measure the material before becoming waste (Gharfalkar M. et al., 2016). To reduce the generation volume of C&D waste and adverse the impacts on the environment, social and the economy and content of harmful substances in material (Gharfalkar M. et al., 2016).

2. Preparation for reusing:

   This covers checking, cleaning, or repairing of building components so they can be furtherly re-used without processing (Gharfalkar M. et al., 2016).

3. Recycling:

   This directs the processing of C&D waste into recycled products or material (Gharfalkar M. et al., 2016).

4. Other recovery:

   This directs the recovery of any C&D waste that does not comply with specific requirements in previous stages like energy recovery (Gharfalkar M. et al., 2016).

5. Disposal of C&D waste:

   This is the least preferable stage where this directs the discarding of any unrecycled, un-reused or unrecovered waste to dumpsites (Gharfalkar M. et al., 2016).

Figure 2-5: Stages of the EU Directive (2008/98/EC) (Gharfalkar M. et al., 2016)

The UK's DEFRA 2013 and WRAP 2011 have been including the same stages in (2008/98/EC) directive, but with some different approaches (DEFRA, 2015; DEFRA, 2013; Ajayi S.O. and Oyedele L.O., 2017; Gharfalkar M. et al., 2016). They are as follows; (i) prevention by avoidance, reduction and reuse through using fewer items per unit, using long-lasting material and selling and buying used items. (ii) preparing for reuse as mentioned above (DEFRA, 2015; DEFRA, 2013; Ajayi S.O. and Oyedele L.O., 2017; Gharfalkar M. et al., 2016). (iii) converting waste into new material that meets quality criteria. (iv) other recovery stage that involves the recovery of waste to produce energy like incinerations (DEFRA, 2015; DEFRA, 2013; Ajayi S.O. and Oyedele L.O., 2017; Gharfalkar M. et al., 2016). It entails the disposal of waste or the cremation of material with no energy recovered (Gharfalkar M. et al., 2016).

Another strategy promoted by UK was the strategy of zero construction waste to landfill that encourages industry to undertake resource efficiency programs and minimize waste to landfill by half by 2020 (Osmani M. et al., 2008). To improve the performance of the built environment by reducing carbon emissions, resource and energy consumption (Osmani M. et al., 2008).

Additionally, the UK has made initiatives to limit landfilling, reuse and recycling. By requiring construction firms to have waste management plans for projects above £300,000 and charging a landfill charge of £82.60/ton and £2.60/ton of active and inert waste respectively placed in landfill (Ajayi S.O. and Oyedele L.O., 2017; Osmani M., 2012). Additional UK perspectives are provided by studies from Akanbi L.A. et al. and Huang B. et al. (2018) and Yeheyis M. et al. (2012). Nevertheless, the UK government is to be expected to present future programmes, strategies, tools, regulations and legislations allowing the construction industry to contribute into closed loop production systems (Osmani M., 2012). These actions may be related to Jordan's push for C&D waste management rather than landfilling.

Landfill fees are widely recognized as a significant factor in reducing waste disposal (Ghisellini P. et al., 2018; Wang et al., 2018). To reduce disposal costs, charging systems will economically incentivize and motivate waste producers to favour recovery over disposal during construction and demolition activities (Wang T. et al., 2018; Yu T.W. et al., 2013). This has been evidenced in Hong Kong, as high landfilling fees resulted in a 60% reduction in the dumping of C&D waste (Ghisellini P. et al., 2018; Yu T.W. et al., 2013). This could help to encourage waste recovery in Jordan, as low costs associated with landfilling outweigh the benefits of waste minimization and recovery (Ghisellini P. et al., 2018; Huang B. et al., 2018). Nevertheless, high disposal fees, may contritely contribute to a rise in illegal dumping (Huang B. et al., 2018; Yuan H., 2017). This is debatable in Jordan, since charging fees are low, yet formal and informal dumping are widespread.

Ajayi S.O. and Oyedele L.O. (2017) think that incentives and tax breaks are still necessary for construction waste reduction. Other economic requirements, such as penalties and fines, result in less waste being disposed of in landfill and ensuring that polluters bear the cost of waste management (Ajayi S.O. and Oyedele L.O., 2017). It is also identified by Nußholz L.K. et al. (2019), applying taxes on standard material, financial and land leasing incentives could encourage the market of secondary material and manufacturing and promote C&D waste recovery (Gálvez-Martos et al., 2018; Huang B. et al., 2018).

2.3.4 Construction and Demolition Waste Management Applications

This section compares the rates of recycling of C&D waste across continents and countries. According to the World Economic Forum (2016), the global recovery rate for C&D waste is between 20% and 30%. **Table 2-3** outlines that more than 70% of C&D waste is recycled and less than 30% is landfilled in the United States, but only 23% is used to make new concrete (Townsend T. et al., 2014; Zheng L. et al., 2017). Only 7% of C&D waste in Canada gets recycled, while approximately 93% of waste is disposed of in landfill (Statistics Canada, 2015). This is due to a lack of attention paid to C&D waste management, despite the fact that landfilling is still the best alternative for C&D waste end-of-life (EC, 2016). Europe including the UK has a modest average recycling rate of 45% to 55% (del Río Merino M. et al., 2009; Özalp F. et al., 2016; European Commission, 2018; European Commission, 2018). The Czech Republic, Estonia and Denmark all met or exceeded their recycling targets which have recycling rates of 95%. Whereas the recycling rates of UK, Germany and the Netherlands, Italy, Spain and Belgium are 91%, 80-98%, 75%, 73% and 71%, respectively (Li M. et al., 2013; Mulders L., 2013; Bravo M. et al., 2015; EC, 2016; Ministry of Environment, 2014; Rüütelmann M., 2015; Coronado M. et al., 2011). Between 2010 and 2016 as seen in **table 2-4**, the UK recovered approximately 89-92% of non-hazardous C&D waste generated, totalling between 55 and 66 MT (DEFRA, 2015).

C&D waste recycling rates vary significantly between countries in Asia and Africa, probably due to financial and regional disparities. For instance, China's recycling rate is only 8%, despite the fact that the country generated the same amount of C&D waste as the EU and 6 times the US in 2013 (NWMOA, 2009; NDRC, 2014; Estanqueiro B., 2016; Otoko G.R., 2014; Huang B. et al., 2018). Despite this huge production, China in some cases has a way for waste disposal by transferring it to some low developed regional countries (Zheng L. et al., 2017; Duan H. et al., 2016). However, landfilling is the most popular method of immediately disposing C&D waste without regard for environmental protection measures or regulations even on sorting and waste treatments, especially for hazardous C&D waste debris like asbestos (Zheng L. et al., 2017; Duan H. et al., 2016). India, the world's second largest producer of C&D waste, recycles 3000 tons per day in total due to Indian regulations prohibiting the use of RA in concrete (IS 383 (Second rev.) (1970) (Centre for Science and Environment India, 2014). The same may be true in Jordan.

Further statistics on the rest of countries in the EU could be given in several studies and reports such as Ministry of the Environment (2014), Rütelmann M. (2015), Coronado M. et al. (2011), Li M. et al. (2013), Mulders L. (2013), Bravo M. et al. (2015), Akhtar A. and Sarmah K. (2018), European Commission (2015), Fercd (2015), Deloitte (2015), Huang B. et al. (2018), Calvo N. et al. (2014), del Río Merino M. et al. (2009), Östlund C. (2011), Hyder Consulting (2011), Yang W.S. et al. (2015), Nakajima S. and Futaki M. (2002), Zheng L. et al. (2017), Duan H. et al. (2016), Hyder Consulting (2011) and Otoko G.R. (2014). In conclusion, according to Ghaffar S.H. et al. (2020) economic judgment, recycling C&D waste is only economically viable when recycled items are competitive in terms of cost, quantity and quality.

As illustrated in **table 2-3**, numerous recycling initiatives have aided in the disposal of C&D waste at varying rates. In Estonia and Denmark, the landfilling rates were around 5%, UK around 15%, Germany and Netherlands less than 20%, Italy 25%, Spain 27% and Belgium 29% (Islam R. et al., 2019; Li M. et al., 2013; Mulders L., 2013; Bravo M. et al., 2015; EC, 2016; Ministry of Environment, 2014; Rüütelmann M., 2015; Coronado M. et al., 2011).

In the UK, England generated between 50 and 59 MT of C&D waste and recovered more than 90% of it (DEFRA, 2015). Another study by Islam R. et al. (2019) discovered that approximately 86% of C&D waste is recovered in the UK, leaving nearly 14% in permitted landfill. Between 2013 and 2014, the UK detected 56.3 K tonnes of informal C&D waste dumping (fly tipping) (DEFRA, 2015). The UK has said that there is a significant influence on the eventual recovery rate of C&D waste due to the high level of ambiguity around the generation and recovery of absolute tonnage numbers (DEFRA, 2015). Despite this, annual adjustments and updates have resulted in an increase of 10-20% in absolute tonnages (DEFRA, 2015).

In comparison to the previous state, most C&D waste management techniques are ineffective, resulting in vast volume of C&D waste being formally disposed of in landfill or informally (Esa M.R. et al., 2016; Suárez S. et al., 2016). Overall, it is to be noted that minimizing the generation of C&D waste does not always indicate efficient C&D waste management. For instance, Ireland's C&D waste production decreased from 2007 to 2011 because of a decline in construction activities (Staunton J. et al., 2015).

Continent	Country	Recycling Rates	Landfilling Rates
America	USA	> 70%	< 30%
	Canada	7%	93%
EU	France	45% - 50%	50% - 55%
	Netherlands	80%	20%
	Germany	> 69%	< 31%
	Czech Republic	95%	5%
	Estonia	95%	5%
	Denmark	95%	5%
	Italy	75%	25%
	Spain	73%	27%
	Belgium	71%	29%
	Cyprus	59%	31%
	Sweden	50%	50%
Asia	China	8%	92%
	Japan	> 90%	< 10%
	Bangladesh	2%	98%
Africa	South Africa	< 10%	> 90%
Australia	Australia	55%	45%

Table 2-3: Recycling and Landfilling Rates of C&D Waste Across the Globe (Akhtar A. and Sarmah K., 2018)

Year/Recovery Rate	UK	England
	Recovery Rate	Recovery Rate
2010	89.7%	92.2%
2011	91.4%	92.5
2012	91.1%	92.0
2013	91.2%	92.0
2014	91.5%	92.4%
2015	91.1%	92.3%
2016	91.0%	92.1%

Table 2-4: Recovery Rates of Non-hazardous C&D Waste in the UK including Backfilling (DEFRA, 2015)

The primary shortcoming is that it is impossible to establish which country manages C&D waste the best or adopts the most effective C&D waste management. Estonia, Malta and Denmark, for example, have high rates of recycling, although, they generate less C&D waste than other countries. Despite this, when considering the generation volume and the recovery rates together, the UK appeared to be a leader in promoting an effective C&D waste management, as it generates approximately 2 T/capita of C&D waste and recovers approximately 1.82 T/capita.

2.3.5 Benefits of C&D waste management

It is important now to outline the effectiveness of C&D waste management. Yuan H. (2013) defines the effectiveness of C&D waste management as "the degree to which objectives are achieved when implementing C&D waste management; where the objectives mainly concern how to simultaneously promote the economic, environmental and social performance of C&D waste management activities in the project". As seen in the illustration below, an effective C&D waste management must strike a balance between the three performance criteria (Yuan H., 2013). As illustrated in **figure 2-6**, the inconsistency of those measures undermines their effectiveness in regions A-G (whereas area F encourages the most contented position) (Yuan H., 2013).

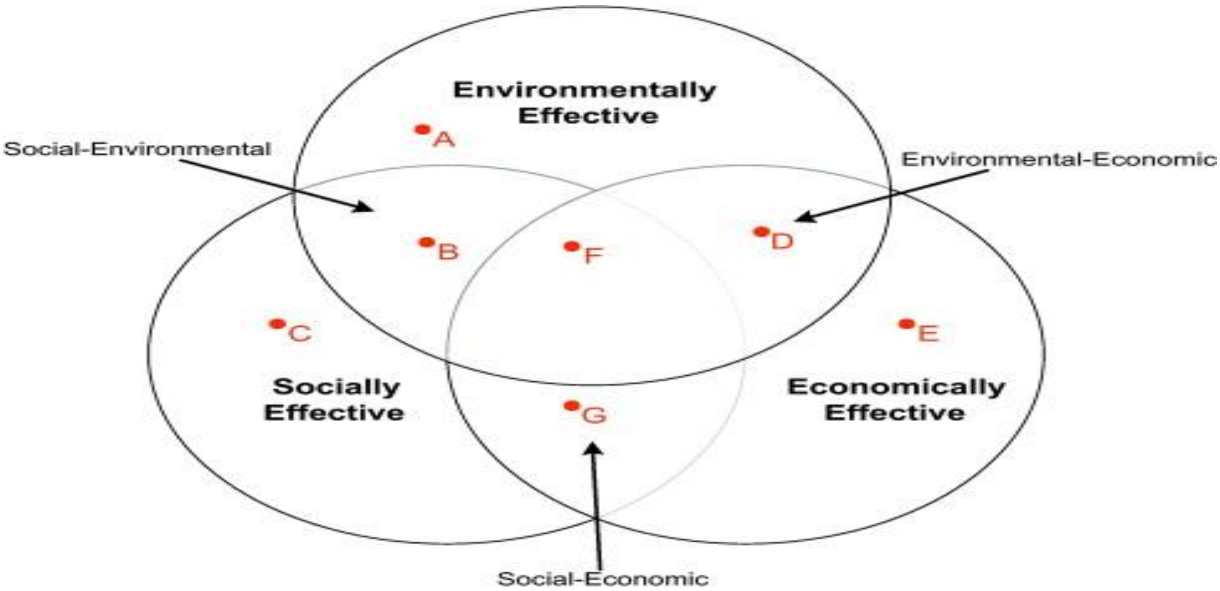

Figure 2-6: Three Spheres of Effective C&D Waste Management (Yuan H., 2013)

As previously noted, C&D waste has substantial environmental, social and economic consequences, making it vital to support management practices that minimize its generation. According to Brambilla G. et al. (2019), Smol M. et al. (2015), Wu H. et al. (2019) and Jin R. et al. (2017), the recovery practices of C&D waste offer significant environmental and social benefits and delivers circular economy. Certain C&D wastes offer significant economic potential via substituting the material end of life with reduce, reuse, recycle and recovery in the construction industry (Wang J. et al., 2019; Kirchherr J. et al., 2017). According to Hossain Md. and Poon C.S. (2018) and Cruz Rios F. et al. (2019), the environmental value of C&D waste reuse is contingent upon positive reuse rates. As previously said, however, the industry's primary focus is on economic performance, just as it does in area E above (Wang

J.Y. et al., 2010). Deconstruction, reuse and recycling all benefit the environment, society and economy in a variety of ways as follows (Zhang C. et al., 2019; Ding Z. et al., 2018):

A. Environmental Benefits:

1. Conservation of natural resources by reduced exploitation and resource life extension (Li X. , 2009; Huang T. et al., 2013; Marzouk M. and Azab S. , 2014; Doan D.T. and Chinda T., 2016).

2. Reducing greenhouse gas emissions and energy consumption through C&D waste recycling through decreasing extraction, production and transportation processes of material (Li X. , 2009; Huang T. et al., 2013; Marzouk M. and Azab S. , 2014; Doan D.T. and Chinda T., 2016). As C&D waste recycling saves the accumulated energy in waste material which is the driving force behind emission savings (Roussat N. et al., 2009).

3. Lowering landfilling rates that helps to extend the life span of landfill and reduce C&D waste emissions and transportation also avoid landfilling impacts like air, soil and water pollution (Ismail S. et al., 2013; Ding Z. et al., 2018).

B. Social Benefits:

1. Increasing the number of skilled occupations (Yuan H., 2013). This is because recycling construction and demolition debris requires manual sorting, mechanical equipment, processing, marketing and transportation, thus more people are needed (CDRA , 2017). As according to Pacheco-Torgal F. et al. (2012) 10,000 tons of waste requires 1 job for incineration, 6 jobs for landfilling and 36 for recycling.

2. Unlike demolition, deconstruction minimizes site disruption (U.S. Environment Protection Agency (EPA), 2008; Chong W.K. and Hermreck C., 2010).

3. Preventing unsightly dumping and eyesores especially in countries that suffer from informal dumping like Jordan (Hadadin N. and Tarawneh Z.S., 2007).

C. Economic Benefits:

1. Benefiting the economy by saving high disposal costs when landfilling (Li X. , 2009; Huang T. et al., 2013; Marzouk M. and Azab S. , 2014; Doan D.T. and Chinda T., 2016). Reducing disposal fees and landfill taxes saved the UK £1 billion and is expected to save the country another £3 billion by 2020 (DEFRA, 2015).

2. Saving high costs of construction material. As recycling provides similar material with less prices through reducing transportation cost, fees, or charges for dumping waste at landfill as well as material import costs in some cases (Ismail S. et al., 2013). This may inspire Jordanian actors, given the cost of construction material has significantly increased in recent years, increasing from 11.5% in 2010 to 15.2% in 2012 (Akhtar A. and Sarmah K., 2018).

3. Enhancing the competitiveness through price protection and coverage of raw material shortages, as in the UK (Kirchherr J. et al., 2017; Witjes S. and Lozano R., 2016).

4. Setting a foundation for opportunities for the creation of innovative businesses (Kirchherr J. et al., 2017; Witjes S. and Lozano R., 2016; Brambilla G. et al., 2019); Smol M. et al., 2015).

5. Reducing production energy costs (Di Maria A. et al., 2018; Hossain Md. U. et al., 2016); Suárez Silgado S. et al., 2018). For instance, recycling C&D waste in USA saved nearly 85 million barrels of oil (Townsend T. et al., 2014).

6. Effectively deriving a circulation in the economy as C&D waste management promotes closing the loops of building material (U.S. Environment Protection Agency (EPA), 2008; Chong W.K. and Hermreck C., 2010; Wang J. et al., 2018; Kirchherr J. et al., 2017). Besides, obtaining profitability from re-selling recycled products. As reselling recycled products has added $7 billion to the US economy, while recycling C&D waste added $2.7 billion to South Korea's economy (Akhtar A. and Sarmah K., 2018). However, the global circular economy remains at a low level, having reached 6% in 2015 (Haas W. et al., 2015).

Apart from these benefits, the environment is still suffering from some burdens during the recycling process as it includes several activities such as sorting, cleaning, crushing, transportation and remanufacturing (Gorgolewski M. , 2008). These burdens include resources use, atmospheric emissions, leaching and dust emissions (Coelho A. and de Brito J., 2013; Faleschini F. et al., 2016). According to Galvn A.P. et al. (2012) and Rosado L.P. et al. (2017), these leachates may contaminate the underlying soil and groundwater. According to Rosado L.P. et al. (2017), the environmental impacts are primarily related to fuel consumption. Although, prior research indicates that C&D waste management can have environmental, social and economic benefits, especially in developing countries such as Jordan that lack proper waste management strategies (Kumi-Larbi A. et al., 2018).

Recycling C&D waste, although, has a lower environmental impact than conventional construction activities (Coelho A. and de Brito J. , 2013). Recycling, according to Coelho A. and de Brito J. (2013) study, emits less CO_2 and consumes less energy than extraction (Li X., 2009; Huang T. et al., 2013; Marzouk M. and Azab S., 2014; Doan D.T. and Chinda T., 2016). CO_2 emissions and energy consumption associated with raw material extraction are anticipated to be 16% and 35% greater, respectively, than those associated with recycled aggregate (Coelho A. and de Brito J. , 2013). According to López Ruiz L.A. et al. (2020), recycled aggregates may have higher production costs than natural aggregates (NA) due to the additional processing methods required, which accounts for almost 64% of total production costs. Although, according to Wijayasundara M. et al. (2016), this figure may vary depending on the size of the industry. That is why reuse is preferable to recycling (Akanbi L.A. et al., 2018); (Gorgolewski M. , 2008).

According to Minunno R. et al. (2018) and Nußholz L.K. et al. (2019), the application of reuse is considered one of the best practices of waste management in terms of environment and economy. As it reduces energy consumption and eliminates the environmental impacts involved with manufacturing building material, which is particularly beneficial when dismantled buildings are located adjacent to other structures (Akanbi L.A. et al., 2018; Gorgolewski M., 2008). According to Gálvez-Martos J.L. et al. (2018), reusing construction components (prefabricated elements) in concrete structures saves approximately 40% energy and 60% carbon footprint. Thus, reuse and recycling can help the environment by avoiding landfilling of C&D waste, saving production energy costs, preventing the manufacture of new material and substituting recycled material for natural resources (Di Maria A. et al., 2018; Hossain Md. U. et al., 2016; Suárez Silgado S. et al., 2018). However, if reuse or recycling are not feasible or are environmentally hazardous, energy recovery can be employed instead (Schultmann F. and Sunke N., 2007).

Nevertheless, Huang B. et al. (2018) claims that the absence of standards results in uncertainty regarding the quality of recycled material which makes the reuse of secondary material is not widely accepted. However, the design team should place a premium on material reuse to be efficiently used in construction projects (Huang B. et al., 2018).

The three sections above examined and comprehended the global construction sector and its practices on waste management. The following is a description of the Jordanian construction industry's characteristics and practices regarding C&D waste management. However, before discussing C&D waste management in the Jordanian construction industry, it is necessary to analyse the country's solid waste management.

2.4 Waste Management of Industrial Material in Jordan

This section examines the industrial waste management in Jordan. Prior to examining this, it is vital to comprehend the country's industrialization.

It has recently been revealed that industrial operations in Jordan contribute to poverty reduction by producing additional jobs (Fanack, 2013). Due to the current regional situation (conflicts), the country has lost certain historic and traditional markets, including those in Iraq and Syria (Fanack, 2013; Alshoubaki W. and Harris M., 2018). Nevertheless, Jordan has successfully augmented its sector, according to MITS (2019) analysis, by leveraging both foreign and domestic markets throughout investing heavily by extracting and manufacturing a variety of material.

Additionally, these regional wars have resulted in a massive influx of refugees into the country (Alshoubaki W. and Harris M., 2018). Thus, demand for products, food, energy, housing and infrastructure has skyrocketed, as has waste generation (Alshoubaki W. and Harris M., 2018). Perhaps one serious advantage is that it has accelerated the country's urbanization and industrialization to meet tremendous demand and stay up with the global trend toward urbanization and industrialization (Alnsour J.A., 2016).

2.4.1 Production of Industrial Material

Jordan's industrialization contributed 24% to the Gross Domestic Product (GDP) in 2010 which is around $ 2.9 billion and increased 1% in 2011 (MITS, 2019). As illustrated in **chart 2-8**, this contribution climbed to almost 30% in 2016, bringing the total debt to $5.2 billion in 2019 (MITS, 2019).

Manufacturing accounts for around 75% of the industry's overall output, followed by mining (DOS, 2020). Jordan possesses a variety of natural resources and quarries for both metallic and non-metallic minerals, according to MITS (2019). According to DOS (2020), 42% of the mining sector's output is used as raw material in the creation of other products, while 58% is used directly as aggregates. This knowledge should aid in forecasting the impact of the construction industry on the country's natural resources. According to the report of DOS (2020), the construction industry employs several sectors within the industrial sector at varying percentages: mining (9.31%), plastics (36.09%), wood (76.4%), cement (83.75%), steel (85.42%) and other construction material including concrete (91.54%). The most important criticism of all studies is that they failed to address the production rates of material including construction material, since they are restricted to limited generalisability.

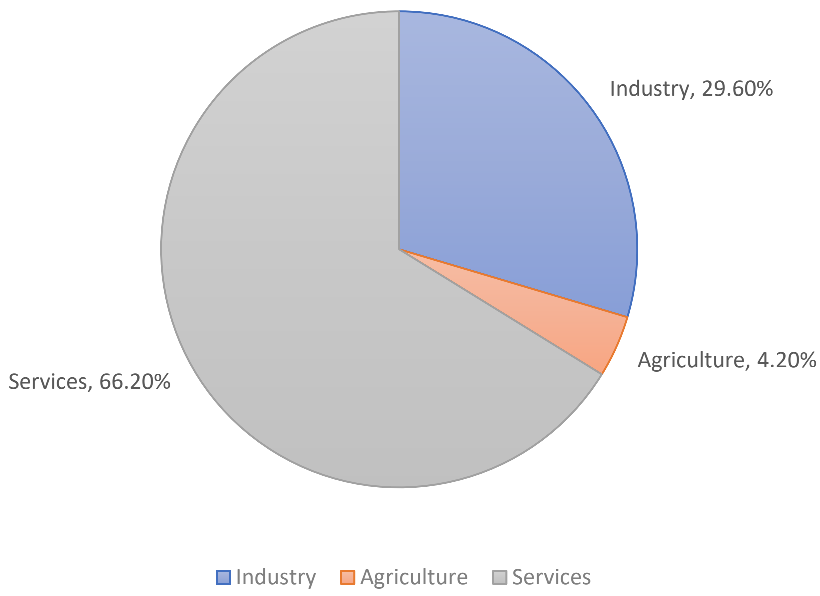

Chart 2-8: Contribution of Several Jordanian Sectors in GDP 2016 (Source CIA) (MITS, 2019)

According to the report of Centre for Global Development (2011), manufacturing has a dangerously influential impact to the environment in developing countries than in developed countries. According to the data, developing countries are responsible for 63% of global greenhouse gas emissions, while the Middle East and North Africa (MENA) region is responsible for 8% (Centre for Global Development, 2011).

According to critics of Hadadin N. and Tarawneh Z.S. (2007), rapid urbanization and industrialisation have increased water demand, creating a significant environmental challenge in Jordan owing to water scarcity. They stressed that excessive energy consumption from rapid urbanization and industrialisation associated with the extraction, transportation and manufacturing of material and products had a significant influence on agriculture, degrading soil and wreaking havoc on land and natural resources (Hadadin N. and Tarawneh Z.S., 2007).

Jordan's 2018 GHG emissions were 26 MT, according to the MOE (2019) report. According to Hadadin N. and Tarawneh Z.S. (2007), Amman's annual greenhouse gas emissions exceeded WHO air quality standards due to low efficient cars. **Chart 2-9** below determines the underlying sectors of greenhouse gas emissions in Jordan in 2016: the waste sector (12%), industrial processes and product use (10%) and agriculture, forestry and other land usage are all close behind (nearly 2%) (UNDP, 2020). While 93% of emissions in the waste sector originate from waste disposal, wastewater treatment (5%) and incinerators and open burning (2%) (**chart 2-12**). Further detailed data on Jordan's greenhouse gas emissions may be included in the UNDP (2020) report.

The following is a few sub-sectors that are known to contribute to these emissions in the energy sector as outlined in **chart 2-10**: oil (2%), transportation (37%), energy industries (38%), manufacturing industries (10%), other sectors (10%) and non-specified sectors (3%) (UNDP, 2020). As illustrated in the graph below, Jordan's transportation industry utilised the most energy in 2018 with around 49% (UNDP, 2020). Followed by household (21.5%), industrial (15.5%) and other service sector (14%) (**chart 2-11**) (UNDP, 2020).

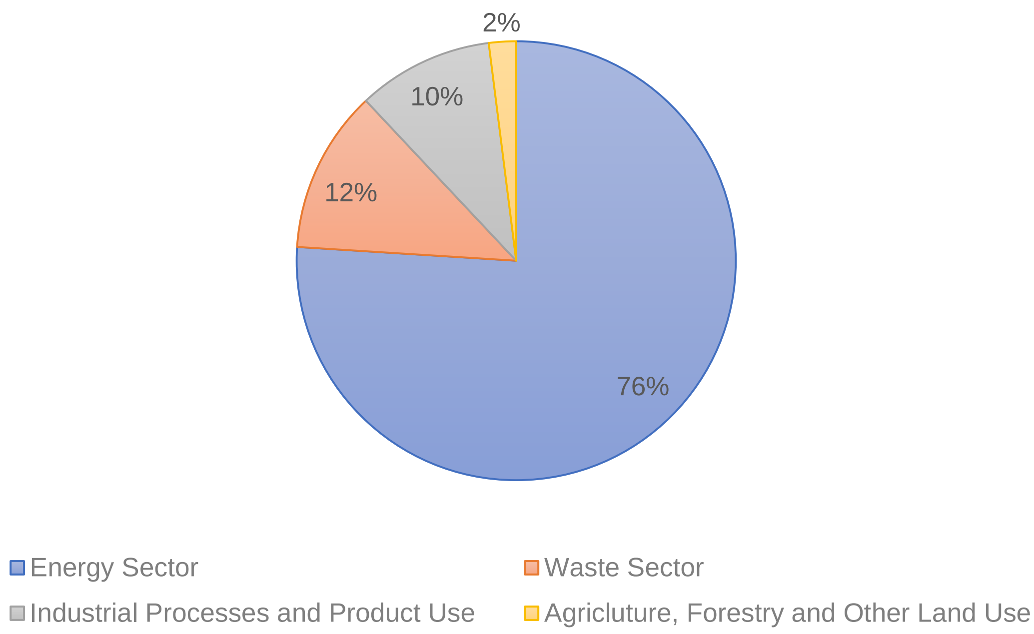

Chart 2-9: Greenhouse Gas Emissions Covered by Different Jordanian Sectors (UNDP, 2014)

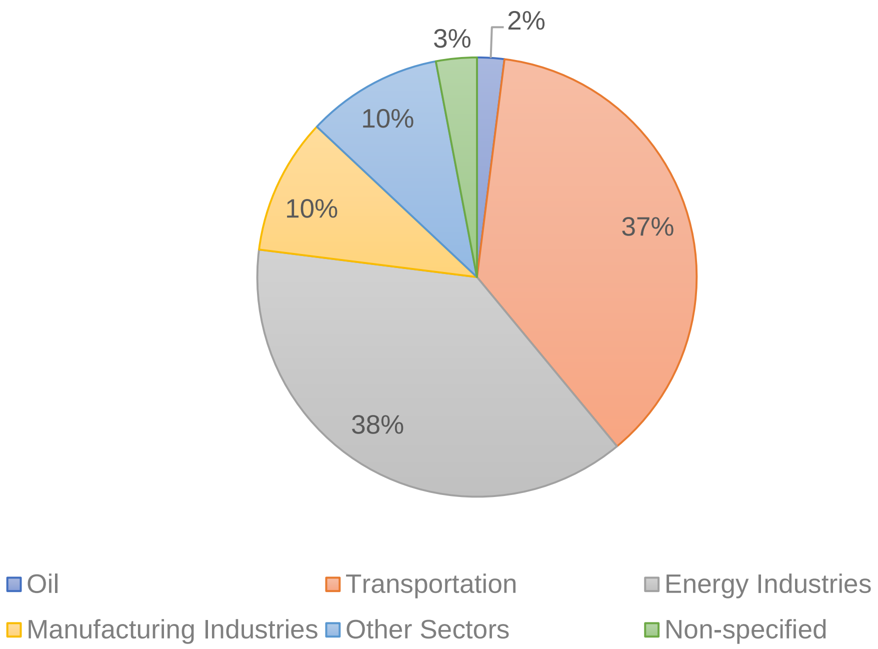

Chart 2-10: Contribution of Energy Sub-sectors to Gas Emissions in Jordan (UNDP, 2020)

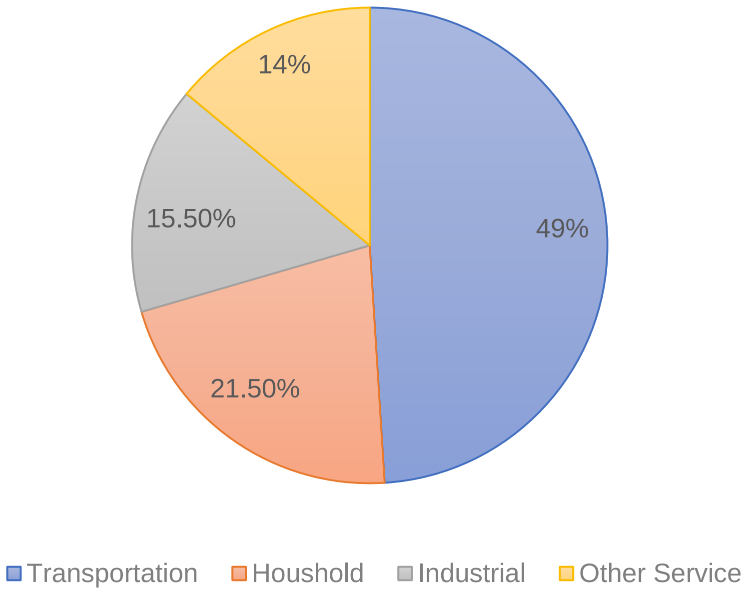

Chart 2-11: Percentage of Energy Consumption in Jordan (UNDP, 2020)

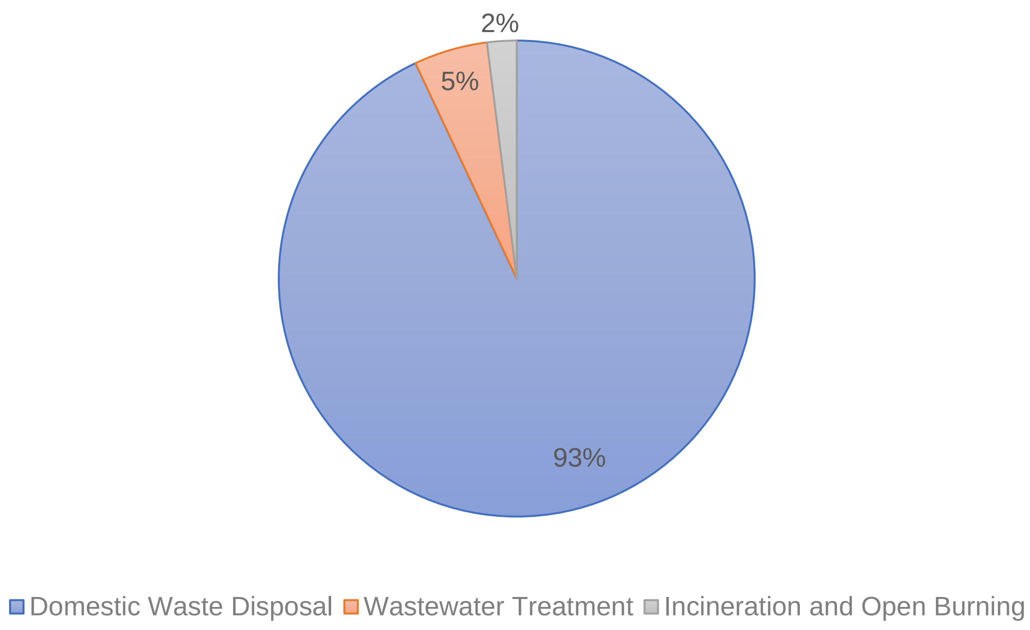

Chart 2-12: Waste Sub-sectors Contribution to Gas Emissions in Jordan (UNDP, 2020)

As will be seen in the next sections, most studies on the construction industry have concentrated on a small number of areas, failing to address one of the sector's primary concerns, which is C&D waste. Because trustworthy and reliable data on C&D waste in this country is currently unavailable. These investigations would have been more beneficial and useful if they had concentrated only on this subject. Thus, a reasonable approach to tackle this issue before primary investigation would be to review Jordan's industrial sector. Including the production of industrial material, the generation of solid waste, including its types and volume and the management of solid waste, which includes applications, activities and regulations.

2.4.2 Types and Volume of Industrial Waste Material

The increase in solid waste generation is a significant issue related with Jordan's industrialization (Alshoubaki W. and Harris M., 2018). They ascribe this spike to the country's regional hostilities, which have resulted in a large influx of refugees (an additional 10% of the population) seeking asylum. DOS (2020), Aljaradin M. (2014) and Alshoubaki W. and Harris M. (2018) noted that this issue is also a result of modern living standards, urbanization and a projected population increase of over ten million people by 2020 and their consumption patterns.

According to Amine Y. et al. (2018), the MENA region generated around 63 MT of solid waste in 2017 and is predicted to double or even more in the next five years. Yamin M.Z. (2019) and GIZ (2014) have released a credible analysis estimating Jordan's solid waste generation which kept inclining from 1.5 MT in 2000, to 2 MT in 2012 to 2.1 MT in 2014, to 2.6 MT in 2015. The UNDP (2014) estimated that waste production is increasing at a rate of 3.3% each year (UNDP, 2014). Additionally, this waste will reach 5.2 MT by 2034 (EC, 2016). According to their investigation, more than half of this volume originates in Amman (Yamin M.Z., 2019; GIZ, 2014). These findings corroborate the scope of the research focusing on Amman as the chosen study geographical location.

As illustrated in **chart 2-13**, the GIZ (2014) classifies municipal solid waste into a variety of categories with differing levels of accountability. Municipal waste is classified into six types: organic waste (50%), plastic (16%), cardboard (15%), glass (2%), steel (1.5%) and other types (15.5%) including C&D waste (GIZ, 2014). In Jordan, agriculture waste accounts for nearly 4 MT/Y, solid waste accounts for 2.07 MT/Y, C&D waste accounts for 0.1 T/capita, or 0.9 MT/Y, or 2.6 million m^3 (GIZ, 2014; JGBC, 2016). In addition to, packaging waste that accounts for 0.7 MT/Y, rubber tire waste accounts for 0.42 MT/Y, 45000 T/Y of industrial waste and 4000 T/Y for medical waste (**table 2-5**) (GIZ, 2014; JGBC, 2016).

The percentage of C&D waste in GIZ (2014) report must be approached with some caution. Because it shows that C&D waste is equal or less than 15.5%, while according to a study conducted by JGBC (2016), C&D waste accounts for approximately 43% of total solid waste composition, as indicated in **table 2-5**. This apparent contradiction may be a result of the difficulties in quantifying C&D waste due to the variety of disposal methods used. According to several international studies, C&D waste accounts for between 30% and 40% of total solid waste composition and that clearly comes in line with JGBC (2016) study (Shen L.Y. and Tam V.W.Y, 2002; Akhtar A. and Sarmah K., 2018; Jin R. et al., 2017; Solís-Guzmán J. et al., 2009; JGBC, 2016).

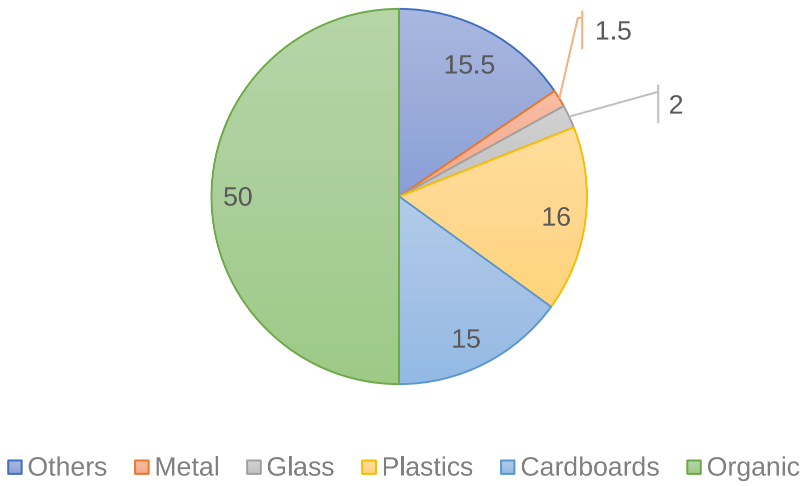

Chart 2-13: Solid Waste Composition in Jordan (GIZ, 2014)

Waste Types		**Waste Generation (MT/Y)**	
Agriculture Waste		4.0	
Solid Waste	C&D Waste	0.9	2.07
	Packaging Waste	0.7	
	Tires Waste	1.5 million tire/year	
	Industrial Waste	0.045	
	Medical Waste	0.004	

Table 2-5: Solid Waste Generation Volume and Composition in Jordan (JGBC, 2016)

It has been demonstrated that the volume of solid waste pollutes the environment and has a negative impact on people's health and welfare, as well as on the economy via disposal fees and transportation costs (Hadadin N. and Tarawneh Z.S., 2007). If this is not appropriately controlled, it may continue to contribute to generating more waste.

2.4.3 Collection, Sorting, Landfilling and Recycling

The insights gained from studying solid waste management in Jordan may be of assistance to extend our knowledge of understanding the local context. Since most studies have been unable to address C&D waste management in Jordan and have been descriptive in nature.

According to the study of Al-Rifai J. and Amoudi O. (2016), Jordan's solid waste management system is based entirely on collection and disposal in designated landfill without sorting. This can have profound consequently to encompass Jordan 18 landfill and 14 transfer stations (JGBC, 2016). According to a GIZ (2014) survey, 90% of non-hazardous solid waste was collected in urban areas and 70% in rural ones. Meanwhile proper landfilling rates of non-hazardous solid waste stood on 48% and 45% openly dumped in 2014 (GIZ, 2014). According to GIZ (2014), the Jordanian government is attempting to increase waste collection rates to 100% and curb informal waste dumping across the country.

The empirical findings in JGBC (2016) and Aljaradin M. (2014) studies provide an understanding of how landfill are constructed in Jordan. All of landfill sites except (Al-Ghabawi Landfill) are not engineered and do not follow international standards since population density was the only factor considered during building and a lack of infrastructure and equipment. A possible explanation according to GIZ (2014), these landfill sites were established solely to control the influx of solid waste by dumping. This study demonstrates how the local context can be exploited to ensure compliance with solid waste management regulations. However, because the requirements only apply to appropriate landfilling, sorting appears to be impossible prior to or following collection. Thus, the absence of sorting is consistent with different literature agreements over the necessity of sorting as a pre-requisite for solid waste management application, which may have a causal role in Jordan.

Figure 2-7: Process of Waste Collection and Landfilling

Jordan has taken numerous measures toward solid waste management, but none toward sustainable waste management solutions (GIZ, 2014; JGBC, 2016). Thus, Jordan currently considers landfilling as the current preferable approach for discarding waste (GIZ, 2014; JGBC, 2016).

According to studies of GIZ (2014) and Amine Y. et al. (2018), Jordan's recycling rate remains low at less than 7%. The low recycling rates may be likely attributed to the government's lack of involvement, as the government neither regulates nor aids these initiatives. Since these movements are primarily initiated by non-governmental organisations, a few municipalities such as Greater Amman (GAM) and Aqaba (AM) and informal actors that accounts for the majority of recycling movements, depending on the type of waste (steel and timber, for example), as illustrated in the figure below (GIZ, 2014; Amine Y. et al., 2018). As previously said, economic performance is the most critical factor to consider when implementing waste management strategies. This comes in line with the recycling movements in Jordan as they are extremely reliant on profit and the ease of recycling or reuse (Saidan M.N. et al., 2017; Wang J.Y. et al., 2010).

Consequences of inadequate solid waste management have risen and will continue to worsen in the future. That is why several studies have advocated undertaking greater study on solid waste in Jordan, particularly C&D waste (Al-Rifai J. and Amoudi O., 2016).

Figure 2-8: Involvement of Informal Actors in Recycling

2.4.4 Regulations, Strategies and Initiatives

While Jordan has improved its solid waste management through legal frameworks and policies, it continues to struggle with technique integration according to a recent study by Amine Y. et al. (2018). As illustrated in **table 2-6** and **2-7**, Jordan's government has been tackling the problem of solid waste since 1991. By initiating many national strategies and regulations to be matched with international actions and plans aimed at addressing and controlling the environmental issues including solid waste in more detail.

For example, the development of a long-term renewable energy plan with the goal of becoming carbon neutral by 2050 (GAM, 2019). Jordan's participation in the Environmental Information Systems for Southern Mediterranean Horizon 2020 project (EISSMH), which aims to reduce greenhouse gas emissions, wastewater and waste in the Mediterranean Sea Region, highlights this distinction (DOS, 2020). Additionally, developing a National Environmental Action Plan (NEAP) that recognizes the outdated solid waste management system as a polluter of water, land and air (UNDP, 2006; UNDP, 2015).

Another good illustration was the Ministry of Environment (MoE) that was founded in 2003 according to law (No. 52/2006) (GIZ, 2014). To protect Jordan's environment and to monitor (inspect) and control solid waste, as well as to offer solid waste management policies, laws, regulations and legislation, as well as to implement awareness campaigns (GIZ, 2014). The Greater Amman Municipality (GAM) is another example which is in charge for regulating and operating solid waste management system in Amman (GIZ, 2014). This municipality is Jordan's sole authority that deals primarily with C&D waste and regulates it through lawful landfilling (GIZ, 2014). When service coverage and efficiency, environmental impact and financial performance are considered, this municipality is considered advanced in its accomplishments compared to other municipalities in Jordan (GIZ, 2014).

Table 2-6 shows some of the most significant policies, legislation, rules, programs and initiatives implemented by the Jordanian government in the early 2000’s to establish a variety of institutional authorities and legal frameworks providing short and long-term improvements and clear roles and duties (MOP, 2015). Notable among these is the national solid waste management strategy (2014), which was established in 2015 in accordance with Jordan's Vision 2025, the EU Waste Framework Directive 2008/98/EC and the EU-Jordan Compact 2016-2020 (UNDP, 2020). Utilising the three R's (Reduce, Reuse and Recycle) to improve the inefficient solid waste management system already in place, the public awareness of the socioeconomic status of informal waste pickers (NSWMS, 2015). Additional information can be found in NSWMS (2015) report.

Additionally, Jordan's government adopted and amended legislation governing solid waste management (Amine Y. et al., 2018). By excluding the private sector involvement in 2014 and tasked municipalities with the responsibility of collecting solid waste and disposing of it legally (Amine Y. et al., 2018). While these data are debatable, the UNDP (2014) indicates that there is no uniform agreement on the private sector's role. Since GAM proposes to engage the private sector in solid waste management to accomplish its goals (UNDP, 2014). It also refutes several conclusions of Amine Y. et al. (2018), suggesting that most recycling is carried out by unauthorised actors. Regardless of their engagement, the government may face significant obstacles in implementing recycling, as local scavengers may lose jobs, pushing the unemployment rate which reached 24.7% in 2021 (Amine Y. et al., 2018; DOS, 2020). However, the government may be able to provide such jobs (Amine Y. et al., 2018).

Jordan's municipalities have implemented three clauses in respect to solid waste management fee systems. For example, as seen in **table 2-7**, GAM charges a flat cost of 20 JD/year to its citizens, but other municipalities charge a flat cost of 24, 15, or 8 JD/year, depending on the municipality's categorisation. Although, all municipalities in the country charge a 20% yearly fee on any professional license for commercial, institutional, or industrial activities (GIZ, 2014).

The fundamental shortcoming of legislative frameworks is that they make no reference to solid waste management and landfilling responsibilities (Aljaradin M., 2014). Thus, impreciseness and ambiguity are particularly relevant in a country with regional inequalities in institutional and financial features between municipalities, most notably between GAM and other municipalities (Amine Y. et al., 2018). Nevertheless, the absence of solid waste management policies and strategies in the MENA area has resulted in inconsistencies in GAM's waste management. As it is successfully improving and progressing in areas such as city sanitation, engineered landfill and waste disposal (landfilling) (GIZ, 2014).

	Phases		
	2015-2019	**2020-2024**	**2025-2034**
Policies	Serving the urgent solid waste management needs of the Jordanian society	N/A	N/A
	N/A	Delivery of safe solid waste management services (street cleaning and collection) for entire municipalities	N/A
	Long term solid waste management on a local, regional and national level including constructing, rehabilitation, operating and maintenance of sanitary landfill and transfer stations along the whole periods		
	N/A	Avoidance of co-management of solid waste with hazardous (industrial and medical) and C&D waste by the issuance of relevant legal framework including targets, management, technical specifications, monitoring and penalties.	
	N/A	Mitigation of informal waste picking by integrating them with the proper solid waste management system throughout the issuance of legal framework defining responsibilities and providing trainings and incentives etc.	
	Improvement of cost recovery as the income from the old situation of solid waste management is not covering up the cost of the service, in which it was 53.7% in Amman, 48.2% in Irbid and 40.5% in Zarqa (Abu Qdais H.A., 2007). Involvement of private sector in partnerships with the public sector in respect to solid waste management system		
	N/A	Improvement of the local, regional and national institutional context in respect to solid waste management	
	Increasing the public awareness and education in relation to solid waste management and motivate the public to be involved in it.		
	Improvement of the operational and environmental monitoring aspects of solid waste management		
	Updating the legislative framework of solid waste management		

Table 2-6: Phases of National Solid Waste Management Strategy

Regulations	Description
No. 27/2005	“Demands general requirements in terms of equipment, container management, manpower, monitoring, separation of hazardous waste, documentation and disposal control and final treatment”
No. 83 and No. 72/2009	“Determines the different types of nuisance activities and the municipal control measurement, including the municipalities responsibilities related to transportation, waste collection, treatment and disposal and the fee system”. The Jordanian government has decided in 2008 to embed a part of the cost of solid waste management (collection and disposal) in Jordan with the electricity bills, municipalities in Jordan have implemented three clauses in respect to solid waste management fee systems, according to the law, GAM applies a fixed fee of 20 JD/year on its residents, whereas other municipalities apply also a fixed fee, however of 24, 15 and 8 JD/year depending on the municipality classification, although all municipalities apply an annual fee percentage of 20% from any professional licence of any commercial, institutional or industrial activity in the country (GIZ, 2014).
No. 75/2009	“Sets the joint services council responsibility for the construction and operation of landfill”,
No. 7/2012	“Sets the municipal responsibilities such as waste collection, municipal cleaning and disposal”.

Table 2-7: Current Regulations of Solid Waste Management

2.4.5 Benefits of Solid Waste Management

Jordan has not examined the benefits of effective solid waste management due to low recycling rates. Although, numerous studies have demonstrated the benefits of effective solid waste management to both the environment and society. Without regard for the environmental and social benefits of solid waste management in Jordan, recycling solid waste in developing nations would increase manufacturing's economic contribution and achieve a circular economy (Ajayi S.O. and Oyedele L.O., 2017; Sieffert Y. et al., 2014; Kirchherr J. et al., 2017). Hence, economic benefits will be attained and development will rapidly increase (Ajayi S.O. and Oyedele L.O., 2017; Sieffert Y. et al., 2014; Kirchherr J. et al., 2017).

Jordan is promoting several solid waste management applications at the moment. For instance, in Al-Russeifa Landfill, a biogas company has invested in reducing greenhouse gas emissions by 1.4 MT/year while also producing power and organic fertilizers (Aljaradin M., 2014). Another example is the collection, sorting and recycling of solid waste, such as paper, metals and plastics (GIZ, 2018). This project has resulted in the creation of approximately 22,000 jobs in 9 municipalities across Jordan covering only refugee camps (GIZ, 2018). Another example of Jordanian waste management is in Aqaba for attaining resource efficiency and providing jobs (UNEP, 2018). Waste from 15 hotels and 17 restaurants in Aqaba project was reduced and recycled (UNEP, 2018). This will assist in lowering disposal costs by reducing landfilling rates by 25% (UNEP, 2018).

In the next section, the research discusses the characteristics of the Jordanian construction industry. Including construction and demolition methods, material utilised in the industry, industry’s impacts such as C&D waste, C&D waste management operations such as collection, sorting, recycling and landfilling, applications, regulations and legislations.

2.5 Impacts of Construction in Jordan Industry

In the previous two decades, developed and developing countries have experienced significant urbanization and globalization growth, with developing countries such as Jordan growing at a quicker rate than developed countries (Sadorsky P., 2014; Shahbaz M. et al., 2016; Wang T. et al., 2018). Jordan has witnessed rapid urbanization, with the country's population growing to reach approximately ten million in 2020 (DOS, 2020). This has boosted demand for construction and demolition activities. This had a substantial impact on Jordan's environmental, social and economic well-being.

Jordan's construction sector consumes a great deal of raw material resulting to depleting natural resources, consumes energy and produces greenhouse gases because of its operations and activities (Hadadin N. and Tarawneh Z.S., 2007). Regardless of the industry's impact, estimating how much natural resources, greenhouse gases, or energy it consumes or produces is challenging because most studies not easily available and descriptive in nature.

According to a study by Grifa M. (2006), most Arab region construction projects use concrete. Indicating that steel and concrete are the region's most extensively used building material. This is consistent with Sharaf J.M. and Hamideen M.S. (2013) study, as most Jordanian structures are constructed of limestone, concrete, aggregate, bricks and cement. Najmi H.S. (2011) confirmed this by illustrating that construction in Jordan utilizes local natural resources such as stones and crushed stones, cement, sand and gravel.

Another key concern affecting the Jordanian construction industry is the generation of C&D waste and its consequences, as well as informal waste disposal (Al-Rifai J. and Amoudi O., 2016). According to JGBC (2016) and GIZ (2014), most excavation material, debris and C&D waste is disposed of informally on roadside ditches or open spaces near residential areas, where no license or permit exists to accept such an action. Including but not limited to timber, steel and other removable or disassembled components such as doors and window frames as furtherly explained in other sections (GIZ, 2014; JGBC, 2016; Al-Rifai J. and Amoudi O., 2016).

Despite a severe lack of literature on the Jordanian construction industry, this section provides background information on the Jordanian construction industry. Including construction and demolition operations, contractual arrangements, production of construction material, types and volume of C&D waste generated, as well as their causes and impacts. In addition to, C&D

waste management strategies including its activities, regulations and legislations and practices.

2.5.1 Types and Volume of Construction and Demolition Waste - Jordan

According to GIZ (2014), the Jordanian construction industry generates tons of waste each year with roughly 2.6 million $m^3/year$. Regrettably, our analysis excluded C&D waste generated across Jordan as per lack of data. Thus, it would have been more interesting if the study had quantified the whole amount of C&D waste generated by Jordan's construction and demolition projects. This lays the groundwork for future research into quantifying the total amount of C&D waste generated in Jordan.

According to research conducted by Bekr G.A. (2014), construction waste increased from 11.5% to 15.2% between 2010 and 2012. Bekr G.A. (2014) claimed that just 15% to 21% of C&D waste originates from Jordanian construction projects only. A more enlightening study would have included demolition waste. However, numerous studies indicate that renovation and demolition waste present the biggest proportion of C&D waste. Thus, logically most of waste in Jordan should be generated from renovation and demolition activities (Ding Z. et al., 2016; Wu H. et al., 2016; Abreu P.F. et al., 2015). This means that the amount of C&D waste could be more than the amount estimated above.

The composition of waste generated on construction sites is illustrated in **table 2-8** by the study of Al-Rifai J. and Amoudi O. (2016). It comprises a variety of material in varying proportions, including timber at a percentage of 10% to 40%, cement at a percentage of 3% to 20%, sand and aggregates at a percentage of 3% to 15%, concrete at a percentage of 2% to 12%, steel at a percentage of 2% to 10% and ceramics and tiles at a percentage of 3% to 11%. Contrary to the findings of Al-Rifai J. and Amoudi O. (2016), Bekr G.A. (2014) study concluded that sand comprised around 21% of construction waste, followed by aggregates (20.7%), timber formwork (19.49%), cement (18.34%), concrete and concrete blocks (16.76% and 17.05%, respectively) and steel reinforcement (16.91%).

Compositions of C&D Waste	Range of Actual Percentage
Concrete	2-12%
Steel	2-10%
Sand and aggregates	3-15%
Cement	3-20%
Ceramics	3-11%
Tiles	3-11%
Timber formwork	10-40%

Table 2-8: Construction Waste Composition (Al-Rifai J. and Amoudi O., 2016)

Much of the research conducted thus far has been limited to a small number of discrete aspects and suffers from significant generalisability problems and lack of data. In comparison to other studies, only two examined C&D waste in great depth and they were the largest studies to date documenting this issue (Al-Rifai J. and Amoudi O., 2016; Bekr G.A. , 2014). Existing accounts fall short of resolving the discrepancy between the two investigations. Another significant shortcoming of those research was their failure to adequately analyse the composition of demolition waste and informal dumping. Thus, both studies would have been more pertinent if they examined a broader range of waste and concentrated on demolition activities and informal dumping. This in conclusion is an exciting subject that could benefit from additional research and hence additional examination into C&D waste is strongly encouraged.

2.5.2 Causes of Construction Waste – Jordan

According to the study of Chowdhury M. et al. (2016), the key causes of construction waste in developing countries include a lack of public awareness, lack of regulatory frameworks and enforcement and the use of outmoded technologies.

Bekr G.A. (2014) attributes the problem primarily to repeated design and client revisions and modifications during a project. His findings corroborate those of Al-Rifai J. and Amoudi O. (2016), who discovered that worker and subcontractor errors, insufficient contract documentation, improper material storage are all strongly associated with construction waste generation. In addition to, the insufficient waste management strategies, low-quality material selection, improper cutting of certain construction material and material damage. However, studies have been unable to disentangle the absence of onsite or offsite sorting from the sources of construction waste arising as based on international literatures.

Table 2-9 illustrates the potential reasons of Jordan's construction waste generation together with their likely percentages (Al-Rifai J. and Amoudi O., 2016).

<table>
<tr><th>Compositions of C&D Waste</th><th>Range of Actual Percentage</th><th>Reasons</th></tr>
<tr><td>Concrete</td><td>2-12%</td><td>• Lack of quality management systems and teams
• Worker’s awareness</td></tr>
<tr><td>Steel</td><td>2-10%</td><td>• Improper cuttings of steel reinforcement and improper supervision</td></tr>
<tr><td>Sand and aggregates</td><td>3-15%</td><td rowspan="2">• Absence of material management causing damages</td></tr>
<tr><td>Cement</td><td>3-20%</td></tr>
<tr><td>Ceramics</td><td>3-11%</td><td rowspan="2">• Improper cuttings and production defects</td></tr>
<tr><td>Tiles</td><td>3-11%</td></tr>
<tr><td>Timber formwork</td><td>10-40%</td><td>• Absence of Constructability aspects in design</td></tr>
</table>

Table 2-9: Causes of Construction Waste Arising (Al-Rifai J. and Amoudi O., 2016)

2.6 Jordanian Construction and Demolition Methods

The construction sector in developing countries is characterised by a lack of knowledge and a tendency to evolve through time (Ali H.H. and Al Nsairat S.F., 2009). Despite this, the study of Ali H.H. and Al Nsairat S.F. (2009) contributes to our understanding that Jordan's construction industry is more arranged, organised and adequate than that of other developing countries. Owing to its association with several governmental organisations, including the Ministry of Public Works and Housing (MPWH), the Jordanian Construction Contractors Association (JCCA) and the Jordanian Engineers Association (JEA) (Ali H.H. and Al Nsairat S.F., 2009).

This study established that the construction industry is a significant sector in the country that is growing at a quick pace. In 2014, Jordan's annual total of construction permits was anticipated to be around 11.8 million m^2 (GIZ, 2014). Residential buildings are anticipated to cost $954.8 million (Fanack, 2013). The amount that Fanack (2013) has identified recognised that the role of the construction industry as one of the big contributors to the Jordanian economy. Accounting for between 5%-10% of Jordan's Gross Domestic Product (GDP) and grew at a compound annual growth rate of 20.5%, 24.4% and 34.3% in 2008, 2009 and 2010, respectively (Al-Rifai J. and Amoudi O., 2016). Additionally, another study by Sweis R. et al. (2011), Sweis J.R. et al. (2014) and the Department of Jordanian Statistics (2012) indicated that the industry was on track to contribute 4.6% of GDP between 2002 and 2011. According to the Department of Jordanian Statistics (2013), its contribution has increased to 5% of GDP and was expected to reach 8.3% in the next five years.

These investigations demonstrate that they are achievable when a big number of workers is involved. According to Sweis G. et al. (2008) and Najmi H.S. (2011), this industry employs more than 12% of Jordan's workers. The findings of this study corroborate those of MOP (2010), which revealed that employment in this industry has increased over the last 30 years. According to MPWH (2011) report, 487,861 persons were employed informally in 2010 with a percentage of 44% to total employment in Jordan. According to a survey conducted by MOP (2010), the construction industry employs 11.1% of the total informal sector employment in the private sector. However, a conclusion has been drawn indicating that employability rate has declined from 9.7% to 6.4% (MOP, 2010). A significant disadvantage of this decline was the increase in foreign labour, which increased from 224 k to 336 k in 2010 (MOP, 2010).

The Jordanian construction industry is responsible through several actors as mentioned below for supplying Jordan with structures classified according to Sweis G. et al. (2008) and Al-Rifai J. and Amoudi O. (2016) as follows:

1. Residential projects such as housing type projects.
2. Building projects (Non-Residential) such as hospitals, schools and shopping malls.
3. Non-Building projects such as infrastructure and highway

According to AlSubeh M.A. (2013), about 60% of those construction projects are constructed by the private sector falling into three broad categories as follows (Al-Rifai J. and Amoudi O., 2016):

1. Clients or owners:
   Actors that have the right and the necessary powers and funds to efficiently authorise the construction of projects by using two key specialised advising and executive tools (Al-Rifai J. and Amoudi O., 2016). The owner for most of the major construction projects in Jordan is the government through its entities, officials and companies (Al-Rifai J. and Amoudi O., 2016).

2. Engineers, designers, or consultants:
   Actors that are responsible on undertaking design and engineering supervision classified as small, medium and large companies (Al-Rifai J. and Amoudi O., 2016).

3. Local contractors and sub-contractors:
   As the prime movers of the industry that undertake the construction. These are classified into six grades according to JCCA (2012) as follows in ascending order (Grade 1 represents the qualified company and Grade 6 represents the least qualified company):

   a. Grade 1
   b. Grade 2
   c. Grade 3
   d. Grade 4
   e. Grade 5
   f. Grade 6

The gradings of contractors are based on the financial status, administrative and technical staff, equipment, expertise and qualifications (Abbasi G.Y. et al., 2005; Department of Jordanian Statistics, 2012; JCCA , 2012; Alkilani S.Z. et al., 2013). Thus, Grade 1 contractors are the most experienced and qualified for large-scale projects, whereas Grade 6 contractors are the opposite (JCCA , 2012; Alkilani S.Z. et al., 2013).

A committee, according to Alkilani S.Z. et al. (2013), can evaluate bids made by contractors for projects posted in formal publications or on the Jordanian Government Tendering Department's website. Unlike in the UK, these contractors are chosen using the lowest price tender procedure, as is the case in any developing country (Wells J. and Hawkins J., 2010; Alkilani S.Z. et al., 2013). Thus, this evaluation of bids verifies pricing in accordance with the contractors' selection criteria (Alkilani S.Z. et al., 2013).

Sweis G. et al. (2008) has also stated that "a big number of the Jordanian construction contractors are independent, small in size and often resorts to under-bidding rivals to win contracts". This has a detrimental effect on contractor's attitudes and reduces the cost of winning bids. "Reducing the tender's cost can lead to a contractor to look for material that meet the minimum specifications and/or limit some unnecessary producers or activities within the project", a planner wrote in the study of AlZohbi M. (2015). Additionally, "The value the contract is one of the factors that can affect the production-quality of the projects in Jordan", according to Sweis J.R. et al. (2014). This may lead contractors to overlook excessive operations such as C&D waste management or the legal disposal of C&D waste in permitted landfill which ultimately result in informal dumping as outlined by JGBC (2016) and GIZ (2014). This aids in improving predictions of the numerous arguments against the legal disposal of C&D waste causes.

This has been evidenced also by Al-Rifai J. and Amoudi O. (2016) that have categorised the construction firms in Jordan into two groups based on their size as follows:

1. Small and medium sized companies.
2. Large sized companies.

These small and medium-sized firms are owned and operated by a single family member whose profitability is his own interest and have no intention of managing C&D waste (Al-Rifai J. and Amoudi O., 2016). Large firms, on the other hand, frequently employ waste management systems that exclusively dump and recycle steel and timber, as illustrated below (Al-Rifai J. and Amoudi O., 2016).

Regrettably, research about construction and demolition methods in the Jordanian construction industry has been mostly restricted to limited data and has relied heavily on old data. This research might be more beneficial if they concentrated on these activities. Additional research in this area would aid in establishing a greater degree of precision and accuracy in this matter.

2.6.1 Jordanian Production of Construction Material

In the previous quarter century, Jordanian construction practices have shifted from craft to industry, replacing traditional material like mud and stones with concrete, masonry and steel to cope with modernization (Ali H.H. and Al Nsairat S.F., 2009).

However, most research to date has been descriptive in nature and lacks data on extraction and manufacturing amounts of construction material. EnConsult (2007) indicates that the Jordanian construction industry lacks in critical studies and analyses as most data remain unavailable. It was consequently impossible to estimate the industry's contribution to extractions and manufacturing of material. Thus, further research to clarify and elucidate such quantities would be a fruitful area of further work.

2.6.2 Jordanian Demolition Methods

Unfortunately, there was no precise data and no published studies that comprehensively investigate demolition methods and its significance to C&D waste generation within the Jordanian construction industry. As they have significant limitations and weaknesses due to their emphasis on construction over demolition, including waste generated and contractual arrangements. Thus, numerous questions remain to be answered, showing the way forward for further research.

The study has thus far evaluated Jordan's industrial sector, solid waste management and the Jordanian construction industry. The following section of the research discusses C&D waste management in the country.

2.7 Construction and Demolition Waste Management in Jordan

One criticism levelled at most of the literature on C&D waste management in Jordan is that it is failing to engage with international discourses. Due to the scarcity of studies recognizing the critical nature of C&D waste management in the country, practically all stakeholders in the sector disregard this issue. Thus, a study of how C&D waste is treated in Jordan is required.

This section summarises the operations associated with the management of C&D waste, including collection, sorting, recycling and landfilling, as well as the applicable legislation and legal frameworks.

2.7.1 Collection, Sorting, Landfilling and Recycling

As illustrated in the diagram below, GAM is Jordan's sole municipality that specialises in C&D waste, however, it is restricted to legal landfilling only (GIZ, 2014). Other municipalities are responsible for solid waste collection and disposal, but not for C&D waste (GIZ, 2014). This contributes to our existing knowledge of waste management that sorting process in all municipalities does not occur. According to critics of GIZ (2014), municipalities not only do not handle C&D waste, but also are unable to create a sustainable solid waste management strategy. Aljaradin M. (2014) critiques this because Jordan's municipalities face budgetary difficulties.

These factors may help explain why most C&D waste is placed informally in Jordan as illustrated in **figures 2-10** to **2-22** (JGBC, 2016; GIZ, 2014). Yuan H.P. (2008) defines informal dumping as "the unlawful deposit of C&D waste onto land". Illegal dumping, he and Vitale P. et al. (2017) assert, can contaminate municipal rivers, hinder city subway development and contaminate the air and soil. Furthermore, it eventually harms public health by contaminating ground and surface water supplies, posing major health hazards and hurting people as most of the places of informal dumping is freely accessible to people. This key conclusion means that rural Jordan's C&D waste concerns are worse, highlighting the importance of C&D waste management and its definite need in the country.

Despite the current nature of this management, GIZ (2014) offers some insight by indicating that hazardous waste such as Asbestos are treated and regulated very cautiously via collection and sorting to be dumped in a specialised landfill for hazardous waste material called Al-Swaqa (GIZ, 2014). Jordan's Ministry of Environment presently operates the country's sole landfill for this type of waste. Critics question the landfill's efficiency, alleging that it gets only about 10-20% of generated hazardous waste (GIZ, 2014).

Figure 2-9: Process of C&D Waste Collection and Landfilling

Figure 2-10: Informal Dumping of C&D waste

Figure 2-11: Informal Dumping of C&D waste

Figure 2-12: Informal Dumping of C&D waste

Figure 2-13: Informal Dumping of C&D waste

Figure 2-14: Informal Dumping of C&D waste

Figure 2-15: Informal Dumping of C&D waste

Figure 2-16: Informal Dumping of C&D waste

Figure 2-17: Informal Dumping of C&D waste

Figure 2-18: Informal Dumping of C&D waste

Figure 2-19: Informal Dumping of C&D waste

Figure 2-20: Informal Dumping of C&D waste

Figure 2-21: Informal Dumping of C&D waste

Figure 2-22: Informal Dumping of C&D waste

The problem of informal dumping is more frequent in developing countries, where governments (local authorities) are less stringent about C&D waste, than in developed ones, where the problem is not visible. The findings of GIZ (2014) corroborate studies made in the Levant region (Iraq, Jordan, Syria, Lebanon and Palestine). As detailed by Amine Y. et al. (2018), trucks in Lebanon tip their buckets on the sides of the road. Leaving trails of C&D debris consisting of tiles, ceramics and concrete that cannot be resold, in contrast to steel, timber and removable material (Amine Y. et al., 2018). The insights gained from their study, outlines that informal dumping occurs primarily at night since it is against the law, yet some occurs during the day (Amine Y. et al., 2018).

The study of Al-Rifai J. and Amoudi O. (2016) elucidates the role of several factors contributing to informal dumping in Jordan. Including governments (local authorities) not being strict enough with C&D waste, a lack of quality management and skilled labour in a sector that is highly reliant on skilled labour with low wages (mostly Egyptian) (MOL, 2010; Al-Rifai J. and Amoudi O., 2016).

According to studies by Al-Rifai J. and Amoudi O. and JGBC (2016), around 40% of Jordanian construction firms do not have a waste management system or strategy in place. While the remaining 60% does that, although limited to proper landfilling (Al-Rifai J., Amoudi O. and JGBC, 2016). Nevertheless, 50% of them are only considering waste for some important material mainly steel and timber to return with direct profit to the company or for energy recovery as seen in **figure 2-23** to **2-28**. For instance, steel is a highly profitable waste to recover because it can be sold for only 20% of its original worth as scrap (Al-Rifai J. and Amoudi O., 2016). Timber is an excellent waste material for energy recovery in incinerators (Al-Rifai J. and Amoudi O., 2016). Due to the inability of material such as tiles, ceramics and concrete to be resold or recovered due to a lack of recycling facilities, they are declared waste and are put in landfill or unauthorised places. This raises several interesting points for future research.

Unfortunately, most research in the field of C&D waste management have been restricted to generalisability. Because it has raised numerous unanswered questions and yet most data on C&D waste management remains inaccessible. Thus, there are a few critical issues that must be addressed to generate intriguing findings that account for C&D waste management in greater detail and completely comprehend the ramifications of this management in the country.

Figure 2-23: Steel Reinforcement Sorting

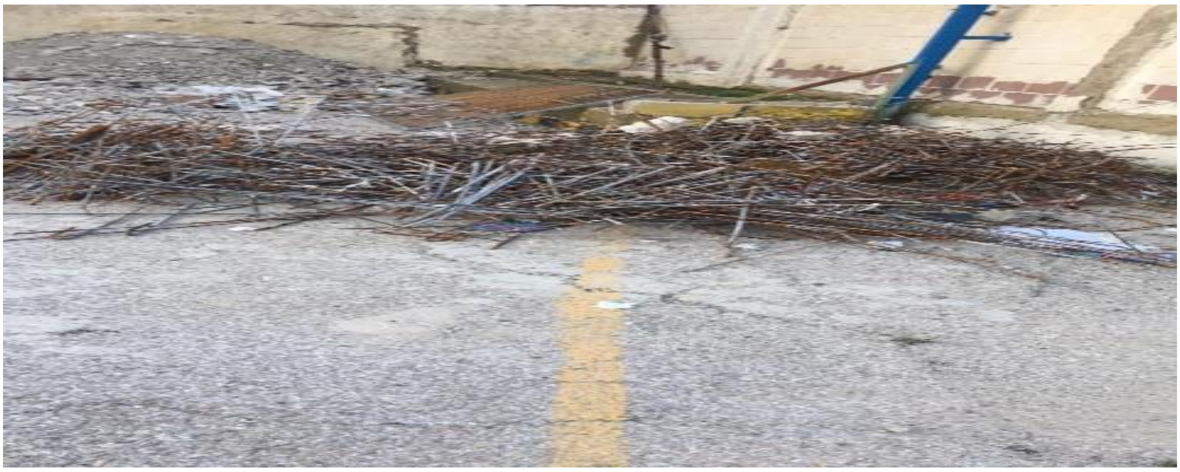

Figure 2-24: Steel Reinforcement Sorting

Figure 2-25: Steel Reinforcement Sorting

Figure 2-26: Steel Reinforcement Sorting

Figure 2-27: Timber Sorting

Figure 2-28: Timber Sorting

2.7.2 Regulations, Strategies and Initiatives

This section contains the legal frameworks governing Jordan's C&D waste management. As previously said, most local studies and research overlook C&D waste, which results in disregarding governmental stipulations. Few governmental authorities and officials, such as GAM and the Jordanian Engineers Association, are in place to regulate C&D waste by few stipulations and regulations in general in Jordan.

Contract provisions in GAM require contractors and construction firms to ensure that their C&D waste is disposed of properly prior work and all project's BOQ's should include this requirement (GAM, 2020). Jordanian Engineers Association (2011) also addresses the issue of C&D waste in Jordan by proposing legislation in 2011 for the disposal of C&D waste in designated landfill. The tables below illustrate the most recent regulations of C&D waste in Jordan. Although, one major criticism of these regulations that they do not adequately manage C&D waste effectively. As they are mostly concerned with dumping waste legally and applying fines for violators. Therefore, as previously indicated, a significant portion of C&D waste is still discarded informally (GIZ, 2014).

<table>
<tr><th>Law No.</th><th>Description</th><th>Current Attitude</th></tr>
<tr><td>(Law No. 21/2005)</td><td>“Sets permit regulations for construction and demolition waste and illegal dumping”</td><td>No current adoption, except for GAM is proposing several regulations and adopting different approaches lately to deal with proper disposal of C&D waste like the below regulations under law (No.150/2016).</td></tr>
<tr><td>Clause 4/Par. F</td><td>“Dumping of C&D waste in streets, sidewalks or any place that could affect others or social care is considered to be as a health hated area”</td><td>--</td></tr>
<tr><td>Clause 5, Par. B</td><td>“A first warning will be given if any of …..C&D waste has been spotted by the GAM supervision team in any place or project in an inappropriate manner to be dumped properly within a given period of time”</td><td>--</td></tr>
<tr><td>Clause 5, Par. C</td><td colspan="2">“If the spotted waste of ……C&D has not been solved and properly dumped in authorised landfill, the GAM supervision team has the right to assign a fine as per the volume (m^3) of C&D waste and also to be properly dumped by the responsible side (contractor, sub-contractor and construction companies as the case may be) to landfill”.

The fining system:
<table>
<tr><th>Clause</th><th>Fines (JD/m^3)</th></tr>
<tr><td>Random dumping of C&D waste (informal dumping)</td><td>50</td></tr>
<tr><td>Not reaching the authorised landfill for dumping C&D waste</td><td>50</td></tr>
<tr><td>Start working on the project without obtaining an authorisation</td><td>100</td></tr>
<tr><td colspan="2">C&D waste includes Concrete, Concrete blocks or bricks, timber, steel, cement, excavation debris, ceramics and tiles.</td></tr>
</table></td></tr>
</table>

Table 2-10: Current Regulation of C&D Waste Management

Law No.	Description	Current Attitude
Chapter IV, Article 96 (No. 1)	“No natural or legal public or private person may construct a building, start works, add any part to them, demolish them or any part of them, make any modification to them by expansion, raising or reinforcing whether in the external shape or internal arrangement of the building. Furthermore, no land features may be changed through excavation or filling without obtaining a license from the Committee”	--
Chapter IV, Article 96 (No. 16)	“The licensee must obtain from the Committee a license of excavation and/or debris transport after providing a financial guarantee to ensure his commitments to meet the conditions of license. Such guarantee shall be made for the benefit of the Municipality upon a resolution made by the Committee if the licensee violates such conditions”	--
Chapter IV, Article 96 (No. 20)	“The mayor or a person authorised by him shall issue the license that include the conditions to be met, work duration, the place to leave the wastes and debris, the numbers of machineries operated at the site and the public safety requirements”	--
Chapter IV, Article 96 (No. 21)	“No person may put debris, wastes or rubbles with no permission or in a place other than the permitted one or in violation of the license conditions; the Committee or anyone authorised by it may immediately suspend such person until he fixes his situations”	--
Law (No. 7/2012) and Law (No. 83/2009)	“Municipalities shall regulate, monitor and enforce C&D waste management”.	No current adoption, except for GAM that is only handling the destination of C&D waste based on the quality of the buildings and the zoning regulation.

Table 2-11: Current Regulations of C&D Waste Management

2.7.3 Waste Management Practice

Jordanian literatures are deficient in discussing C&D waste management and its benefits. This could be a result of the country's lack of C&D waste management plans, strategies, regulations and application. Though, as previously indicated, the country's sole recovery movement is focused on non-inert waste material such as steel and timber (Al-Rifai J. and Amoudi O., 2016).

Although, **section 2.3.5** above provides a wide comprehension of the C&D waste management advantages that Jordan could benefit from when applying an effective C&D waste management. In conclusion, if improper solid waste management in Jordanian municipalities is not addressed appropriately, the future repercussions will exacerbate (Al-Rifai J. and Amoudi O., 2016). Thus, Jordan, like other industrialized countries, should prioritise the management of C&D waste in the construction industry at early stages to avoid any future implications (Esa M.R. et al., 2016). A C&D waste management system could assist Jordan in increasing Jordan’s competitiveness in controlling the prices of construction material and compensating for a scarcity of raw supplies (Kirchherr J. et al., 2017; Witjes S. and Lozano R., 2016). Particularly since MPWH (2011) indicated that construction material costs have been continuously increasing throughout the years, with an estimated increase of 11.5-15.2% between 2010 and 2012. Additionally, one added advantage to Jordan would be reducing the percentage of informal dumping.

Although there have been few studies on the Jordanian construction industry, none have addressed C&D waste management. Thus, the research conducted a cross-national study on the management of C&D waste.

Following the discussion of C&D waste management internationally and in Jordan, it is critical to explore notably the technical viability of using CCA in new concrete mixes as seen in the next section.

2.8 Concrete Manufactured Using Crushed Concrete Aggregates

Several researchers had conducted studies to investigate the influence of using CCA in new concrete mixes (Brandes M.R. and Kurama Y.C., 2018; Pedro D. et al., 2014; Seo D.S. and Choi H.B., 2014; Yildirim S.T. et al., 2015; Verian K.P. et al., 2018; Zhou C. and Chen Z., 2017; Dimitriou G. et al., 2018; Choi W.C. and Yun H.D., 2012; Omary S. et al., 2016; Bhasya V. and Bharatkumar B.H., 2018; Wijayasundara M. et al., 2018; Bui N.K. et al., 2017; Xuan D. et al., 2017).

CCA is technically distinct from NA in that it is composed of two distinct material: natural and old cement mortar (Çakır O., 2014). The primary reason CCA performs poorly in comparison to NA is due to the old cement mortar (Debieb F. et al., 2010). Which results in a low density, a high degree of heterogeneity and impurities, a high-water absorption rate and a low resistance to fragmentation (Debieb F. et al., 2010).

According to Medina C. et al. (2015), the addition of CCA to concrete mixtures had no effect on workability since results of slump test ranged between 32 and 43 mm. This conforms to the British Standard (BS EN 12350-2) for slumps ranging from 10 and 210 mm. Additionally, due to the above properties, using CCA in concrete mixes might result in a reduction of up to 40% in compressive and tensile strength, depending on the CCA replacement ratio (Andreu G. and Miren E., 2014; González-Fonteboa B. et al., 2016; Verian K.P. et al., 2018). Although multiple studies have established a direct correlation between concrete performance and a 20%-30% in CCA replacement (Andreu G. and Miren E., 2014; González-Fonteboa B. et al., 2016; Verian K.P. et al., 2018). Numerous studies, however, demonstrate that concrete can have found a direct relationship with CCA replacement by up to 20% (Li X., 2009; Shatarat N. et al., 2019). Another study by Medina C. et al. (2015) assessed the replacement of 25%-30% CCA in concrete mixes and discovered that the concrete's 28-day compressive strength was 39.82 MPa. Cakir O. (2014) analysis revealed that concrete mixtures containing CCA have a lower compressive strength than mixes including NA. That is referred to being CCA as the weakest link in the concrete chain. Additionally, because of increased porosity in mixtures and a lack of bonding between concrete components as per the old, attached mortar (Lee G.C. and Choi H.B., 2013). Further detailed data can be found by an experimental evaluation of concrete mixes using compressive and tensile strength measurements with variable quantities of CCA conducted by Cakir O. (2014).

Hereafter, it is possible to construct concrete driveways, foundation trenching, pipe bedding and levelling surfaces etc using CCA in concrete manufacturing (Medina C. et al., 2015). In comparison to NA, it is preferable to be used as a road base due to mainly its wide particle size distribution (Akhtar A. and Sarmah K., 2018; Zhao W. et al., 2010).

Ratio of CCA to NA	Compressive strength (MPa)	Tensile splitting strength (MPa)	Density (kg/m^3)	Water absorption (%)
CCA 0% OR NA 100%	42.4	3.3	2513	5.1
CCA 25%	37.9	3.2	2317	7.2
CCA 50%	34.7	3.2	2254	9.6
CCA 75%	33.0	2.6	2103	12.4
CCA 100%	32.1	3.0	2008	15.6

Table 2-12: Compressive and Tensile Strength of Concrete with Different Proportions of CCA (Çakır O., 2014)

Following the discussion of numerous studies that have examined the impacts of including CCA into concrete mixes (Brandes M.R. and Kurama Y.C., 2018; Pedro D. et al., 2014; Seo D.S. and Choi H.B., 2014; Yildirim S.T. et al., 2015; Verian K.P. et al., 2018; Zhou C. and Chen Z., 2017; Dimitriou G. et al., 2018; Choi W.C. and Yun H.D., 2012; Omary S. et al., 2016; Bhasya V. and Bharatkumar B.H., 2018; Wijayasundara M. et al., 2018; Bui N.K. et al., 2017; Xuan D. et al., 2017). Jordanian research findings corroborate earlier international research findings that CCA in concrete mixtures has a detrimental effect on workability, durability and mechanical properties.

Previously published studies on properties of CCA are consistent of those published in Jordan, due to higher water absorption, surface fissures and remaining mortar particles, the features and quality of CCA are typically lower to those of NA. Additionally, CCA has a lower specific gravity and density than NA, as shown by Shatarat N. et al. (2019). Furthermore, the mortar attached with CCA diminishes its resistance to fragmentation, raising the abrasion values (Shatarat N. et al., 2019). The old, attached mortar can have far-reaching consequences (Shatarat N. et al., 2019).

These characteristics have resulted a decrease in the compressive strength of concrete mixtures, depending on the CCA replacement ratio (Shatarat N. et al., 2019). Due to the strong bond between CCA and concrete matrix, results indicate that up to 20% CCA replacement produces superior results over NA (Shatarat N. et al., 2019). The lower the NA level in concrete mixtures, the lower the compressive strength (Shatarat N. et al., 2019). Numerous investigations have demonstrated that as the NA concentration in concrete decreases, the compressive strength of the concrete decreases and hence the value of the load decreases (Shatarat N. et al., 2019). The study of Shatarat N. et al. (2019) gives additional detail on the characteristics of CCA and their performance in concrete.

Property	**NA**	**CCA**
Specific gravity (apparent)	2.68	2.53
Specific gravity (bulk dry)	2.39	2.29
Specific Gravity (bulk SSD)	2.50	2.38
Water Absorption (%)	1.1	6.4
LAAV (%)	38.96	40.82
Concrete Mixes	**Compressive Strength on 28 days**	
CCA 0% or NA 100%	48.0	
CCA 20%	49.0	
CCA 40%	39.0	
CCA 60%	40.0	
CCA 80%	37.0	
CCA 100%	30.0	

Table 2-13: Physical Properties of CCA and Compressive Strength of Concrete with Different CCA Ratios (Shatarat N. et al., 2019)

This knowledge should aid in the development of more accurate projections of the impact of employing CCA in new concrete mixes. One question, however, remain unanswered, is why CCA is not currently employed in Jordan's concrete mixes. Thus, additional research should be conducted to ascertain the barriers to CCA use in the country.

2.9 Barriers to C&D Waste Management and the Way Forward

Despite the benefits of C&D waste management, its implementation may be hindered by a variety of drawbacks (Zhao W. et al., 2010; Duan H. et al., 2016; Domingo N. and Luo H., 2017; Yuan H., 2017). According to Ritzén S. and G.O. Sandström (2017) and Singh J. and I. Ordoez (2016), the life cycle of material includes various processes and thus transition to C&D waste management is rather difficult. The data in this section demonstrate the barriers to implementing recovery practices and the way forward.

It is unfortunate that the barriers of C&D waste management are being limited to empirical based literatures (Ranta V. et al., 2018; Ritzén S. and Sandström G.O., 2017; Li J. and Yu K., 2011). This enables us to understand Jordan's dearth of research, which has delayed the adoption of C&D waste management.

The level of construction material recovery, including reuse and recycling, is influenced by environmental, design, construction, operational and managerial considerations (Akanbi L.A. et al., 2018). His results contribute to a variety of ways to current study. Firstly, the specifications of recovered construction material during design and construction stages are one of the most influential factors. Secondly, the use of prefabricated elements, the reduction of the number of different types of construction elements and the avoidance of secondary finishes. In addition to the avoidance of poisonous or hazardous material are all closely related with ensuring the practicality of recycling material (Akanbi L.A. et al., 2018). The findings of his investigation complement those of Huang B. et al. (2018), Nußholz L.K. et al. (2019) and Lockrey S. et al. (2016), a lack of regulations, codes and quality standards for recovered material impedes C&D waste recovery practices. Due to a lack of technical knowledge, which results to distrust the use of secondary material (Huang B. et al., 2018; Nußholz L.K. et al., 2019; Lockrey S. et al., 2016). Additionally, architects are not held accountable for waste reduction under current regulations and rules since they fail in imposing responsibilities on architects to minimise waste, as it is judged more feasible to reduce waste during design than during construction (Ajayi S.O. and Oyedele L.O., 2017).

According to several studies, inadequate policies, legal frameworks, rules and monitoring all impede the management of C&D waste (Ranta V. et al., 2018; Mittal V.K. and Sangwan K.S., 2014; Abba A.H. et al., 2013; Li J. and Yu K., 2011). As in some countries C&D waste management faces lack and absence in clear national goals and targets, legal frameworks and sustainable practices (Alkilani S.Z. et al., 2013; Veleva V. et al., 2017; Yuan H., 2017; Mittal V.K. and Sangwan K.S., 2014). According to Ajayi S.O. and Oyedele L.O. (2017), current legislation does not make architects accountable for C&D waste reduction. This accounts for a major barrier hindering waste minimization (Ajayi S.O. and Oyedele L.O., 2017; Chong W.K. and Hermreck C., 2010). This was consistent with the outcomes of Dumlao-Tan M.I. and Halog A. (2017) investigation. However, another cause is a lack of design tools (Kibert C.J. and Chini A.R., 2000; Dumlao-Tan M.I. and Halog A., 2017).

It appears as though designers are responsible for virtually all recycling roadblocks (Chong W.K. and Hermreck C., 2010). Ghisellini P. et al. (2018) work contributes to existing knowledge of Akanbi L.A. et al. (2018), stating that the use of recovered construction material is hampered by the inadequacy of recovered waste material supply in comparison to standard material and the lack of market demand. In addition to, the low cost of standard and raw material in comparison to the high cost of recovered material and the lack of budget for waste management in construction projects (Huang B. et al., 2018; Nußholz L.K. et al., 2019; Dahlbo H. et al., 2015; Ghisellini P. et al., 2018; Lockrey S. et al., 2016).

These do not rule out the influence of other implications such as a lack of recycling facilities, preventive measures and knowledge and the limited utility of hazardous and non-hazardous waste material classification. In addition to, the lack of waste infrastructure in some areas and a lack of producer-based knowledge and accountability systems in the manufacturing of construction material. Besides, the initial cost of recycling that is relatively higher than waste disposal and the long-time consumed in deconstruction compared to regular demolition. Moreover, the lack in demolition waste data in terms of reporting, rules, standards and codes to regulate the construction with recycled material and top urban managers lack commitment towards C&D waste management together with their risk aversion as some of them lacks in experience to recycling and resistance to change. In addition to, the economic judgment towards recycling which considers recycling of C&D waste is only attractive when the recycled product is competitive in terms of cost, quantity and quality and low landfilling fees which indirectly encourage actors to dispose waste in landfill. Further data could be provided in greater detail in several international studies conducted by Mahpour A. (2018); Esa M.R. et al. (2016); Jin R. et al. (2017); Yeheyis M. et al. (2012); DEFRA (2015); Ritzén S. and Sandström G.O. (2017); Li J. and Yu K. (2011); Silva R.V. et al. (2016); Kagioglou K. et al. (2000); Veleva V. et al. (2017); Yuan H. (2017); Ranta V. et al. (2018); Dumlao-Tan M.I. and Halog A. (2017); Mittal V.K. and Sangwan K.S. (2014); Lockrey S. et al. (2016); Hossain Md. U (2017); Sieffert Y. et al. (2014); Ghaffar S.H. et al. (2020); Ghisellini P. et al. (2018); Huang B. et al. (2018).

As in any country, these consequences are apparent in Jordan, particularly given that producers and collectors of C&D waste typically perceive waste collection as being dumped rather than recovered and all actors are attracted to recycling movements to generate revenue.

These findings have major implications for the construction and recycling companies under the pressure for generating profit and may have an impact on Jordan's C&D waste management efficacy in Jordan. Particularly given that Jordan lacks clearly defined roles and responsibilities within the industry and regulatory frameworks and policies that explicitly and unambiguously promote waste management in Jordan (Aljaradin M., 2014; Amine Y. et al., 2018; Yamamoto, A., et al., 2018). If the entire C&D waste management is ineffective or unwilling to transform into circular economy. It is believed that it is attributed to a lack of international cooperation, corruption, outsourcing environmental concerns and the use of old technologies, among other factors (Yuan H., 2017; Li J. and Yu K., 2011).

Despite these drawbacks, the work contributes to our understanding of potential ways for circumventing them. As evidenced by the studies of Yuan H. (2017), Huang B. et al. (2018) and (GIZ, 2014), this can be accomplished by improving existing legal frameworks and regulations, developing new ones and periodically reviewing the performance of regulations against quantifiable criteria. Additionally, pushing governmental organisations to amend Jordan's waste management legislation to provide greater financial incentives for C&D waste management (Al-Rifai J. and Amoudi O., 2016; Yuan H., 2017). This is in line with the assertion made by Huang B. et al. (2018) that the lack of incentives from regulatory authorities hinders the usage of secondary material.

To begin managing C&D waste, López Ruiz L.A. et al. (2020) proposes that the departure towards C&D waste management should be prior construction and renovation activities. This departure is crucially correlated to the development of adequate legislative and regulatory instruments. To delivering a solid base for the enhancement of C&D waste management strategies. Ali H.H. and S.F. Al Nsairat (2009) urged Jordanians to "an urgent need to return back to the vernacular systems into modern perspective, through establishing new building systems and practices based on green thinking and applications". According to Yamin M.Z. (2019), a cost recovery system that is appropriate and equitable should be devised based on the concept of polluters pay and users pay. According to the report of Abu Qdais H.A. (2007), Jordan's informal scavenging sector should be trained and better integrated into solid waste management to attain high waste recovery rates.

Additionally, Yuan H. (2017) recommends involving designers and supporting the usage of a variety of deconstruction and recycling models and techniques to increase demand for recycled material.

The next chapter demonstrates and describes the research mixed methods used in investigation to achieve its aim by tackling the research objectives.

3 Methodology

This chapter discusses the mixed method methodology used in the research. An overview of the research methodology, research philosophy, approaches and techniques are explained in this chapter. Additionally, it justifies the research strategy decision and explains the research methods used, their rationale, sample size and the study validation process. To comprehend what was previously known and unknown about the topic, therefore identifies the gaps in knowledge and evaluates the methods used by others. Part of the data for this chapter is included in **chapter 10-appendix I**.

3.1 Research Methodology

The research methodology has been defined by several literatures and perspectives. One of which was clearly introduced by Fellows R. and Liu A. (2008), Klein H.K. and Myers M.D. (1999) and Binti N. (2008) as "the principles and procedures of the logical thought process which are applied to a specific investigation". **Chapter 10-appendix I** contains additional perspectives and descriptions of methodology.

Choosing the appropriate research approach is crucial for producing credible results and high-quality research (Binti N., 2008). However, according to Walker D.H. (1997) and Fapohunda J.A. (2009), selecting an appropriate methodology remains difficult. Choosing and implementing a technique that is appropriate for producing trustworthy research findings needs a thorough examination of the study's type and methods (Fapohunda J.A., 2009). These data demonstrate that it is worthwhile to go through the study types. **Chapter 10-appendix I** details the various forms of research and their basis.

3.2 Research Philosophy

Holden M.T. and Lynch P. (2004) has correlated the importance of research philosophy with its role in opening the research's mind to different possibilities. As it instils confidence in the application of appropriate methods and enhances research skills.

It is critical to keep in mind that the design of every research project entails several interconnected layers of decision-making (Fellows R. and Liu A., 2008; Creswell J.W., 2013; Higham A.P., 2011). Ranging from broad vision to more specific decisions about data collecting and analysis (Fellows R. and Liu A., 2008; Creswell J.W., 2013; Higham A.P., 2011). Saunders M. et al. (2009) underlines the need of first considering the data collection and analysis methodologies used. Indicating that technique selection is significantly influenced by research philosophy in general. **Chapter 10-appendix I** contains a more detailed description of the research philosophy.

3.3 Research Approaches

Choosing the most appropriate research method is contingent upon the study's objectives and research questions. Thus, it is critical to confront and debate research methodological approaches to justify research methods selected for conducting research (Sherif K.F., 2010).

As indicated in **chapter 10-appendix I**, finding an acceptable study topic can be challenging, emphasizing the importance of evaluating and considering sufficiently a variety of variables. According to Remenyi D. et al. (1998) and Sherif K.F. (2010), this could be distinguished by the research topic and problem. However, as demonstrated by Yin R.K. (2009) and Binti N. (2008), they should be guided by the following when selecting a research method:

1. The nature of enquiry and the types of questions.
2. The level of focus on existed events.
3. The extent of the researcher's control over the actual events.

Qualitative, quantitative and triangulation (mixed) are recognized as the main three types of research methods (Fellows R. and Liu A., 2008; Leedy P.D. and Ormrod J.E., 2005; Creswell J.W., 2013; Neuman W.L., 2006; Binti N., 2008). Rather than examining theories or existing literature, these methods acquire and analyse data (Fellows R. and Liu A., 2008). **Chapter 10-appendix I** has a detailed discussion of the various research methods.

3.4 Research Techniques

Data collection, according to Fellows R. and Liu A. (2008), is a communication process that should contain a chain of communication between the source and the collector to increase data reliability and quality. They classified this method into two taxonomies as follows:

1. One-way method:
   This type of communication method comprises completely structures or unstructured interviews, postal questionnaires, analysis of archived data or documents, diaries and observations by the researcher.

2. Two-way method:
   This type of communication method comprises semi-structured interviews and participant observation.

Numerous research techniques have been proposed, including qualitative interviews, quantitative questionnaires, grounded theory and experimental studies (Yin R.K., 2009). According to Binti N. (2008), selecting an appropriate research technique is contingent upon a variety of elements. Including the research situation, type of research question, data type, size and accessibility (Binti N., 2008). Fellows R. and Liu A. (2008) take an alternative interpretation to determining an appropriate research technique, claiming that the scope and depth of a study are inextricably linked. **Figure 3-1** below illustrates the decision to do a broad, shallow, narrow, deep, or intermediate investigation (Fellows R. and Liu A., 2008).

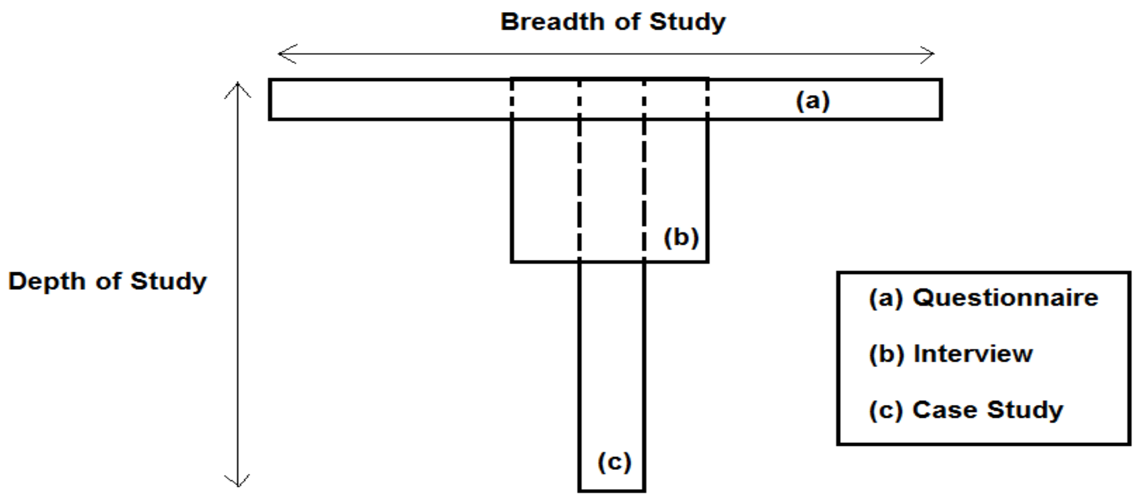

Figure 3-1: Breadth and Depth of in Question-based Studies (Fellows R. and Liu A., 2008)

3.5 Research Strategy Decision and Selection Methods

As stated in **chapter 10-appendix I**, a research project can be conducted and implemented in a variety of philosophies, strategies and techniques. It has however been demonstrated that selecting an appropriate research method can have a detrimental effect on the research's quality (Kerlinger F.N. , 1979; Remenyi D. et al., 1998; Tzortzopoulos P., 2004; Binti N., 2008).

To accomplish the study's purpose and answer the research question, it is believed that a rational choice should be made (Robson C., 2002). Most significantly, determining what and how to choose research approach to collect critical data is challenging (Walker D.H., 1997; Binti N., 2008; Ali M.M., 2011). Therefore, a critical assessment and rational of the possible research techniques that can be used should be done.

3.5.1 Research Philosophy and Methodology Selection

Insights from Creswell (2013), Leedy (2005) and Binti (2008) studies may assist in recognizing that constructing any research methodology should fully take into account the topic's complexity, types of collected data required and entirely address the study aim and/or question. In addition to taking the topic's complexity and types of required data into account. Thus, an examination of an issue necessitates feasible means of data collection (Binti N., 2008); (Leedy P.D. and Ormrod J.E., 2005).

The decision to employ a research methodology is exemplified in **figure 3-2** of nested research methodology proposed by Kagioglou K. et al. (2000). Additional material is included in **chapter 10-appendix I**.

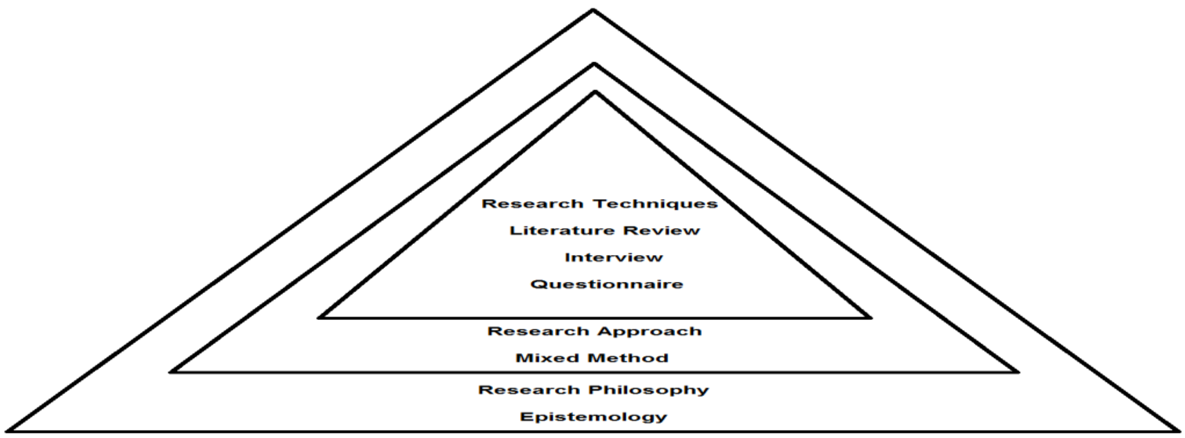

Figure 3-2: Selection of Research Methodology (Kagioglou K. et al., 2000)

3.5.2 Research Protocol

3.5.2.1 Determining the Study Region

Jordan was selected as the research area derives from having its construction industry as one of the fastest developing in the region. It additionally has a significant problem in C&D waste and how this waste is managed as indicated by GIZ (2014). Along with the halting of construction investments, a lack of security, the difficulty of reaching specialists and professionals and the collapse of governmental organisations and associations in other regions' construction industry which all contribute to Jordan's regional standing.

3.5.2.2 Organisations Selection

This process entails identifying governmental organisations and construction companies that are involved in the construction industry and solid waste management, particularly C&D waste. **Table 10-7** illustrates these organisations in greater detail. This selection is the result of numerous talks with representatives from various ministries and organisations.

3.5.3 Research Flow Chart

The flow chart below illustrates the research's approach to tackle its objectives and encounter its output and outcome. By defining the study's aim and objectives, it is possible to examine prior research to identify knowledge gaps in order to be covered by numerous methodologies. This includes collecting secondary data from peer-reviewed offline and online articles, books and journals, as well as primary data from, archival data, questionnaire surveys and interviews.

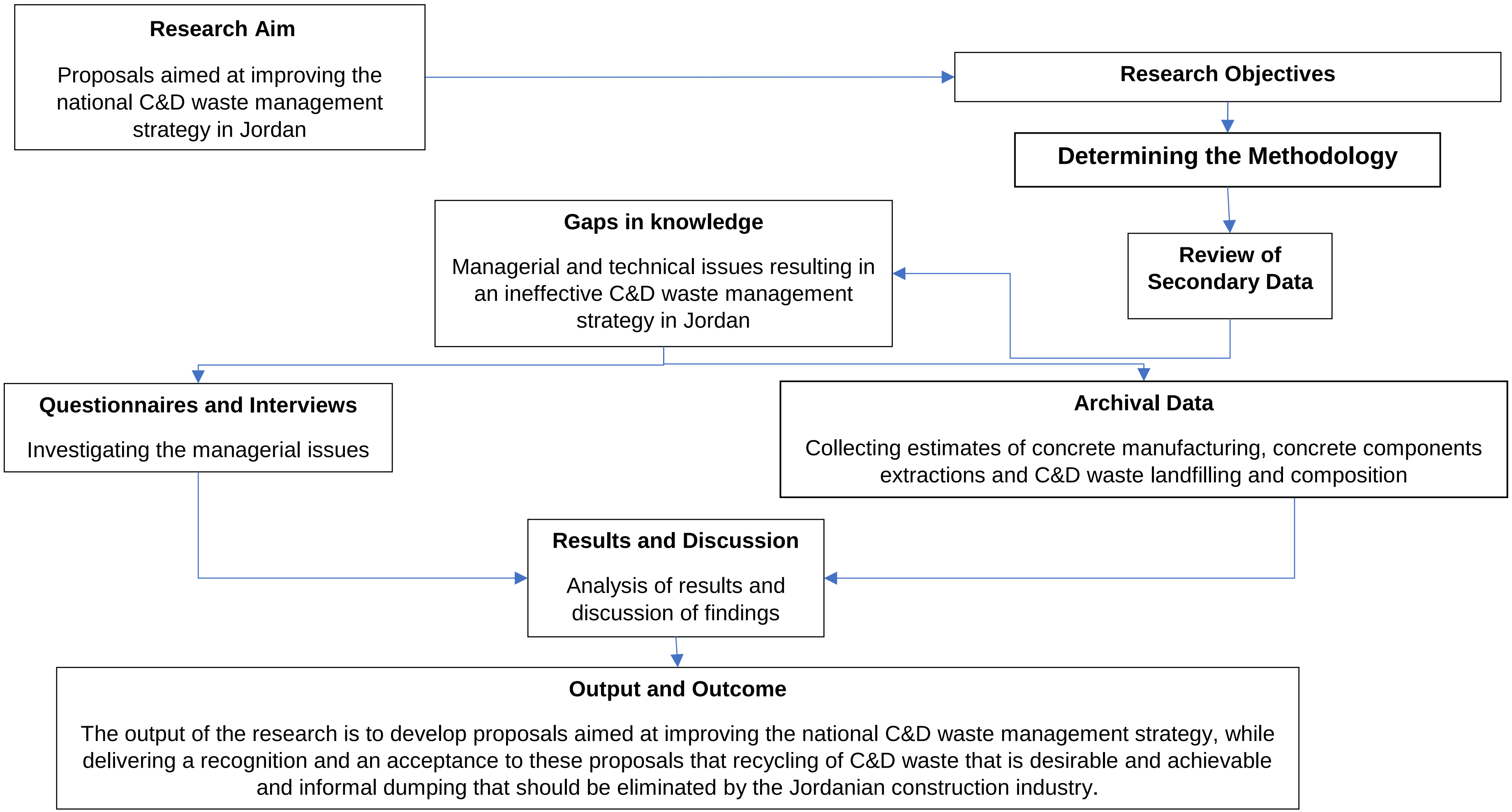

Chart 3-1: Research Flowchart

3.5.4 Research Design Process

This section discusses the process of designing the research and how it contributes to tackling the objectives, by utilising many methodologies to address the identified gaps in knowledge to accomplish the research aim mentioned above.

3.5.5 Research Aim and Objectives

This section presents the five research objectives that have been developed to meet the overall aim of the research as seen below. **Chapter 10-appendix I** details the mechanisms by which the research adjusted its purpose and aim over time.

1. **Review of global construction industries and C&D waste management to identify current best practice and effective methodologies:**
   - Study the types and volume of construction material used, quantifying the volume of raw material consumed as well as the volume and types of C&D waste generated.
   - Identify effective waste management regulations, initiatives, strategies and legal frameworks.
   - Critically evaluate waste collection, sorting and landfilling strategies with a focus on reuse C&D waste.
   - Identify significant limitations and barriers to implementation.
   - Understand the changes that have taken place to drive the construction industry towards improved management of C&D waste.
   - Identify the environmental and economic impacts that changes in C&D waste management strategy have brought about.

2. **Review of solid waste management in Jordan:**
   - Study the types and volume of both domestic and industrial waste generated in Jordan.
   - Identify the waste management approaches currently used including regulations, initiatives, strategies and legal frame works.
   - Critically evaluate the collection, sorting, landfilling and recycling systems currently in place.
   - Understand the changes that have delivered progress in terms of the recycling of domestic waste in Jordan.
   - Identify the environmental and economic impacts that changes in solid waste management strategy have brought about.

3. **Review and investigate C&D waste management in Jordan:**
   - Identify the construction and demolition methods currently employed in Jordan.
   - Study the types and volume of construction material used, quantifying the volume of raw material consumed as well as the types and volume of C&D waste generated.
   - Evidence and quantify any problems related to C&D waste including informal dumping and its causes.
   - Critically evaluate C&D waste collection, sorting and landfilling strategies with a focus on how this permit and encourage informal dumping.
   - Understand the supply chain needed for the recycling and re-use of C&D waste and identify the barriers to recycling and re-use of C&D waste.
   - Identify the changes needed to push the construction industry towards recycling of C&D waste.
   - Understand and quantify any future benefits of recycling C&D waste. Use these to establish its environmental and economic viability.

4. **Establish proposals aimed at improving the national C&D waste management strategy that is currently employed in Jordan through:**
   - Obtaining recognition from the Jordanian construction industry that recycling of C&D waste is both desirable and achievable.
   - Acquiring acceptance from the Jordanian construction industry that informal dumping should be eliminated.

3.5.6 Selection of Data Collection Techniques

Fellows R. and Liu A. (2008), Binti N. (2008) and Dainty A.M. (2008) have stressed that the "reliability of data will also be increased if multiple sources of data on the same phenomena are used". This comes in-line with what Voss C. et al. (2000) argued that a fundamental concept of research is the use of multiple data collection techniques to investigate the same phenomenon. As indicated previously, this study collected data through five techniques: literature reviews, laboratory tests, archival databases, questionnaire surveys and semi-structured interviews. Further information is clarified in **chapter 10-appendix I**.

3.5.6.1 Reviewing of Secondary Data

Blumberg B. et al. (2005) emphasized the need of examining current literatures in any research, which aligns with the Fellows R. and Liu A. (2008) statement on the necessity of reviewing pertinent literatures to the research topic.

The study's literature review was designed to tackle the study's first four objectives. This concerned international best waste management practices and the characteristics of the Jordanian construction industry.

The research examined the industry's activities from material extraction through material manufacture to material transportation. In addition to, design, construction and demolition activities. Additionally, it examined strategies for managing C&D waste, from collection to disposal. Including regulatory and legal frameworks, as well as environmental, social and economic impacts of this industry. As part of the investigation, the study examined how little waste is recycled these days. Since reinforced concrete is the most dominant used construction material in Jordan, the study focused on CCA recycling.

A notable outcome of the literature research was the identification of a significant gap in the body of knowledge about C&D waste management in Jordan as pointed out in **chapter 2**. This absence has laid the groundwork for determining the methods to be used for further investigation, such as archival databases, questionnaires, interviews, to fill in knowledge gaps and thoroughly explore the subject. The review of literature has been completed and portions of it are included in **chapter 2**.

3.5.6.2 Material Testing

As despite global attitudes (practices and studies) toward using crushed concrete aggregates in new concrete mixes, Jordan does not promote recycling of CCA. This has included testing the mechanical and chemical characteristics of Jordanian CCA quantitatively and compare the results with British CCA (sieve analysis, bulk density, specific gravity and water absorption, abrasion (fragmentation), sulphate content and chloride content tests). Thus, to evaluate CCA technical viability in new concrete mixtures in Jordan and demonstrate that CCA can be used in new concrete mixtures and to dispel any mechanical ambiguity or misunderstanding.

3.5.6.3 Archival Data Collection

Throughout the conduction of the research, the researcher discovered a wealth of material that has been archived in governmental bodies and industry organisations databases but has not been previously published in reports, studies, or literature. Including volume of concrete manufacturing and extraction of its components, energy consumption and formal dumping of C&D waste and its composition. This enabled the study planning to compile such informative data, although it is unfortunate that few required data have not been available in those databases. Thus, they remained unknown.

The first step in obtaining access to archived data was to submit cover letters, application forms and student proof letters. To identify the study topic, researcher details and demonstrating that this access is being granted only for PhD research purposes. Upon these submissions, approvals have been granted from a variety of public and private archives and databases such as GAM and Irbid Municipality, Ministry of Environment, Ministry of Energy and Mineral Resources, Jordanian Electricity Company, Jordanian Construction Contractors and Jordanian Construction Actors Associations.

3.5.6.4 Questionnaires and Interviews

3.5.6.4.1 Sampling Method

After establishing the sample frame, the researcher can choose between single-stage or multistage sampling. The one stage sampling can be used by simple random sampling that can be performed in a single step, in which individuals are selected one at a time without replacement (Naoum S.G., 1998). To begin, the multistage method appears to be more appropriate, as it begins by listing all Jordanian construction actors. As previously stated, individuals who work for these actors were selected for inclusion by separating them into clusters of twenty individuals apiece (Naoum S.G., 1998). This practice is utilised since the population's list of individuals is incomplete (Naoum S.G., 1998). This technique has been used to circumvent difficulties associated with random sampling large populations. To break down large groups into smaller ones as necessary to cover them and, most importantly, to group this population without constraint (Naoum S.G., 1998). However, because this method has a level of subjectivity, constant doubts about whether this sample is ideal can be avoided by justifying the research findings (Naoum S.G., 1998). Additionally, no findings of the research will ever be completely representative of the whole population (Naoum S.G., 1998). Thus, the research proposes multistage sampling due to the huge size of samples required.

The classification system was agreed upon after a thorough examination of the Jordanian construction industry's supply chain. This has been accompanied by academics recommending practitioners such as governmental entities including ministries and local authorities, construction contractors, concrete suppliers and locals to engage in this study. These academics were chosen to participate in this study based on their knowledge and academic expertise in engineering in general, specifically in the Jordanian construction industry and more precisely in management-related areas as defined by the study's scope.

To show the industry more realistically, performers from Amman have been selected, as it is Jordan's most populous and developed city (Bank Audi, 2014).

3.5.6.4.2 Questionnaires

According to Dainty A.M. (2008) and Fellows R. and Liu A. (2008), surveys are the most often used data collection technique in construction management and the broader research community. The efficiency and reliability of data collection, as well as the large number of respondents who may be involved in a short period of time are known to be effectual upon highly using this type of survey (Bell J. , 2005; Sherif K.F., 2010; Farrell P., 2011).

Questionnaires were developed in response to the findings of a literature review to ascertain what is lacking in the Jordanian context. As such, they were undertaken to contribute to the achievement of the research's second and third objectives. The survey data was then prepared for analysis to identify and cover several gaps in knowledge such as quantifying the proportion of informal dumping, determining the principal reasons behind informal dumping and identifying those most responsible, identifying approaches and measures that could be employed to reduce the quantity of informal dumping in Jordan. In addition to, identifying the aspects, within Jordanian construction contracts, that lead to low levels of C&D waste re-use, identifying the principal C&D waste management activities which are currently missing in Jordan and determining the main reasons hindering each activity in C&D waste management from taking place. Furthermore, assessing the willingness of construction industry actors to recycle and re-use C&D waste material.

3.5.6.4.3 Interviews

Numerous authors underline the importance of conducting interviews in research current literature (Nachmias C. and Nachmias D., 2000; Rubin H.J. and Rubin I.S., 2012; Higham A.P., 2011). Since they can aid researchers in developing a better understanding generating, explaining comprehensively insights and allowing researchers to capture the richness and complexity of their topic (Nachmias C. and Nachmias D., 2000; Rubin H.J. and Rubin I.S., 2012; Higham A.P., 2011).

Despite the expense and time spent, it was chosen to conduct these interviews in person rather than through telephone or online, based on the interviewee's desire and the evidence supplied by Blumberg B. et al. (2005) that the response rate is larger than that of telephone interviews. These interviews embrace open-ended questions to elicit a genuine picture of Jordan's construction industry. Given that only a few clarification questions are necessary, semi-structured interviews appear to be more appropriate for this research. As semi-structured interview enables the researcher to "obtain full decision story from each of the senior managers, without unwanted interruption or direction and to obtain reflections on their own perceptions" (Gear T. et al., 2013). This interview technique is "widely used within the construction management researches" (Dainty A.M. , 2008).

These semi-structured interviews were undertaken to ascertain the barriers to the implementation of an appropriate C&D waste management, exploring potential solutions to the stated issues, in addition to assessing the willingness of construction industry actors to embrace such a waste management system and determining its viability in Jordan.

Additionally, they aim to learn what causes informal dumping and what motivates people to put an end to it or deliver a reduction.

Following the establishment of the research output (proposals), several interviews were conducted with the same interviewees participating in the study previously (**chapter 10-appendix I**). Aiming to obtain a recognition and acceptance from the Jordanian construction industry, while also attaining recognition that:

1. Recycling of C&D waste is both desirable and achievable.
2. Informal dumping of C&D waste should be eliminated.

Thus, providing evaluation of the proposal's significance by garnering recognition and acceptance from those with great experience and considerable professional competence working in the Jordanian construction industry to conclude that the proposals suggested were reliable.

3.6 Data Analysis

The quantitative analysis summarises. Additionally, this type of analysis evaluates the potential economic value of CCA recycling in Jordan as demonstrated in **chapter 5**. The analysis of quantitative data exposes the tendencies revealed by the questionnaires.

The researcher developed and distributed questionnaires via JISC online survey tool. To avoid misunderstandings, these questions were transcribed in Arabic and English. The preceding section and **chapter 10-appendix I** discuss questionnaires in greater detail. To offer a high-level overview of the results, descriptive statistics were employed. This has aided observers in making sense of massive data sets (Burns B.R., 2000; Ali M.M., 2011). This study demonstrates in percentages or actual numbers, how respondents are distributed among all investigational objects.

The research used a formal term, frequency distribution (category frequency), to summarise and distribute a massive amount of raw data into categories to determine the number of individuals or cases belonging to each category presented in the form of bar charts (**chapter 5**) (Naoum S.G., 1998).

Qualitative data analysis presents and analyses the outputs and patterns of semi-structured interviews. This discussion makes use of NVIVO software to conduct data analysis. Additional information on how to use this software is included in **chapter 10-appendix I**. These interviews lasted approximately 6-7 hours as recorded via a voice recorder application and were conducted in Arabic. They were then loaded and transcribed in Arabic on the researcher's laptop using Microsoft Word; and ultimately, the researcher and an online independent translator translated them into English. **Chapter 10-appendix I** contains a detailed description of the interviews.

Following the examination of survey and interview data, the study concluded that numerous proposals might be implemented to enhance Jordan's existing C&D waste management strategy, as detailed in **section 7.5**. Although, as suggested, these proposals should gain recognition and acceptability throughout the Jordanian construction sector. By interviewing respondents who previously participated in the interviews to ensure that the research achieved its outcome. **Chapter 7** and **chapter 10-appendix I** provide more information.

3.7 Research Validity and Reliability

According to Lewis et al. (2003), research validity is defined as the accuracy of the research findings. The validity of research is concerned with two issues (Punch K.F., 1998; Sweis J.R. et al., 2014):

1. Accuracy of measurement instruments.
2. Measuring precisely what should be measured.

Validity is a term that applies to both qualitative and quantitative research (Ali M.M., 2011). In qualitative research, the research is valid if it examined the topic that claims to examine it (Ali M.M., 2011). Whereas, in quantitative research, validity is determined by whether the research measures what it claims to measure (Ali M.M., 2011).

Lewis T.M. et al. (1996) and Sweis J.R. et al. (2014) defined research reliability as a study's capacity to replicate its findings using the same research techniques and methods. In another argument by Bryant A. and Cramer D. (2008) and Ali M.M. (2011), research reliability refers to the ability of a study's measure to produce consistent results when replicated.

To assure the validity and trustworthiness of the research data, the researcher used previous literatures to design the questionnaires and interviews, collected data and investigated the research issue from a variety of angles. By utilising electronic tools and software and performing high-quality transcription and translation, engaging highly experienced participants in research helped to increase the validity and dependability of the results, the gathered information in the research can be said to be reasonably reliable and valid.

Additionally, the study performed interviews to ensure the validity and reliability of the research output, by gaining recognition and acceptance from the Jordanian construction sector for the proposals. In addition, the diversity of participant positions and areas of expertise enables the research to cover a broad range of experiences within the Jordanian construction industry, resulting in a more realistic assessment and in-depth information, which improved the validity and reliability of responses.

3.8 Bias

This section contributes to the debate of Saunders M. et al. (2009) that research should include a variety of variables to reduce response bias. Including question content, questionnaire length and questions clarity (Saunders M. et al., 2009) they emphasized the questions' content, proving that content always takes precedence over length. The stated criteria assist us in comprehending the importance of avoiding numerous factors that contribute to response bias, as defined by Bryman A. and Cramer D. (2008):

1. The use of ambiguous and generable terminology in questions.
2. Protracted questions.
3. Double-barrelled questions.
4. Leading or provocative questions.
5. Technical terms and acronyms.

As a result of respondents' honesty, responses must be interpreted cautiously, as demonstrated by the existence of disparities between questionnaires covering the same topics. Additionally, a small sample size implies that the conclusions are unlikely to be valid or representative, as was the case with various questionnaires such as academic, Ministry of Environment and Greater Amman Municipality questionnaires (Department of Legal frame works and Regulations). The low level of actor participation in research is majorly related to both the local context's willingness to complete questionnaires and the present Covid-19 Pandemic situation. **Chapter 10-appendix I**, contains information about the sample size design, criteria for selecting respondents and organisations and respondents profile sheet (**table 10-7**). Thus, possible bias could be subjected to these results.

3.9 Ethical Consideration

This section discusses the ethical implications of the research. Prior the commencement of any investigation, the research obtained complete ethical approval by Anglia Ruskin University, as detailed in **chapter 10-appendix I**.

Numerous procedures were employed during the research and data collection process, including the following:

1. Collecting archival data:
   Approval was sought from several organisations, including GAM, Irbid Municipality, Jordanian Electricity Company and association of construction actors. Following receipt of these clearances, written formal requests for permission to access the landfill or supply the relevant data were served to the appropriate departments.

2. Questionnaires and Interviews:
   The ethics form has been updated to incorporate an OA1 travel form as well as a risk assessment for surveys and interviews. On the cover page of the surveys and prior conducting interviews, a participant information sheet (PIS) and a participant consent form (PCF) were also included. The PIS offers context for the research project, confidentiality, anonymity and the participant's involvement in the research. The PCF documents each participant's consent to engage in the research, as any participant may opt-out of completing surveys or interviews.

   Interviews were conducted and processed in such a way that no participant's name or reference was revealed, respondents' names and distinguishing personalities were concealed and responses were used only for this research. While there was a risk that participants' identities could be revealed because of their outputs. Participants' identities have been anonymised to protect individual and corporate identities, as well as commercial interests.
   Data from both surveys and interviews have been anonymised and securely saved on the password-protected student ARU digital space during the research and will be destroyed after the dissertation is completed. To further ensure anonymity, confidentiality and ethical considerations, interviews were prepared and coded to obscure participant identities and references. Respondents' names and distinctive characteristics were also hidden and respondents' responses were used only for this research.

The next chapter examines and shows laboratory test results. It describes the raw data from each experimental test based on the analysis of evaluating the physical and chemical features of Jordanian CCA.

4 Collection of Archival Data

Most studies illustrated in the literature were descriptive in nature and suffer from a serious generality in its discussions. Making no attempt to address issues related to the Jordanian construction industry.

These studies would have been more beneficial if they had concentrated on several aspects within the industry in depth. Thus, additional research into such works may be beneficial for obtaining a higher degree of accuracy and a more complete comprehension of the subject. Where the research has managed to achieve during investigation. By compiling informative data related to the Jordanian construction industry from a wealth of material in governmental bodies and industry organisations archival databases.

This data contains information on the quantity of concrete manufactured and extraction of its components, as well as the amount of energy consumed in the manufacturing process in Jordan. In addition to the quantity of C&D waste that is formally dumped as well as its composition. Although as previously mentioned in **section 3.5.6**, few required data have not been available in those databases yet remained to be unknown. This chapter also has taken a step forward into determining the potential economic value of recycling CCA as based on the data compiled from those databases.

4.1 Concrete Manufacturing

This section examines the production and extraction of raw material required in the manufacture of concrete. **Table 4-1** summarises the quantity of concrete produced and its components in Jordan in 2019. Jordan's concrete production energy consumption in 2017, 2018 and 2019 is shown in **table 4-2**.

Bear in mind that the research used 2019 data to estimate as a proxy for the most recent and normal year onto 2020 and 2021. As during those years, the Covid-19 epidemic decreased construction material production and extraction.

4.1.1 Concrete Volume

	Production Volume (m^3)	Extraction Volume (m^3)	Electricity Consumption (KW)	Energy Consumption (Diesel) (L)	Local Demand
Concrete	5,000,000	--	56,665,064	--	5,000,000
Aggregates (For Concrete)	--	4,000,000 - 4,250,000	--	200,000,000 - 220,000,000 (Transportation)	--
Sand (For Concrete)	--	2,350,000	--	--	--
Water (Litre) (For Concrete)	--	100,000,000-150,000,000	--	--	--
Cement (Tonnes)	9,000,000 - 9,500,000	--	--	--	4,500,000

Table 4-1: Extraction Volume of Concrete Components and Manufacturing Volume of Concrete in Jordan 2019

4.1.2 Energy Consumption of Concrete Manufacturing

Years	Total Consumption of Energy Kilowatt (KW)
2017	**50773481.1**
2018	**58382522.2**
2019	**56665064**

Table 4-2: Energy Consumption in Concrete Manufacturing

According to the archived databases, the volume of concrete produced for local use increased to about 5 million m^3 in 2019. This amount, as mentioned in **table 4-2**, has been produced by consuming as based on the electricity company around 57 million KW in 2019. This amount was slightly higher in 2018 which reached almost 58.5 million KW and lower than both in 2017 which was around 50 million KW. The variation between energy consumption in the last three years indicated that concrete production in 2017 was almost 10% lower than 5 million m^3 in 2019 to be nearly 4.48 million m^3. Although, when compared to 2018, the concrete production was slightly higher than the production of 2019 with almost 3% which was approximately 5.15 million m^3. This concludes the construction industry's role in contributing of greenhouse gas emissions during concrete manufacturing.

As the previous data estimated the volume of concrete manufacturing in Jordan, the research can now have a better understanding of the influence of the Jordanian construction industry on natural resources. It was estimated as seen in **table 4-1** that the volume of aggregates extracted from natural resources for concrete manufacturing purposes only, was roughly 4-4.25 million m^3 in 2019. This volume also necessitated 200-220 million litters of diesel for transportation from natural resources to concrete factories. According to the assumptions of concrete volume manufactured above, the extraction volume of aggregates may have been between 3.5 and 3.8 million m^3 in 2017. Whereas, it may have been between 4.1 and 4.38 million m^3 in 2018. The extraction volume of aggregates would strengthen the research scope of work in establishing the positive environmental and economic impacts of re-using CCA in new concrete mixes as demonstrated in **section 4.3** below.

As also demonstrated in **table 4-1**, the manufacturing of concrete in 2019 has resulted in extracting sand (about 2.35 million m^3), water (100-150 million L) and cement (9.5 million m^3). It is to be noted that the estimated amount of cement was for both domestic and international markets. Despite this, it was estimated that domestic demand accounted for roughly half of total production of cement, which was around 4.5 million m^3 for all uses. Thus, a more precise estimate of the amount of cement used in concrete is required to advance the argument.

This section here has illustrated the influence of the Jordanian construction industry. As it has proved useful in improving the negative environmental impacts forecasting, particularly when Jordanian literatures suffer from serious drawbacks related to these impacts.

4.2 C&D Waste Landfilling Rates and Composition

Jordan has conducted a few studies on the volume and composition of C&D waste. These were limited to waste generated on construction projects only. Therefore, more research is required to ascertain the generation and composition of C&D waste. The research gathered C&D statistics from spreadsheets maintained by municipal and private landfill.

4.2.1 Volume of Dumped C&D Waste and Composition

This data collection may assist in estimating the amount of C&D waste disposed of in Jordan's permitted landfill (**table 4-3**). **Table 4-4** demonstrates how a thorough examination of C&D waste aided in determining the composition of landfilled waste.

As illustrated in **figure 4-1**, Jordan has a few permitted public and private landfill for C&D waste located in the middle and northern region, but none in the southern region. The overall volume of C&D waste dumped in licensed landfill (legally) was anticipated to be around 2.9 million m^3 in 2019. This amount includes the waste dumped in the middle and northern region only. Meanwhile, southern Jordan's lack of landfill sites may indicate that none of C&D waste generated is formally dumped in that region. According to the collection of archival data, the total volume of C&D waste dumped in the middle region of Jordan was roughly 1.97 million m^3 as seen in **table 4-3**. This amount is distributed to GAM's public landfill in Al-Baydah and Na'or private landfill as 877574 m^3 and 1.1 million m^3, respectively. The northern region has four landfill sites: Saal, Al-Hosson, Der Alaa and Al-Hosson Landfill (public). The three private landfill sites have received in 2019 about 476690 m^3 of C&D waste. Meanwhile, the public landfill has received around 481800 m^3 in the same year. **Chapter 10-appendix II** shows images of C&D waste legitimately dumped at GAM's landfill.

The quantity of C&D waste disposed of in private and public landfill varies significantly according to their proximity to work sites. As previously indicated, the private landfill in the middle region received a greater volume of C&D waste than the public landfill, since the private landfill is more conveniently located than the municipal landfill. This may be evidently bolstered by the projected amount of C&D waste disposed in the northern region. Since, both public and private landfill sites received almost the same amount of waste. This was proved by their proximity to work locations and to one another.

Despite the higher rates imposed by private landfill 3-5 JD/m^3 vs. 1-2.5 JD/m^3 for public landfill. The study found that private landfill acquires more C&D waste than public landfill. Most probably as per their proximity to work sites. Although, public landfill sites cannot be constructed close to urban areas like private ones. Since, they are constrained by environmental and social regulations, or by the location of governmental holdings in the suburbs, away from cities. In summary, this study supports the hypothesis that private landfill is constructed with disregard for environmental and social consequences.

It is to be noted that the amount of C&D waste generated is logically greater than the anticipated. Due to the volume of waste that is informally dumped and the absence of landfill in the southern region of Jordan. These findings indicate the need for additional research that will look beyond the rate of informal dumping as seen in **chapter 5**.

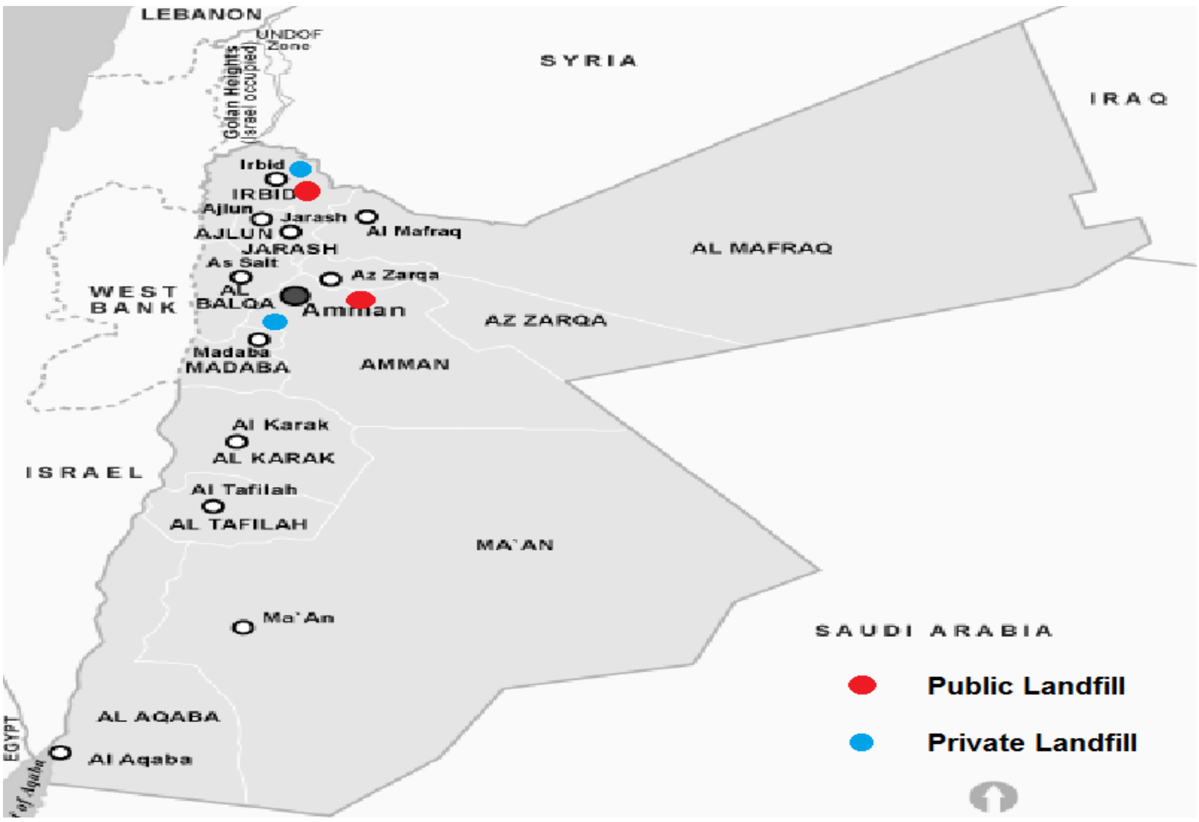

Figure 4-1: Location of Landfill Sites in Jordan

Landfill	Total Volume of C&D Waste Landfilled (m^3)
Jordan's Middle Region	
Al-Baydah GAM Landfill (Public)	**877574**
Na'our Landfill (Private)	**1140260**
Jordan's Northern Region	
Saal, Al-Hosson and Der Alaa Landfill (Private)	**476690**
Al-Hosson (Public)	**481800**
Jordan's Southern Region	
None	--
Total	**2976324**

Table 4-3: Total Volume of Dumped C&D Waste in Jordanian Landfill

As shown in **table 4-4** below, the data collected from archival databases shed light on the composition of C&D waste. It has been estimated that excavation waste accounted for nearly 60% of the total composition of dumped C&D waste. Accounting for approximately 1.7 million m^3 on top of C&D waste material components. Meanwhile, concrete debris accounted for approximately 506 k m^3 with less than 20%. Whereas masonry debris covered for approximately 10% and accounted for approximately 297 k m^3. Steel reinforcement, tiles and ceramics, gypsum board and plastics accounted for approximately 5% and less in the C&D waste composition.

Types of C&D Waste dumped in Jordan's Landfill	Percentage in the C&D Waste Composition dumped in Jordan's Landfill	Quantity of each material in the C&D waste composition
Excavation	60%	1785794.4
Crushed Concrete Aggregates	17%	505975.08
Masonry	10%	297632.4
Steel Reinforcement	3%	89289.72
Tiles and Ceramics	5%	148816.2
Gypsum Board	3%	89289.72
Plastics	2%	59526.48
Total	**100%**	**2.97**

Table 4-4: C&D Waste Composition

Figure 4-2: C&D Waste Landfill Site

Figure 4-3: C&D Waste Landfill Site

Figure 4-4: C&D Waste Landfill Site

The results supported another lawful way of disposal: land reclamation. The investigation discovered that all private landfill in Jordan had been granted land reclamation permits. As seen in the figures below, landowners may benefit from underutilized valleys by levelling them. To be often utilised to develop small companies or farms while also economically gaining profit from waste disposal.

This concept appeared to be similar to informal dumping but in a legalized manner. As municipalities permit property owners to operate their lands for dumping. Regrettably, this concept is being applied in Jordan without regard for environmental measures. This could have significant environmental and social effects such as leachates. These leachates are formed by precipitation or groundwater penetration (Galvín A.P. et al., 2012; Rosado L.P. et al., 2017). Since it contains trace amounts of toxic compounds from solvents, adhesives, or the primary construction material itself (Galvín A.P. et al., 2012; Rosado L.P. et al., 2017). Even more so when C&D waste arrives in a variety of forms, some of which contain dangerous chemicals itself (Galvín A.P. et al., 2012; Rosado L.P. et al., 2017). While both researchers indicated that leachates from C&D debris is not as damaging as other wastes. However, as outlined in **chapter 2** hazardous waste is collected and disposed of in a designated landfill in Jordan.

Regardless of the way that land reclamation is adopted in Jordan, it is critical to recognize the importance of land reclamation. Particularly in decreasing informal dumping of C&D waste along roadsides or between residential and commercial zones. Nonetheless, land reclamation would be more environmentally beneficial and gain widespread acceptance if it incorporates environmental and social concerns. If this is the case, it might stymie the adoption of C&D waste management.

Figure 4-5: Land Reclamation (Private Landfill)

Figure 4-6: Land Reclamation (Private Landfill)

Figure 4-7: Land Reclamation (Private Landfill)

4.3 Economic Value of Concrete Recycling in Jordan

According to the survey results in **chapter 5**, approximately half of Jordan's generated C&D waste is illegally disposed. This indicates that Jordan generates around 6 million m^3 of C&D waste. Meanwhile, assuming a 30% and 70% informal disposal rate, the total amount of C&D waste generated will be around 4.14 million m^3 and 9.66 million m^3, respectively. However, if handled properly, this volume could prove to be a lucrative resource for the country. As the findings of Zheng L. et al. (2017) indicated that C&D waste contains around 80% recoverable material with substantial economic potential.

Thus, findings can indicate that recycling concrete debris has the potential to increase the value of waste material in Jordan. CCA accounts for approximately 17% of total dumped C&D waste volume, or around 0.506 million m^3 over the year 2019. As illustrated in **chapter 5**, the anticipated percentage of informal dumping should help increase concrete composition forecasts to around 1.02 million m^3.

To evaluate the cost savings associated with concrete waste recycling, one must first determine the amount of concrete debris that can be recycled and used into new concrete in Jordan. According to Jain S. et al. (2018), 75% of concrete waste may be repurposed. Thus, the below equations can be employed to estimate the volume of concrete debris that could be recycled in Jordan:

- If informal dumping was 50%, the volume of recyclable concrete waste is:
  $$\mathrm{VRCW} = \mathrm{Total\ Volume\ of\ C\&D\ generated} \times \ \mathrm{CW\%}\ \times 75\%\ = 0.765\ \mathrm{million\ m^3}$$
- If informal dumping was 30%, the volume of recyclable concrete waste is:
  $$\mathrm{VRCW} = \mathrm{Total\ Volume\ of\ C\&D\ generated} \times \ \mathrm{CW\%}\ \times 75\%\ = 0.528\ \mathrm{million\ m^3}$$
- If informal dumping was 70%, the volume of recyclable concrete waste is:
  $$\mathrm{VRCW} = \mathrm{Total\ Volume\ of\ C\&D\ generated} \times \ \mathrm{CW\%}\ \times 75\%\ = \ 1.23\ \mathrm{million\ m^3}$$

- VRCW: Volume of recyclable concrete waste
- CW%: Percentage of concrete aggregates in C&D waste composition which is 17%

Aggregate type	Quantity (Mm^3)	Unit cost (JOD/m^3)	Total cost (MJOD)
Standard	4-4.25	4.00 – 4.50 without transportation	**16 – 19.13**
		6 – 7 with transportation	**24 – 29.8**
Recycled (50% informally dumped)	0.765	4.00 – 4.50 without transportation	**3.06 – 3.44**
		6 – 7 with transportation	**4.59 – 5.35**
Recycled (30% informally dumped)	0.528	4.00 – 4.50 without transportation	**2.11 – 2.37**
		6 – 7 with transportation	**3.17 – 3.69**
Recycled (70% informally dumped)	1.23	4.00 – 4.50 without transportation	**4.92 – 5.54**
		6 – 7 with transportation	**7.38 – 8.61**
Table Guide	(Mm^3): Million Cubic Meter (JOD/m^3): Jordanian Dinars / Cubic Meter (MJOD): Million Jordanian Dinars		

Table 4-5: Economic Value of Concrete Recycling

This section here is the first of its kind to evaluate the cost of conventional aggregates to the predicted economic value of recycled concrete aggregates.

According to **table 4-5**, the cost of extracting 4-4.25 million m^3 of conventional aggregates with transportation is between 24 and 29.7 MJOD. While the cost of 0.765 million m^3 of CCA plus transportation is between 4.59 and 5.35 MJOD. Since, CCA is not extracted from natural resources as standard ones, there would be no extraction cost for such a waste material. Thus, recycling 0.765 million m^3 of CCA has an economic potential value of saving 3.06 and

3.44 MJOD from the total cost of 24 and 29.7 MJOD. This assists in saving between 11.5% and 13% of total cost of sourcing of raw materials in concrete manufacturing if, 50% of generated waste is disposed informally. This saving would be higher than that ranging between 18.5% to 20.5% if 70% of C&D waste is disposed informally. Although, lower than both estimates ranging between 8% to 9% if 30% is disposed informally. Those potential economic estimations seemed to be promising since they were higher than those for other areas such as Dhaka and India that were 0.71% and 6-7%, respectively. However, it is better to bear in mind that this potential saving is prior the recycled concrete manufacturing indicating that this cost reduction does not cover the cost of concrete production nor the transportation of recycled concrete to construction sites. Thus, this cost reduction is only a reduction in the sourcing of raw materials.

In conclusion, this section determined the value of CCA as a resource to be reused in new concrete mixes in Jordan. Which strengthens its definite existence by lowering the need for virgin aggregates while simultaneously benefiting the economy.

The following two chapters present the major findings of the primary investigation of the research through surveys and interviews.

5 Questionnaire Surveys

This chapter relies on questionnaire surveys to investigate what is missing for C&D waste management in Jordan, by studying survey data, synthesizing and evaluating it. These surveys were conducted to elicit wider response from functional Jordanian construction experts. It addresses frequently asked questions about the Jordanian construction industry.

Chapter 10-appendices I and IV details how this chapter makes use of JISC software to produce a robust and structured analysis and contains further statistics on the number of responses and thorough descriptions of common and uncommon questions, respectively.

The data analysis is summarised in tables and charts highlighting similarities and variances in participant percentages, the relationship between respondents and gives sufficient context and clarification for participant responses.

Bear in mind that few questions in questionnaires, as noted in **chapter 10-appendix I**, were sub divided into main categories that each includes several subcategories. In this case the total number of subcategories is multiplied by the real number of respondents to form the final number of respondents of the question main category. This has been exemplified in **section 5.1.1.3** by demonstrating that the number of academics responded to this question was 60. However, the real number of academics participated was only 5, which means that there were 12 subcategories in this question multiplied by 5 forming a total of 60 respondents.

During the initial stage of analysis, data were observed, sorted and grouped to confirm their authenticity and reliability. Then came the data analysis stages, which included the following:

- Data Screening:
  To ensure the data and scales were correctly entered to be used in the analysis.

- Descriptive Analysis:
  A descriptive statistics analysis was performed to analyse the questionnaire data. This was utilised to investigate the acquired data, simplify and summarise large masses of data using easily understood metrics by observers (Burns B.R., 2000; Coakes, S.J et al, 2010). Percentages, averages and the Likert scale were used to quantify data and rank variables based on their values in this study.

The data analysis for the questionnaires is displayed under five main headings that correspond to the major portions of the questionnaire's questions, which are as follows:

1. Informal dumping.
2. Aspects within Jordanian construction industry contracts.
3. Missing C&D waste management activities.
4. Encouragements to improve C&D waste management strategy.
5. Industry actors' perspectives.

Chapter 10-appendix III of the research contains a more complete account of this chapter and delves more into the investigation of the research.

5.1 Questionnaire Analysis

5.1.1 Informal Dumping

This section argues the topic of informal dumping of C&D waste. By evidencing the presence of the informal dumping, estimating the percentages of informal dumping and providing an adequate explanation for the grounds of this attitude. In addition to, finding fundamental approaches that could assist in mitigating the problem and identifying the individuals accountable for the problem.

The tables and charts below summarise the major findings from these surveys.

5.1.1.1 Confirmation of the Informal Dumping

As illustrated in **table 5-1** and **chart 5-1**, several industry actors have confirmed the informal dumping of C&D waste in Jordan.

This section addressed this by asking participants the following question: "Can you confirm whether informal dumping is taking place in the country?"

Actors Involved	**No. of Participants**	**The Presence of the Informal Dumping**		**Respondents % (Confirmed)**
		Yes	**No**	
Academics	5	5	0	100%
Clients	43	43	0	100%
Contractors	27	24	3	89%
GAM – Department of Construction	22	21	1	95%
GAM – Department of Legal Frameworks and Regulations	5	5	0	100%
MoE	7	7	0	100%
MLA - Department of Construction	11	11	0	100%
MPWH - Department of Construction	24	23	1	96%
Total	**144**	**139**	**5**	
Average %	**98%**			

Table 5-1: Evidencing the Informal Dumping

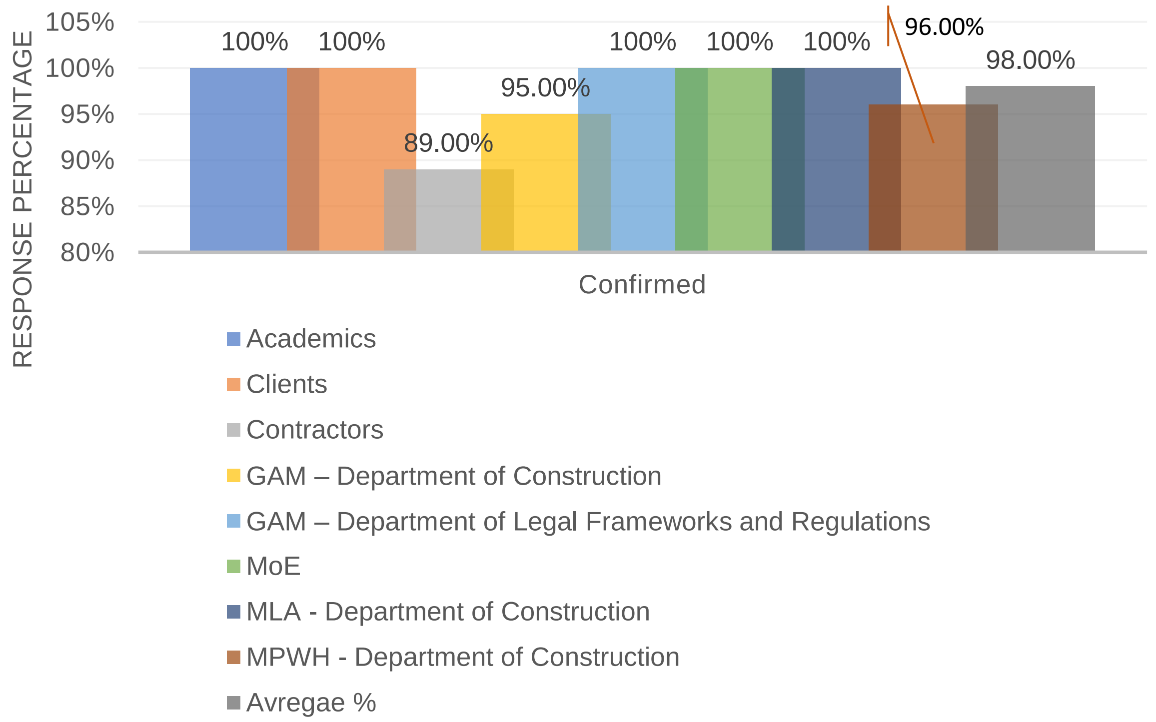

Chart 5-1: Evidencing the Informal Dumping

The study's findings indicate that all participants confirmed that C&D waste is discarded informally throughout Jordan, except for 12% of contractors, 4% of both GAM and MPWH construction departments' participants.

This confirmation could be easily obtained from academics, clients, MoE, GAM and MLA by probably and encountering C&D waste while touring in streets in Jordan as depicted in previous images. In addition to their neutrality, in contrast to contractors and few governmental departments. As contractors would be relieved of the obligation to demonstrate their non-compliance with current regulations. In addition to governmental departments that may raise serious dereliction on managing C&D waste.

This effort contributes to the existing body of knowledge that this issue exists even though it has been contested by few.

5.1.1.2 Percentage of the Informal Dumping

This sub-section illustrates actors' expectations for the percentage of C&D waste disposed of informally as a percentage of total C&D waste generation in Jordan, as shown in **table 5-2**, **chart 5-2** and **chart 5-3**. These percentages are classified into three intervals on a Likert scale: less than 40%, 40% to 60% and more than 60%.

This section addressed this by posing the following question to participants: "Can you approximately quantify the percentage of the informal dumping of C&D waste (for example as a percentage of total C&D waste generated in Jordan):".

Actors	No. of Participants	The Percentage of the Informal Dumping from the Total Generation of C&D Waste			Respondents % (Confirmed)		
		< 40%	40% - 60%	> 60%	< 40%	40% - 60%	> 60%
Academics	5	0	4	1	0%	80%	20%
Contractors	27	6	16	2	22%	59%	7%
GAM – Department of Construction	22	3	13	6	14%	59%	27%
GAM – Department of Legal Frameworks and Regulations	5	2	2	1	40%	40%	20%
MoE – Department of Legal Frameworks and Regulations	7	1	5	1	14%	71%	14%
MLA - Department of Construction	11	1	5	5	9%	45%	45%
MPWH - Department of Construction	24	3	7	14	13%	29%	58%
Total No. of Respondents	**--**	**16**	**52**	**30**	**--**	**--**	**--**
Average % of Respondents	--	--	--	--	**16%**	**55%**	**28%**

Table 5-2: Percentage of the Informal Dumping

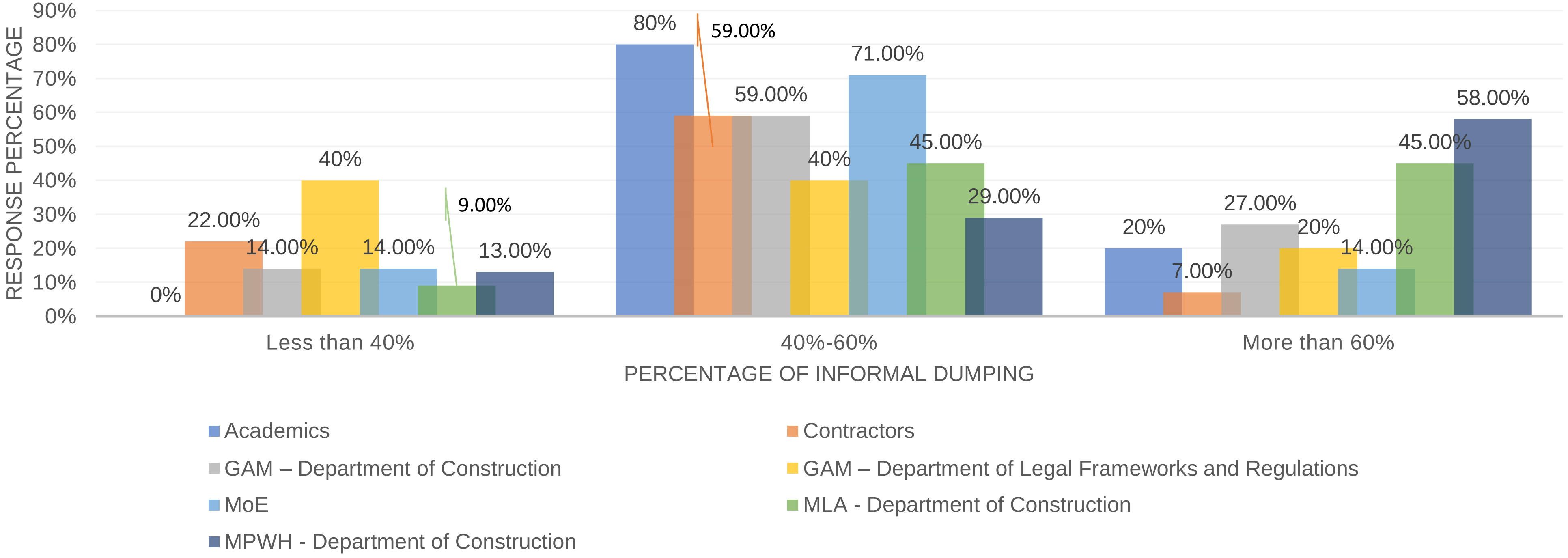

Chart 5-2: Percentage of Informal Dumping

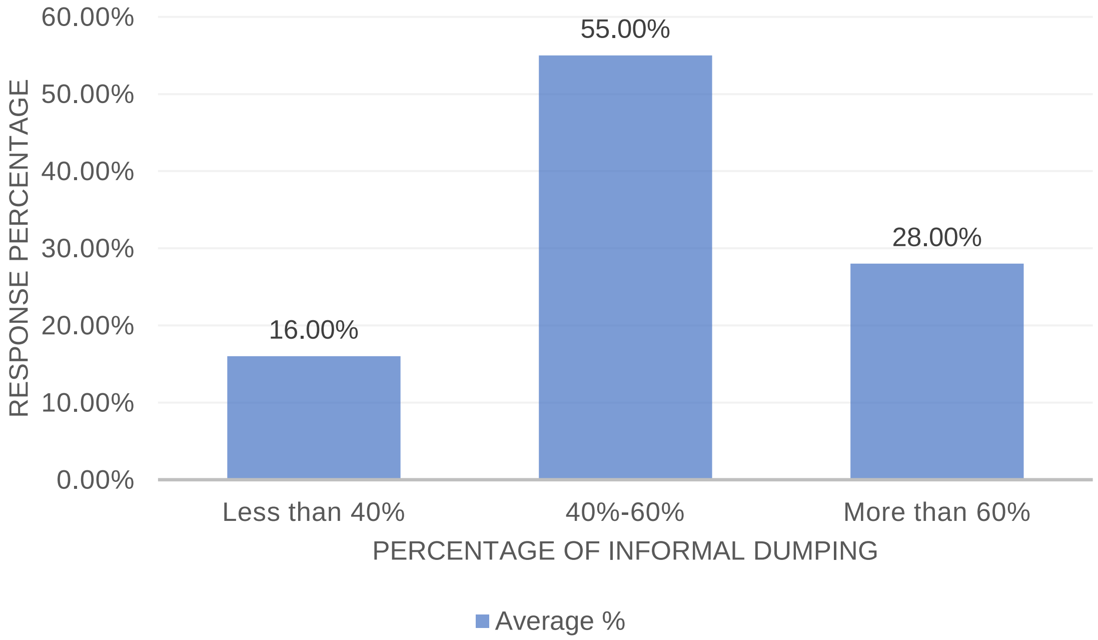

Chart 5-3: Average Percentage of Respondents on the Percentage of informal Dumping

The data above demonstrates a variance between responses regarding the percentage of informal dumping, although nearly 55% of respondents agreed that 40% to 60% from the total quantity of C&D waste generated in Jordan is informally dumped.

This analysis verified the expectation of academics, contractors, GAM's construction department and MoE that informal dumping is occurring at a rate of between 40% and 60%. However, the average percentage of respondents who believed informal dumping occurred less than 40% was extremely low, hovering around 16%. This was also true for the interval of more than 60%, albeit the range was from 7% to 58%, with an average of 28%.

This study's empirical finding indicates that informal dumping occurs frequently at a high rate. Which critics the ability of governmental regulations to control proper landfilling. Particularly when current legislations regulate C&D waste to be dumped in permitted landfill sites.

5.1.1.3 Reasons for Informal Dumping

This section discusses the possible reasons for informal dumping of C&D waste in the Jordanian construction industry, as illustrated in **table 5-3** and **charts 5-4** and **5-5**.

This section addressed the reasons by asking participants the following question: “Can you please scale the following reasons behind the informal dumping of C&D waste”.

Actors	No. of Participants	Reasons of the Informal Dumping			Respondents % (Confirmed)		
		Governmental Controls (1)	Local Actors Involvement (2)	Costs and Expenses (3)	(1)	(2)	(3)
Academics	60	30	14	6	50%	24%	10%
Contractors	324	141	98	32	44%	30%	9%
GAM – Department of Construction	264	108	84	11	41%	32%	4%
GAM – Department of Legal Frameworks and Regulations	60	22	20	3	37%	33%	5%
MoE	84	38	28	2	45%	33%	2%
MLA - Department of Construction	132	69	36	10	52%	27%	8%
MPWH - Department of Construction	288	133	89	8	46 %	31%	3%
Average	**--**	**--**	**--**	**--**	**45%**	**30%**	**6%**

Table 5-3: Reasons of the Informal Dumping

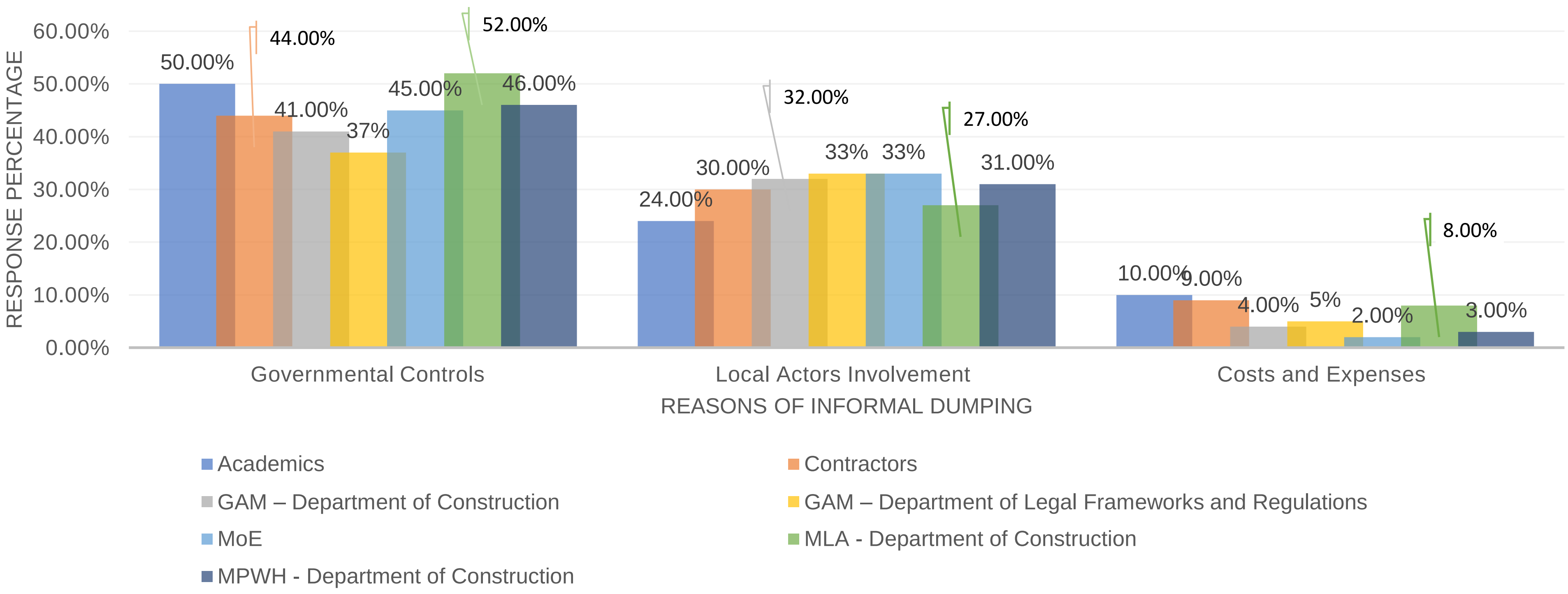

Chart 5-4: Reasons of Informal Dumping

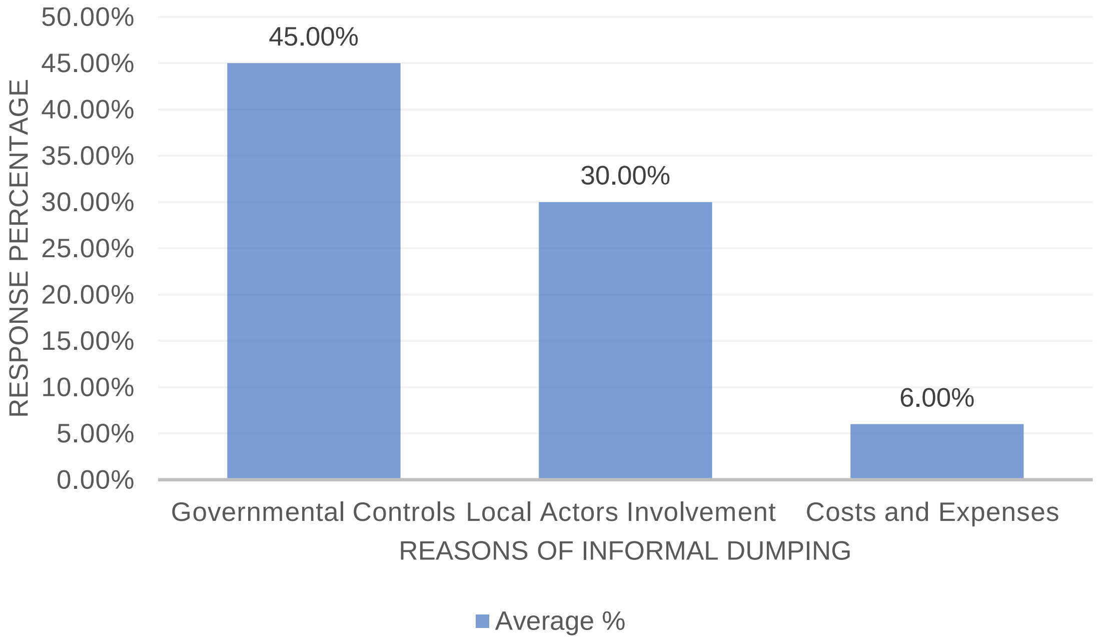

Chart 5-5: Average Percentage of Respondents on the Reasons of Informal Dumping

This research has aided in gaining a better understanding of how governmental restrictions have facilitated informal dumping with an average of roughly 45%. These inadequate restrictions include the absence of legal frameworks and regulations, oversight, supervision and strictness, management and waste disposal systems. It has been noticed that all actors have emphasized on the lack of oversight and strictness except GAM's legal frameworks and regulations department. The reason of their exclusion perhaps is to avoid any dereliction upon them on such an issue as per their responsibility on monitoring. Therefore, caution must be applied when analysing data.

Another reason addressed by participants was the involvement of local actors (30%). This involvement includes the awareness of the advantages and disadvantages of C&D waste, as well as the presence of informal labourers within the industry. According to most participants, excluding academics and few contractors, the lack of understanding among local actors in the construction industry may contribute to informally dump C&D waste.

The research gathered knowledge via academics criticising the government and contractors on such attitudes by informal workers. Although, the government laid the responsibility on contractors. While contractors would not desire to be criticised for such an issue, as they overlooked the presence of informal workers as a secondary element contributing to informal dumping. If the debate is to be moved forward, a critique of the contractor's responses is necessary. Since the government made a specific reference to the disparity between responses by the current legislation requiring contractors to hire formal Jordanian workers for their projects. Consequently, contractors cannot disclose assigning of unregistered labour in their projects.

The high costs and expenses associated with waste disposal appear to be related to informal dumping of C&D waste. Due to perhaps high legal dumping costs (charging schemes) and the lengthy transit distances to permitted landfill (average 6%). Almost 80% of all actors except GAM, however, agree that informal dumping is causally related to large transit distances to licensed landfill. The reason of GAM's denial could be associated with being GAM in charge of landfill construction and allocation. Thus, GAM's participants would not disclose that distances to landfill are prohibitively large. Although, the information mentioned in **section 4.2.1** contradicts what GAM's participants claim here.

However, all responses acknowledged the charging schemes to be a contributory factor to informal dumping. Although, it appears as though participants' comprehension of the consequences of the costs of legal dumping is dubious. Because the research disregards the influence of charging schemes on informal dumping as indicated in **section 4.2.1**. Since the charging schemes are modest. Thus, the costs of legal dumping may be attributed to transportation charges associated with long distances.

5.1.1.4 Approaches for Mitigating the Informal Dumping

This section examines potential approaches for decreasing informal dumping of C&D waste as seen in **table 5-4** and **charts 5-6**, **5-7** and **5-8**.

This section addressed these approaches by asking participants to rate them through the following question: “Can you please scale the following approaches that could contribute to mitigating the informal dumping of C&D waste from 1 to 5 (1 is strongly disagree and 5 strongly agree)?”.

Actors	**No. of Participants**	**Approaches to mitigate the Informal Dumping**			**Respondents % (Confirmed)**		
		Governmental Controls (1)	**Local Actors Involvement (2)**	**Costs and Expenses (3)**	**(1)**	**(2)**	**(3)**
Academics	45	21	10	10	47%	22%	22%
Contractors	243	108	43	48	45%	18%	20%
GAM – Department of Construction	198	70	42	43	35%	21%	22%
GAM – Department of Legal Frameworks and Regulations	45	21	10	10	47%	22%	22%
MoE	63	30	14	14	48%	22%	22%
MLA - Department of Construction	99	38	20	21	38%	20%	21%
MPWH - Department of Construction	216	84	45	46	39%	21%	21%
Average	**--**	**--**	**--**	**--**	**43%**	**21%**	**21%**

Table 5-4: Approaches to Mitigate the Informal Dumping

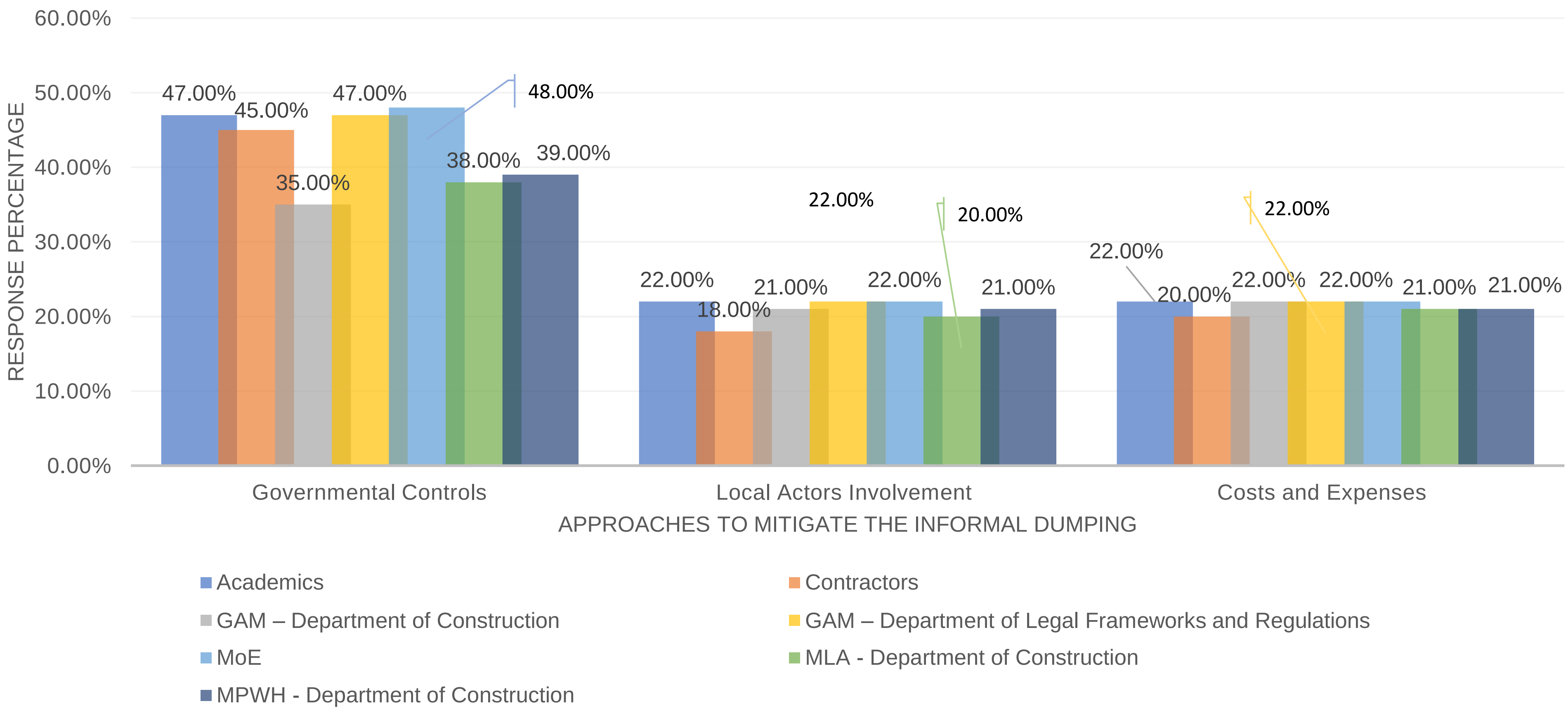

Chart 5-6: Approaches to Mitigate the Informal Dumping

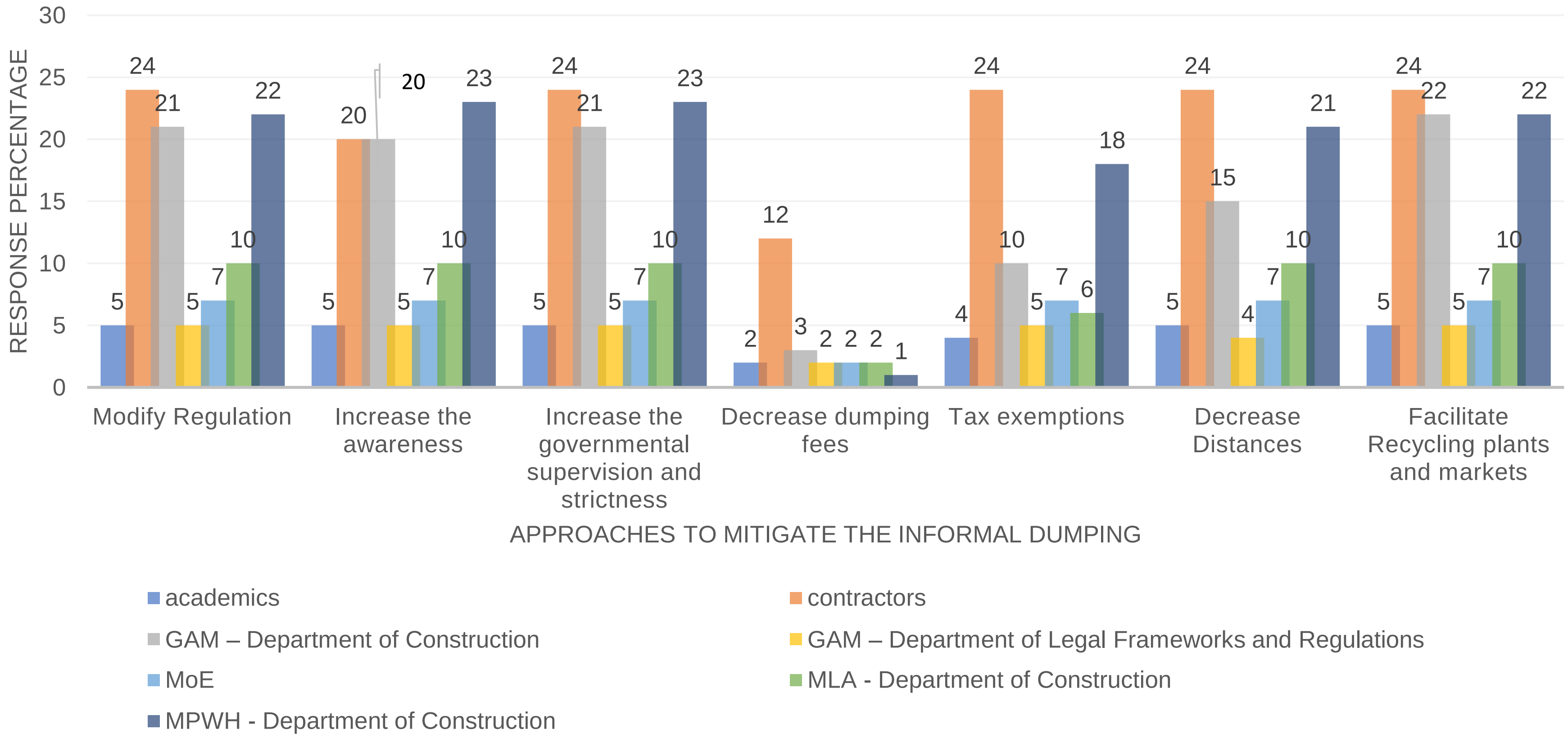

Chart 5-7: Approaches to Mitigate the Informal Dumping

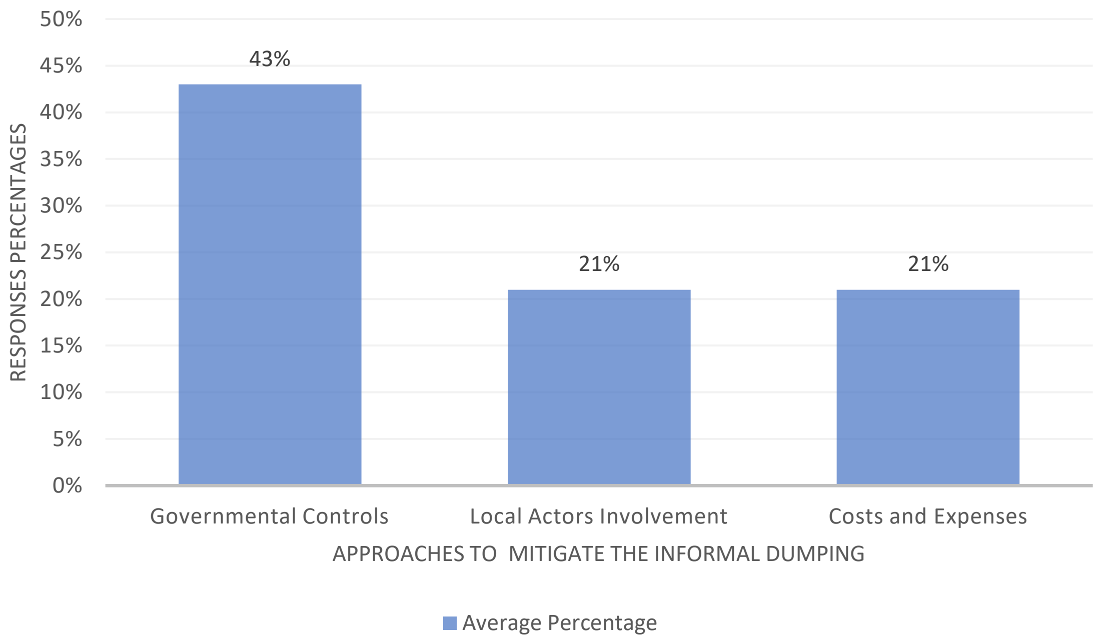

Chart 5-8: Average Percentage of Respondents on the Approaches to Mitigate the Informal Dumping

According to 43% of respondents, government controls should be improved to deliver a reduction in C&D waste informal dumping. This includes enhancing and amending legal frameworks and regulations, boosting governmental oversight and strictness and offering tax breaks. In addition to, promoting the establishment of recycling factories and markets for recycled waste material. The present data underline the government's involvement in decreasing informal C&D waste dumping. As it is responsible for the country's waste disposal system. One approach that seemed to have hesitance by governmental actors was the provision of tax exemptions. This hesitance is probably associated with the potential economic loss that would lay on the government. Another reason could be the governmental actor's belief that contractors should comply with regulations (proper landfilling) without incentives or exemptions. Although, **chart 5-7** above demonstrates that nearly all contractors support the idea of providing tax exemptions.

Both techniques, facilitating recycling facilities and markets for recycled waste material, are complementary, because recycling activities are impossible without recycling waste marketplaces where waste products can be sold.

The study's findings indicate that expenditures and expenses are a secondary element in reducing informal dumping as agreed by 21% of participants. The findings of this study indicate that lowering charging fees and transportation distances may aid in the reduction of informal attitudes. Although GAM has outlined that the landfilling charging fees are adequately acceptable and landfill sites are not located far from sites or projects. These data suggest steps to improve the current situation by reducing transportation distances to permitted landfill. However not by reducing waste disposal fees, as agreed upon by most actors and more than half of contractors. This enables us to perceive Jordan's feeing system as reasonably priced as outlined in **section 4.2.1**. Despite GAM's inconsistent findings, the research indicates that shifting landfill near sites could lessen informal dumping. Albeit as mentioned in **section 4.2.1**, GAM was unable to do so owing to environmental and social concerns.

Local actors' engagement was agreed on average by 21% of respondents, compared to the other categories. This category is majorly related to increasing the awareness of local actors to the impacts of C&D waste informal dumping. Although, this finding could be also associated with the government being viewed as the most responsible party when it comes to eliminating informal dumping. As improving governmental controls may serve to compel actors to comply with the regulations of landfilling without boosting actor’s awareness.

5.1.1.5 Responsible Side on the Informal Dumping

This sub-section identifies the actors responsible for the informal dumping of C&D waste, as illustrated in **tables 5-5** and **5-6** and **charts 5-9** and **5-10**.

This section addressed this by posing the following question to participants: “Scale the following actors by their responsibilities for the informal dumping of C&D waste in Jordan from 1 to 5 (1 strongly disagree and 5 is strongly agree)?”.

Actors	No. of Participants	Ministries	Local Authorities	Contractors and Sub-Contractors	Engineering Companies	Design Companies	Clients	Transportation Contractors
Academics	5	5	5	4	3	4	0	5
Clients	43	40	39	37	27	16	20	36

Table 5-5: Responsible Actors on the Informal Dumping

Actors	No. of Participants	Responsible Actors on the Informal Dumping			Respondents % (Confirmed)		
		Government	Construction Practitioners	Clients	Government	Construction Practitioners	Clients
Academics	35	10	16	0	29%	46%	0%
Clients	301	79	116	20	26%	39%	7%
Average	**--**	**--**	**--**	**--**	**27%**	**42%**	**7%**

Table 5-6: Responsible Actors on the Informal Dumping

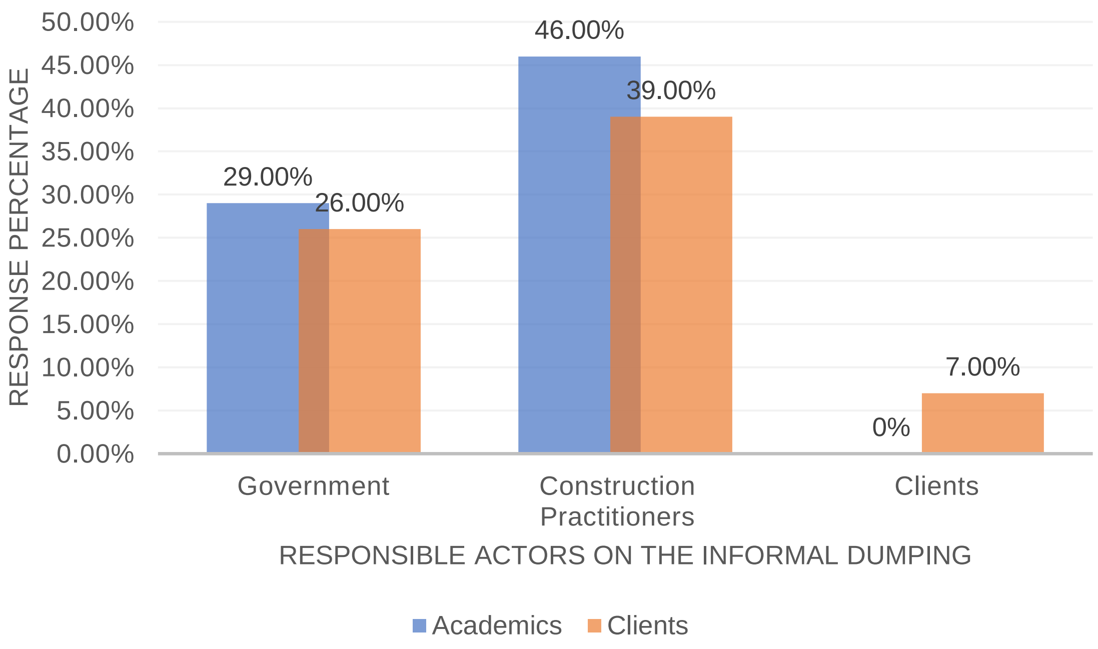

Chart 5-9: Responsible Actors on the Informal Dumping

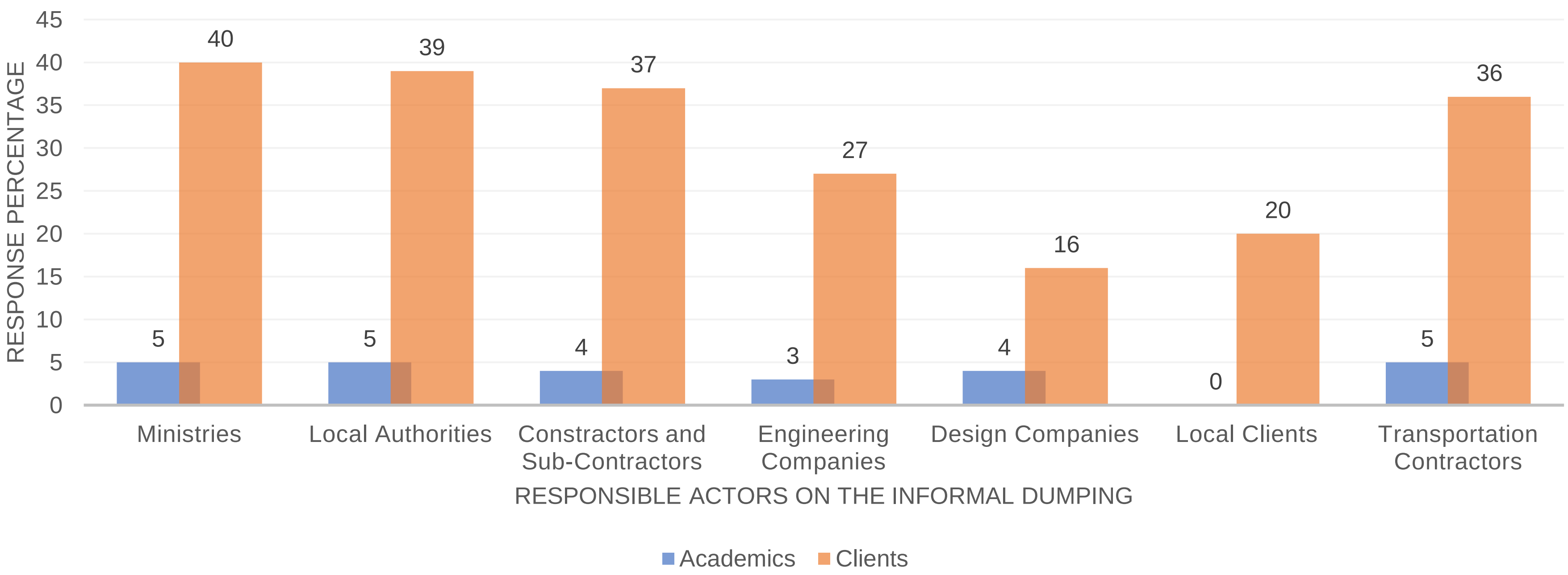

Chart 5-10: Responsible Actors on the Informal Dumping

The statistics in **chart 5-5** corroborated those in **chart 5-9**, which illustrates the government's involvement in informal C&D waste disposal. The findings clearly indicate that public entities, including ministries and local authorities, are to blame. Accounting for an average of 27.41% of the total.

Surprisingly, the statistics revealed that not only government, but also construction professionals are personally invested, with an average of more than 40%. The findings of this study demonstrate unequivocally that construction and transportation contractors is more responsible on this attitude over engineering and design companies. These findings are logically consistent with the fact that current regulations require legal landfilling. Thus, it is not the government's responsibility. But rather the construction and transportation contractors' disproportionate involvement in C&D waste landfilling compared to other actors.

Clients also has an influence on such attitudes, although with low percentage amongst other actors, accounting for almost 7%. The results shown that less than half of clients could account for informal dumping. This could be probably due to some client’s inappropriate actions by not paying for legal dumping or paying less payments, considering it as a less vital activity. Or pay the full payment but consider it as an extra amount of payment for contractors which may contribute to contractors not depositing waste legally to save money.

5.1.2 Aspects within Jordanian construction industry contracts

This section addresses the contractual arrangements applicable to construction, demolition and design activities on public and private projects. By examining the exclusion of C&D waste from current regulations, the types of contracts used in these activities and the procurement method for construction and demolition projects. The tables and charts below summarise the major findings from these surveys.

5.1.2.1 C&D Waste Exclusion

This subsection adequately explains why C&D waste is excluded from the current regulatory system, as illustrated in **table 5-7** and **chart 5-11**.

This section addressed this exclusion by asking participants the following question: “Can you scale the reasons that might be behind excluding C&D waste from the current regulations from 1 to 5 (1 strongly disagree and 5 strongly agree)”.

Actors	No. of Participants	C&D Waste Exclusion						
		Poor Infrastructure	Absence of design codes	Lack of awareness	Planned to be included later upon providing studies	Not considering C&D waste as an issue	Construction actor's willingness	Considering C&D waste as a special type of waste
GAM – Department of Legal Frameworks and Regulations	5	60%	0%	100%	100%	0%	60%	100%
MoE – Department of Legal Frameworks and Regulations	7	43%	0%	86%	100%	0%	57%	100%
Average %	**--**	**51%**	**0%**	**93%**	**100%**	**0%**	**59%**	**100%**

Table 5-7: Reasons Excluding C&D Waste from Current Regulations

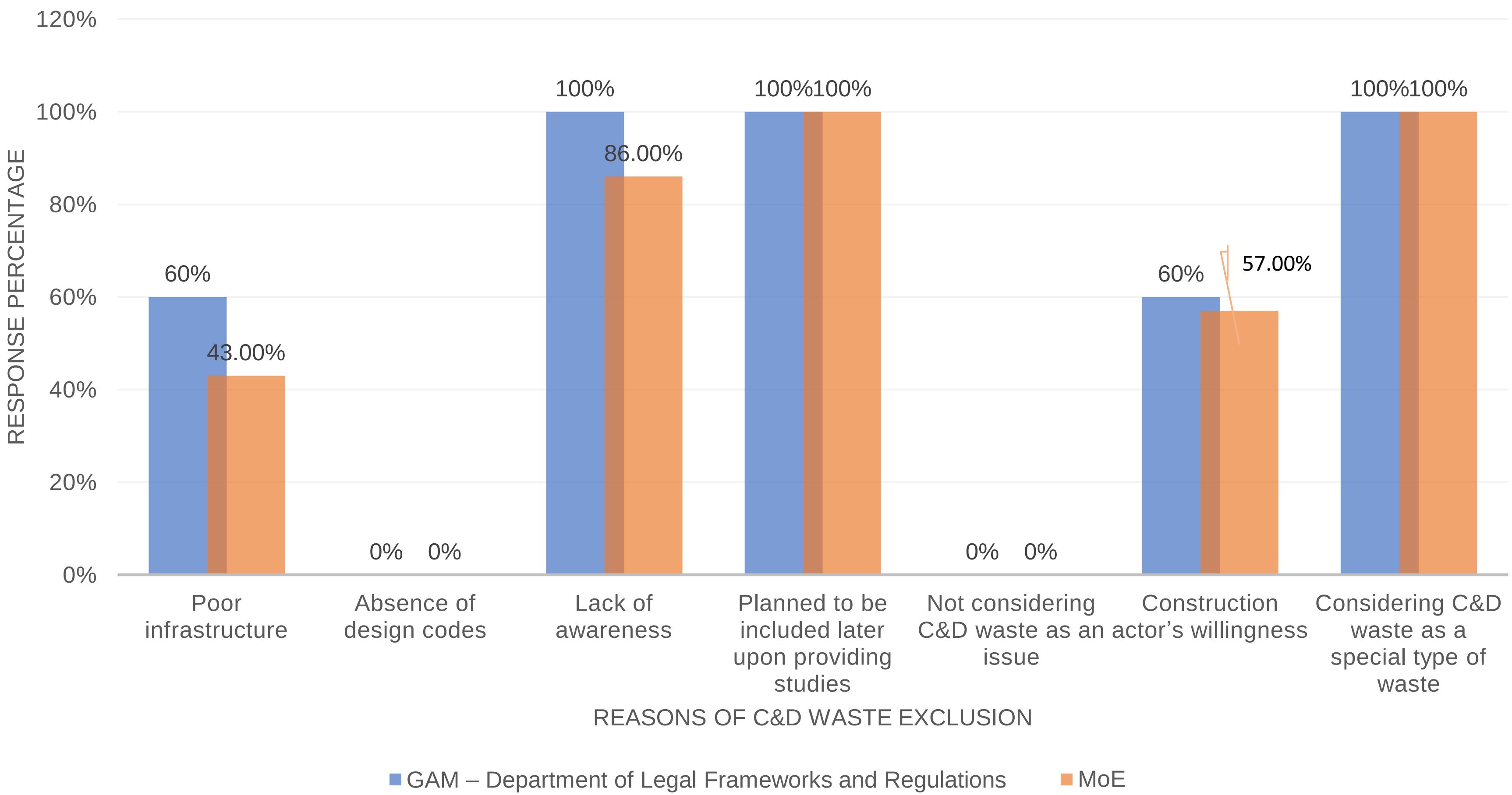

Chart 5-11: Reasons of C&D Waste Exclusion

The investigations discovered a tenuous link between the country's absence of design codes and C&D waste exclusion from present solid waste regulatory systems, as none of participants agreed on this. This consistency appeared as a reliable predictor of showing how participants are quite knowledgeable about C&D waste and its issues in Jordan.

The study discovered that over 90% of respondents from both departments agreed that this exclusion was the result of actors' lack of awareness. In addition to considering that C&D waste is a unique type of waste that requires special controls. These contributing factors do not preclude the influence of additional factors, such as the lack of infrastructure that may aid recycling efforts. In addition to, construction actors' willingness to deal with C&D waste even in the presence of regulations as observed by a range of 40% to 60% of participants.

The lack of awareness amongst local actors have been mentioned in previous arguments. Which were majorly related to informal workers.

According to the study's findings, government entities now view this type of waste as a waste that cannot be handled as solid waste. Highlighting the fact that it requires additional research and unique regulations. Although, as demonstrated in **chart 5-11**, C&D waste regulations are planned to be later upon further studies as agreed by all participants. Those arguments are further investigated in **chapter 6**.

In general, it appears as though increased awareness and establishment of regulations are necessary. The results of this survey support the government's intention to eventually bring C&D waste into the solid waste regulatory system. Although this should be compatible with the preceding justifications for C&D waste exclusion. There would therefore seem to be a definite need for investigating the solid waste regulatory system furtherly as illustrated in **chapter 6**.

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5.1.2.2 Types of Contracts Used

This sub-section attempts to differentiate between the various forms of contracts utilised in the Jordanian construction industry, as illustrated in **tables 5-8** and **chart 5-12**.

This section addressed these contracts by asking participants the following question: “Can you please choose what are the types of contracts used when constructing governmental projects by the ministry?”.

Actors	No. of Participants	Types of Contracts used in the Jordanian Construction Industry			
		General contracting	Design and build	Construction management	Management contracting
MLA – Department of Construction	11	91%	91%	0%	0%
MPWH – Department of Construction	24	96%	92%	0%	0%
Average %	**--**	**93%**	**91%**	**0%**	**0%**

Table 5-8: Types of Contracts Used

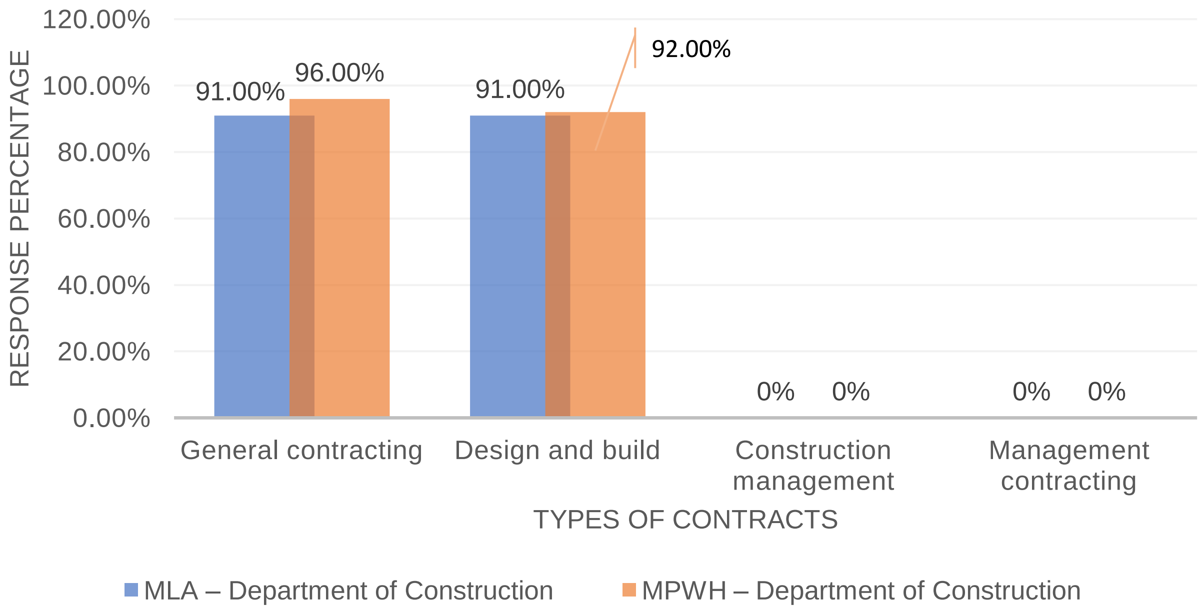

Chart 5-12: Types of Contracts Used

5.1.2.3 Procurement Method for Bidding

This section discusses the distinction between construction and demolition procurement methods, as illustrated in **table 5-9**, as well as **charts 5-13** and **5-14**.

This segment addressed the procurement methods by asking participants the following question: "What is the procurement method used for bidding on construction and demolition projects?".

Actors	No. of Participants	Procurement Methods						
		Type of Project	Best Value	Low Bidding	Negotiated	Qualification Based	Direct selection	No Methods for Selection
MLA – Department of Construction	11	Construction Projects	0%	100%	0%	0%	0%	0%
		Demolition Projects	0%	55%	0%	0%	0%	45%
MPWH – Department of Construction	24	Construction Projects	0%	92%	0%	4%	4%	0%
		Demolition Projects	0%	21%	0%	0%	4%	75%

Table 5-9: Procurement Methods

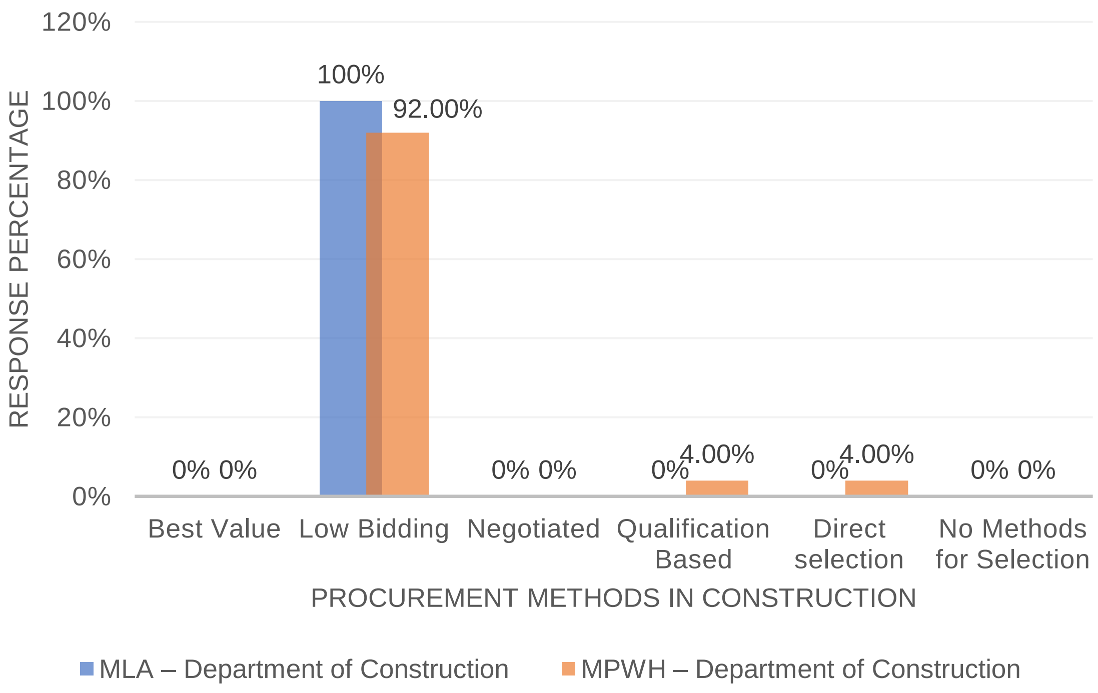

Chart 5-13: Procurement Methods in Construction

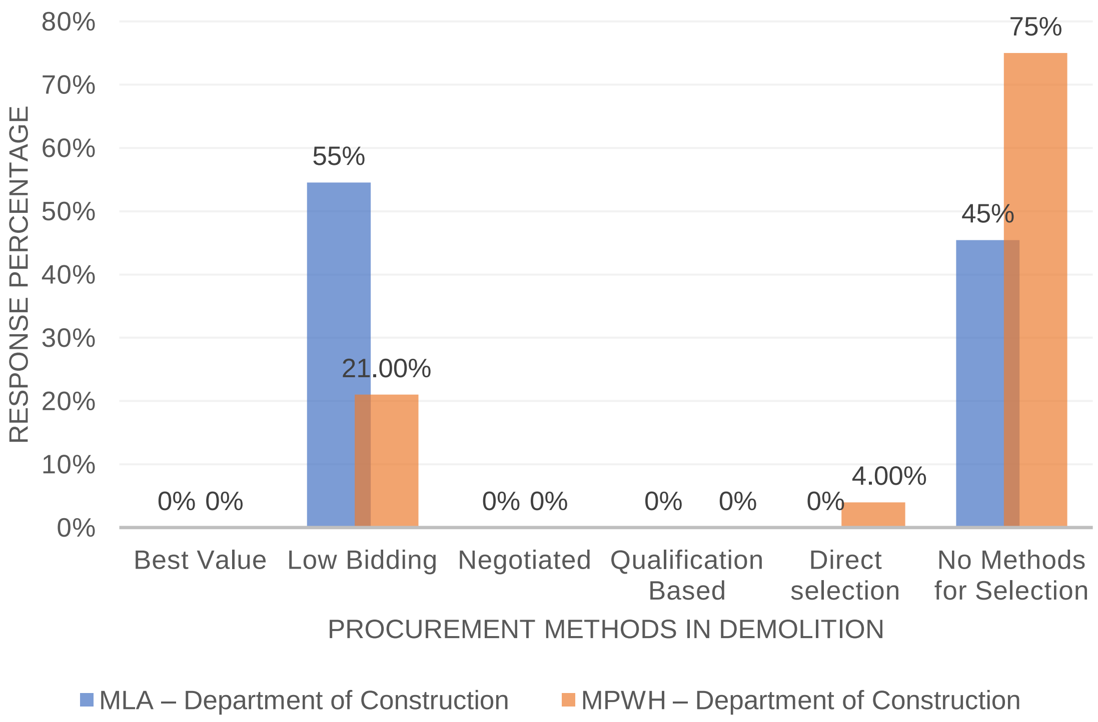

Chart 5-14: Procurement Methods in Demolition

The findings of this survey confirm to existing knowledge that general contracting and design-build contracts are the only types of contracts used in government projects, as stated by an average of 93.37% and 91.28% of participants from both departments, respectively.

This survey indicates that over 90% of respondents acknowledged that the only method to procure construction projects is through a low bidding approach. The research conducted here confirms that construction participants prioritise economic concerns over other considerations, as indicated previously in the research literature. This raises serious concerns about project standards and quality, because minimal investment compensates for substandard quality. The study confirmed that in Jordan, the lowest price selection procurement approach could have a significant impact on C&D waste management. By overlooking less vital tasks such as legal dumping or even C&D waste management.

This survey intended to distinguish between procurement practices for construction and demolition projects. By demonstrating that the procurement methods for the two activities are distinct, as only 37.68% of respondents indicated that demolition projects are procured through low bidding. While nearly twice that percentage indicated that no selection is utilised. According to the information provided, no pre-existing selection criteria are employed in the procurement process for demolition projects.

Taken together, these findings demonstrate that observations are failing to recognize demolition as a critical activity which aids in the promotion of a no selection procurement strategy. This data indicates a strong correlation between the procurement of demolition projects and the hindrance to C&D waste management. Indeed, during demolition, only two factors are considered: safety measures and legal dumping of C&D waste.

5.1.3 Missing Construction and Demolition Waste Management Activities

This section reviews Jordanian construction's present C&D waste management processes and highlights the underlying reasons for their non-adoption. These include waste collection, sorting, legal landfilling, recycling and waste-out design. The tables and charts below summarise the major findings of surveys.

5.1.3.1 Construction and Demolition Projects

This sub-section acknowledges the industry's present approaches to C&D waste management, as illustrated in **table 5-10** and **chart 5-15**.

It addressed these present activities by asking participants to respond to the following question: "Do you use any approach for construction waste management when constructing a project by your company and if yes tick the approaches that are included in this management".

Actors	No. of Participants	Current approaches of C&D Waste Management					
		Collection	Sorting	Landfilling	Recycling		Designing out Waste
					Profitable waste	All types of waste	
Contractors	27	89%	44%	89%	37%	0%	0%
Concrete Suppliers	22	100%	0%	100%	0%	0%	0%
GAM – Department of Construction	22	86%	14%	77%	64%	9%	9%
MLA – Department of Construction	11	100%	45%	100%	73%	0%	0%
MPWH - Department of Construction	24	92%	8%	92%	92%	8%	0%
Average %	**--**	**93%**	**22%**	**92%**	**53%**	**3%**	**2%**

Table 5-10: Current Approaches of C&D Waste Management

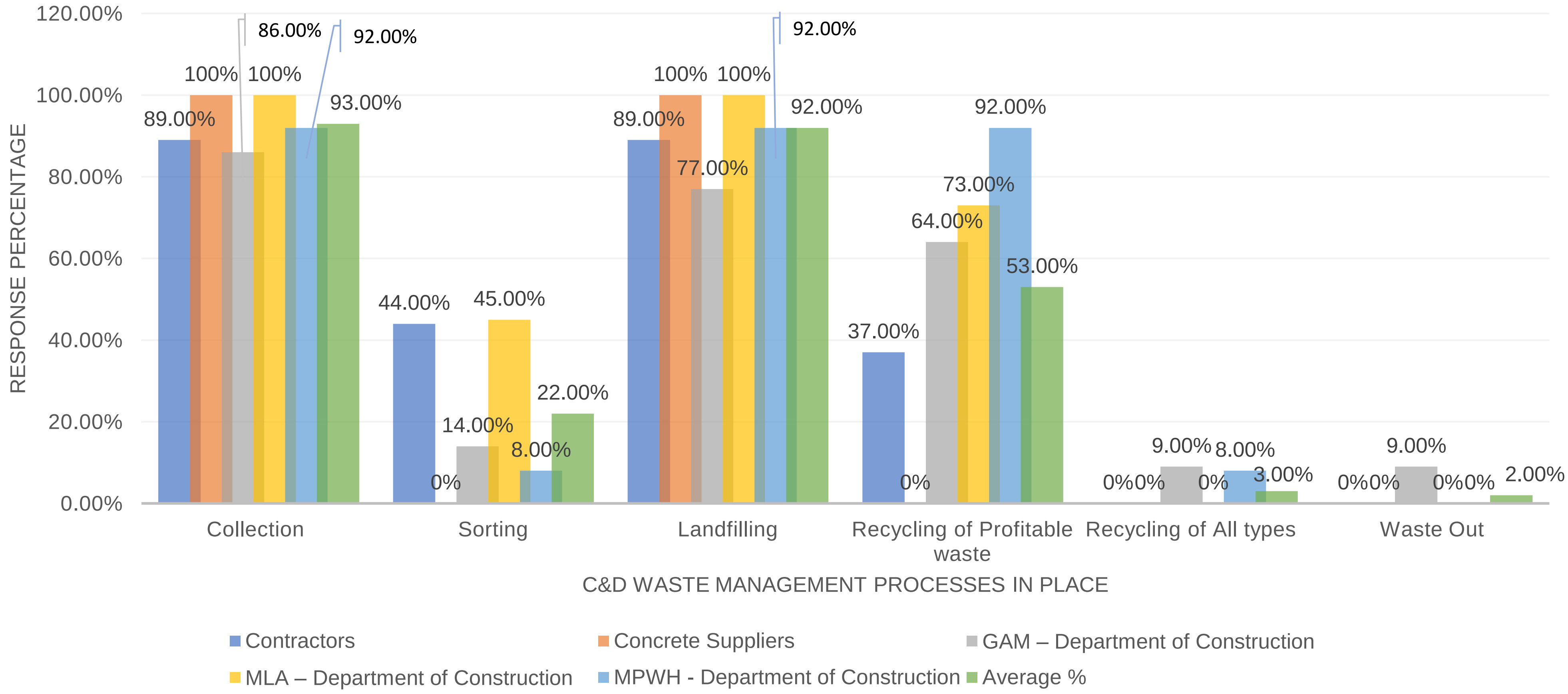

Chart 5-15: C&D Waste Management Processes in Place

The findings of this study contribute to our existing understanding of C&D waste management. The average proportion of respondents was 93.38% for collection and 91.56% for landfilling, with a range between 75% to 100% from all participants for both operations. The most plausible explanation for this is that the current regulatory framework requires actors to collect and deposit waste legitimately. The conclusions of this study corroborate those of **chapter 2**. Although, due to the high prevalence of informal dumping, these findings should be regarded with caution.

One of the most striking findings of this survey was that sorting and recycling of all waste types, as well as designing out waste, do not exist as agreed by above 75% of participants. The primary theoretical implication of their existence could be either that:

1. These activities do not exist in regulatory systems.
2. The industry actors are unaware of the types of waste that may be sorted and recycled except steel and timber.
3. Considering sorting as a time-consuming process which hinders its implementation, acquiescing collecting and landfilling to be more viable and practical than sorting.
4. The absence of design codes for recycled waste material.

However, a total of 53.01% of participants that recycling occurs only on few waste material that seem to have direct revenue or profit. This comes in line with what was found in **chapter 2**. As industrial actors in Jordan recycle valuable wastes such as steel and timber on a profit basis only without the presence of regulations. Which corroborates the findings of Wang J.Y. et al. (2010) in **section 2.3.5**.

This in conclusion may aid in understanding the mentality nature of industry actors in Jordan. Which aids in our comprehension that if industry actors were aware of the economic benefits of recycling C&D waste, particularly CCA. They would be willing to recycle it without the presence of regulations.

5.1.3.2 Construction and Demolition Waste Management

As previously said, this section offers information on the variables that inhibit the collecting, sorting, transportation, recycling and waste-out design processes of C&D waste management. **Tables 5-11, 5-12, 5-13** and **5-14**, as well as **charts 5-16, 5-17, 5-18** and **5-19** below summarise the major findings from these surveys.

This section addressed those variables by asking participants the following: "Select the top 3 reasons behind preventing each process including collection, sorting, transporting C&D waste to landfill and recycling and reusing from happening within the C&D waste management on site".

5.1.3.2.1 Reasons Preventing Collection of Construction and Demolition Waste

This sub-section attempts to acknowledge the strongly related factors that obstruct on-site collection of C&D waste, as seen in **tables 5-11** and **5-11**, as well as **charts 5-16** and **5-17** below.

Actors	No. of Participants	Reasons		Respondents % (Confirmed)
			No. of Participants	
Academics	5	Informal Workers	2	40%
		lack of management system	2	40%
		Poor Awareness	3	60%
MLA – Department of Construction	11	Time concerns	7	63%
		Lack of skills and knowledge	6	55%
		Lack of management system	5	45%
GAM – Department of Construction	22	Informal Workers	15	68%
		Lack of skills and knowledge	13	59%
		Poor Awareness	10	45%
MPWH – Department of Construction	24	Informal Workers	22	92%
		Lack of skills and knowledge	16	67%
		Poor Awareness	13	54%

Table 5-11: Reasons Preventing Collection of C&D Waste

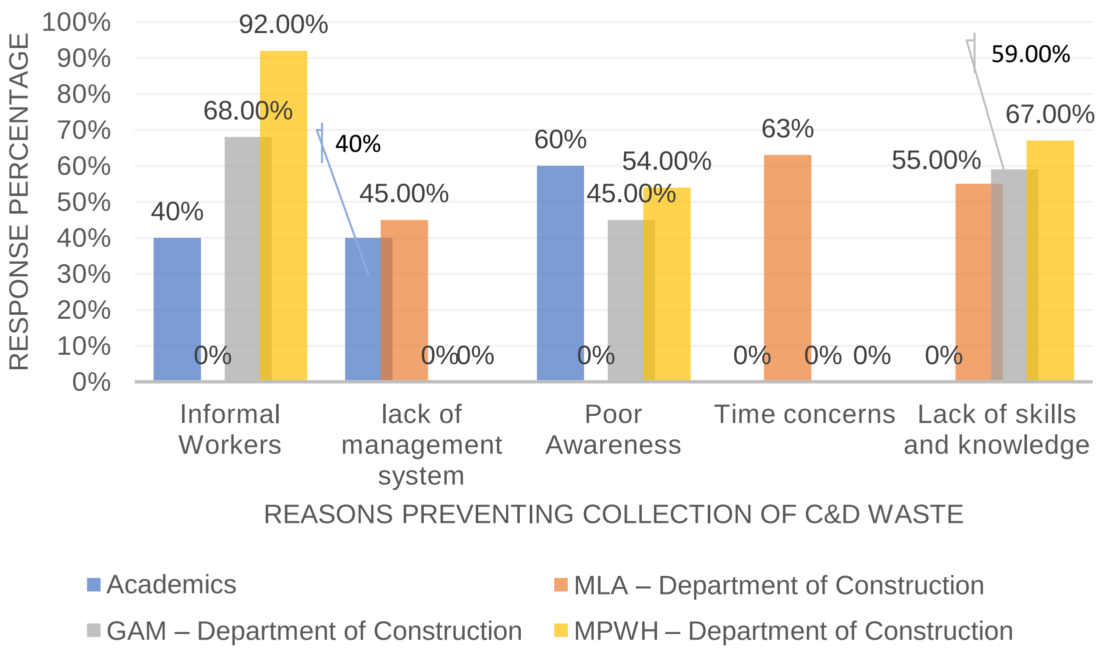

Chart 5-16: Reasons Preventing Collection of C&D Waste

Contributory Factors	Actors	Average %
Lack of skills and knowledge	MLA – Department of Construction	**45%**
	GAM – Department of Construction	
	MPWH – Department of Construction	
Informal Workers	Academics	**50%**
	GAM – Department of Construction	
	MPWH – Department of Construction	
lack of management system	Academics	**21%**
	MLA – Department of Construction	
Poor Awareness	Academics	**40%**
	GAM – Department of Construction	
	MPWH – Department of Construction	

Table 5-12: Most Reasons Preventing Collection of C&D Waste

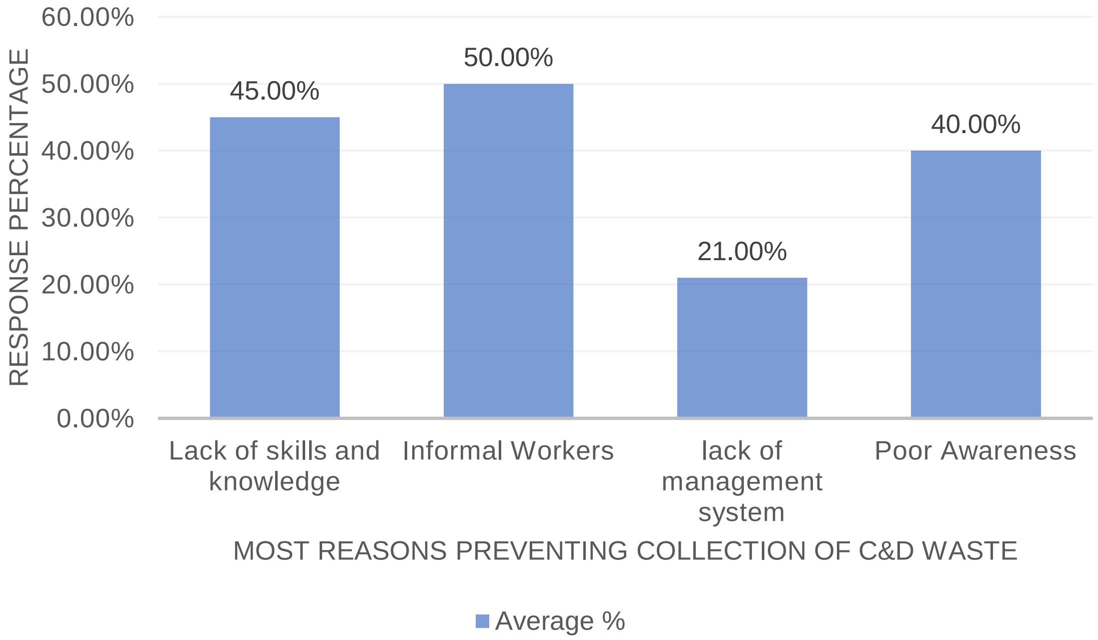

Chart 5-17: Average Percentage of Respondents on Most Reasons Preventing Collection of C&D Waste

The involvement of informal workers and the lack of skills and awareness among local actors have a significant impact on C&D waste collection, with an average response rate of roughly 50% and 45%, respectively.

Members from GAM, MPWH, MLA and academics agreed that informal laborers should be included. However, academics detractors assert that the lack of skills and awareness precludes on-site collection of C&D waste. This addition may help to cast doubt on the adverse effect of informal workers on the management of C&D waste. As the previous sections demonstrated a tenuous connection between informal labour and informal dumping of C&D waste. Although, their involvement prompted an investigation.

The primary finding of lack of awareness appeared to be confirmed by an average of 39% of GAM, MPWH and academics. Although, MLA participants did not place a high premium on GAM, MPWH, or academics' knowledge of the influence of poor awareness. This could be due to the fact that MLA participants observe it as a simple process that may be performed without high awareness. Thus, according to this low average percentage and inconsistency between responses, the low awareness is trivial in comparison to the variables listed above.

Those implications do not rule out the influence of other barriers. Such as the lack of management system as agreed by 40% of academics and 46% of MLA participants with an average of 21% of respondents. This low percentage could be correlated with participants' suggestion that a weak link may exist between the lack of management system and on-site collection of C&D waste since collection is a process that does not require a management system. In addition to, the time constraints as agreed by 63% of MLA participants. However, time limits may well have a bearing on collection, as it is a labour-intensive procedure that requires time and excessive costs.

5.1.3.2.2 Reasons Preventing Sorting of Construction and Demolition Waste Management

This sub-section was created to ascertain numerous elements that contribute to the inability of sorting to occur, as illustrated in **tables 5-13** and **5-14**, as well as **charts 5-18** and **5-19**.

Actors	No. of Participants	Reasons		Respondents % (Confirmed)
Academics	5	Informal Workers	2	40%
		lack of financial rewarding	3	60%
		Poor Awareness	2	40%
MLA – Department of Construction	11	Absence of equipment	6	55%
		Lack of skills and knowledge	5	45%
		Lack of regulations	4	36%
GAM – Department of Construction	22	Absence of equipment	18	82%
		Informal workers	12	55%
		Lack of regulations	11	50%
MPWH – Department of Construction	24	Absence of equipment	20	83%
		Lack of management systems	9	38%
		Lack of regulations	8	33%

Table 5-13: Reasons Preventing Sorting of C&D Waste

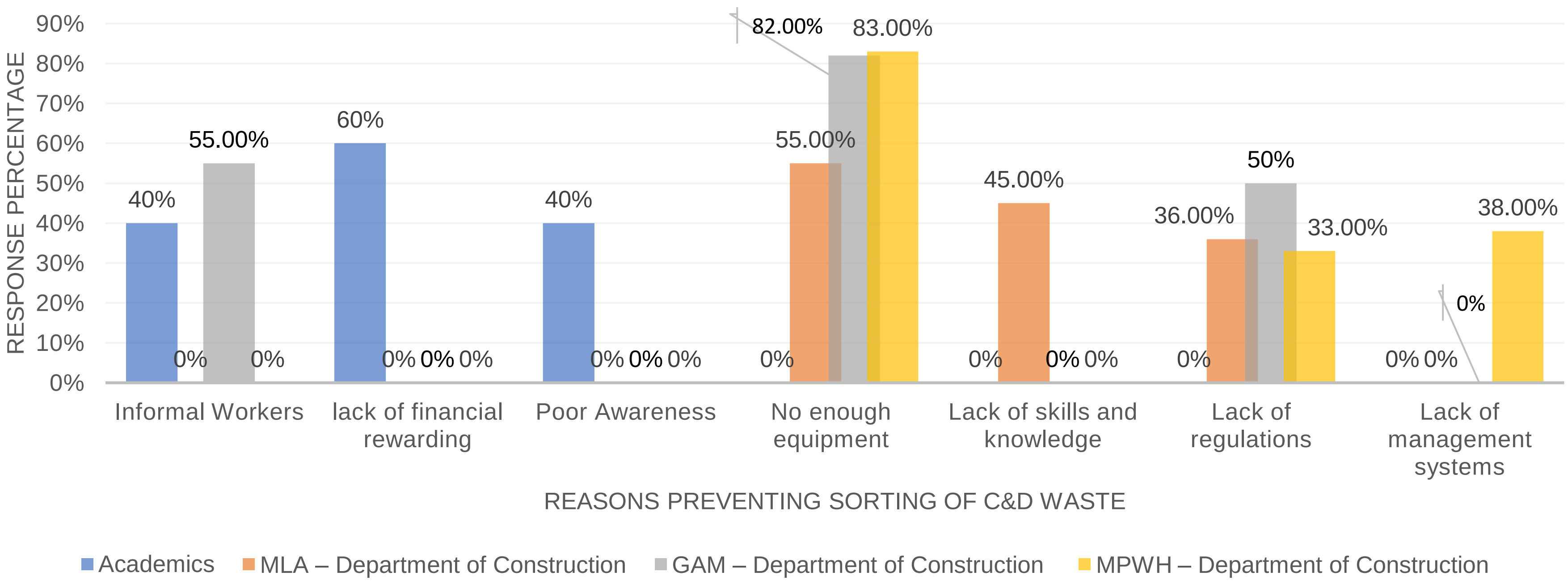

Chart 5-18: Reasons Preventing Sorting of C&D Waste

Contributory Factors	Actors	Average %
Informal Workers	Academics	**24%**
	GAM – Department of Construction	
Absence of equipment	MLA – Department of Construction	**55%**
	GAM – Department of Construction	
	MPWH – Department of Construction	
Lack of regulations	MLA – Department of Construction	**30%**
	GAM – Department of Construction	
	MPWH – Department of Construction	

Table 5-14: Most Reasons Preventing Sorting of C&D Waste

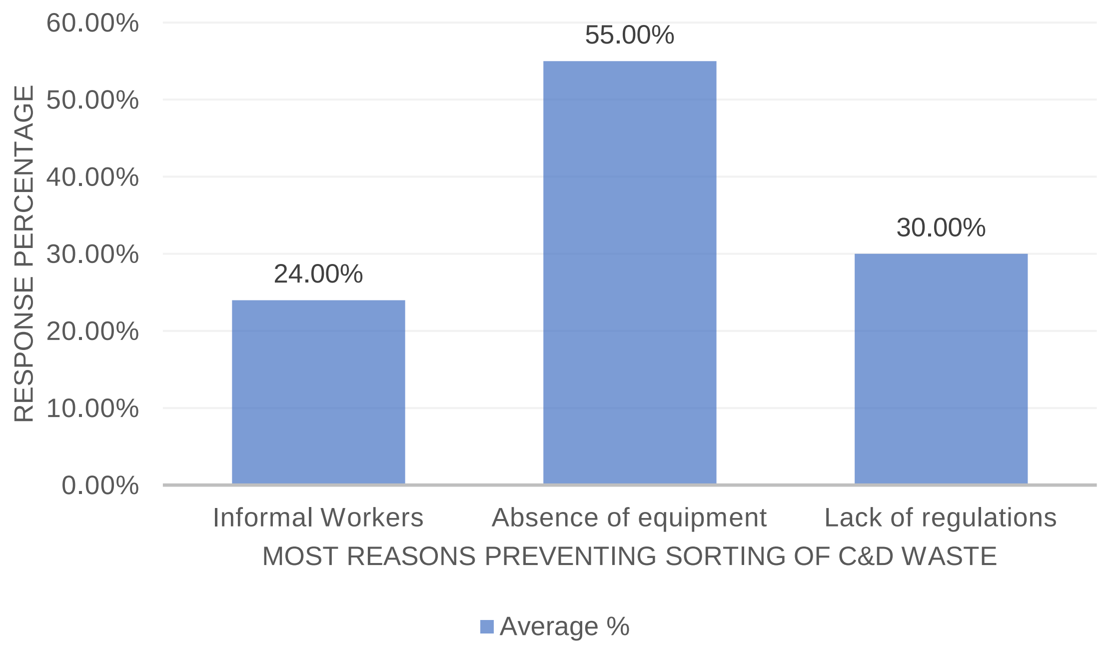

Chart 5-19: Average Percentage of respondents on the Most Reasons Preventing Sorting of C&D Waste

According to this survey's findings, the most important impediment to sorting is the lack of equipment as agreed by an average of almost 55% of participants. This percentage ranged between 55% to 85% of GAM, MLA and MPWH participants. The relevance of this is clearly demonstrated by equipment that is both timely and efficient in sorting waste.

Additionally, the findings of this study suggest that the absence of legislations may have a significant impact on implementing sorting. As agreed by nearly 30% of the same participants mentioned above ranging between 33% to 50%. The outcomes of this survey corroborate previous findings that the regulatory system is limited by a dearth of sorting regulations. One primary reason for the low average percentage of this aspect to hinder sorting is probably the current attitudes of the construction actors in Jordan. Since they currently separate steel and timber with the absence of such regulations. Thus, the incorporation of sorting regulations into the regulatory system may be trivial. This could be linked to what was mentioned previously in **chapter 2** about the economic preference.

According to the numbers presented here, informal workers are a significant factor in impeding sorting, with an average of 23.63%. Accounting for 40% of academics and 54% of GAM participants. This survey indicated that informal workers lack the necessary expertise to facilitate such a process on the job. The apparent conflict between governmental officials presented in **chart 5-18** could be explained by the law of labour. Since it requires to employ exclusively Jordanian formal workers in work sites.

5.1.3.2.3 Reasons Preventing Transportation of Construction and Demolition Waste to Landfill

This section evaluates the possible grounds for the avoidance of transporting C&D waste to a licensed landfill, as illustrated in **tables 5-15** and **5-16**, as well as **charts 5-20** and **5-21**.

Actors	No. of Participants	Reasons	No. of Participants	Respondents % (Confirmed)
Academics	5	Long transportation distances	5	100%
		lack of financial rewarding	2	40%
		Low supervision on waste disposal systems	2	40%
MLA – Department of Construction	11	Low supervision on waste disposal systems	9	82%
		Long transportation distances	7	64%
		Cost concerns	6	55%
GAM – Department of Construction	22	Long transportation distances	17	77%
		Cost concerns	11	50%
		Incomplete waste disposal system	10	45%
MPWH – Department of Construction	24	Long transportation distances	23	96%
		Low supervision on waste disposal systems	14	58%
		Incomplete waste disposal system	17	71%

Table 5-15: Reasons Preventing Transportation of C&D Waste to Landfill

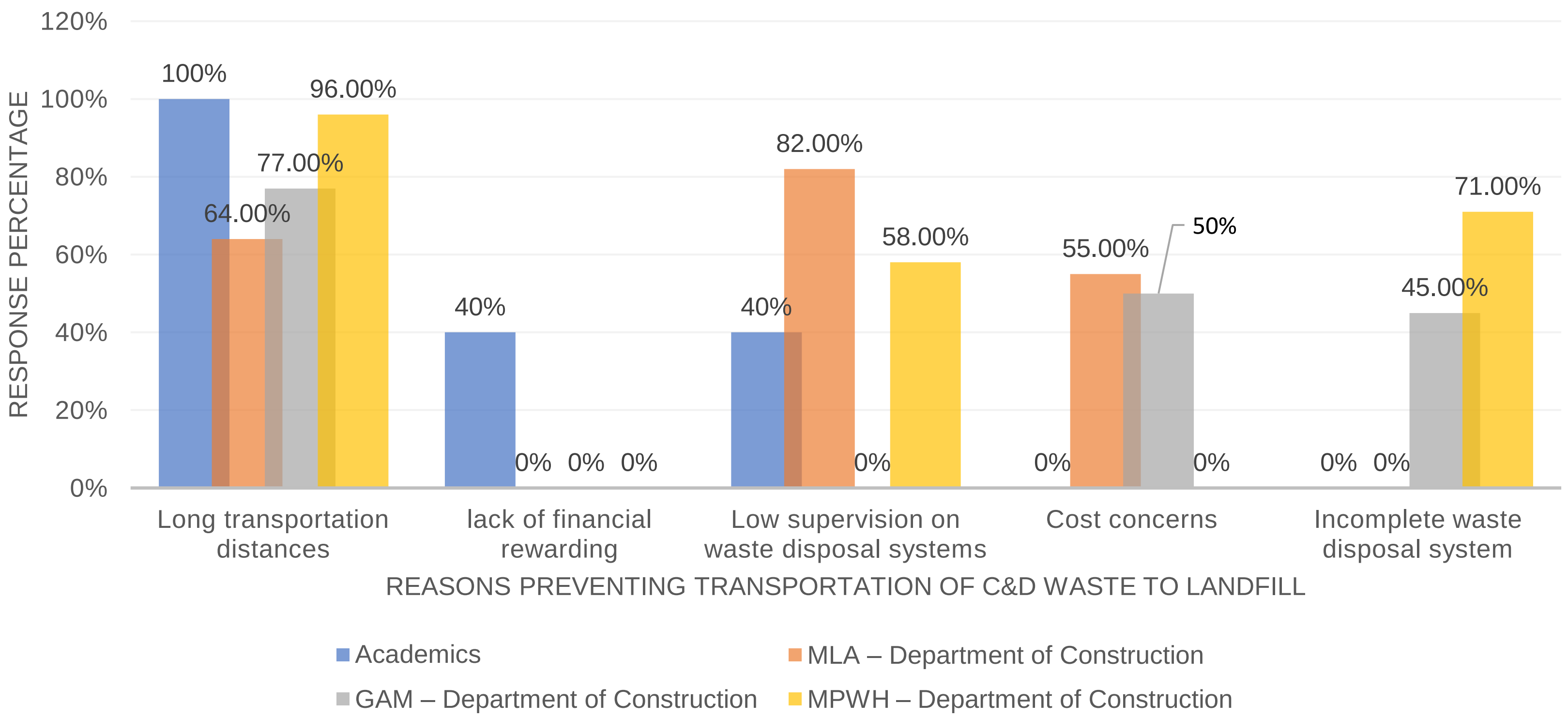

Chart 5-20: Reasons Preventing Transportation of C&D Waste to Landfill

Contributory Factors	Actors	Average %
Long transportation distances	Academics	**84%**
	MLA – Department of Construction	
	GAM – Department of Construction	
	MPWH – Department of Construction	
Low supervision on waste disposal systems	Academics	**45%**
	MLA – Department of Construction	
	MPWH – Department of Construction	
Cost concerns	MLA – Department of Construction	**26%**
	GAM – Department of Construction	
Incomplete waste disposal system	GAM – Department of Construction	**29%**
	MPWH – Department of Construction	

Table 5-16: Most Reasons Preventing Transportation of C&D Waste to Landfill

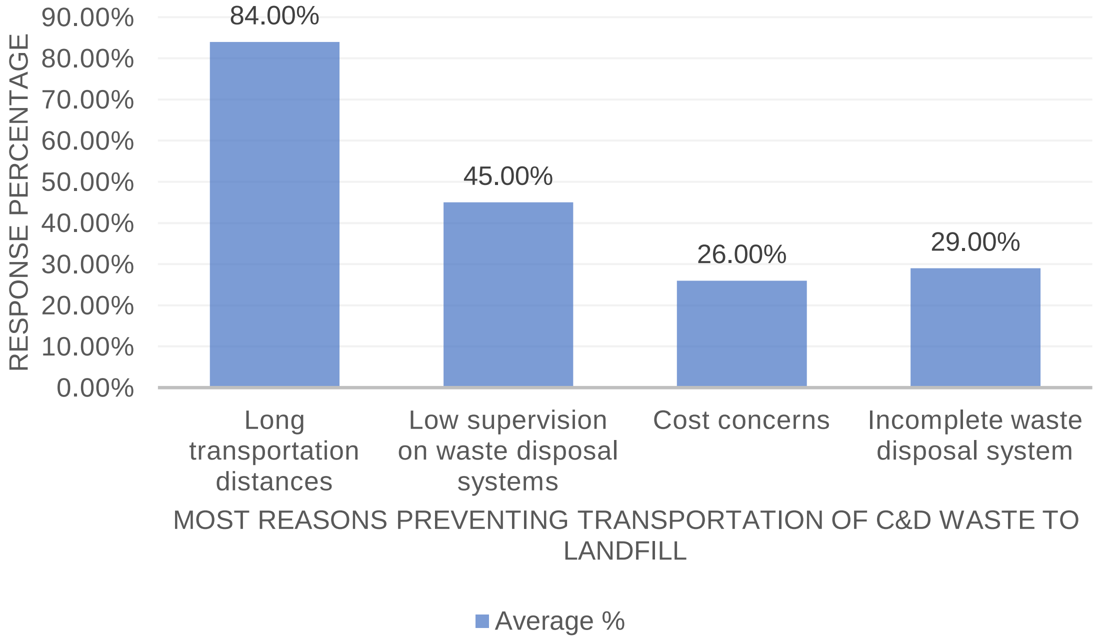

Chart 5-21: Average Percentage of respondents on the Most Reasons Preventing Transportation of C&D Waste to Landfill

The survey's findings indicate that lengthy transportation distances to landfill is a significant factor inhibiting the delivery of C&D waste to permitted landfill sites. Regardless of functional differences, all participants felt that this was the most significant impediment to such an activity, with an average of 84.18%. This strategy proved useful in expanding our understanding that permitted landfill are located away from work sites. Thus, they may result in increasing the transportation costs, as noted by an average of around 26% of GAM and MLA participants. This figure is representative of the volume of C&D waste dumped at nearby private landfill as demonstrated in **section 4.2.1**.

Additionally, an average of 45% of academics, MLA and MPWH participants agreed that insufficient oversight of waste disposal activities was a severe concern in this survey. As a result of GAM's obligations for waste disposal monitoring and control, GAM participants have not extrapolated this conclusion. A serious weakness with this argument is that despite the existence of legislative dumping prohibitions, informal dumping happens at an alarming rate. Thus, caution must be applied. As is additional investigation into the current oversight system is essential to validate the need for improvement.

This does not rule out the influence of an insufficient waste disposal system, which was cited as a factor by an average of 29% of GAM and MPWH participants but received no reaction from academics or the MLA.

5.1.3.2.4 Reasons Preventing Recycling and Reusing of Construction and Demolition Waste

This section discusses the important constraints that have been identified as impeding the adoption of recycling C&D waste, as seen in **tables 5-17** and **5-18**, as well as **charts 5-22** and **5-23**.

Actors	No. of Participants	Reasons		Respondents % (Confirmed)
Academics	5	lack of financial rewarding	3	60%
		Limited availability of infrastructure facilities	2	40%
		Absence of recycled waste material design codes	2	40%
MLA – Department of Construction	11	Absence of recycled waste material design codes	7	64%
		Limited availability of infrastructure facilities	5	45%
		Lack of demand on recycled waste material	5	45%
GAM – Department of Construction	22	Absence of recycled waste material design codes	12	55%
		Lack of demand on for recycled waste material	11	50%
		Absence of equipment	8	36%
MPWH – Department of Construction	24	lack of financial rewarding	18	75%
		Absence of recycled waste material design codes	12	50%
		Absence of equipment	10	42%

Table 5-17: Reasons Preventing Recycling and Reusing of C&D Waste

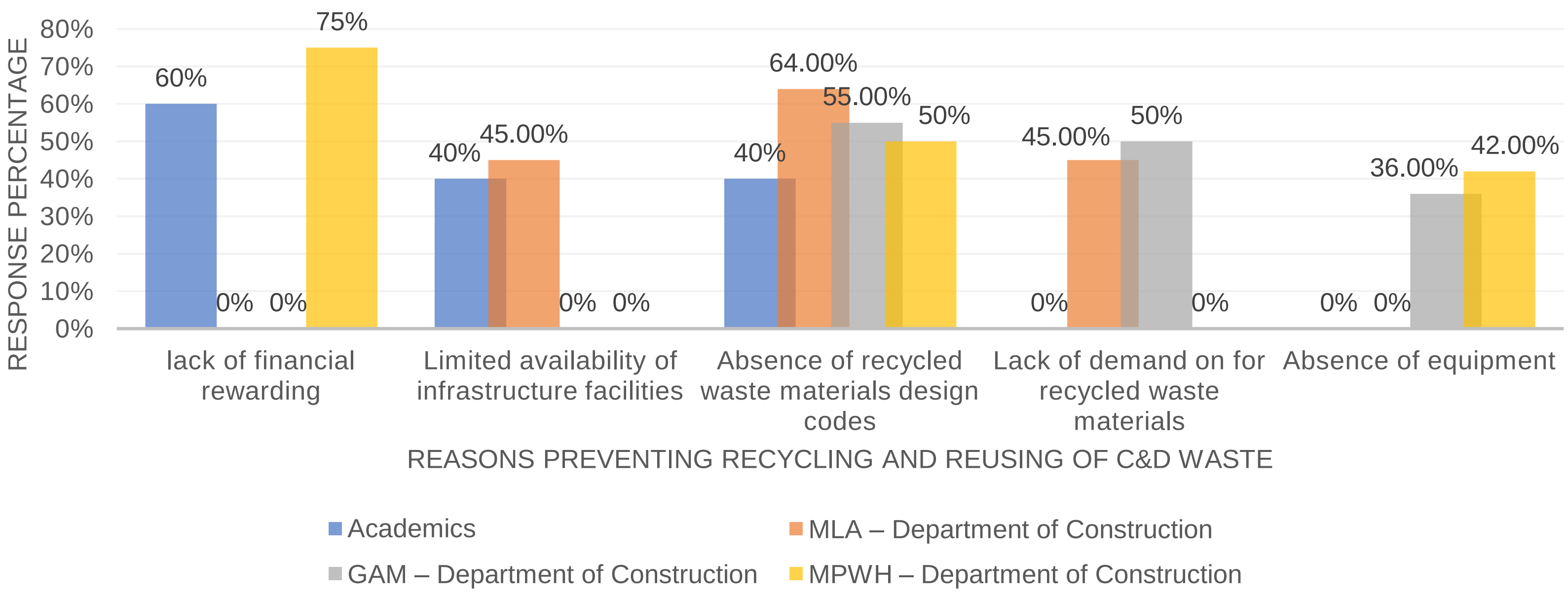

Chart 5-22: Reasons Preventing Recycling and Reusing of C&D Waste

Contributory Factors	Actors	Average %
Lack of financial rewarding	Academics	34%
	MPWH – Department of Construction	
Limited availability of infrastructure facilities	Academics	21%
	MLA – Department of Construction	
Absence of recycled waste material design codes	Academics	52%
	MLA – Department of Construction	
	GAM – Department of Construction	
	MPWH – Department of Construction	
Lack of demand for recycled waste material	MLA – Department of Construction	24%
	GAM – Department of Construction	
Absence of equipment	GAM – Department of Construction	20%
	MPWH – Department of Construction	

Table 5-18: Most Reasons Preventing Recycling and Reusing of C&D Waste

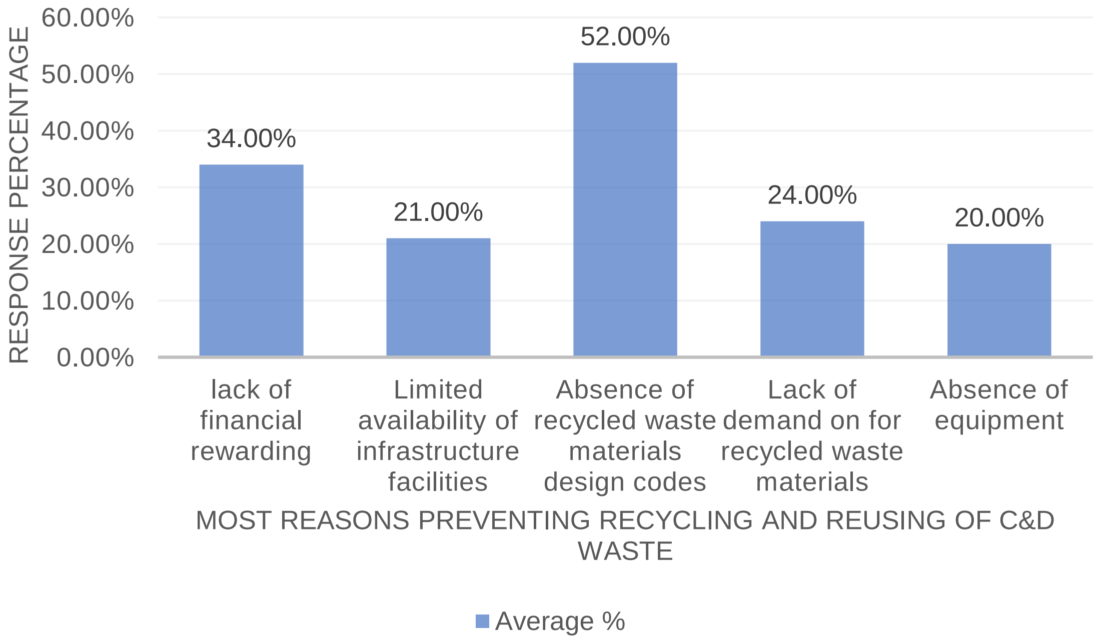

Chart 5-23: Average Percentage of respondents on the Most Reasons Preventing Recycling and Reusing of C&D Waste

The absence of codes governing the design of recycled waste material appears to be the primary constraint to C&D waste recycling. Academics, MLA, GAM and MPWH participants, on average of 52% ranging between 40%, 63.63%, 54.54% and 50%, respectively agreed on this finding. The primary constraint is that projects cannot be constructed using material that are not specified in design codes. This adds to the growing body of evidence suggesting that Jordan's design codes are highly enforced. Hence projects are constrained by these standards. Notably, the primary shortcoming of this finding is that even if recycling were to occur, the recycled waste products would be discarded, as there will be no official use for them. Regardless of the usage of recovered waste material, the absence of design codes can cause reluctance consequences for construction stakeholders, as codes are critical for quality assurance.

Almost 24% of MLA and GAM participants agreed that the lack of demand for recycled waste material may be associated with hindering C&D waste recycling. The low demand could be attributed to local actors' poor awareness of the benefits of C&D waste recycling. Or the absence of design codes that assure the quality of recycled waste material. The absence of academic and MPWH statements noting a lack of demand as a significant hurdle to C&D waste recycling could be explained by their perspective that studies and workshops will address this.

Another contradictory result has been discovered concerning insufficient infrastructure and a shortage of recycling equipment, as around 21% of academics and MLA participants and 20% of GAM and MPWH participants agreed on average. The mixing of those two indicates that they do not appear to have a significant impact on recycling prevention. Although it is worth noting that they may make landfilling less expensive than recycling C&D waste, as the absence of infrastructure and equipment may allow actors to pay more to providing recycling facilities. This discrepancy could be explained by increased infrastructure investment to provide recycling facilities and equipment.

As previously stated, the absence of financial incentives discourages recycling C&D waste at an average response rate of 33.75%. By only 60% of academics and 75% of MPWH participants. As previously indicated, critics cast doubt on the government's ability to incentivize recyclers. Although critics have argued that financial compensation is unnecessary because recycling is intrinsically rewarding.

5.1.3.3 Design Out Waste

This section examined the current design methods in C&D waste management. Including the hindrances to not adopting its approaches such as reduction, prevention, or deconstruction. In addition to, determining the critical driving encouragements to design out waste on projects. Additionally, this section has given a wide understanding on the absence of recycled waste material design codes by identifying the most likely causes.

The tables and charts below summarise the major findings from these surveys.

5.1.3.3.1 The Adoption of Design Out Waste Approach

This part determines if the industry employs one of the three design out waste approaches on projects, as seen in **table 5-19** and **chart 5-24**. By posing the following question to academics: “Do design companies in Jordan design out waste of projects (design for reduction/prevention/deconstruction)” and to other participants: “Does the ministry use any approach for designing waste out of projects (design for reduction/prevention/deconstruction)”.

Actors	No. of Participants	Design for Reduction/Prevention/Deconstruction		Respondents % (Confirmed)	
		Yes	No	Yes	No
Academics	5	0	5	0%	100%
MLA – Department of Design	18	0	18	0%	100%
MPWH – Department of Design	19	1	18	5%	95%
Average %	**--**	**--**	**--**	**2%**	**98%**

Table 5-19: Adoption of Design Out Waste Approaches

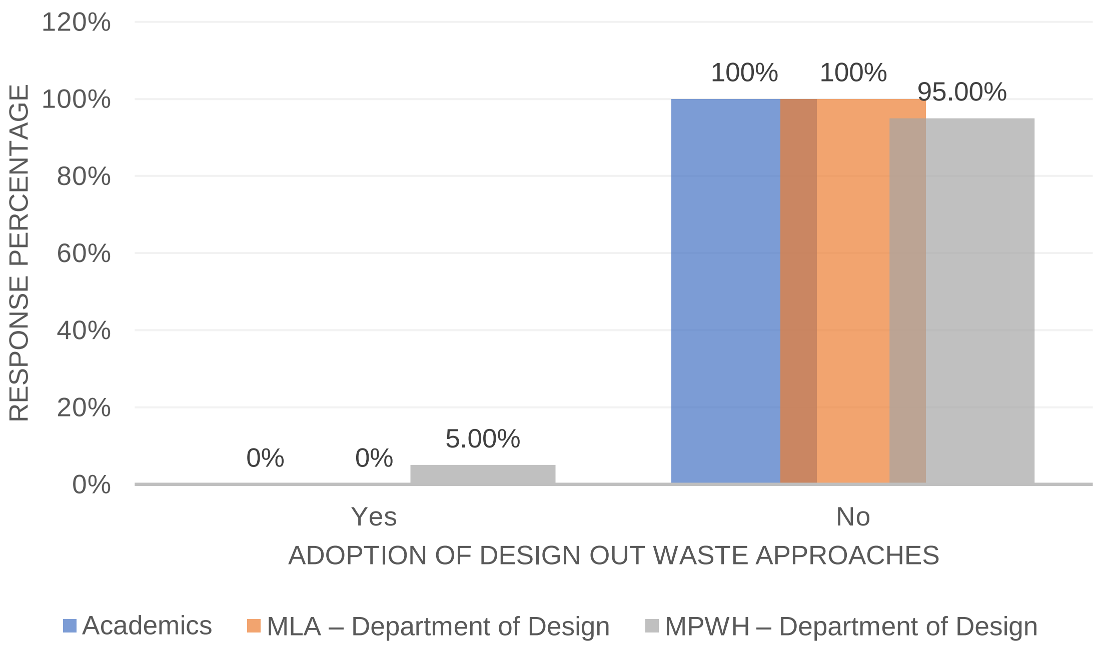

Chart 5-24: Adoption of Design Out Waste Approaches

The findings of this survey support the assumption of disregarding C&D waste throughout the design phase of projects. As the analysis reveals that Jordanian design firms do not push any design out waste methods. Academics, MLA and MPWH respondents correctly identified the outcomes over 95% of the time.

Chapter 10-appendix III appears to verify the concept that this phase is mainly concerned with general design aspects. Including design layouts, electrical, mechanical and plumbing systems, as well as interior and exterior finishes. The next subsection investigates this adoption in depth.

5.1.3.3.2 Reasons Behind not Designing Out Waste

This sub-section covers the critical elements that contribute to the previous adoption of design firms and departments in the government, as illustrated in **table 5-20** and **chart 5-25**.

This was addressed by asking participants the following question: “Can you please scale the reasons preventing the adoption of such approaches in the country from 1 to 5 (1 strongly disagree and 5 is strongly agree)?”.

Actors	No. of Participants	Respondents on the Reasons of not using Designing Waste Out of Projects Percentage						
		Absence of Design Codes	Concerns			Awareness & Willingness	Demolition Techniques	Governmental Controls
			Technical	Time	Cost			
Academics	5	80%	20%	20%	80%	60%	100%	100%
MLA – Department of Design	18	100%	33.3%	67%	56%	89%	100%	89%
MPWH – Department of Design	19	95%	21.1%	63%	74%	89%	95%	95%
Average %	**--**	**92%**	**25%**	**50%**	**70%**	**79%**	**98%**	**95%**
			48%					

Table 5-20: Reasons Behind not Designing out Waste of Projects

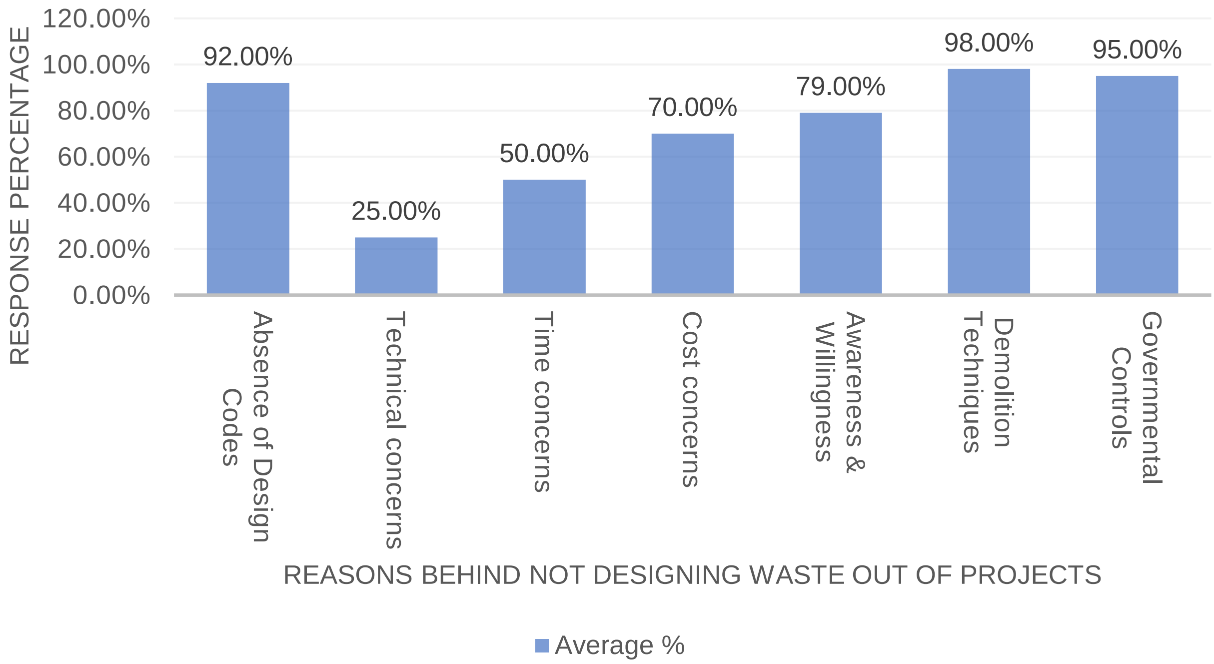

Chart 5-25: Reasons Behind not Designing Waste out of Projects

According to the findings of this survey, an average of 98.2% and 94.5% of academics, MLA and MPWH participants believed that the ineffective demolition techniques and poor governmental controls impede design out waste approaches.

These governmental controls include the absence of regulations, inadequacy of the current regulations, and enforcement of regulations and compliance of local actors to the regulations. The outlined in previous sections above criticise the influence of the government in all aspects of the C&D waste management. Meanwhile, the inadequate demolition techniques may be explained by the ambiguity of contractual arrangements of demolition projects as mentioned in **section 5.1.2.3**.

An average of 91.6% of participants including 80% for academics, 100% for MLA and 94.7% for MPWH indicated that the absence of design codes is one of the main reasons causing design companies and departments not to design out waste of projects. One criticism on participants' agreement is that the absence of these codes should not significantly hinder this approach from taking place. Although the most significant consequence of this could be that recycled waste material cannot be legally used or designed to be used. According to few participants from governmental departments a construction permit cannot be obtained without official approval on project design. Thus, the absence of design codes could create contractual complications prior construction. This is explained in depth in **chapter 6**. Although the data indicated that recycled waste material might be employed in less-frequently used applications that do not require permits or approvals. Such as platforms, walkways and internal walls.

5.1.3.3.3 Approaches to Adopt Design Out Waste

This sub-section evaluates the efficacy of various approaches that could aid in the adoption of design out waste approaches, as illustrated in **table 5-21** and **charts 5-26** and **5-27**.

This section addressed these encouragements by asking participants the following question: “Can you please scale the following approaches that could contribute to implementing or adopting the design of C&D waste out of projects from 1 to 5 (1 strongly disagree and 5 is strongly agree)?”.

Actors	**No. of Participants**	**Respondents on Possible Approaches assisting to design out waste of projects Percentage**				
		Design Codes Establishment	**Regulating Designing out Waste of Projects**	**Provide recycling Facilities**	**Encouragements**	
					Tax Exempts	**Proper Training**
Academics	5	100%	100%	100%	60%	80%
MLA – Department of Design	18	100%	100%	100%	89%	89%
MPWH – Department of Design	19	95%	95%	95%	89%	95%
Average %	**--**	**98%**	**98%**	**98%**	**79%**	**88%**

Table 5-21: Approaches to Adopt a Design out Waste Approaches

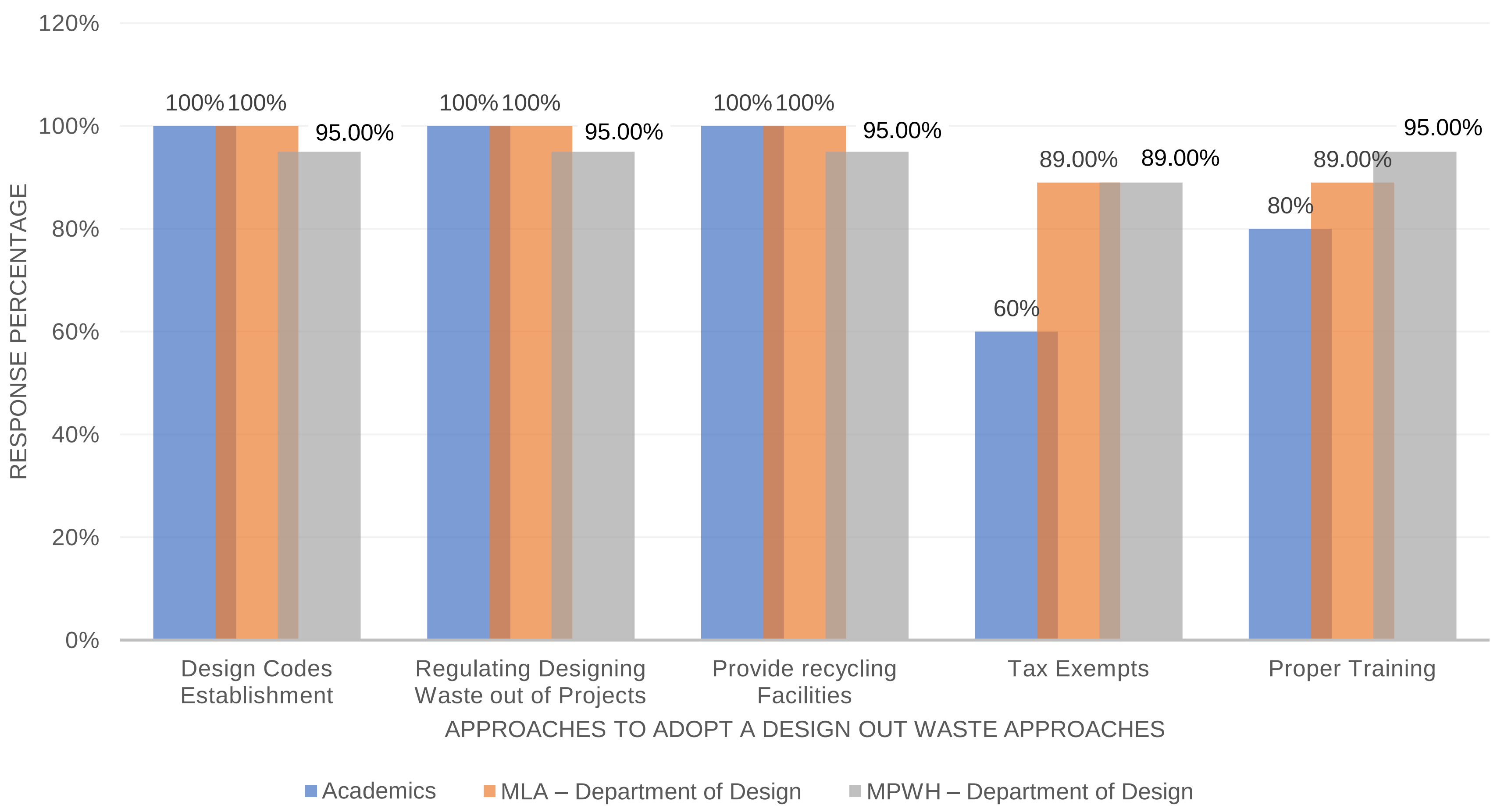

Chart 5-26: Approaches to Adopt a Design out Waste Approaches

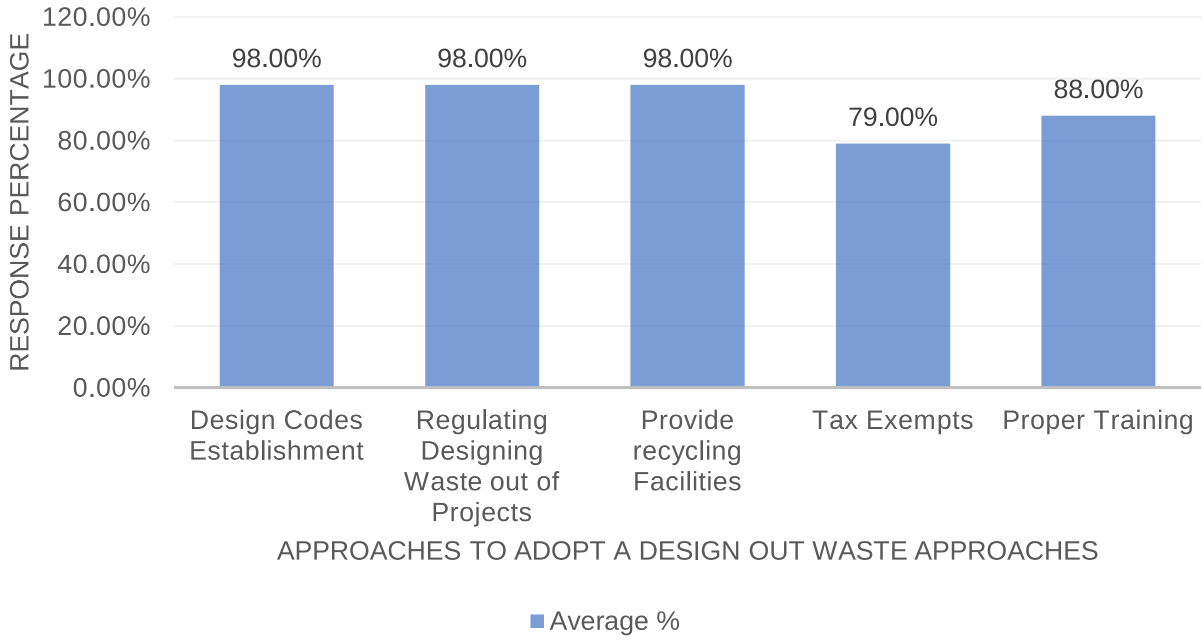

Chart 5-27: Average Percentage of Respondents on the Approaches to Adopt a Design out Waste Approaches

The present findings emphasize the critical nature to encourage the implementation of design out waste programs. By establishing design codes and legislation and recycling facilities, as indicated by an average of 98.24% of participants.

The evidence presented here appears to substantiate the premise of the lack of design codes, insufficient regulations and insufficient infrastructure to impede designing out waste on projects.

The survey's conclusion about establishing design codes appear unduly hopeful and over-ambitious. As their establishment requires time, money and effort, all of which are particularly significant hindrances. Especially in a country that does not favour C&D waste management movements. In addition to MLA and MPWH findings in **chapter 10-appendix III** that indicated that there is currently no plan or vision for establishing such codes. Thus, those results may be biased and caution should be applied when interpreting these findings. Therefore, the research had made an effort in allowing the liable actor for design codes (Jordanian National Building Council) to participate to avoid biased findings. However, the council was unwilling to participate in the research study.

A great recognition could be noticed that those three approaches were equally agreed on by participants. Thus, it is to be noted that they should be initiated simultaneously to be effective. Additional qualities that favour the use of design out waste approaches are detailed in **chapter 10-appendix III**.

5.1.3.3.4 Hindrance to Design Codes Existence

This section discusses the factors that contribute to the absence of recycled waste material design codes, as illustrated in **table 5-22** and **charts 5-28** and **5-29**.

This section addressed these hindrances by asking participants the following: "Can you please scale the reasons hindering the existence of recycled material design codes from 1 to 5 (1 strongly disagree and 5 is strongly agree)?".

Actors	No. of Participants	Causes of the Absence of Recycled Waste Material Design Codes			
		The Generation of C&D Waste is low	Recycling is Relatively a New Technology	Establishing Codes Requires time	Establishing codes Requires high Costs
Academics	5	20%	80%	100%	100%
MLA – Department of Design	18	6%	78%	94%	78%
MPWH – Department of Design	19	5%	79%	95%	89%
Average %	**--**	**5%**	**78%**	**95%**	**84%**

Table 5-22: Hindrances to Design Codes Existence

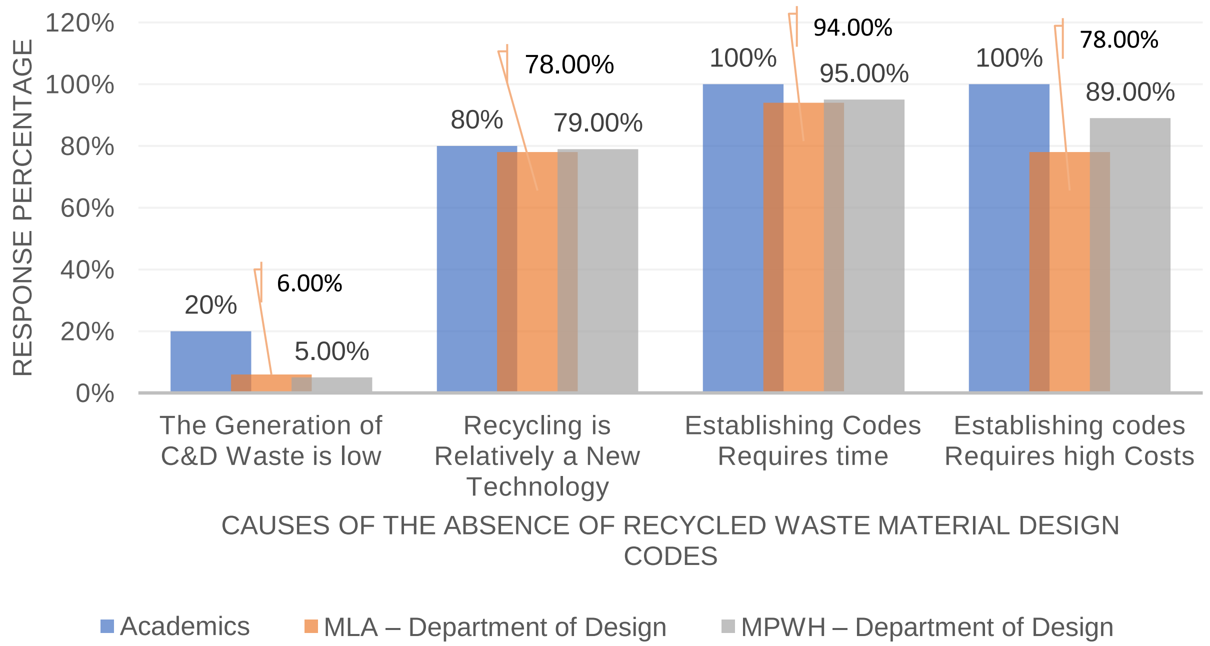

Chart 5-28: Causes of the Absence of Recycled Waste Material Design Codes

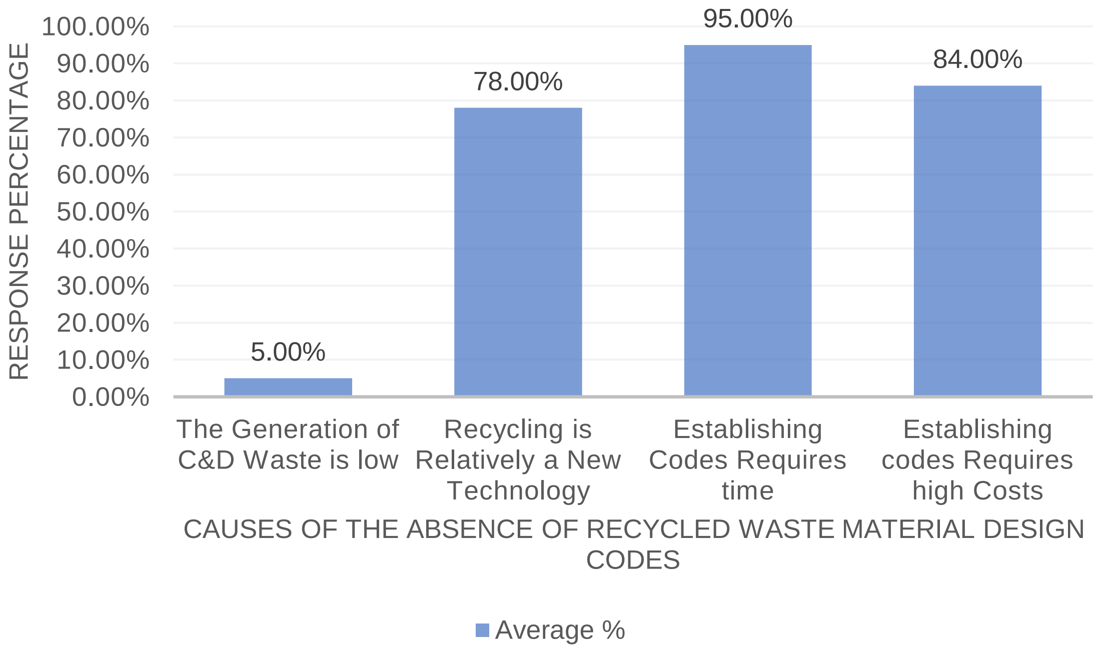

Chart 5-29: Average Percentage of Respondents on the Causes of the Absence of Recycled Waste Material Design Codes

An average of 94.58% among all participants indicated that the time constraints is a contributory factor to the absence of design codes. This is associated with experimental testing. Meanwhile, according to an average of 83.62% of all participants, including 100% of academics, 77.77% MLA and 89.47% MPWH correlated the absence to the cost concerns. This huge agreement between academics on time and cost constraints hindering the existence of design codes could strengthen the fact that those two key factors are the most significantly contributory to this absence. As academics are the most knowledgeable actors in experimental testing as per their deep involvement in experimental testing. Therefore, establishing design codes is an expensive and time-consuming process.

These do not rule out the influence of other variables, as indicated by an average of 78.35% of participants. Including 80% of academics and above 77% of MPWH and MLA respondents referring to consider C&D waste recycling as a relatively new technique. Unfortunately, participants have not provided further clarifications to correlate this with the absence of design codes.

As mentioned previously, design codes are the liability of the Jordanian National Building Council. Thus, its participation would have been more significance, however unfortunately they refused to participate in the research due to personal reasons.

5.1.4 Encouragements to Improve C&D Waste Management Strategy

This section assesses the proposed encouragements to engage the industry actors in C&D waste management, namely recycling C&D waste. The responses on those encouragements are given in **table 5-23** and **charts 5-30** and **5-31**.

This section addressed the encouragements by asking participants the following question: "Can you please scale the following encouragements that can transform the construction industry towards adopting a C&D waste management strategy from 1 to 5 (1 is strongly disagree and 5 is strongly agree)?".

Actors	No. of Participants	Respondents % on Encouragements				
		Modifying the regulations and legal frameworks	Enriching the local market with recycled waste material market	Tax exempts	Increase the disposal fees	Apply Fines or penalties for Polluters
GAM – Department of Construction	22	100%	100%	73%	36%	100%
GAM – Department of Legal Frameworks and Regulations	5	100%	100%	100%	60%	100%
MoE	7	100%	100%	100%	29%	100%
MLA - Department of Construction	11	100%	82%	82%	27%	91%
MLA - Department of Design	18	100%	100%	100%	33%	94%
MPWH - Department of Construction	24	96%	92%	92%	33%	100%
MPWH - Department of Design	19	100%	100%	100%	5%	100%
Average %	**--**	**99%**	**96%**	**92%**	**32%**	**98%**

Table 5-23: Encouragements to Improve C&D Waste Management Strategy

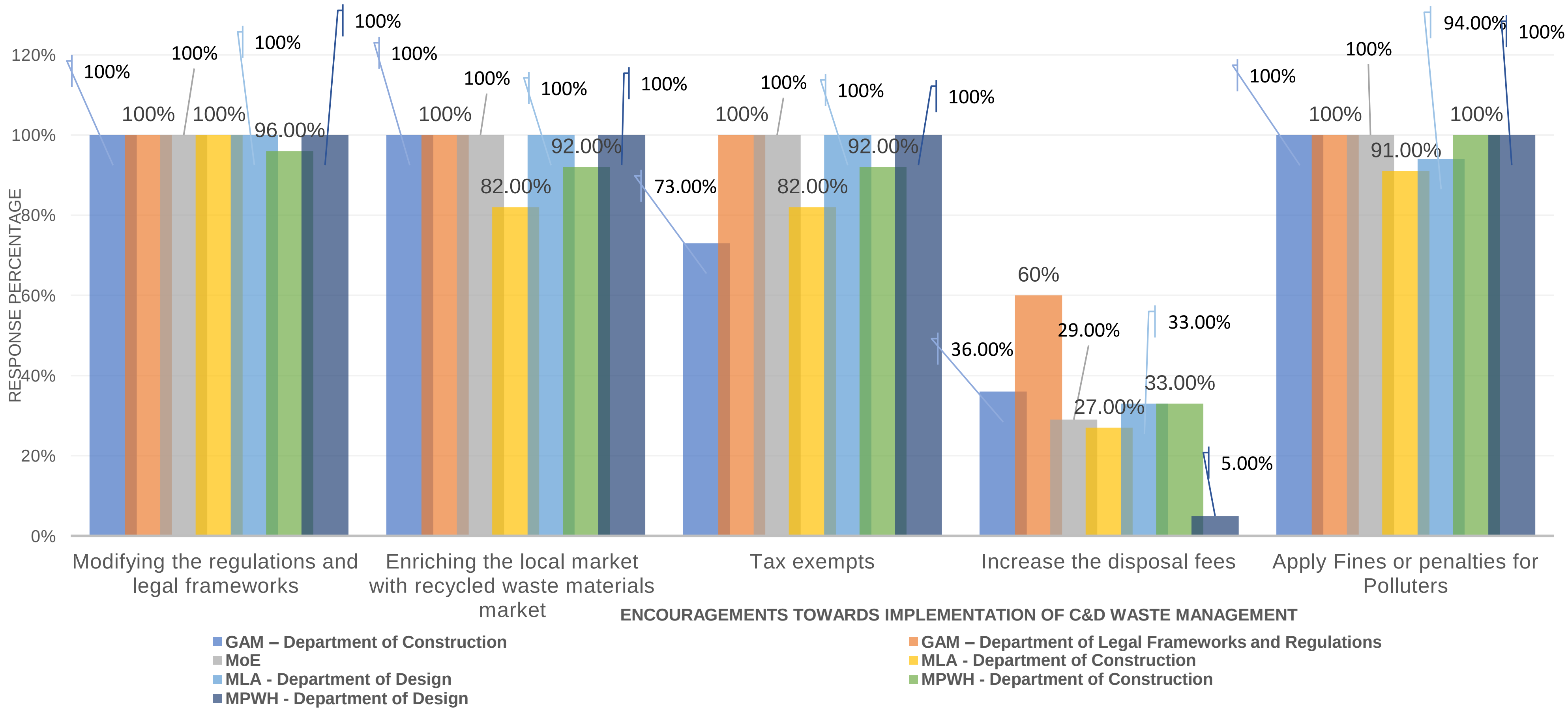

Chart 5-30: Encouragements to Improve C&D Waste Management Strategy

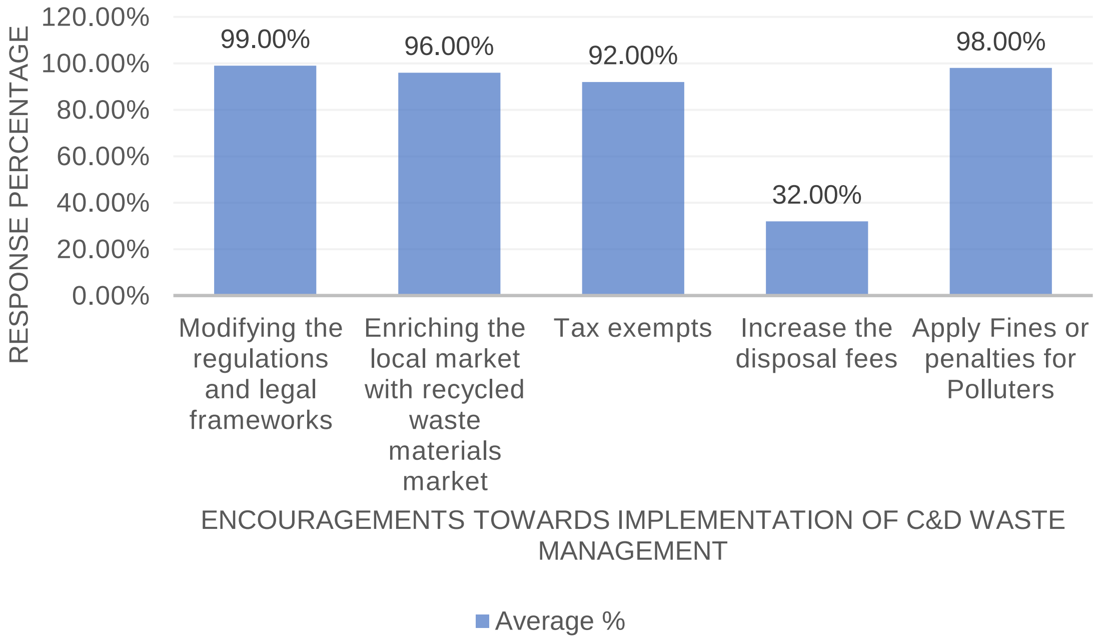

Chart 5-31: Average Percentage of Respondents on the Encouragements to Improve C&D Waste Management Strategy

The survey's most obvious finding according to more than 95% of all participants that modifying existing regulations, imposing fines or penalties on polluters and complementing the local market with recycling markets are the primary drivers to promote C&D waste management.

Over 90% of GAM, MLA, MPWH and MoE members support amending legislation and legal frameworks. Analysis of past research and questionnaires demonstrates unequivocally that regulatory systems lack effective restrictions. Thus, enhancing regulations may compel industrial participants to prioritise C&D waste management. Although, the research critics the government's adherence to enforce these regulations. Particularly when significant volume of C&D waste is disposed informally even though current legislation permits legal landfilling. Therefore, the governmental controls might be more attributed to law enforcement and strictness. This is investigated in depth in **section 5.2.4**.

By imposing fines on polluters, the industry is compelled to use recyclable material and develop alternative methods of disposing of C&D waste other than landfilling. This analysis could be based on previous experiences with the industry actors, since as stated industry actors could be more compliant to regulations when fines are placed. However, the absence of regulations may jeopardize the enforcement of those fines and penalties.

More than 90% of participants agreed on the need of expanding the local market with recycled waste material. A possible explanation for this might be that even with restrictions in place, the local market may still lack specialised markets for recovered waste material. Thus, actors will not find a place to sell or acquire recovered waste material which consequently will push to hold back on what they already know and feel comfortable about.

Along with the aforementioned approaches, an average of 92.31% of respondents with more than 70% of each actor individually, believed that granting tax benefits could influence the outcome. The findings presented in this section reveal an inconsistency in governmental responses as was revealed in previous sections. Although, one criticism on their low response is that recycling is a relatively new concept in Jordan and so requires more encouragement. However, as mentioned in **section 5.1.3.2.4** that recycling is fundamentally rewarding and does not need tax granting. Thus, this should be interpreted cautiously.

Increased disposal fees by an average of around 32% could help the country promote a C&D waste management. This approach is divisive and debatable since it may aid in the promotion of C&D waste management. But may also increase illegal dumping, particularly in Jordan. As the existing fee scheme is low and yet informal dumping is widespread as referred to in **section 4.2.1**.

5.1.5 Industry Actors Perspective

This part discussed the environmental, social and economic considerations of the industry actor's perspective, and the industry actors' willingness to promote C&D waste management.

The major findings of these surveys, as reported by respondents, are summarised in the tables and charts below.

5.1.5.1 Possible Concerns

This sub-section addressed the interests of governmental actors. By adequately addressing their environmental, social and economic considerations, as illustrated in **table 5-24** and **charts 5-32** and **5-33**.

This section addressed their consideration by asking the governmental participants the following question: "tick the possible concerns that the authority you work at takes into consideration and scale them from 1 to 5 (1 strongly disagree and 5 strongly agree)". Meanwhile, other participants' question was "tick the possible concerns that the construction industry actors take into consideration and scale them from 1 to 5 (1 strongly disagree and 5 strongly agree".

Actors	No. of Participants	Respondents on Considerations Percentage		
		Environmental Concerns	Social Concerns	Economic Concerns
Academics	5	20%	40%	100%
GAM – Department of Construction	22	95%	86%	95%
MLA - Department of Construction	11	91%	82%	82%
MLA - Department of Design	18	61%	61%	94%
MPWH - Department of Construction	24	71%	50%	92%
MPWH - Department of Design	19	68%	47%	100%
Average %	**--**	**68%**	**61%**	**94%**

Table 5-24: Considerations and Willingness

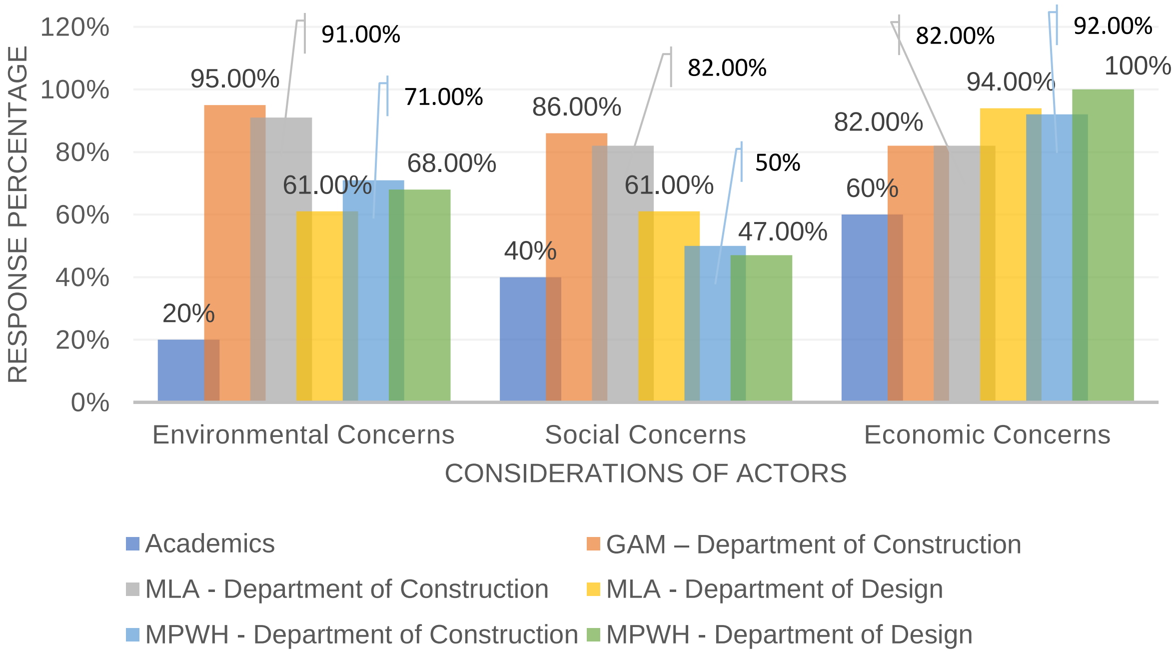

Chart 5-32: Considerations of Actors

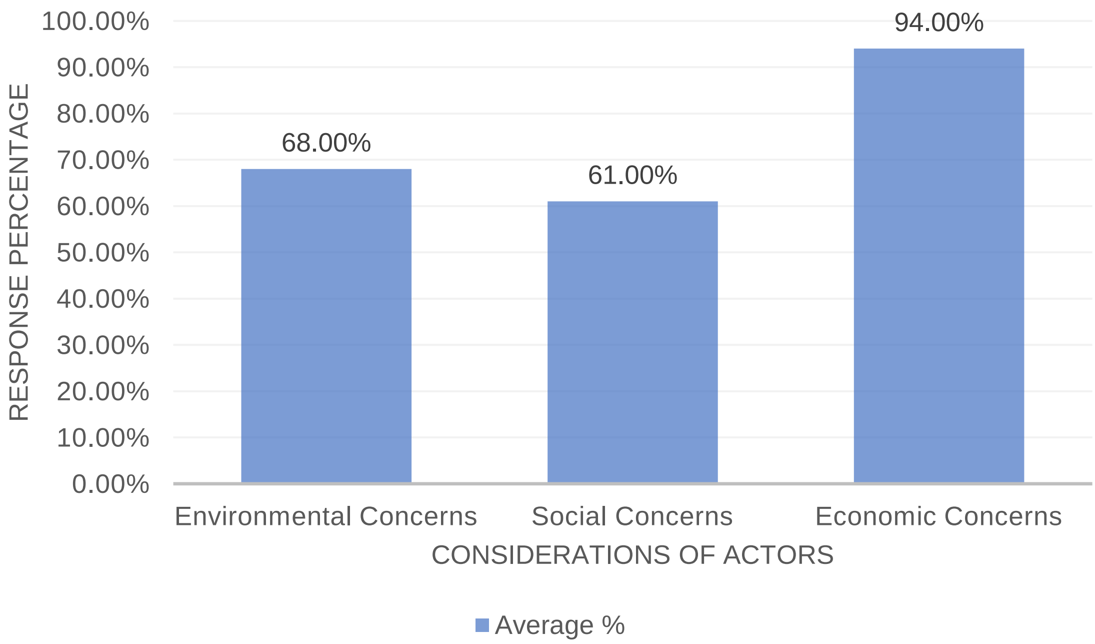

Chart 5-33: Average Percentage of Respondents on the Considerations of Actors

According to the results of this survey, it appeared that the economy is the primary source of concern for Jordanian industry actors. This was indicated by an average of more than 90% of participants, ranging from 60% to 100%.

The survey's findings indicated that environmental and social concerns are less important than economic concerns. As indicated by an average percentage range of 60% to 70% of all participants and a range of around 50% to 95% of all participants. Except academics, with only 20% and 40% of them considering environmental and social concerns a priority, respectively. One criticism about this finding, is that if governmental bodies took these concerns into account. Informal dumping would be currently significantly more controlled. Thus, these findings should be interpreted cautiously.

Economic and non-economic factors are distinguished in these findings. This seemingly contradictory result may be the result of the government placing financial concerns above anything else. This investigation verifies previous findings that projects are procured exclusively through low bids only. Additionally, it verifies the inconsideration of governmental participants regarding the tax exemptions. Another possible explanation could include the country’s financial situation or viewing environmental concerns as a luxurious or prestigious aspect. Contributing to lessen their consideration upon the environmental and social concerns.

The variation between governmental participants’ responses could be correlated to their accountability on environmental and social concerns, as MoE might be more involved in such concerns. Therefore, their involvement in such survey could be more beneficial. Although, the involvement of academics as a neutral actor could increase the impartiality of the current findings.

5.1.5.2 Willingness towards Using Recycled Crushed Concrete Aggregate

This section assesses the willingness of industry actors towards designing out waste and using recycled aggregates in new concrete mixes.

The major findings of these surveys, as reported by respondents, are summarised in the tables and charts below.

5.1.5.2.1 Client's and Concrete Supplier's willingness towards using Recycled Crushed Concrete Aggregate

This section discusses the industry participants' readiness to willingness, as illustrated in **table 5-25** and **chart 5-34**.

This section addressed their willingness by polling clients the following question: "As a client would you consider using recycled aggregates in new concrete mixes in new projects if designed by specific codes and specifications?". Concrete suppliers were also asked the following question: "Do you think that constructions actors as below would use recycled material if designed under recycled material codes?".

Actors	No. of Participants	Respondents on the Willingness towards Using recycled aggregates in new concrete mixes Percentage	
		Yes	No
Clients	43	88%	9%
Concrete Suppliers	22	64%	36%
Average %	**--**	**76%**	**23%**

Table 5-25: Clients Willingness Towards Using Recycled Aggregates in New Concrete Mixes

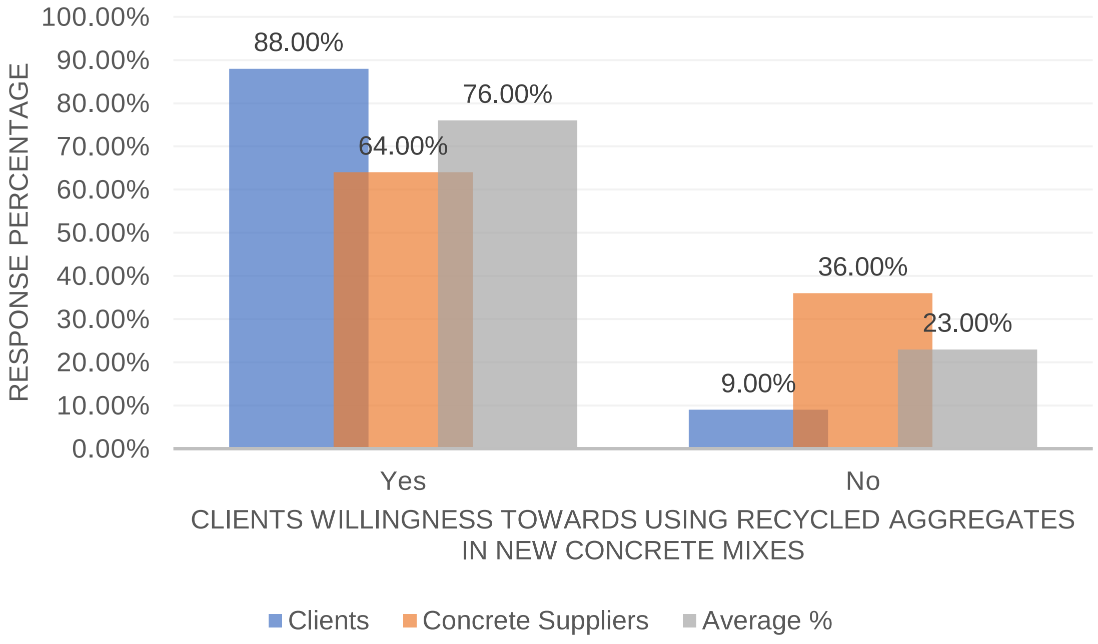

Chart 5-34: Clients Willingness Towards Using Recycled Aggregates in New Concrete Mixes

5.1.5.2.2 Contractors Willingness

This sub-section contains information about the contractor's willingness to use recycled aggregates in new concrete mixes, as illustrated in **table 5-26** and **chart 5-35**.

This section addressed their willingness by posing the following question to concrete suppliers: “Do you think that constructions actors as below would use recycled material if designed under recycled material codes?”. Meanwhile, contractors by asking the following question “As a contractor, would you consider using recycled aggregates in new concrete mixes in new projects if designed by specific codes and specifications?”.

Actors	No. of Participants	Respondents %	
		Yes	No
Contractors	27	81%	19%
Concrete Suppliers	22	95%	5%
Average %	**--**	**88%**	**12%**

Table 5-26: Contractors Willingness Towards Using Recycled Aggregates in New Concrete Mixes

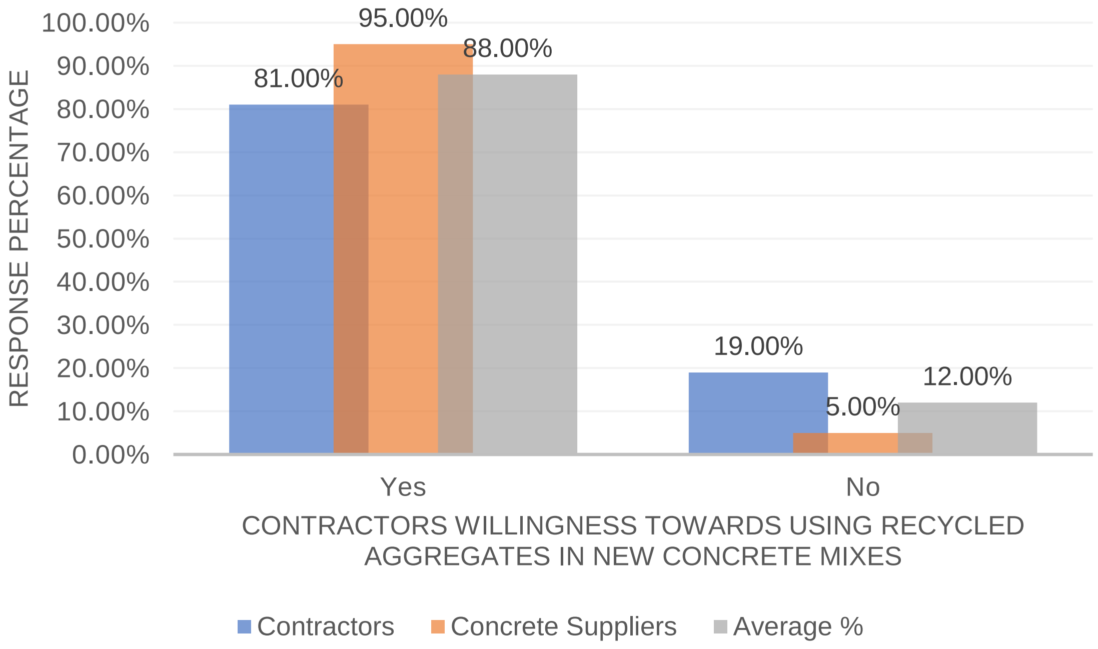

Chart 5-35: Contractors Willingness Towards Using Recycled Aggregates in New Concrete Mixes

5.1.5.2.3 Government willingness towards using Recycled Crushed Concrete Aggregate

This sub-section examines governmental actors' willingness to use recycled aggregates in new concrete mixes, as illustrated in **table 5-27** and **chart 5-36**.

This section addressed their willingness by asking participants the following question: “Do you think that the governmental authority you work at would consider using recycled aggregates in new concrete mixes in new projects if designed by specific codes and specifications?”.

Actors	No. of Participants	Respondents %	
		Yes	No
GAM – Department of Construction	22	95%	5%
MLA - Department of Construction	11	91%	9%
MLA - Department of Design	18	100%	0%
MPWH - Department of Construction	24	96%	4%
MPWH - Department of Design	19	95%	5%
Average %	**--**	**95%**	**5%**

Table 5-27: Governmental Departments Willingness Towards Using Recycled Aggregates in New Concrete Mixes

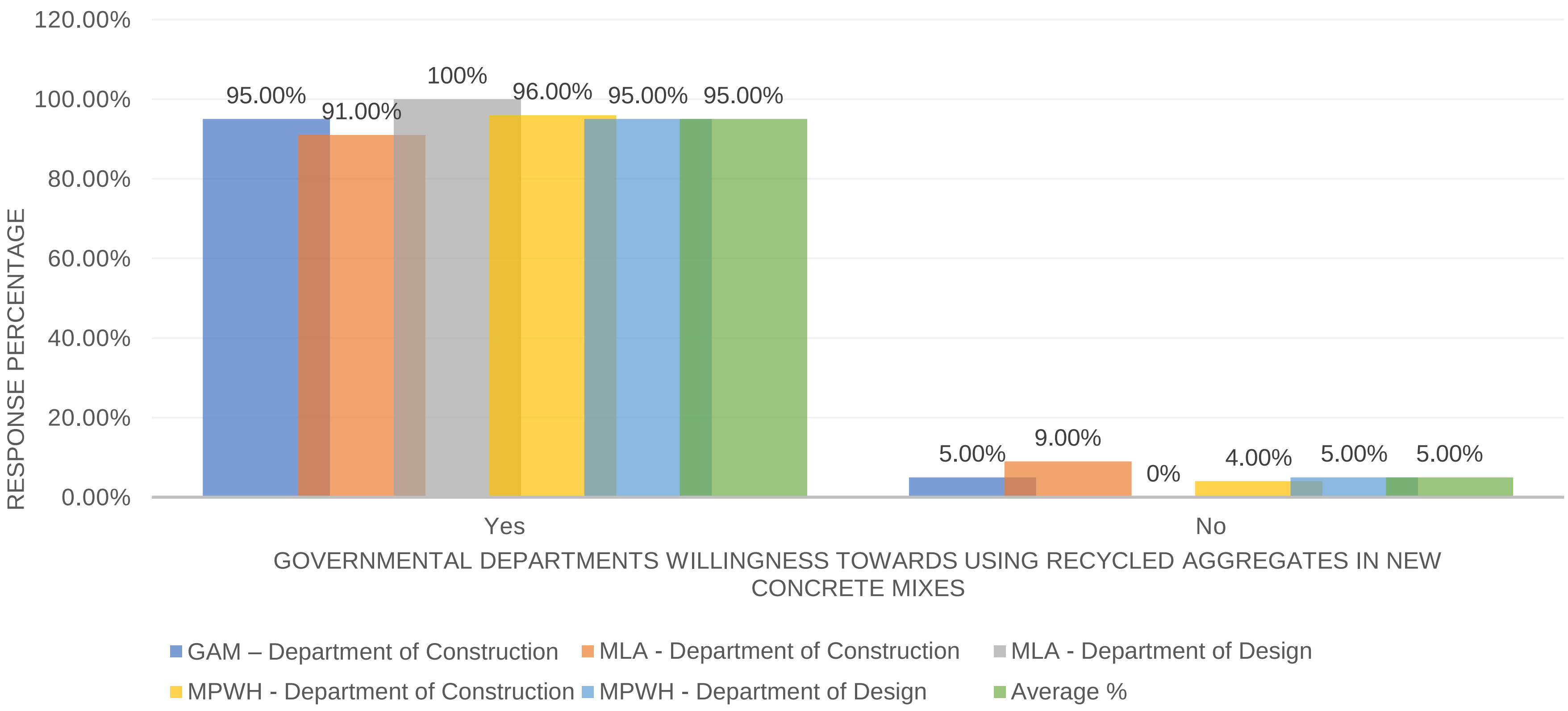

Chart 5-36: Governmental Departments Willingness Towards Using Recycled Aggregates in New Concrete Mixes

5.1.5.2.4 Government Willingness for designing Waste Out

This section discusses the willingness of government actors in design departments to eliminate waste from projects, as illustrated in **table 5-28** and **chart 5-37**.

This section addressed their willingness by asking participants the following question: “Would the ministry consider designing governmental projects with recycled aggregates in new concrete mixes?”.

Actors	No. of Participants	Respondents %	
		Yes	No
MLA - Department of Design	18	100%	0%
MPWH - Department of Design	19	100%	0%
Average %	**--**	**100%**	**0%**

Table 5-28: Design Governmental Departments Willingness Towards Designing Governmental Projects with Recycled Aggregates in New Concrete Mixes

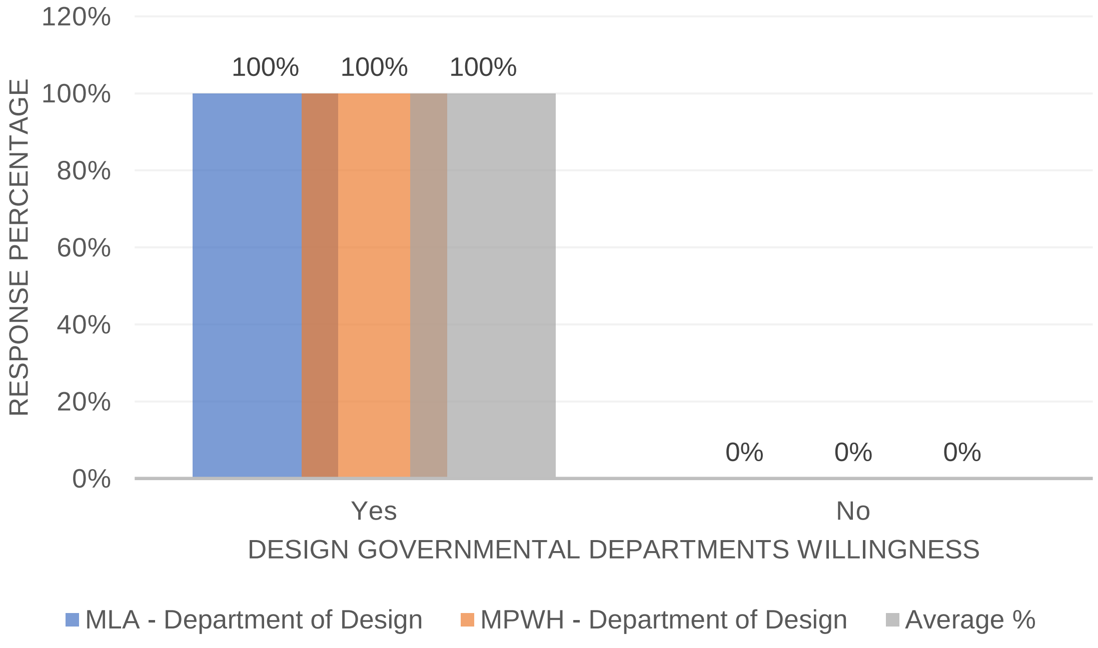

Chart 5-37: Design Governmental Departments Willingness

This survey reported an initial observation to the willingness of the use of recycled aggregates in new concrete mixes in general by clients and concrete suppliers by an average of 76%.

According to this research, around 89% of clients and 64% of concrete suppliers say that clients are eager to incorporate recycled aggregates into new concrete mixes. Although, participants' willingness to authorise and the existence of design codes for recycled waste material are inextricably linked. This comes in line with the prior statement concerning the significance of design codes.

These findings cannot be extrapolated to all participants, as around 23% stated a rejection to use recycled aggregates regardless of whether they were authorised. Only 19% of contractors, according to the research, are opposed to using recycled aggregates in new concrete mixes. The data presented are rather uncontroversial and around 5% of concrete suppliers concur.

Additionally, the findings may prove useful in expanding our understanding of why contractors choose conventional aggregates over recycled aggregates, including issues with quality, avoiding hazardous material in recycled waste material and the lower costs/prices and longer life of standard material. Although, it could be possible that construction actors may reconsider their beliefs if they were aware enough of the benefits and safeness of using recycled aggregates into new concrete mixes besides the other encouragements mentioned in **section 5.1.4**.

Additionally, this survey emphasizes the critical role of government actors' willingness to design out waste of projects and the use of recycled aggregates into new concrete mixes. Over 90% of government respondents indicated that they are willing to use recycled aggregates in new concrete mixes only when authorised by specific codes and specifications. Other participants, with optimum percentage of 10% of all participants and an average of 4.61%, prefer not to employ recycled aggregates in new concrete mixes.

Current accounts substantiate the aforementioned analysis. According to the survey, both ministries' design departments would be willing to design governmental projects with recycled aggregates in new concrete mixes with an average of 100%. Caution is urged when interpreting the survey's findings, as the survey's primary drawback may be related to the economic considerations discussed previously. Thus, a serious weakness in this hypothesis is that if recycled waste material is more expensive than standard material, actors will resist advocating for their use. However, despite their considerations, the government should push towards such practices to improve the country's current status of C&D waste.

5.1.5.3 Evaluation

This section assesses the current collection, sorting, landfilling and recycling regulations of C&D waste. It additionally evaluates contractor’s compliance with the current regulations and compliance of government monitoring and supervision. **Table 5-29** and **charts 5-38** and **5-39** summarise the major findings from these surveys.

This section addressed those assessments by posing the following question to participants: "Can you please scale the effectiveness of C&D waste regulations in respect to the collection, sorting, landfilling and recycling, measure the construction contractors or companies compliance to the current regulations of C&D waste and measure the governmental departments strictness in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations from 1 to 5 (1 is strongly disagree and 5 is strongly agree)?".

Actors	No. of Participants	Informal Dumping					
		Proper Collection	Proper Sorting	Proper Landfilling	Proper Recycling	Compliance of contractors	Governmental Strictness in terms of Monitoring
Contractors	27	63%	4%	78%	7%	78%	67%
GAM – Department of Construction	22	86%	5%	91%	9%	36%	86%
GAM – Department of Regulations	5	100%	0%	100%	0%	40%	100%
MoE	7	86%	14%	71%	0%	29%	29%
MLA - Department of Construction	11	82%	9%	82%	9%	45%	73%
MLA - Department of Design	18	89%	11%	78%	11%	39%	78%
MPWH - Department of Construction	24	79%	8%	79%	8%	25%	21%
MPWH - Department of Design	19	84%	0%	79%	0%	21%	58%
Average %	**--**	**84%**	**6%**	**82%**	**6%**	**39%**	**64%**

Table 5-29: Evaluation of Current C&D Waste Management Regulations, Compliance of Contractors and the Governmental Departments

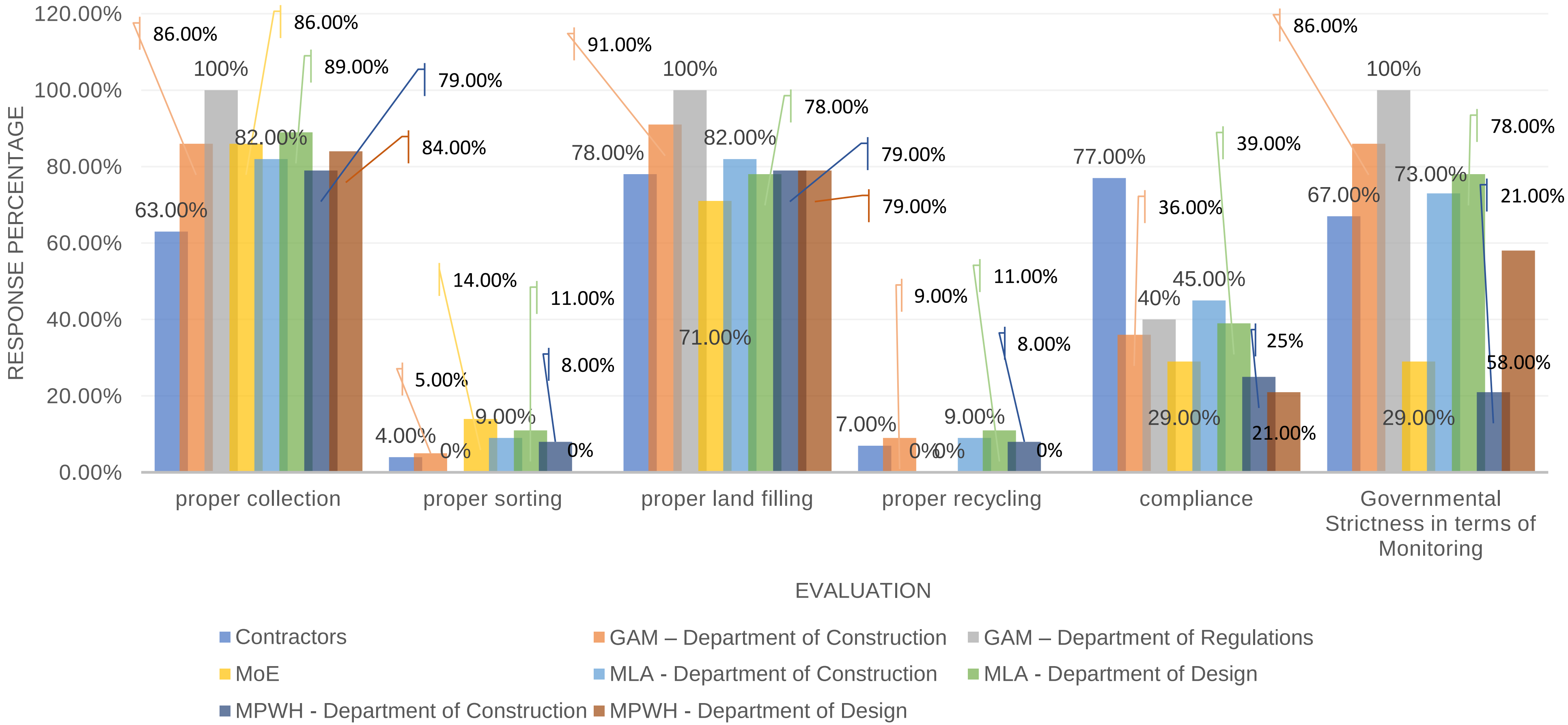

Chart 5-38: Evaluation of current C&D Waste Management Regulations, Compliance of Contractors and the Governmental Departments

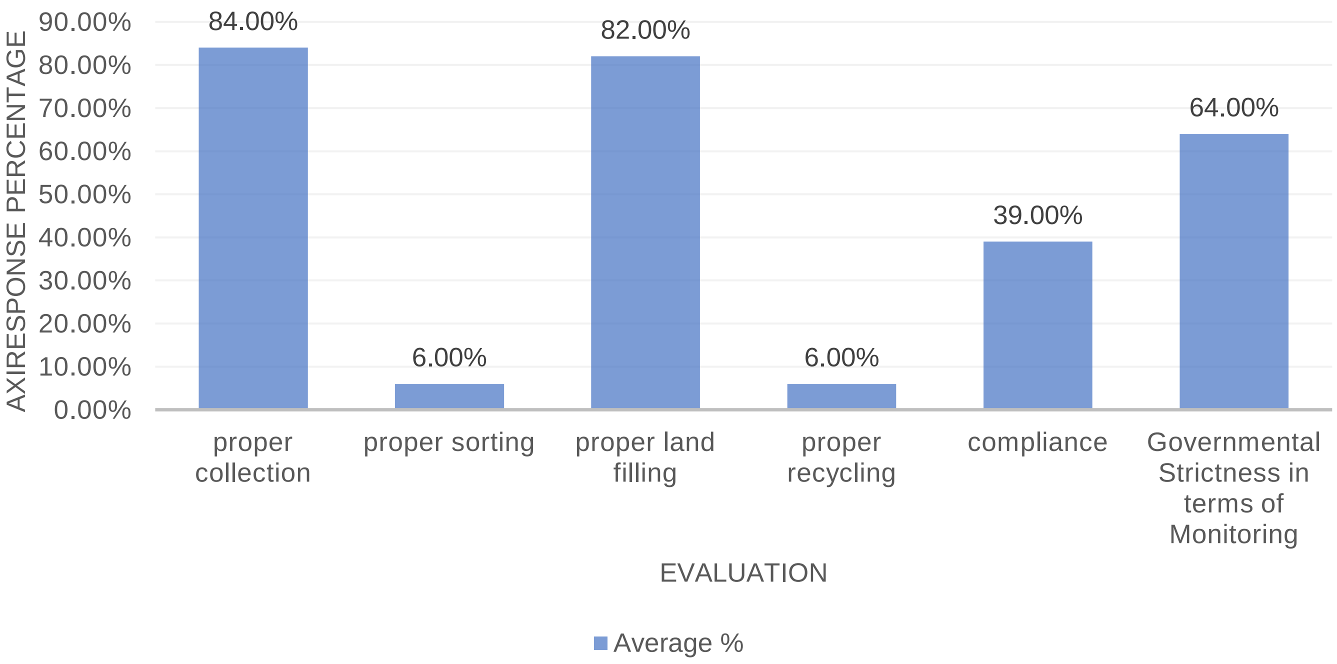

Chart 5-39: Average Percentage of Respondents on the Evaluation of Current C&D Waste Management Regulations, Compliance of Contractors and the Governmental Departments

The findings of this survey indicate that current legislation is adequate to regulate collection and disposal activities properly. This was unanimously agreed upon by an average of 80% to 85% of all participants. It is important to bear in mind the possible bias in these responses, as informal dumping would be uncommon if landfilling regulations were sufficient. The analysis undertaken here corroborated previous findings that Jordan's C&D waste management is confined to collection and disposal.

A serious weakness with this strategy is that participants estimate that illegal dumping accounts for between 40% and 60% of total C&D waste generated. Thus, critics contest the legal frameworks that regulate formal landfilling in northern and central Jordan to private and public landfill. As the latter point has been devastatingly critiqued by the study. Arguing that if landfilling regulations were effective and adequate, informal disposal of C&D waste would be less than projected. Although, informal dumping may be the result of other factors over the lack of regulations. Such as long transportation distances to licensed landfill, a lack of regulatory control of waste disposal activities and an insufficient waste disposal system.

Additionally, this survey discovered that sorting and recycling regulations are insufficient, with an average of 7% and 6% of respondents, respectively. This survey confirmed that no sorting or recycling occurs during construction or demolition projects. The present findings appear to corroborate previous research indicating the absence of sorting and recycling legislation in the regulatory system. The findings of this survey show that the absence of regulations may impede the implementation of sorting and recycling activities which results to dump waste mixed in landfill. Additionally, this absence has the potential to dramatically hinder C&D waste recovery.

The results of this survey assist in assessing contractors' compliance with existing C&D waste legislation. This survey demonstrates that contractors adhere to C&D waste regulations to a degree, with an average of approximately 39%. However, data demonstrates diversity amongst contractors and other participants. This seemingly contradictory outcome could be the result of not showing themselves violating current regulations. Thus, this account must be approached with some caution.

This does not exclude government responses from being prejudiced, since they may be unwilling to recognize their insufficient oversight, preferring instead to blame contractors for their misbehaviour. Participants from MoE did not believe the government was strict enough in monitoring such views. Despite the fact that an average of roughly 64% of respondents indicated that the government is stringent about monitoring such views. This discrepancy may be explained by the impartiality of these entities in comparison to GAM and MLA. As they are directly responsible for monitoring on such activities.

Despite these shortcomings, the study emphasizes the critical importance of expanding and upgrading Jordan's regulatory system to promote C&D waste management. Because it would be for legal landfilling only in accordance with current legislation. Even if the government were strict and contractors adhered to regulations.

As a result of the current investigation, the following conclusion can be drawn indicating that the current stipulations are insufficient to enable an effective C&D waste management strategy. Particularly when license agreements do not govern sorting and recycling. However, this hindrance to C&D waste management could be the result of contractors failing to comply with current regulations or a lack of government control. Thus, combining these obstacles may exert a powerful effect on the management of C&D waste. Thus, those two aspects should be concentrated on simultaneously.

5.2 Conclusion of Analysis

This investigation significantly enhanced our understanding of the major findings from questionnaire data that impediment of C&D waste management and encourages the informal dumping as depicted in fish bone diagrams and a table.

These diagrams draw a distinction between the major and minor issues of hindrance. Each diagram is denoting the significance of the factors according to participants' responses. **Figure 5-1** presents the least significant components, **figure 5-2** shows the intermediate ones and **figure 5-3** demonstrates the most significant ones. Taxonomies of four causation have been developed for these variables. Meanwhile, **table 5-30** draws a distinction between the actors' responses. This distinction gives a wider understanding by a correlation analysis of actors involved in those surveys.

The research findings shed new light on the issue of C&D waste by demonstrating that it is primarily associated with managerial issues over technical ones. These are generally related to governmental controls and industry actors as explained above and in **chapter 10-appendix III**.

5.2.1 Informal Dumping

Around 55% of all participants agreed on approximating that informal dumping occurs on a range of 40% to 60. Which demonstrates that informal dumping happens at a significant pace, casting doubt on the government's capacity to regulate appropriate landfilling.

The analysis revealed that informal dumping occurs mostly because of lax governmental controls, including a lack of legal frameworks and rules, monitoring, supervision and strictness, as well as management and waste disposal systems. This is true since the government is the primary actor accountable for the country's C&D waste disposal system. Additionally, as described in **section 5.1.1.3**, the engagement of local actors, informal workers and high expenditures and expenses all contribute to informal dumping.

Governmental involvement in C&D waste disposal systems seemed to be bolstered by participants' assertions that public institutions are responsible for informal dumping. This includes ministries and municipalities. Apparently, construction and transportation contractors also adopt this attitude, although one could argue that current regulations should require contractors to properly dispose of C&D waste in permitted landfill. Thus, the government is not responsible for informal dumping. Nevertheless, the current rate of informal dumping attributes responsibility to the government's strict enforcement of current formal landfilling regulations.

5.2.2 Aspects within Jordanian Construction Industry Contracts

The outcomes of surveys established that C&D waste is not regulated under current solid waste management regulatory system. This exclusion has a significant impact on having an ineffective C&D waste management and informal waste dumping. This is largely due to the industry's view that C&D waste is a distinct type of waste that cannot be treated as solid waste. In addition to, lack of awareness, lack of willingness amongst actors to manage C&D waste and lack of infrastructure. This has been a fruitful area for further work via interviews (**chapter 6**).

Another factor influencing the effectiveness of C&D waste management was the construction industry's procurement method, which is based on lowest price selection. This as previously stated, can have a significant impact by omitting less critical tasks such as legal dumping or even C&D waste management. This factor is likely to be more problematic in demolition projects. Particularly given the fact that many participants claimed that no pre-existing selection criteria are used when bidding on demolition projects. The precise mechanism of demolition projects procurement method remains to be elucidated. Thus, further work via interviews examined more closely the links between demolition projects and their current procurement method (**chapter 6**). Additional information is available in **section 5.1.2.2 and 5.1.2.3**.

5.2.3 Missing Construction and Demolition Waste Management Activities

The findings of these surveys identified that the missing C&D waste management activities are designing out waste, sorting and recycling. Although for recycling, few recycling movements of valuable wastes such as steel and timber are taking place within the industry operations. The most logical explanation for this was because the current regulatory structure enforces actors to collect and dispose waste in a lawful manner, excluding other movements. However, as per the few green treatment movements of steel and timber without the presence of regulations makes their existence unnecessary.

On the other hand, participants stated that all activities of C&D waste management could be impacted by several hindrances. For instance, collection practices can be impacted by actors' lack of skills and awareness, informal worker involvement and a lack of management system. Meanwhile, sorting, might be influenced by also informal workers, as well as a lack of regulations and equipment. As reported by participants, landfilling may be hampered significantly by long transportation distances and an insufficient waste disposal system. In addition to inadequate supervision of waste disposal behaviours and cost concerns that may be correlated to long transportation distances. Recycling may be hampered by the absence of design codes, a lack of financial incentives and restricted infrastructure availability. In addition to, a lack of demand for recycled waste products and a lack of equipment. Further clarifications are explained in **section 5.1.3.2**.

The absence of design codes has also been identified as a significant factor impeding to design out waste. Alongside ineffective demolition techniques that may be a result of ineffective procurement methods for demolition projects and lax governmental controls. Those governmental controls include the absence of regulations, inadequacy of existing regulations etc. Additionally, the most important effect of the lack of design codes was that even if regulations were incorporated to allow for recycling, the use of recovered aggregates would remain illegal (**section 6.1.1**).

According to surveys, the existence of such codes is harmed by arguments that recycling is a new technology. Additionally, the findings added that their establishment requires money and time. This, however, is too reliant on the Jordanian National Building Council, which refused to participate in the research.

In general, this does not exclude the potential of further obstacles for the missing activities, as detailed in **section 5.1.3**. Further investigation would need to be conducted through interviews to determine why these activities are not carried out in Jordan.

5.2.4 Industry Actors Perspective

Other implications could be reasons behind the current ineffective C&D waste management strategy. These could be that most industry actors prioritise economic concerns above all else as seen in **section 5.1.5.1**. This is consistent with what was discovered regarding industry actors' desire to employ recycled waste material. As indicated that most of them are willing to do so under two conditions:

1. Cheaper prices than standard material.
2. The availability of recycled waste material design codes for quality assurance.

Although, most of participants from the industry actors have shared their willingness to use recycled waste material as seen in **section 5.1.5.2**.

Additionally, regulations' adequacy impacted its effectiveness, as sorting and recycling regulations looked to be insufficient due to their absence. Although, this does not rule out the influence of the compliance and strictness of contractors and governmental institutions, respectively, however, they have been shown to be less likely to contribute to C&D waste management failure. **Section 5.1.5.3** contains a fuller account of these perspectives and evaluations.

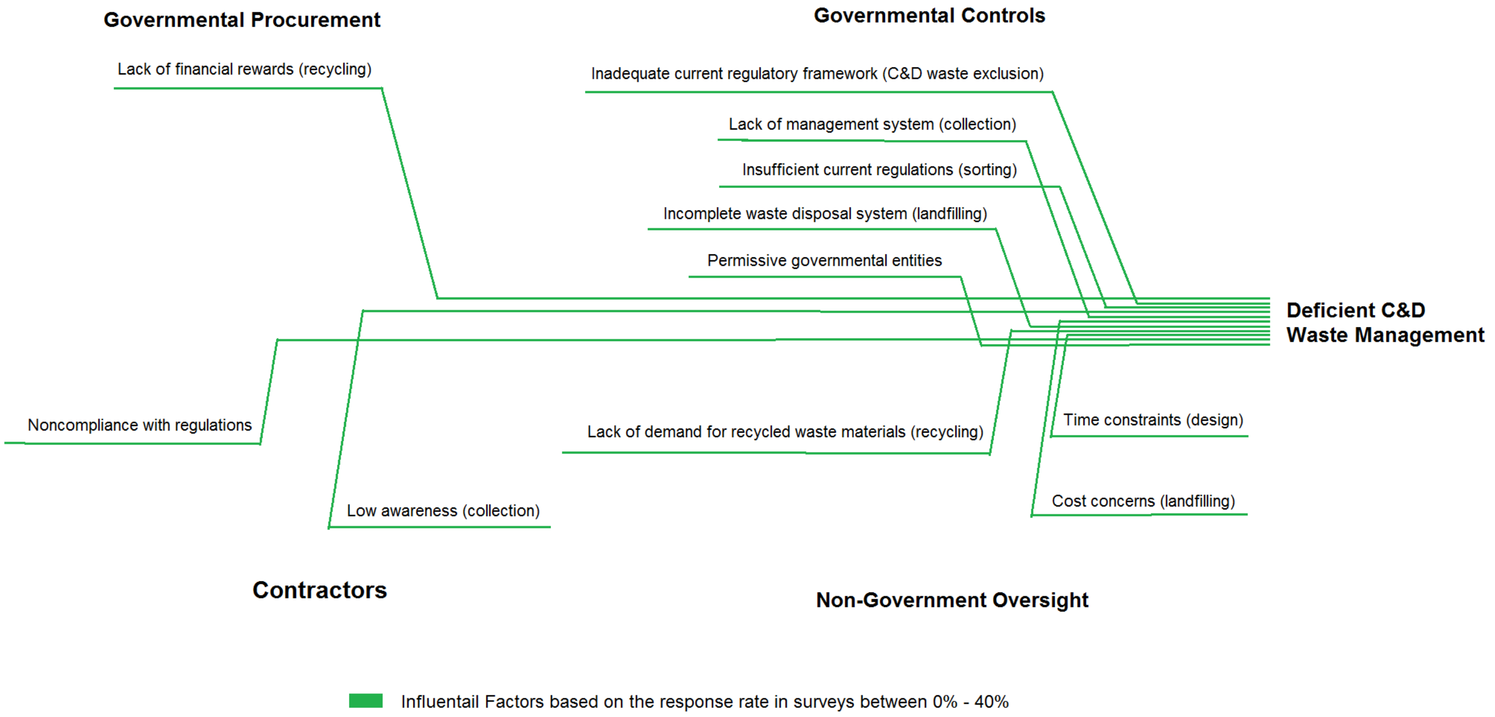

Figure 5-1: Fish Bone Diagram of the Least Influential Factors of C&D Waste Management

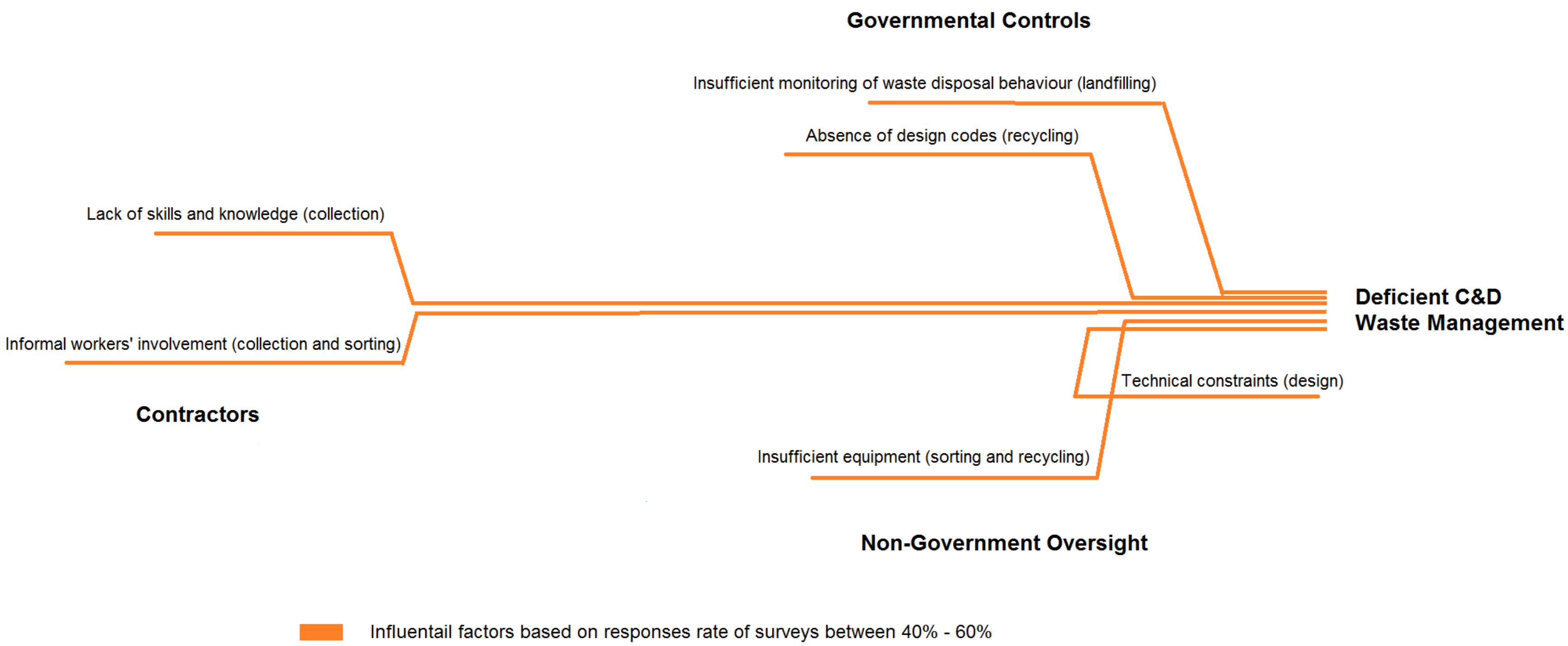

Figure 5-2: Fish Bone Diagram of the Intermediate Influential Factors of C&D Waste Management

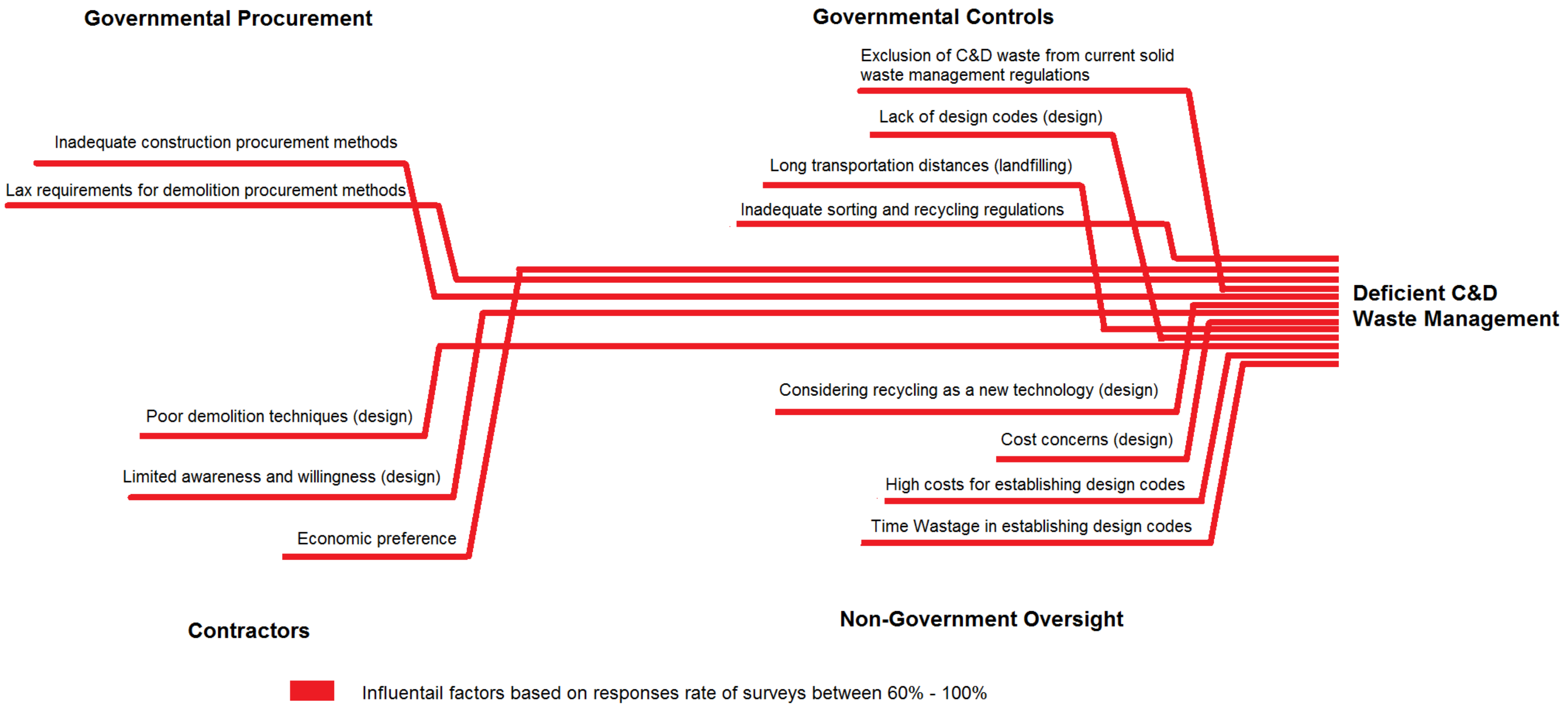

Figure 5-3: Fish Bone Diagram of the Most Influential Factors of C&D Waste Management

Summary of survey responses of the potential barriers								
Barriers		Total Answers	Yes Responses	Yes responses per Group				
				Governmental Entities	Contractors	clients	Academics	Concrete suppliers
Informal dumping								
Reasons of Informal Dumping	Governmental Controls	**1212**	**541**	**370**	**141**	**--**	**30/**	**--**
	Local actors' involvement	**1212**	**369**	**257**	**98**	**--**	**14**	**--**
	Costs drivers	**1212**	**72**	**34**	**32**	**--**	**6**	**--**

Summary of survey responses of the potential barriers								
Aspects within Jordanian Construction Industry Contracts								
C&D waste exclusion	Considering C&D waste as a special type of waste	**12**	**12**	**12**	**--**	**--**	**--**	**--**
	Lack of awareness	**12**	**11**	**11**	**--**	**--**	**--**	**--** **--**
	Construction actors' willingness	**12**	**7**	**7**	**--**	**--**	**--**	**--**
Procurement method of Construction	Low bidding	**35**	**33**	**33**	**--**	**--**	**--**	**--**

Summary of survey responses of the potential barriers								
Procurement method of Demolition	No selection method	**35**	**23**	**23**	**--**	**--**	**--**	**--**
Missing Construction and Demolition Waste Management Activities								
Reasons Preventing Collection	Lack of skills and knowledge	**62**	**35**	**35**	**--**	**--**		**--**
	Informal Workers	**62**	**39**	**37**	**--**	**--**	**2**	**--**
	lack of management system	**62**	**7**	**5**	**--**	**--**	**2**	**--**
	Poor Awareness	**62**	**26**	**23**	**--**	**--**	**3**	**--**
Reasons Preventing Sorting	Informal workers	**62**	**14**	**12**	**--**	**--**	**2**	**--**

Summary of survey responses of the potential barriers								
	Absence of equipment	**62**	**44**	**44**	**--**	**--**	**0**	**--**
	Lack of regulations	**62**	**23**	**23**	**--**	**--**	**0**	**--**
Reasons Preventing Landfilling	Long transportation distances	**62**	**52**	**47**	**--**	**--**	**5**	**--**
	Low supervision on waste disposal systems	**62**	**25**	**23**	**--**	**--**	**2**	**--**
	Cost concerns	**62**	**17**	**17**	**--**	**--**	**0**	**--**
	Incomplete waste disposal system	**62**	**27**	**27**	**--**	**--**	**0**	**--**
	Lack of financial rewarding	**62**	**21**	**18**	**--**	**--**	**3**	**--**

Summary of survey responses of the potential barriers								
Reasons Preventing Recycling or Reusing	Limited availability of infrastructure facilities	**62**	**7**	**5**	**--**	**--**	**2**	**--**
	Absence of recycled waste material design codes	**62**	**33**	**31**	**--**	**--**	**2**	**--**
	Lack of demand on for recycled waste material	**62**	**5**	**5**	**--**	**--**	**0**	**--**
	Absence of equipment	**62**	**18**	**18**	**--**	**--**	**0**	**--**
Reasons Preventing Designing out waste	Absence of Design Codes	**42**	**40**	**36**	**--**	**--**	**4**	**--**
	Demolition Techniques	**42**	**41**	**36**	**--**	**--**	**5**	**--**
	Governmental controls	**42**	**39**	**34**	**--**	**--**	**5**	**--**

Summary of survey responses of the potential barriers								
	Awareness & Willingness	**42**	**36**	**33**	**--**	**--**	**3**	**--**
Hinderances to Design Codes Existence	Establishing Codes Requires time	**42**	**20**	**15**	**--**	**--**	**5**	**--**
	Establishing codes Requires high Costs	**42**	**36**	**31**	**--**	**--**	**5**	**--**
	Recycling is Relatively a New Technology	**42**	**35**	**31**	**--**	**--**	**4**	**--**
Industry actors Perspective and Evaluation								

Summary of survey responses of the potential barriers								
Preference	Economic preference over environmental and social preferences	**99**	**93**	**88**	**--**	**--**	**5**	**--**
Willingness towards Using Recycled Waste Material	Clients	**65**	**52**	**--**	**--**	**38**	**--**	**14**
	Contractors	**49**	**43**	**--**	**22**	**--**	**--**	**21**
	Governmental Entities	**94**	**90**	**90**	**--**	**--**	**--**	**--**
Willingness towards Designing Out Waste	Governmental Entities	**37**	**37**	**37**	**--**	**--**	**--**	**--**
	Collection	**133**	**107**	**90**	**17**	**--**	**--**	**--**

Summary of survey responses of the potential barriers								
Evaluation of Regulations and Compliance	Sorting	**133**	**8**	**7**	**1**	**--**	**--**	**--**
	Landfilling	**133**	**108**	**87**	**21**	**--**	**--**	**--**
	Recycling or reusing	**133**	**9**	**7**	**2**	**--**	**--**	**--**
	Contractors	**133**	**55**	**34**	**21**	**--**	**--**	**--**
	Governmental entities	**133**	**82**	**64**	**18**	**--**	**--**	**--**

Table 5-30: Correlation Analysis of Respondent

If the debate is to be moved forward, a better understanding of these implications needs to be developed. Thus, the following chapter is representing the last investigation technique that conducts interviews. To delve into ascertaining the constraints of effective C&D waste management and legal landfilling. In addition to explore specifically the linkages between various C&D waste management and formal landfilling approaches and implementation.

6 Interviews Analysis

This chapter details the final data collection strategy by using NVIVO through conducting semi-structured interviews, as specified in **chapter 10-appendix I**.

The purpose of these interviews was to cover the gaps in knowledge to gain a better understanding of the implications of an effective C&D waste management and legal dumping. In addition to, determining the approaches to improve C&D waste management and reduce informal dumping.

Prior to conducting the interviews, questions were given to several professionals and experts in the sector to ensure their utility in producing trustworthy results. Additional information is available in the methodology section and **chapter 10-appendix I**.

This chapter can be best treated under five main headings which are as follows:

1. Current situation.
2. Hindrances to C&D Waste Management.
3. Promoting C&D Waste Management.
4. Informal Dumping of C&D Waste.
5. Conclusion of analysis.

Chapter 10-appendix IV contains a detailed description of this chapter.

6.1 Current situation

This section illustrates what participants said when explaining the industry's current general state of the Jordanian construction industry. Due to the nature of the responses, this section contains very little quantitative data.

Participants were chosen based on their broad knowledge and comprehension of construction.

6.1.1 Narrative Review

Several governmental interviewees have discussed what happens during the bidding process once the contract of each project has been established. The process can be outlined as follows:

- The proposed project is advertised using several methods, for example in several formal newspapers.
- Contractors bid on the project.
- The bids are reviewed to ensure that they comply with the specifications, with the contract and with any local pricing restrictions. The approach for non-compliant bids is discussed below.
- The project is assigned to the contractor that quotes the lowest price for the project and complies with the specifications.

Additional information on bids and specifications is included in **chapter 10-appendix IV**.

On construction and demolition projects in Jordan, contract provisions regarding the management of C&D waste may vary. Numerous participants from MPWH and GAM affirmed that the waste generated during a project may be utilised for backfilling only as seen in **figure 6-1**. If it has been proved experimentally to be suitable. On the other hand, if waste has not been experimentally shown to be suitable for use as backfill, the contractor must follow the regulations and standards for transporting the waste to the nearest authorised landfill. The primary shortcoming of this approach as criticised by the research, is that waste would be never reused except for backfilling even when experimentally feasible. This could plainly benefit contractors from using project waste as backfill by saving costs on new backfill supplies and transportation to a licensed landfill. However, perhaps the most severe drawback of this strategy could be that the industry actors would be encouraged to dump waste either formally or informally if no backfilling was needed even if waste has proven experimentally to be acceptable.

According to a participant from MPWH – Renovation Department, CCA debris is not treated the same as other waste types. As apparently the current laws compel the industry actors to discard this type of waste without experimentally testing it. Thus, this type of waste should be disposed off to the nearest permitted landfill when generated. This criterion could be a hindrance to C&D waste management, particularly when the charging schemes are modest. Hence, the current strategy of CCA is subjected to a huge criticism. Therefore, a question here remained to be unanswered about why CCA cannot be experimentally tested to be reused in other purposes even for backfilling.

It is to be noted that few participants from MPWH, GAM, MLA and contractors that recycling of few types of material takes place in the country. This was controversial with what was found previously in the literature. For instance, doors and windows can be dismantled to be reused, steel can be sold for recycling and timber for energy recovery. Apart from those movements according to an engineer at GAM – Construction Monitoring Department, the recovery of C&D waste in the Jordanian construction sector is limited for backfilling only. However, recycling, he asserts, is more than reusing waste for backfilling.

Figure 6-1: Backfilling in a Construction Project

Both demolition and C&D waste transportation, according to participants from JCCA, MoE and GAM, require municipal permissions and must adhere to existing legislation. The JCCA's responsibility is limited to ensuring that demolition is carried out professionally. Under the supervision of an engineering firm and with necessary safety precautions and measures. Meanwhile, the municipalities' responsibility is to provide permits for demolition only if actors estimated the volume of C&D waste generated (w_1). This demolition permit obliges actors to dump waste in an allocated landfill site as requested by the municipality and is subjected to a refundable deposit. Although, the refund is correlated with the volume of C&D dumped in permitted landfill sites (w_2) that should be approximately equivalent to the volume of C&D waste generated (w_1).

It is to be noted according to an engineer with the Ministry of Environment's Solid Waste Department that GAM is more improved than other municipalities in Jordan in managing C&D waste. As per the local culture, greater budget, additional employees and equipment and the government's designation of GAM as a national priority.

Those licenses seem to be effective to initially manage C&D waste in Jordan. Although, critics of research contend that these permits are insufficient. Particularly, when a sizable portion of C&D waste is informally dumped in Jordan. Although, violating those licenses by informal dumping is subjected to a penalty system as seen in **section 2.7.2**. To be fair, the research indicates that licensing should encompass additional controls in addition to landfilling, such as C&D waste management. **Chapter 10-appendix IV** gives a wider understanding about the informal dumping and the concept of land reclamation.

Several participants from governmental organisations have highlighted in the questionnaires chapter that there are no design codes that permit the use of recycled C&D waste in the design process. This is regarded as a major impediment to the utilisation of C&D waste in governmental projects. This impediment is correlated with the sequence of codes and specifications as the third priority item on the list below. Even if the bill of quantities specifies that a certain volume of waste should be recycled or that the project should be built with recycled waste material. Thus, an increasing body of research indicates that design codes are legally arranged as a secondary priority after signing the contract in the documentation hierarchy. Thus, designers would face refusal even if they advocated for the use of recycled waste material in projects.

The following list shows the documentation in governmental projects in ascending order. For instance, the codes of practice listed in number 3 should not be contradictory to other documents.

1. The contract.
2. The agreement of the contract.
3. Specifications, codes of practice and drawings.

4. Bill of quantities.

Thus, following contract execution, the first aspect to analyse is the specifications. Without design guidelines, no one in the sector may use recycled waste material. This demonstrates how recycling waste material design codes can aid in the promotion of C&D waste management.

Another significant hurdle to C&D waste management is construction firm owners. According to some contractors, most current construction firms appear to have been established by ancestors. Those who prefer to adhere to old techniques and strategies, thereby rejecting innovative technologies such as recycling. Or have limitations on the extent to which the concept of recycling can be applied. This could be related to actors' lack of knowledge regarding C&D waste management. As these companies recycle steel and wood without the presence of applicable rules. This impediment corresponds to **section 2.9**.

The absence of design codes and attitudes among most construction firms does not negate the impact of existing solid waste management regulations. According to engineers at the Ministry of the Environment, the restrictions in place prior to 2020 did not encourage waste sorting. After 2020, the Ministry of the Environment has suggested new solid waste guidelines that incorporate sorting at source. These new regulations took effect in 2020. Despite the fact that they feature numerous faults detailed in **chapter 10-appendix IV**, the study suggests that guidelines have a little impact on C&D waste management, as industry participants recycle steel and wood in the absence of legislation.

6.2 Hindrances of Construction and Demolition Waste Management

This section discusses the challenges associated with developing an effective strategy for the management of C&D waste in Jordan and actors’ perspective on re-using of recycled CCA in new concrete mixes. Identifying those challenges may be able to assist the research achieving its purpose.

As few participants represented regional organisations. Only 19 out of 25 participants representing various governmental organisations and associations, as well as construction contractors, responded to this question based on their expertise and knowledge.

6.2.1 Results

Bar chart and Venn diagrams reflect participants' observations on impediments to C&D waste management adoption across the country.

The accompanying chart depicts the anticipated challenges to hinder an effective national C&D waste management strategy in percentage form. Additionally, the Venn diagrams represent the interview participants' organisations, highlighting the most significant barriers to an effective national C&D waste management strategy as coded. In addition to, showing how common responses are based upon participants’ area of expertise and their organisations.

Figure 6-2 includes lack of studies and workshops and cost and time wastage. A lack of clear responsibilities and the willingness of local actors to adopt a C&D waste management strategy, as illustrated in **figure 6-3**. In addition to, **figure 6-4** that illustrates the profitability and absence of clear responsibilities. **Figure 6-5** that presents the shortage of recycling facilities and the actors’ perspective.

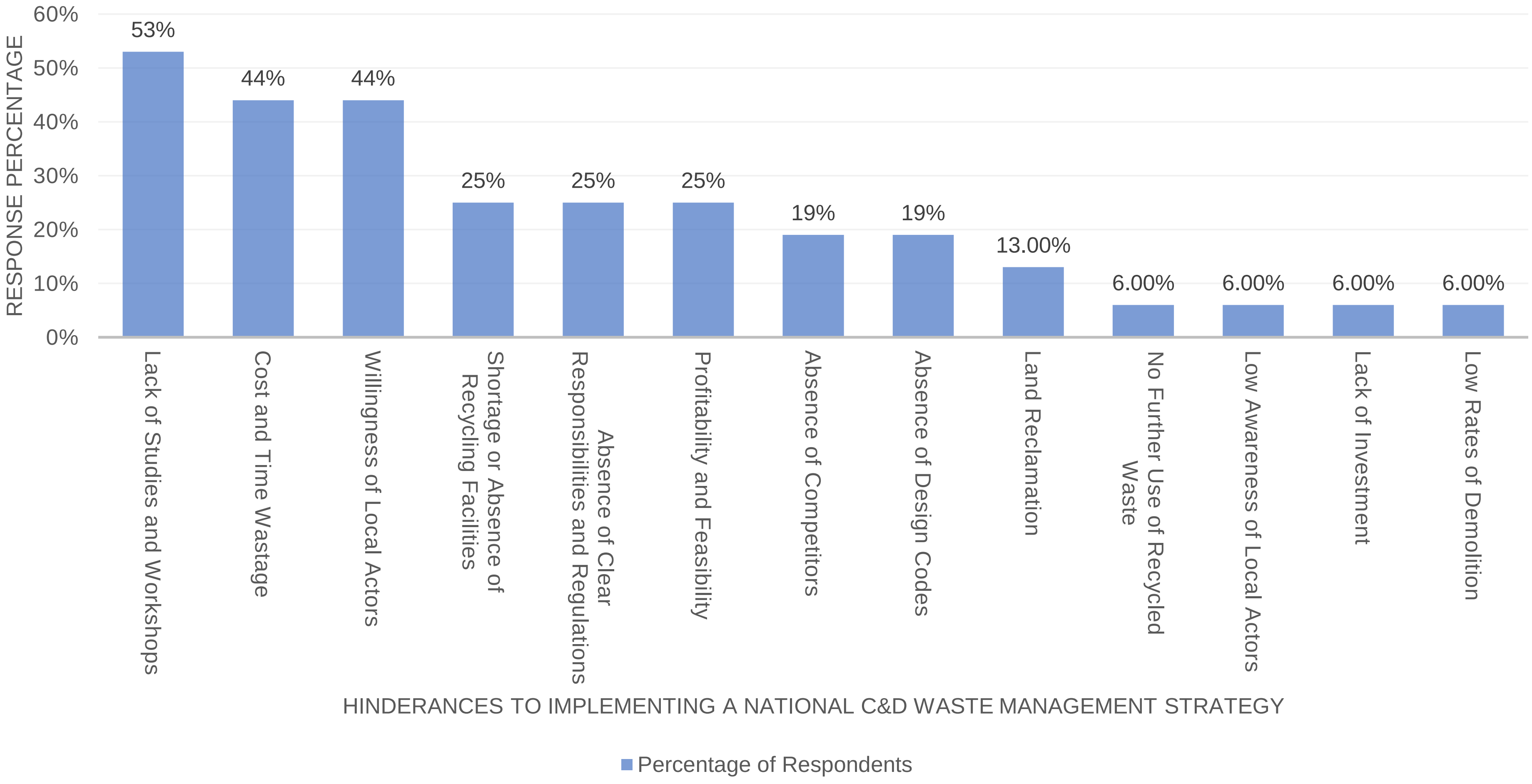

Chart 6-1: Hinderances to Implementing a National C&D Waste Management Strategy

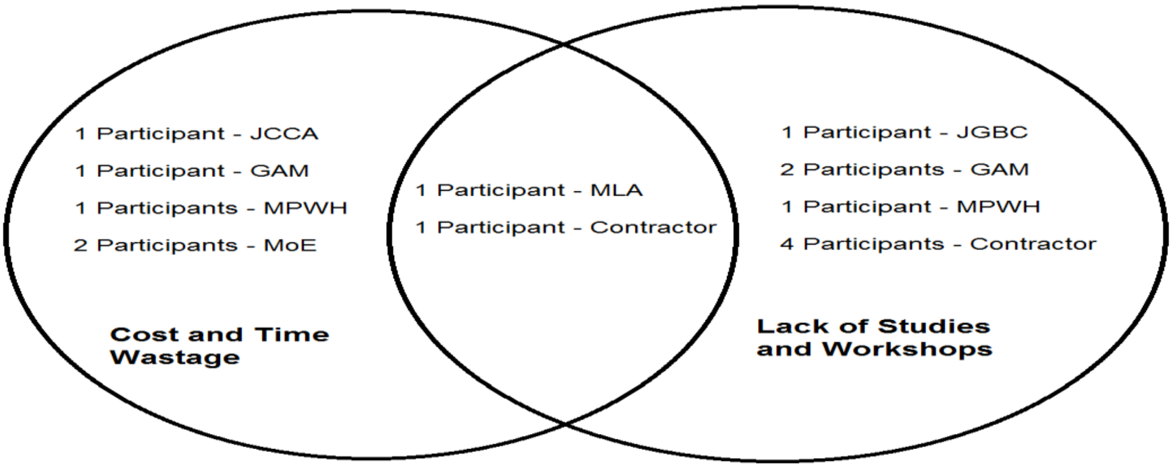

Figure 6-2: Venn Diagram of Participants Commonalities – Hinderances to Implementing a C&D Waste Management Strategy

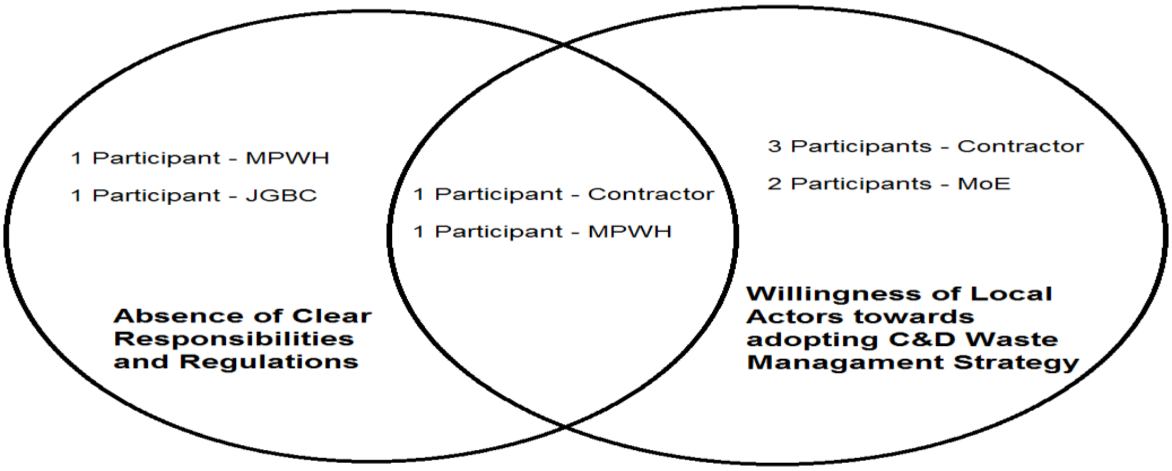

Figure 6-3: Venn Diagram of Participants Commonalities - Hinderances to Implementing a C&D Waste Management Strategy

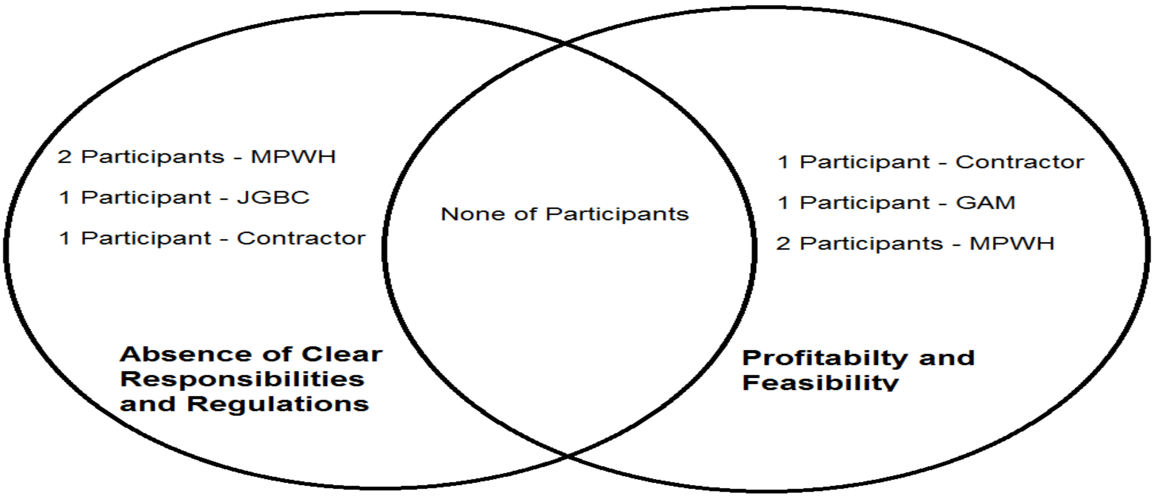

Figure 6-4: Venn Diagram of Participants Commonalities - Hinderances to Implementing a C&D Waste Management Strategy

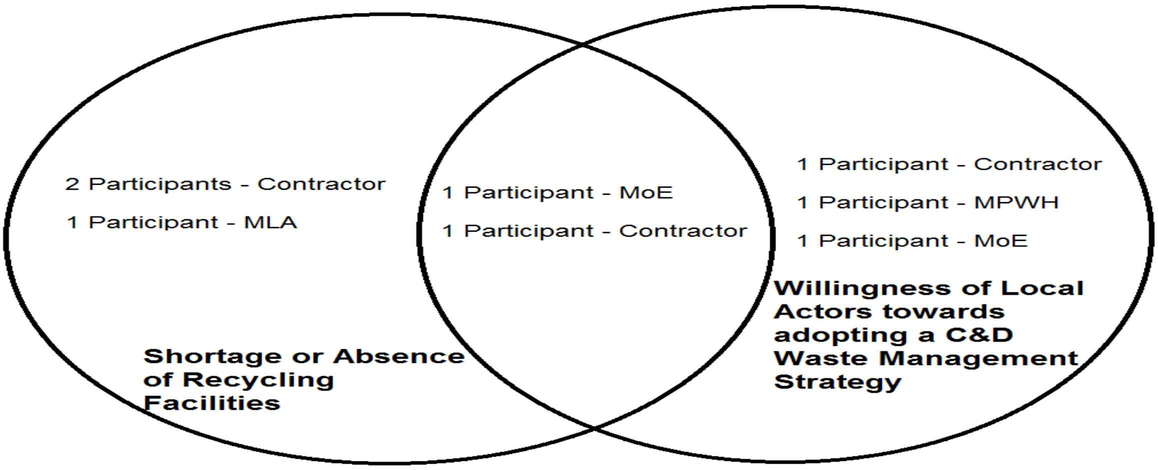

Figure 6-5: Venn Diagram of Participants Commonalities - Hinderances to Implementing a C&D Waste Management Strategy

6.2.2 Analysis

The figures above clearly shows that many participants agreed on three significant hurdles to implementation. Including lack of studies and workshops, cost and time waste and local actors' willingness to adopt C&D waste management. These major challenges were mentioned by a wide range of responders from various fields. This group included virtually all contractors and government representatives from various institutes such as the JGBC, GAM, MPWH, MLA, as shown in **chart 6-1**. This broad consensus among participants may emphasize the topic's executional relevance.

As it was cited by over half of the 19 participants, the lack of research and workshops in the construction sector affects numerous aspects of C&D waste management. Including the existence of regulations and design codes, which cannot be developed without well-understood studies. As they stated that we need facts and data to build national policies, regulations and specifications, as well as promote and increase local actors' willingness.

However, another drawback of this dearth is that, even with legislation, industry actors will lack knowledge and know-how about C&D waste management. As this increases the possibility of missing the environmental, social and economic advantages of C&D waste management if implemented. Additionally, owing to a lack of knowledge, few local actors believe recycling is necessary only for environmental reasons and should not take priority over other concerns. In addition to a few people realising that landfilling is already a green alternative. Thus, the lack of studies and workshops contributes to increase their low awareness.

However, critics assert that this lack has a negative effect on C&D waste management. Since actors recycle steel and timber without their presence. Nonetheless, their approach has not escaped criticism as how they do that without their presence.

As shown in **chart 6-1** and **figure 6-2**, contractors and government participants from various institutes such as JCCA, GAM, MPWH, MoE and MLA indicated that cost and time waste are contributing elements limiting the execution of an effective national C&D waste management strategy. Because it involves several actions such as design out waste, collection, sorting, recycling and landfilling. Thus, problems emerge when attempting to execute such a plan. Particularly when an inexpensive and expedient alternative, landfilling, is legally available. The study devastates the latter argument by suggesting that this alternative would be cheaper and faster if waste is deposited informally.

As shown in **figure 6-3**, contractors, two MoE engineers and an MPWH engineer mentioned local actors' willingness to adopt C&D waste management as a second significant factor. As participants said that local actors would not employ recycled waste material in new projects if the pricing were comparable to standard material. The interviewees' findings are consistent with the local Jordanian actor's preference for profitability and viability above all other factors. Particularly when environmental elements are considered a luxury. This may be explained by participants' lack of knowledge of C&D waste management. Or their perception that C&D waste management is purely environmental in nature and has nothing to do with the economy. Additionally, it may be linked with what was found in **section 6.1.1** about the establishment of companies by forefathers who chose to reject new technologies.

In general, it can be observed that a significant portion of the argument is predicated on the absence of research and workshops. Since they are more likely to contribute to affect the effectiveness of C&D waste management than other obstacles, according to participant consistency. However, as shown in **chart 6-1** and **chapter 10-appendix IV**, these limitations do not preclude the inclusion of further constraints.

6.3 Promoting Construction and Demolition Waste Management

This section delves into participants' perspectives on C&D waste management including feasibility and willingness of actors to embrace such a strategy. In addition to, spotting the light on how an effective national C&D waste management strategy could be implemented via approaches and encouragements.

On this subject, a wide variety of governmental bodies and groups, as well as construction contractors with varying degrees of expertise and knowledge have participated.

This section is sub-divided into 2 sections (**7.4.2 and 7.4.3**). These sub-sections provide interviewees' perspectives in the form of bar charts, Venn diagrams and an analysis of the outcomes of the participants' perspectives, as shown below.

6.3.1 Approaches, Improvements and Encouragements

This section discusses potential methods that may assist the industry in improving its present practices for handling C&D waste in Jordan.

This has been investigated with various governmental organisations and associations, as well as construction contractors. This element elicited responses from 25 individuals.

It includes a bar chart and Venn diagrams that detail the many methods, incentives and enhancements that may improve the national C&D waste management strategy. In addition to an analysis of participants' perspective as depicted below.

6.3.1.1 Results - Approaches, Improvements and Encouragements

This sub-section uses a bar chart and diagrams to show participants' views about potential methods for improving the national C&D waste management strategy. These diagrams demonstrate how typical answers vary according on participants' fields of expertise and organisations.

Chart 6-2 depicts the anticipated methods to improving C&D waste management in percentages based on interviewees' perspectives.

The Venn diagrams represent interview participants according to their organisations. Highlighting the most important factors that contribute to the improvement of the national C&D waste management strategy as coded in the chapter methodology. Such as conducting additional detailed studies and workshops and providing incentives, as illustrated in **figure 6-6**. **Figure 6-7** that illustrates the connection between company upgrades and recycling movements, as well as clarifying regulations. In addition to **figure 6-8** that compares participant responses to one of the most significant impediments to improving a national C&D waste management strategy and the most effective approach of improvement. Such as a lack of studies and workshops and the conduct of additional detailed studies and workshops.

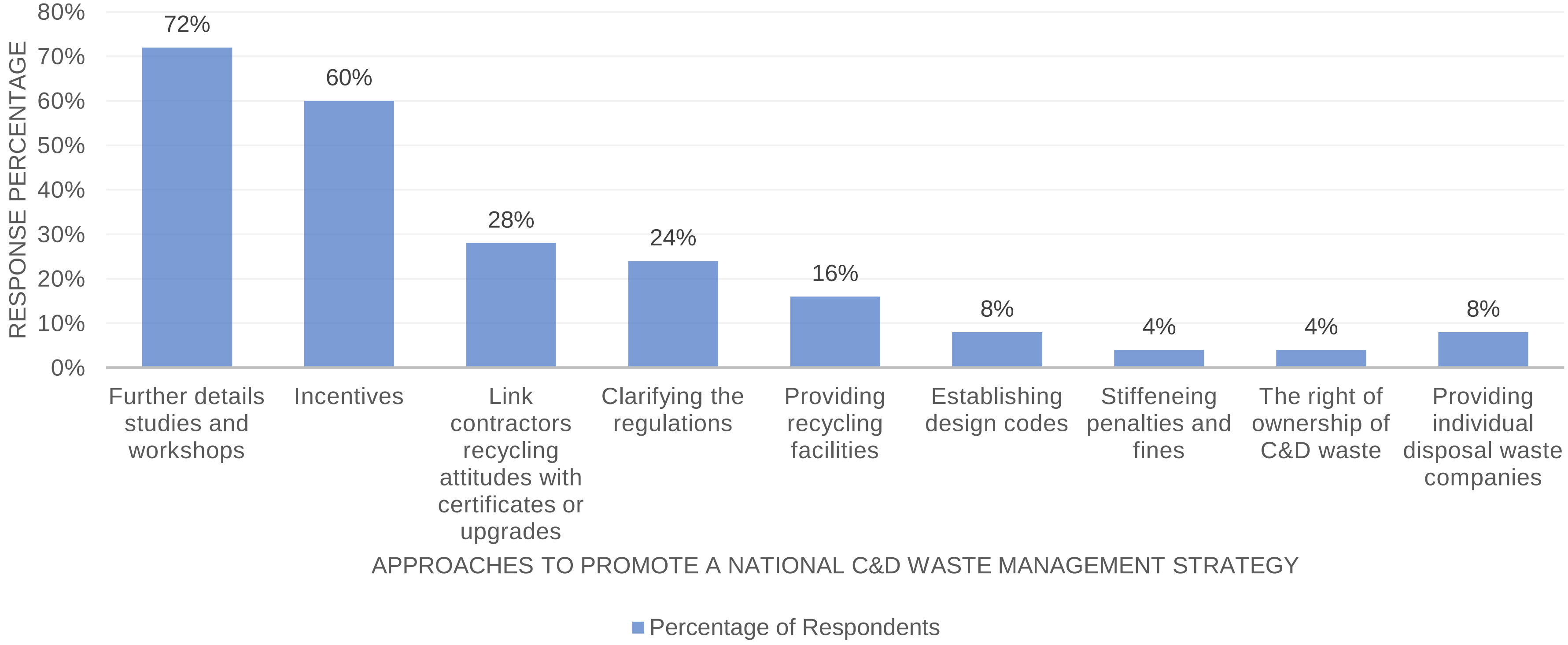

Chart 6-2: Approaches to Promote a National C&D Waste Management Strategy

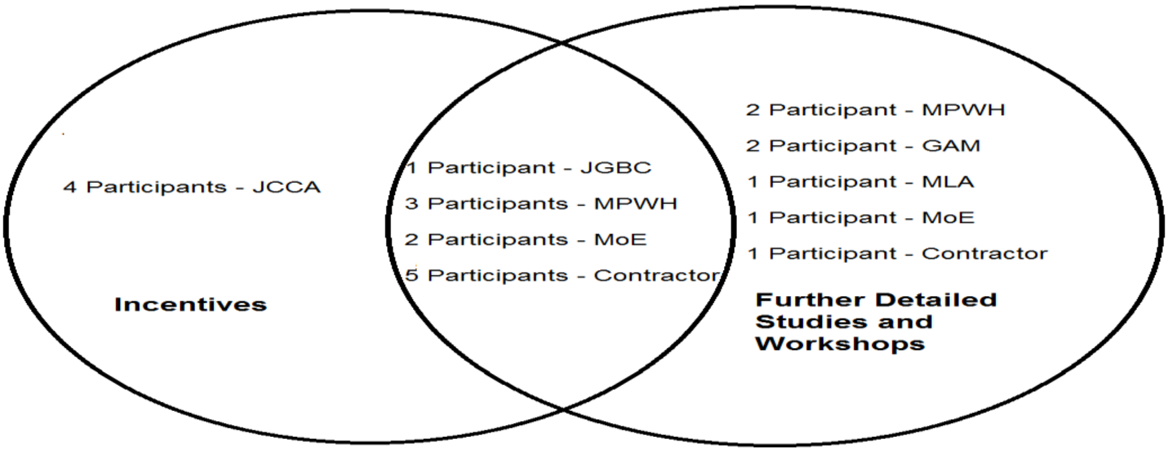

Figure 6-6: Venn Diagram of Participants Commonalities – Approaches to Promote a C&D Waste Management Strategy

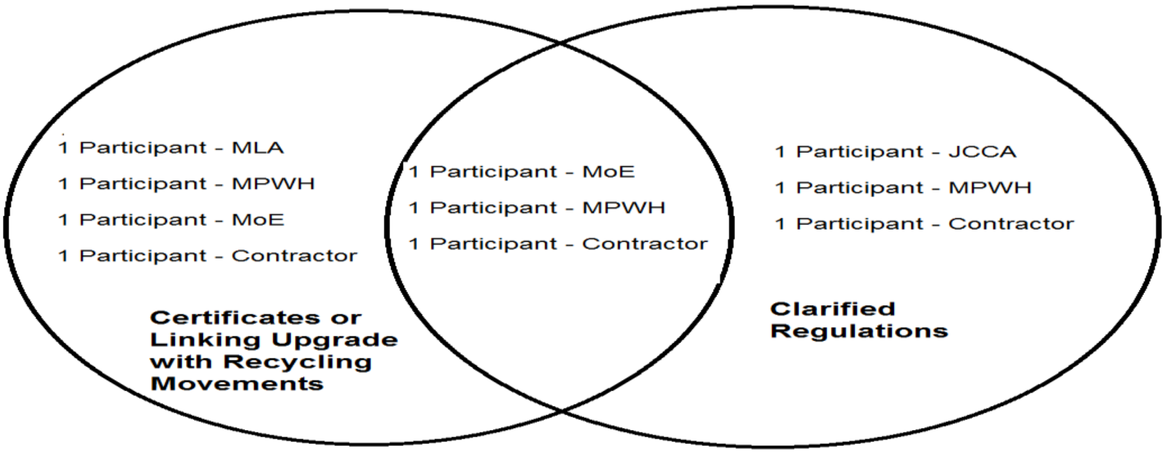

Figure 6-7: Venn Diagram of Participants Commonalities – Approaches to Promote a C&D Waste Management Strategy

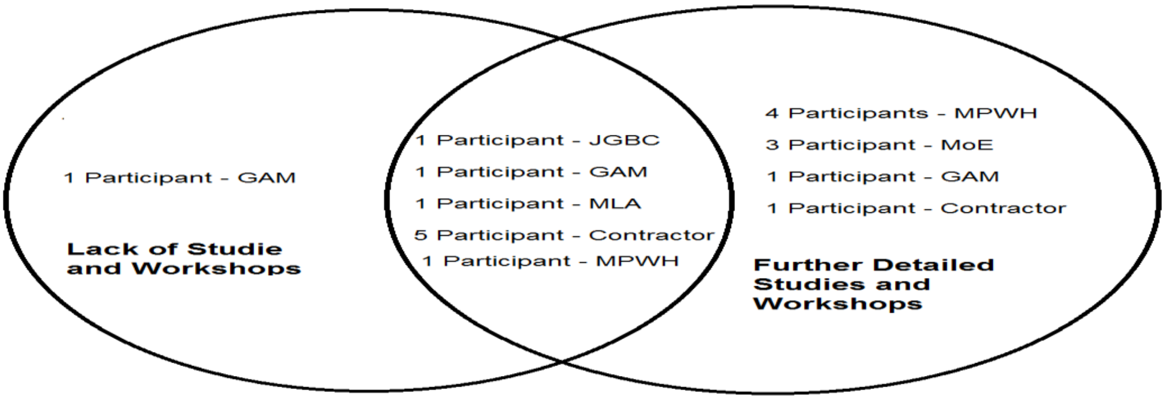

Figure 6-8: Venn Diagram of Participants Commonalities – Approaches to Promote a C&D Waste Management Strategy

6.3.1.2 Analysis - Approaches, Improvements and Encouragements

A large majority of respondents agree on two main techniques for improving a national strategy (**chart 6-2**). Around 72% of respondents from various governmental agencies and contractors stated that the sector needs more detailed research and workshops. Meanwhile, over 60% of them stated that the sector needs more incentives.

Since lack of studies was identified as a significant impediment by 55% of participants (**figure 6-8**). The investigation confirmed the need for more detailed studies and workshops to be conducted. By nearly all participants from various organisations (**figure 6-6**). As they clearly demonstrate how recycling is superior to landfilling in terms of both the environment and the economy. Also, how recycled C&D waste is adequate in terms of quality and cost efficiency even if it can be used for fewer purposes. Additionally, how C&D waste management can result in profit and savings and how to measure distance to permitted landfill. In addition to helping in establishing design codes. These findings show that research and workshops can directly inspire industry actors to manage C&D waste. While this result may contribute to the improvement of the current C&D waste management, participants' perceptions of the importance of studies and workshops seem dubious. Particularly given that actors often recycle steel and timber without their presence, as previously stated.

As shown in **figure 6-6**, industry actors will be motivated to embrace C&D waste management as agreed upon by participants from MPWH, JGBC, JCCA, MoE and virtually all contractors. As shown in the same diagram, these incentives were not chosen by most governmental participants. Most likely owing to the imposition of additional costs on the government, as described in **chapter 5**. Nevertheless, this research established that incentives are not limited to tax rebates or licensing reductions. According to these results, more built-up space may be added to the regulated built-up area. To accommodate actors who promote recycling movements and the use of recycled waste material. Or by linking contractor upgrades to recycling operations and the use of recycled waste material. Contractors, however, may feel compelled to embrace such methods, which may or may not benefit them. Therefore, several participants felt that this approach could work if it was optionally integrated with the upgrading process.

Other techniques, as shown in **chart 6-2** and described in **chapter 10-appendix IV**, do not diminish the significance of these two. This research demonstrates that conducting in-depth studies and workshops, as well as offering incentives, are much more suitable for the Jordanian industry. Therefore, extensive study, workshops and incentives may be utilised to eliminate or mitigate significant impediments to the present national C&D waste management strategy.

6.3.2 Feasibility and Willingness

The sub-section below details the participants' assessment of whether an effective national C&D waste management strategy is possible in the country. In addition to, their expectations about industry actors' willingness to implement such a strategy. This component assessed the feasibility of developing a national strategy for the management of C&D waste and the acceptance of such a strategy by local actors.

It includes a bar chart and a Venn diagram illustrating the perspective of interview participants, as well as an analysis.

Only 23 out of 25 participants from various governmental organisations and associations, as well as construction contractors, responded to this element. Since the remaining participants were unfamiliar with these elements. Due to their geographical affiliations disabling them from offering relevant data on this subject.

6.3.2.1 Results - Feasibility and Willingness

The findings include a bar chart and a Venn diagram that show the participants' observations about feasibility and willingness.

Chart 6-3 depicts the feasibility and willingness of a national C&D waste management strategy based on interview participants' perspectives in percentages. **Figure 6-9** depicts interviewees according to their views, indicating their assessment of the feasibility and willingness. Which demonstrates the similarities in respondents' answers depending on their area of expertise and organisation.

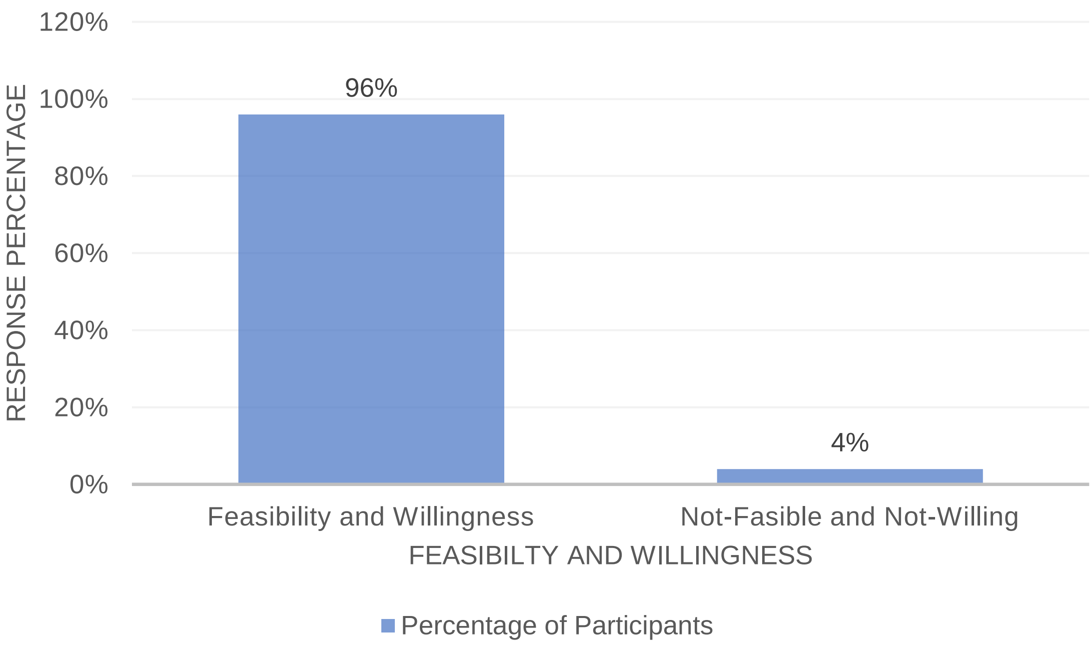

Chart 6-3: Feasibility and Willingness

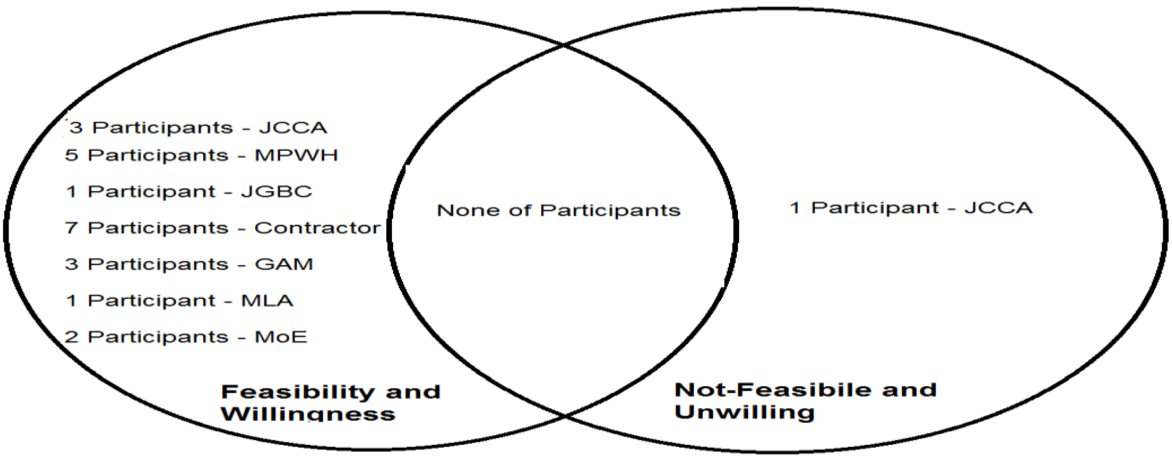

Figure 6-9: Venn Diagram of Participants Commonalities – Feasibility and Willingness

6.3.2.2 Analysis - Feasibility and Willingness

According to **chart 6-3**, industry actors' desire to adopt C&D waste management or use recycled waste material has not been recognized a major constraint. A C&D waste management strategy or using recycled material is viable in the country, according to 96% of interviewees (**figure 6-9**).

Many participants agreed that the C&D waste management system could reduce formal and informal dumping, increase profitability and create jobs. This desire corresponds to their existing views about steel and timber recycling. Although this attitude may be related to actors' knowledge of the economic benefits of steel and timber recycling. This demonstrates that a dearth of research and workshops is a significant impediment to recycling various types of waste material, such as CCA. This widespread agreement among industry actors shows their desire to control C&D waste or recycle discarded waste. Particularly when the benefits and viability of C&D waste management are fully understood.

Another less concerning factor that may impede CCA recycling, as agreed upon by one participant, is Jordan's low rate of demolition. One criticism is that this approach, however, is not restricted to demolition. Since construction projects may produce C&D waste as well. Although 9% of respondents said that recycling alone would be sufficient for Jordan to assist neighboring nations such as Syria and Iraq, which are devastated by civil wars and destruction.

6.4 Informal Dumping of Construction and Demolition Waste

This section discusses the participants response to C&D waste informal dumping, including reasons and approaches for reducing it.

It is divided into two sub-sections named, as shown below. The reasons behind the informal C&D waste disposal and the methods that may assist in achieving a reduction in informal dumping. It includes bar charts, Venn diagrams and an analysis of the findings of participant's responses.

This issue was studied in consultation with several governmental bodies and groups, as well as construction contractors with varying degrees of expertise and knowledge.

6.4.1 Reasons of the Informal Dumping

This section is stressed to identify the causes of informal waste disposal of C&D waste. By 24 out of 25 participants from various governmental organisations and associations and construction contractors responded on this element. Based on their breadth of experience and knowledge. The only one participant that has not responded was unfamiliar with the factors that could contribute to such an attitude. Due to his/her affiliation with regional bodies and thus was unable to provide informative data on this subject.

6.4.1.1 Results - Reasons of the Informal Dumping

Chart 6-4 depicts the assumptions of the industry actors that lead to dump C&D waste informally, as expressed in percentages. The figures of **6-10** and **6-11** depict interview participants based on their field of work. Highlighting the primary variables that contribute to this attitude and showing how typical responses differ according to the areas of competence and organisations of participants.

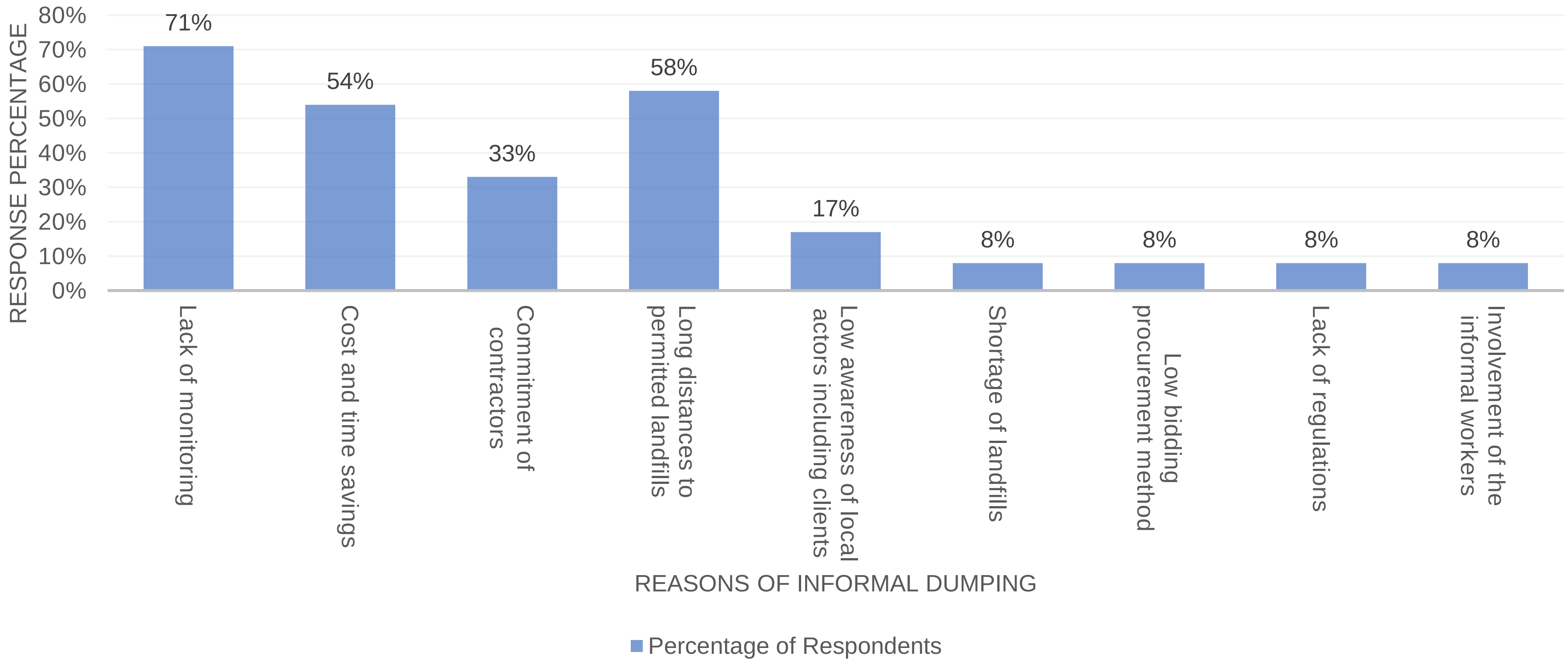

Chart 6-4: Reasons of Informal Dumping

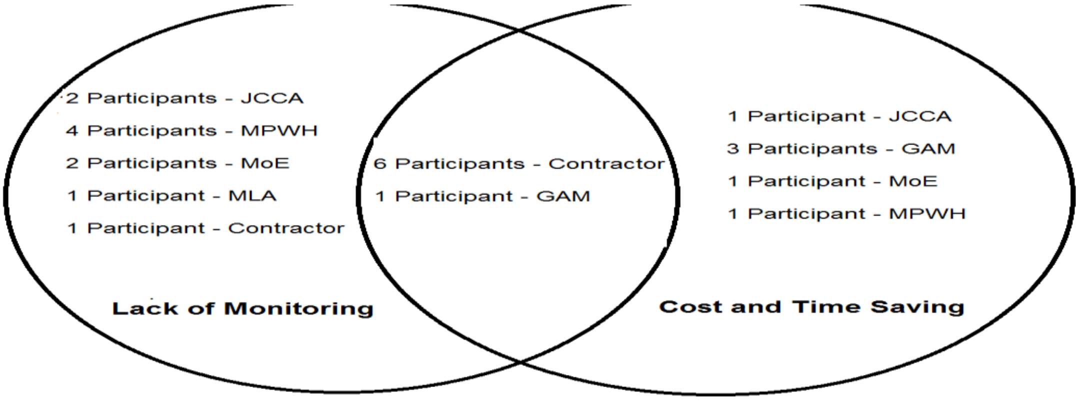

Figure 6-10: Venn Diagram of Participants Commonalities – Reasons of Informal Dumping

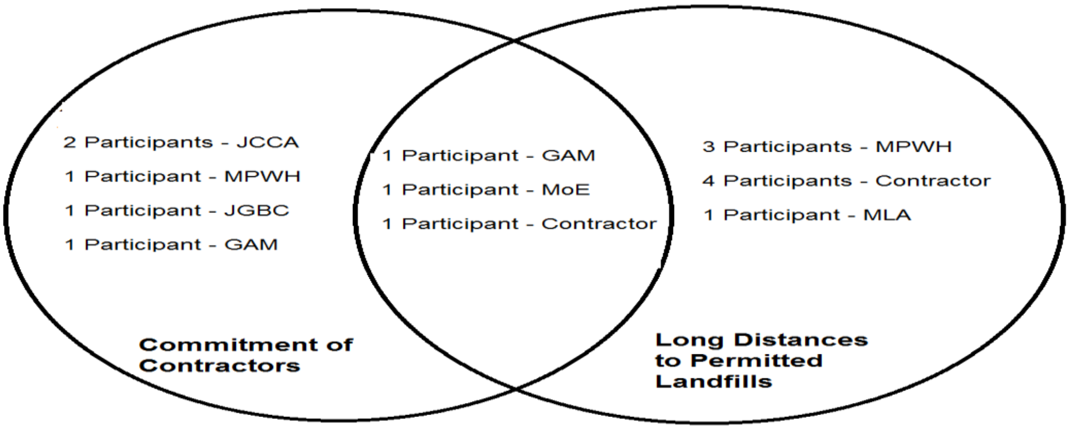

Figure 6-11: Venn Diagram of Participants Commonalities – Reasons of Informal Dumping

6.4.1.2 Analysis - Reasons of the Informal Dumping

Lack of monitoring, lengthy distances to licensed landfill and cost and time savings that is correlated to long distances are the key causes for informal disposal of C&D waste. As indicated in **chart 6-4** and agreed by more than 50% of participants. These reasons are commonly connected with informal dumping. Demonstrating that contemporary informal dumping is not due to a lack of legislation as outlined in the questionnaires chapter. Particularly when regulations oblige actors to discard waste in licensed landfill, but rather a lack of monitoring.

Two major causes for the impediment imposed by a lack of monitoring are as follows:

1. In comparison to the number of contractors or transporters, there are few people responsible for monitoring.
2. Limited monitoring hours from 8:00 a.m. to 5:00 p.m.

Meanwhile, most contractors have complained about the long distances to authorized landfill. Claiming that they use excessive amounts of fuel and time, making the process both costly and time consuming. This confirms what was revealed in **chapter 4**: the volume of C&D waste disposed of in nearby private landfill is more than that disposed of in public landfill. Showing that long travel distances are a significant role in informal dumping. That is why contractors tend to dump waste informally. As it allows them to dispose of more waste dumps for less money and time using less fuel and shorter travel distances. Thus, it contributes to cost and time savings. Although, as indicated previously, government officials have clarified that this is illegal. In addition, it can be convincingly demonstrated to be overcome through precise calculations of distances to landfill, volume of waste generated on projects and expenses. Particularly gasoline prices, which are updated monthly by the government and priced during the bidding process. Thus, contractors have no excuse for illegally dumping this material. Particularly given that current regulations compel contractors to dispose of waste in designated landfill.

As detailed in **chapter 10-appendix IV**, participants agreed on other restrictions that have been demonstrated to be less successful at preventing lawful dumping.

6.4.2 Approaches to Reduce the Informal Dumping

As stated earlier, this section shows the methods that may help decrease informal dumping of C&D waste. Using a bar chart, Venn diagrams and an analysis of participant perspectives of 24 out of 25 participants from various governmental organisations and associations and construction contractors. Based on their breadth of experience and knowledge. The reason why one participant has not participated is mentioned in the previous section.

6.4.2.1 Results - Approaches to reduce the Informal Dumping

This section shows participant observations on approaches to limit the volume of informal C&D waste disposal using a bar chart and Venn diagrams.

Chart 6-5 depicts the expected methods for reducing informal waste disposal of C&D waste, as expressed by participants in percentages. **Figures 6-12, 6-13** and **6-14** depict interview participants in their respective roles. Highlighting the most important elements that lead to informal dumping and contribute to reducing it. These diagrams illustrate how typical answers vary according to the participants' areas of expertise and organizational affiliations.

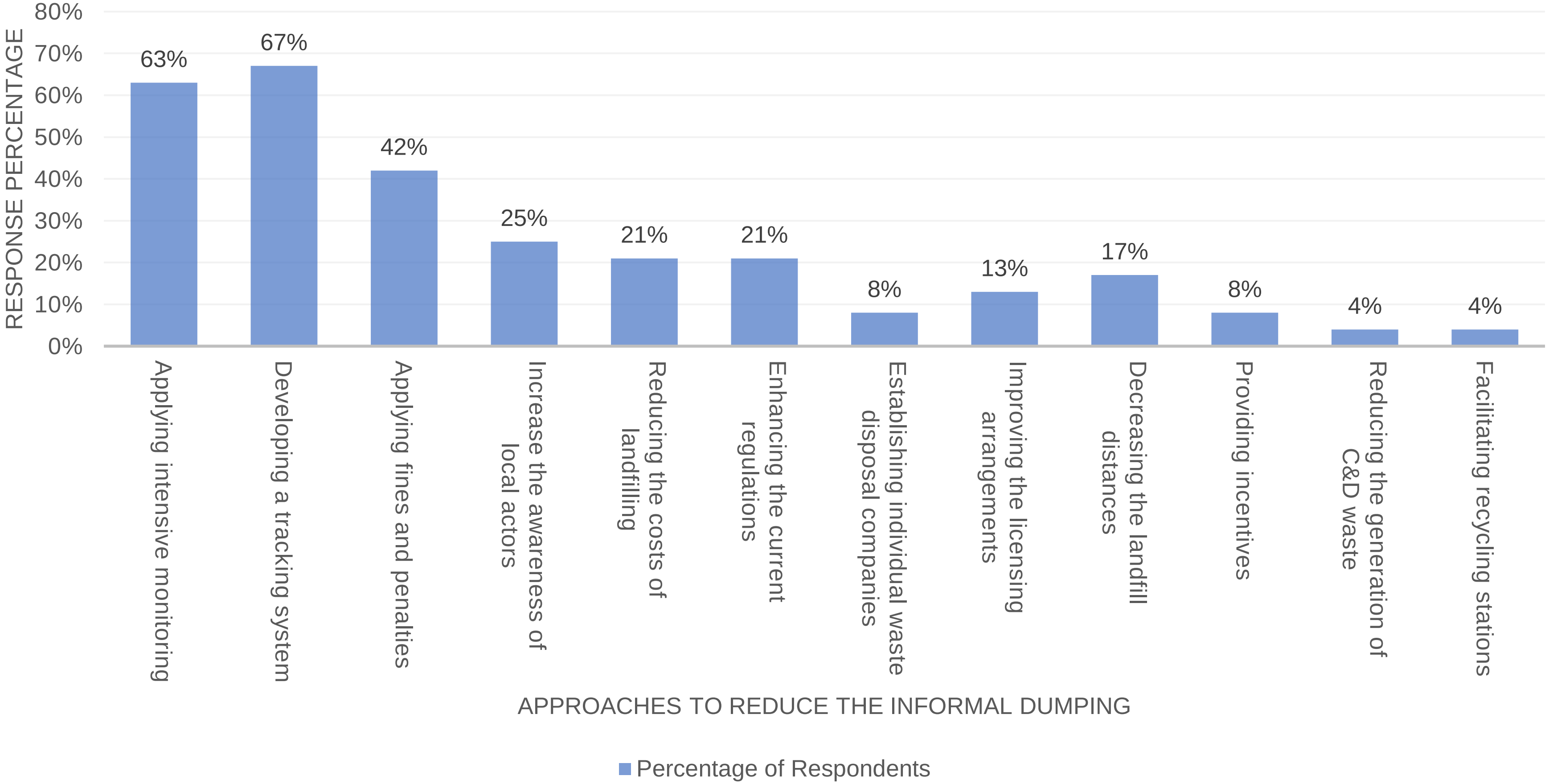

Chart 6-5: Approaches to Reduce the Informal Dumping

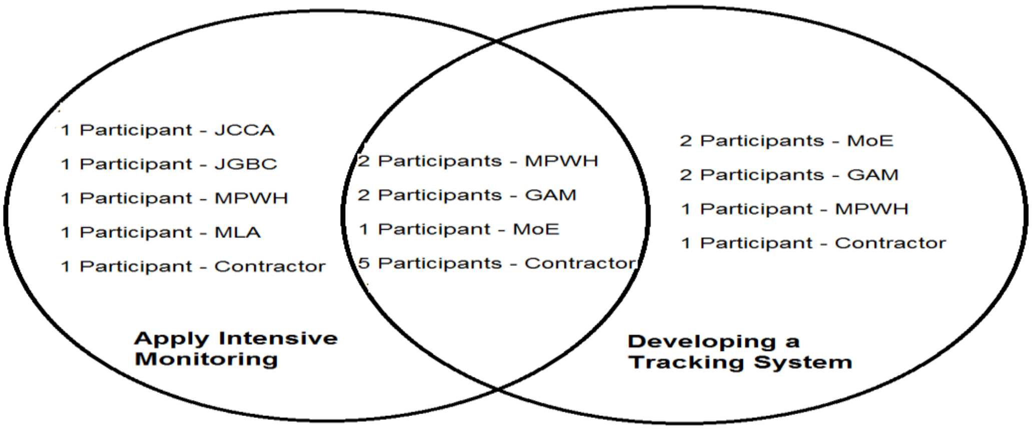

Figure 6-12: Venn Diagram of Participants Commonalities – Approaches to Reduce the Informal Dumping

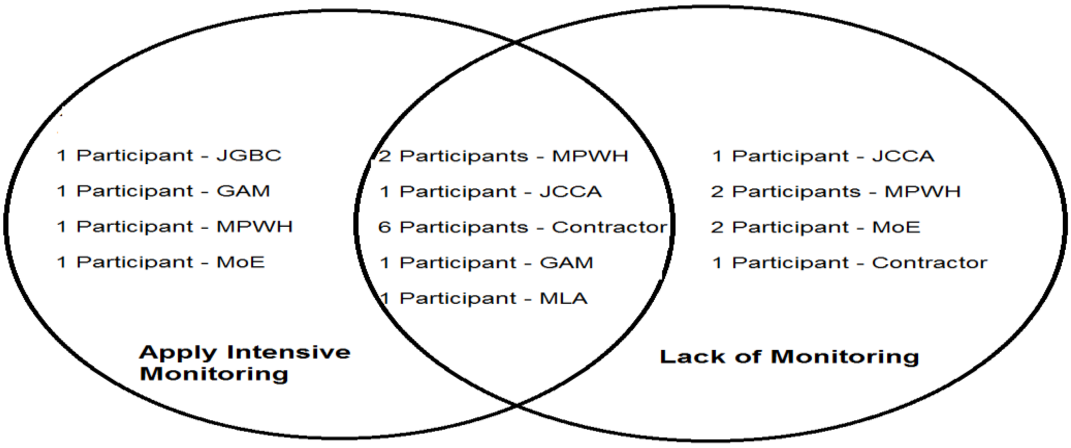

Figure 6-13: Venn Diagram of Participants Commonalities – Approaches to Reduce the Informal Dumping

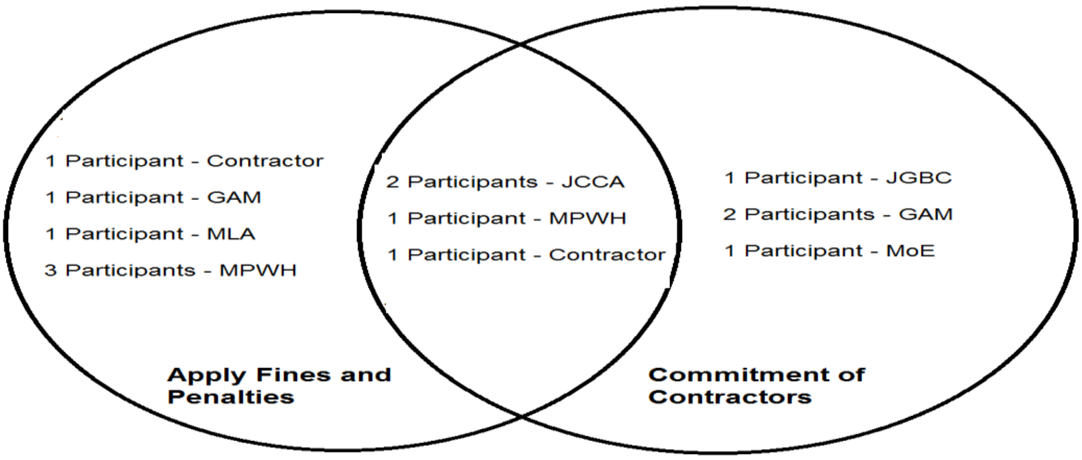

Figure 6-14: Venn Diagram of Participants Commonalities – Approaches to Reduce the Informal Dumping

6.4.2.2 Analysis - Approaches to Reduce the Informal Dumping

In **chart 6-5**, participants' ideas on how to reduce informal waste disposal of C&D waste are shown. As shown in this chart, around 67% of MPWH, GAM, MoE and contractor interviewees felt that implementing a tracking system might successfully offset this informal attitude.

A growing body of research shows that municipally intense monitoring. Including installing cameras on roadways or increasing the number of persons monitoring to cover more regions and prolong monitoring hours. Hinders the eradication of illegal dumping. Developing a tracking system can have a big impact and be very beneficial, according to the study's findings. This tracking technology may help increase monitoring efficacy without increasing employee levels and at 24 hours a day. The research opposing this approach's capacity to boost monitoring has been criticised. However, the data presented here tend to support the idea that a tracking system can reduce informal dumping as previously experienced by MPWH and MOE. As MPWH has utilised a tracking system for its vehicles which helped cut fuel costs by reducing consumption. Meanwhile, the MoE have used it to track wastewater transporters which helped to minimize unlawful wastewater disposal by approximately 70%. Thus, using tracking system in the construction industry may help reduce the challenges connected with informal C&D waste disposal. Though useful, the investigation confirmed our suspicions that the organisation responsible for developing a system for the construction industry may be hindered by cost concerns. Particularly when the construction industry has many actors or transporters compared to other industries. Although, according to few participants' preference, this system should be developed by traffic departments.

Most respondents (63%) from different entities as in shown in **figure 6-12**. Agreed that municipalities should perform comprehensive monitoring to curb informal attitudes. Whereas in **figure 6-13**, approximately 60% of participants also from different entities believed that significant monitoring was required. These strategies have been linked to a reduction in informal C&D waste dumping. As many respondents preferred them over alternative techniques.

According to GAM, MPWH, MLA, JCCA and a few contractors, implementing fines and penalties of roughly 42% has been shown to reduce C&D waste informal dumping (**figure 6-14**). Also, by around 25%, local actors' awareness should be improved.

As shown in **chart 6-5** and **chapter 10-appendix IV**, the above approaches do not prohibit other influences.

6.5 Conclusion of Analysis

This section summarises the investigation's results using two fishbone diagrams. By illustrating the important variables influencing the efficacy of the C&D waste management strategy and informal dumping of C&D waste.

Notably, these diagrams are not color coded, which means that colors provide no information. While the thickness of implications represents the significance of each component as determined by the responses' similarities.

The four zones used to divide the diagrams include:

1. Governmental controls.
2. Governmental procurement.
3. Contractors.
4. Non-government oversight.

These four zones do not correspond to the respondents' answers, but rather to the cause's origins. For instance, the absence of design codes is a matter for the government and therefore falls within the purview of governmental controls.

6.5.1 Hindrances to Construction and Demolition Waste Management

This section here is representing the hindrances to an ineffective C&D waste management strategy in Jordan in fish bone **figure 6-15**.

As indicated by slightly more than 40% of participants from various governmental organizations' and contractors, the lack of studies and workshops, cost and time waste and local actors' willingness are the most significant factors affecting C&D waste management efficiency. Over half of the 19 participants mentioned a dearth of studies and workshops as the primary contributing reason.

As they help in affirming and fostering the aspirations of local actors towards C&D waste management as clarified above. That is why more than 75% of participants believed that additional research and workshops were necessary. Particularly when respondents limited their adoption to a few specific components, as previously discussed in this chapter and **chapter 5**.

According to 37% of respondents, the second significant factor is cost and time waste, as well as the willingness of local actors. As several participants from various governmental institutions noted that implementing an effective strategy for managing C&D waste is expensive and time consuming. Thus, design out waste, collection, sorting, recycling and landfilling are all tasks that might be substituted at a reduced cost. Through regular structure design or legalized collection and landfilling. Particularly, when local actors assign expenses and timelines to each stage of construction or demolition.

The willingness of local actors is related with a few actors' personal preferences for standard material. Due to mostly technical reasons and local actors' low awareness. Particularly when local actors revealed their believe that C&D waste management is solely concerned with the environment and has no bearing on the economy. Or few participants voiced concern about Jordan's low demolition rate, which may feasibly preclude such an approach.

Although 96% of respondents expressed a desire to implement an effective C&D waste management strategy or to utilise recycled waste material, according to the study. This does not exclude the possibility of providing incentives to induce actors to adopt an efficient C&D waste management system, as agreed upon by 60% of respondents. Further clarifications are provided in **section 6.3.2**.

According to a range of 5% to around 25% of interviewees, issues such as a lack of defined responsibilities and regulations, a lack of recycling facilities in Jordan, a lack of design codes and land reclamation all contribute less powerful effect than earlier factors.

As seen in **figure 6-15**, these barriers are having a diminishing effect on the effectiveness of C&D waste management. Further clarifications on these fewer contributory factors are explained in greater details in **section 5.2.2** and **chapter 10-appendix IV**.

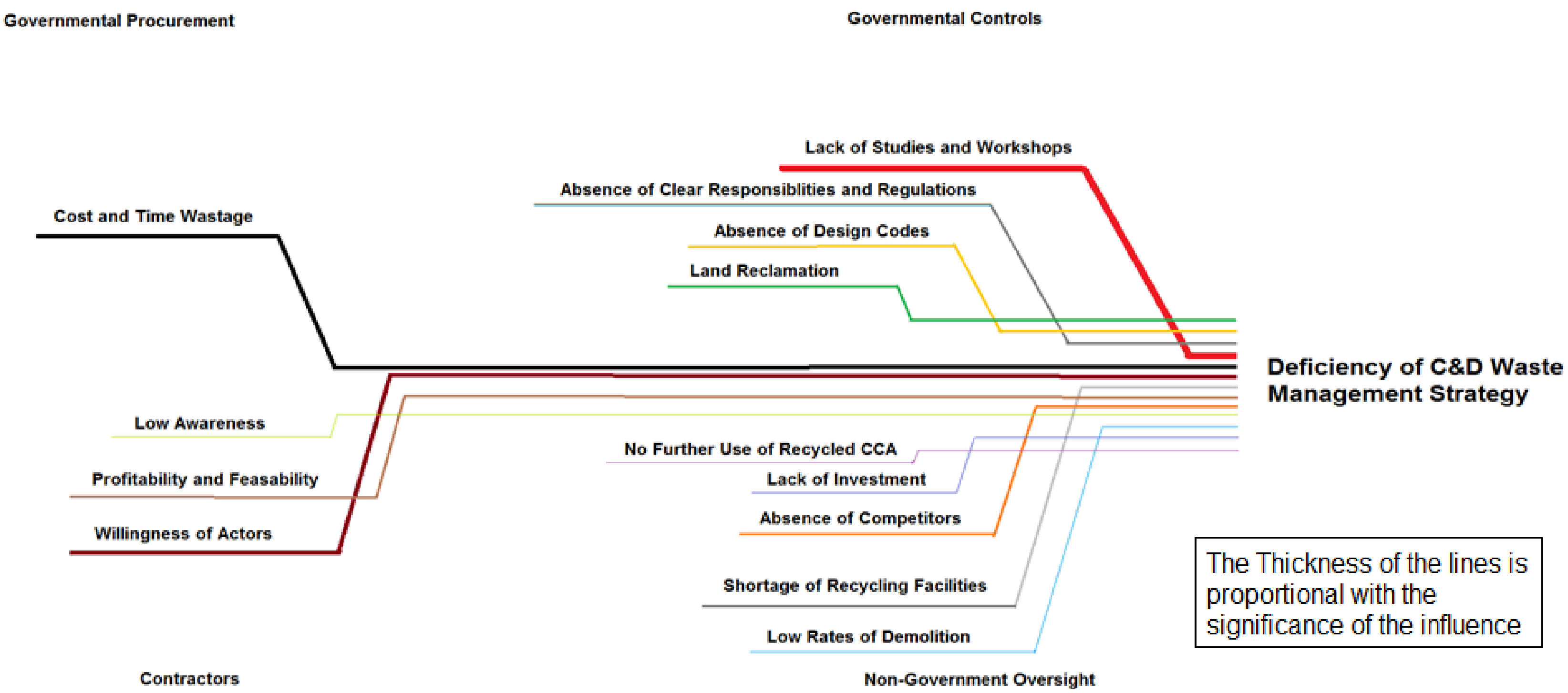

Figure 6-15: Fish-Bone Diagram of Reasons Hindering the Implementation of a C&D Waste Management

6.5.2 Informal Dumping of Construction and Demolition Waste

This section illustrates the drawbacks of Jordan's informal dumping of C&D waste using a fish bone **figure 6-16**.

According to around 71% of participants from various governmental organisations and contractors. There is a strong association between a lack of monitoring and informal C&D waste dumping. This obstacle is caused by two fundamental factors:

1. Monitoring personnel are insignificant in comparison to contractors or transporters.
2. Monitoring during the hours of 8:00 a.m. and 5:00 p.m.

Nearly 54% and 58% of participants, respectively, noted cost and time savings, as well as long traveling distances to permitted landfill (mainly contractors). Contractors believe that lawfully depositing C&D waste is costly and time consuming. Due to the great distances between landfill sites. Thus, informal waste disposal enables contractors to dispose of more waste dumps at a lower cost and in less time. By lowering fuel use and travel distances. Governmental participants have clearly demonstrated that this is not a cause for contractors or transporters to do so. As in fact they should accurately measure distances to landfill, volume of waste created on projects and costs, particularly gasoline prices, which the government updates monthly.

These factors do not rule out the influence of other factors, although seemed to be less contributory as based on interviewees’ perspective. These include commitment of contractors, low awareness of actors, shortage of landfill, low procurement methods, lack of regulations and involvement of informal workers which can be clearly clarified in **section 6.4.1**.

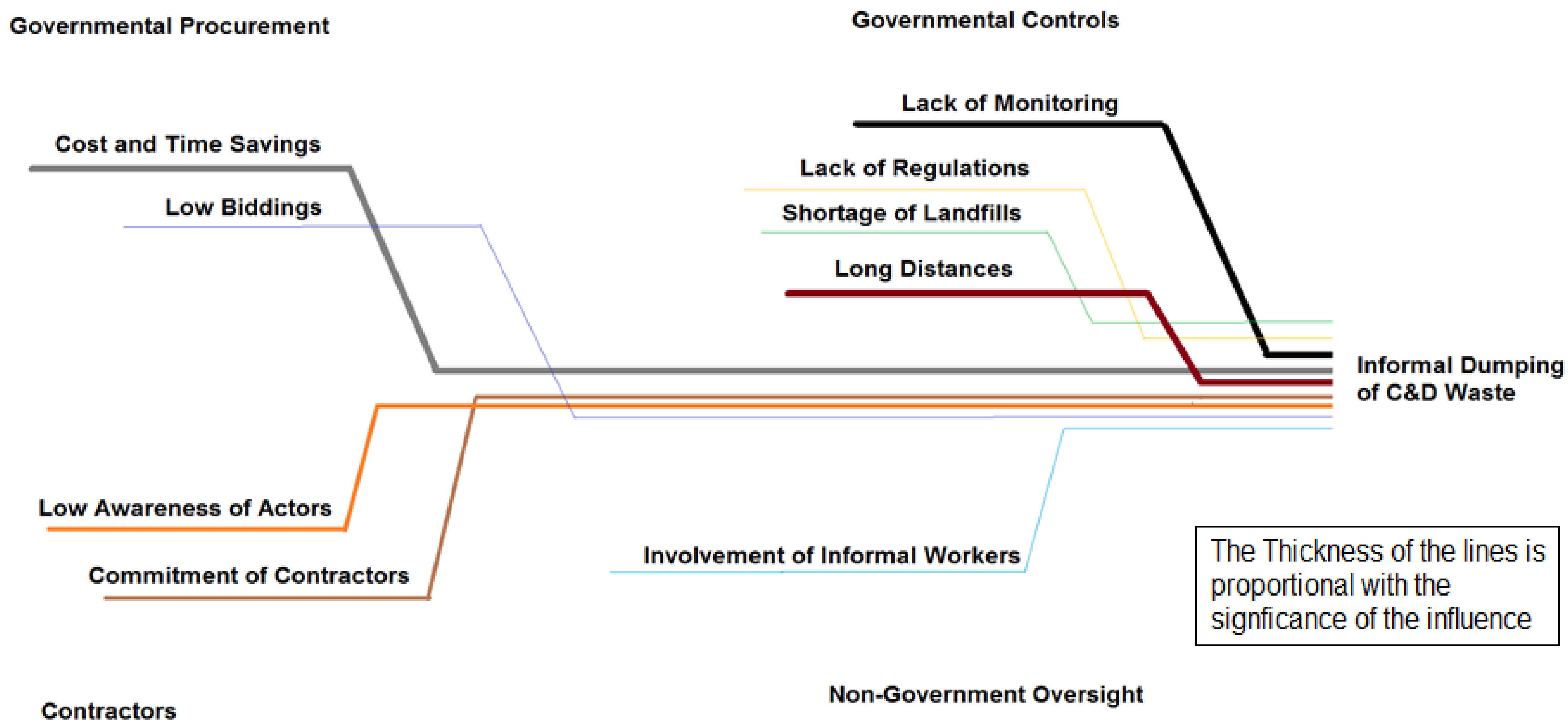

Figure 6-16: Fish-Bone Diagram of Reasons of Informal Dumping of C&D Waste

Applying the knowledge gained from the literature review and data gathering procedures above. The following chapter comprises a discussion of the research main findings that set the groundwork for the research to establish its purpose throughout establishing a set of proposals targeted at enhancing the current national C&D waste management strategy in Jordan.

7 Discussion of the Main Findings

This chapter gives an overall understanding on all the above chapters encountering the research objectives to achieve its aim as outlined in **chapter 3**. It is the author's conviction that the aim, objectives and question of the research have been met and answered, through adopting a mixed eclectic approach that involved several research techniques.

In summary, this chapter aims to help the reader to understand and build a holistic picture and argument to demonstrate that there is a problem in C&D waste management in Jordan. Which should be resolved by viable solutions and proposals as demonstrated in **section 8.5**.

The main findings of the work can be sub-divided into 5 categories, which are summarized below individually in **sections 7.1, 7.2, 7.3, 7.4** and **7.5**:

1. Existing literature:
   This section summarises findings related to gaps in and the out-of-date nature of the existing literature on the Jordanian construction sector. It continues by describing how this effort addresses many significant gaps in the literature (or could be tackled in the future) as demonstrated in **chapter 2**.

2. Positive environmental and economic impacts:
   This section summarises the findings that were outlined in **chapter 4** about the environmental and economic impacts of the Jordanian construction sector. Specifically, the manufacture of concrete and the generation of C&D waste. The potential positive impacts of improving Jordanian construction are therefore established.

3. Constraints within Jordan's construction industry:
   This section summarises the main findings of problems associated with waste management in the Jordanian construction industry. As based on the results of **chapters 5** and **6** of the research.

4. Proposals for improving C&D waste management strategy in Jordan:
   This section outlines the research output of proposals aiming to enhance the current C&D waste management strategy in Jordan as based on the results of **chapters 5** and **6** of the research.

7.1 Gaps in and Obsolescence of the Jordanian Literatures

According to the study's review of the literature, most research has concentrated on a few key aspects of waste management. These discrete aspects were mostly associated with solid waste management (**section 2.4**).

In fact, there is a dearth of thorough literature about the Jordanian construction industry. Current construction and demolition methods (contractual arrangements) and waste management are included. In addition to, quantifying the environmental and economic benefits of C&D waste recycling as outlined in **sections 2.6** and **2.7**. Regrettably, the extant study on the subject is descriptive in nature and limited in scope. Additionally, the Jordanian construction sector has received less attention. As no study has attempted to quantify the industry's impacts. This includes analysing the utilisation of construction material and the generation of C&D waste (**section 2.5**).

The key knowledge gaps identified throughout the literature review are summarised in **table 7-1**.

Main Gaps in Knowledge	Methods covering the Identified Gaps
• Estimation of the environmental impacts of the Jordanian construction industry. Including majorly the extraction and manufacturing amounts of construction material (concrete and its components). • Quantifying the volume, composition and percentages of C&D waste generated from construction and demolition projects. • Identifying the contractual arrangements of construction and demolition operations. • Recognizing the critical nature of C&D waste management in the country. In addition to determining the ramifications of implementing this management and the way forward in Jordan. • Identifying the reasons behind the informal dumping of C&D waste. Particularly when regulations permit to dump waste formally in landfill sites. • Identifying the potential economic value of recycling CCA.	Questionnaires, Interviews and archived data

Table 7-1: Identified Gaps in Knowledge in L.R

In general, the gaps identified in **chapter 2** have revealed several questions that needed further investigation as explained in **chapter 3**. Utilising research to cover knowledge gaps and conducting an exhaustive examination of the subject, as illustrated in **chapters 4, 5,** and **6**. Tackling the problems of C&D waste and determining the measures necessary to push the construction industry toward C&D waste management. Throughout establishing a set of proposals as based on the research purpose.

7.2 Technical Viability of Jordanian Crushed Concrete Aggregates

Jordan does not encourage CCA recycling, despite global attitudes (practices and studies) toward using CCA in new concrete mixes as mentioned in **section 3.5.6.2**. Thus, to minimize mechanical ambiguity or misinterpretation, the technical viability of CCA was investigated.

The study's results corroborated several previously established facts about Jordanian CCA's physical and chemical properties as outlined in **section 2.8**. Including gradings, bulk density, specific gravity, water absorption, fragmentation, Sulphate and Chloride content. Therefore, CCA is theoretically feasible for application in new construction, as shown by testing. Which overall, corroborate previous international and Jordanian research.

7.3 Positive Environmental and Economic Impacts

Jordanian literatures and studies such as Hadadin N. and Tarawneh Z.S. (2007), Al-Rifai J. and Amoudi O. (2016), JGBC (2016), GIZ (2014) and Bekr G.A. (2014) are widely viewed as having significant weaknesses to engage with current discourses. On how the Jordanian construction industry interacts with other variables correlated to a variety of environmental, social and economic issues. Such as Cheng K. et al. (2018), Augiseau V. and Barles S. (2017), Pacheco-Torgal F. et al. (2017), Iacovidou E. and Purnell P. (2016), Ness D. et al. (2015), Zea Escamilla E. et al. (2016), Llatas C. (2011), Faleschini F. et al. (2016), Coelho A. and de Brito J. (2013), Marzouk M. and Azab S. (2014), Ram V.G. et al. (2020), Zheng L. et al. (2017), Chau CK et al. (2017), Huang B et al. (2018), Faleschini F. et al. (2016), Llatas C. (2011), Coelho A. and de Brito J. (2013), Marzouk M. and Azab S. (2014), Ram V.G. et al. (2020), Zheng L. et al. (2017), Ye G. et al. (2012), Ding Z. et al. (2016) and Akanbi L.A. et al. (2018).

The study attempted to examine the numerous ramifications of the country's construction industry using archival data as in **chapter 4**.

7.3.1 Raw Material Extraction and Construction Material Manufacturing

According to the study's empirical findings as outlined in **section 4.1.1**. Jordan manufactured over 5 million m^3 of concrete in 2019, supplying only the local market. It additionally, utilises approximately 4 to 4.25 million m^3 of aggregates. **Section 4.1.1** contains additional statistics on various concrete components.

This illustrates that the construction sector has a significant impact on Jordan's environment. By causing depletion in natural resources, releasing greenhouse gas emissions, consuming energy as outlined in **section 4.1.2**. In addition to, having a significant impact on Jordan's economy via transportation costs of raw material as seen in **table 4-5**.

7.3.2 Landfill and Land Reclamation

The research has advanced to distinguish the relationship between the Jordanian construction sector and landfilling of C&D waste.

According to **section 4.2**, Jordan's northern and central regions have a limited number of public and private C&D waste landfill sites. This study raises serious concerns about the handling of C&D waste in the South. That no C&D waste generated may be disposed of in the southern region on an official basis (**section 4.2**).

According to this data, 2.9 million m^3 of C&D waste were legally disposed of in permitted landfill in 2019. Nearly 2 million m^3 were dumped in the central region, while 0.9 million m^3 were dumped in the north. Construction and demolition operations are more prevalent in the middle region than in the other areas, which explains the geographical disparity. Amman's dense population and environs attest to this.

Additionally, there is a distinction between public and private landfill. By determining that private landfill receive a greater volume of C&D waste than public landfill. Even if the cost of private landfill disposal is somewhat greater. These findings demonstrate that transportation distances influence permissible landfilling. As a result of the closeness of construction and demolition sites. A growing body of data demonstrates that long transportation distances contribute to informal dumping by raising transportation costs, fuel consumption, and journey duration.

As seen in **section 5.1.1.2**, about 50% of C&D waste generated is disposed of informally. This allowed the research to predict that around 6 million m^3 of C&D waste was generated in total. However, using the volume estimated above and in **section 4.2**, the volume of C&D waste generated may be greater than 6 million m^3. Due to the southern region's scarcity of landfill sites.

Regardless of the volume, informal disposal of C&D waste may influence the environment. According to Yuan H.P. (2008), in addition to damaging surface and groundwater, it may also pollute the air and soil. Apart from posing serious health hazards and inflicting damage to people, as most of informal dumping sites are freely accessible to the public (Yuan H.P., 2008).

Additionally, this analysis uncovered land reclamation or valley rehabilitation in Jordan's private landfill (**section 4.2**). This was the first comprehensive investigation of these landfill. This concept is adopted in these areas to be utilised for small factories (hangers) or agriculture after leveling. While economically benefiting from the application of disposal fees. This concept appeared to be similar to informal dumping. As regrettably it is adopted without regard for environmental considerations causing several environmental and social effects such as leachates released from solvents, adhesives, or the primary construction material itself which may contaminate the underlying soil and groundwater (Galvín A.P. et al., 2012 and Rosado L.P. et al., 2017). Unfortunately, municipalities permit landlords to operate dumping operations on their property. **Section 4.2** discusses land reclamation in further detail.

7.3.3 Composition of Construction and Demolition waste

The archival data enabled the identification of different components of C&D waste landfilled in 2019. Excavation waste accounted for nearly 60% of the total composition. Then followed CCA, which accounted for around 17% of the total and masonry, which accounted for 10%. Additional wastes included steel reinforcement, tiles and ceramics, gypsum board, and plastics, which contributed up around 5% of total waste (**section 4.2**).

7.3.4 Opportunities for Economic Benefits

This study established that C&D waste is a valuable economic resource that, when properly managed, may be recycled (**section 4.3**).

According to the research findings in **section 4.2**, CCA accounts for 17% of total C&D waste in Jordan in 2019. Considering the amount projected in **sections 4.2** and **6.1.1.2**, this equates to about 1.02 million m^3. If recycled, this amount would have a significant economic value in Jordan. According to Jain S. et al. (2018), around 75% of concrete waste is recyclable. Thus consequently, recycling CCA might save Jordan around 11.5-13% of the total cost of extracting and transporting standard aggregates excluding the costs of manufacturing new concrete mixes with recycled aggregates. This percentage accounts for 3.06 and 3.44 MJOD from the total cost of 24 and 29.7 MJOD in 2019, respectively, including transportation costs (**section 4.3**).

7.4 Constraints within Jordan's Construction Industry

The findings of this study provide new insight into the issue of C&D waste. By demonstrating that most concerns about C&D waste are associated with governmental controls and industry actors including as outlined in **chapters 5** and **6**:

Concerns	Issues
Management Controls	Legal frameworks, regulations and clear responsibilities
	Oversight, supervision and strictness
	Waste disposal systems and recycling facilities
	Types of contracts used
	Procurement methods
	Studies and Research
Contractors Perspective	Local actors' awareness, willingness and economic preferences
	Presence of informal labourers

Table 7-2: Main Hindrances to the Jordanian Construction Industry

Through surveys and interviews, we may glean more information on primary and secondary findings as seen in the fish bone diagrams in **chapters 5** and **6**. Which impede the effectiveness of the present national C&D waste management strategy in Jordan and causes informal dumping. Notably, this section discusses only the most crucial repercussions, as seen in **sections 5.2** and **6.5**.

7.4.1 Management Controls

Numerous challenges hamper the efficacy of C&D waste management, as shown by the findings of the surveys and interviews chapters. Although, this part covers the most critical aspects. These chapters shed new light on the issues of C&D waste. By comprehending that this issue is mostly hindered managerially rather than technically in Jordan.

According to **sections 5.2.1, 5.2.2, 5.2.3 and 5.2.4**, many obstacles impede the management of C&D waste, including the following:

1. The general lax of legislative controls.
2. Insufficient procurement methods, particularly for demolition projects.
3. The industry actors' perspective.
4. The absence of recycled waste material design codes.
5. Poor demolition techniques.

Meanwhile, according to **section 6.2**, the most contributory factors to impede a wide variety of professions from implementing a proper C&D waste management, include:

1. The dearth of studies and workshops.
2. Cost and time waste.
3. The industry actors' perspectives.

For informal dumping, several factors appeared to exert a powerful effect on proper landfilling according to **chapter 5** including the following:

1. Lack of legal frameworks and regulations.
2. Lack of oversight, supervision and strictness.
3. Poor waste disposal systems.
4. The involvement of local actors.
5. Cost and time waste.

According to **section 6.4.1**, the most contributory factors hindering the formal dumping of C&D waste are as follows:

1. Lack of monitoring.
2. Cost and time savings.
3. Long traveling distances to permitted landfill.

This section is best categorised under six sub-sections which are legislative controls, design codes, recycling, research and studies, procurement methods and demolition operations.

7.4.1.1 Legislative Controls

The lack of design codes and the exclusion of C&D waste from current solid waste regulatory system have a tenuous link (**section 5.1.2.1**). This is because C&D waste is classified as a special type of waste. Requiring specific controls that cannot be included in the most recent regulatory framework. This exclusion adds to the mismanagement of C&D waste. By prohibiting industry actors from separating and recovering waste generated expressly. Inadequate sorting and recycling instructions significantly impair the efficacy of C&D waste management. Therefore, mixed C&D waste is disposed informally or formally.

Considering landfill restrictions and the prevalence of informal dumping, research has cast doubt on the effectiveness of regulatory measures. Thus, further study was conducted to better understand the current C&D waste legislations within the regulatory framework for solid waste management.

The research identified numerous reasons for the absence of key activities in current C&D waste management practices (**section 5.1.3**).

In terms of design out waste of projects, the survey discovered several impediments to design out waste activities including:

1. Insufficient governmental restrictions which include:
    a. Lack of regulations.
    b. Inadequacy of existing regulations.
    c. Enforcement of regulations.

According to **section 5.1.3.2.2**, the primary impediment to on-site sorting was a dearth of regulations. This absence of legislations is criticised, especially when industry participants seek to sort steel and timber. Thus, casting doubt the effectiveness of the regulatory measures. Concluding that it may be trivial to include sorting regulations into the regulatory system.

Jordan's contract provisions for C&D waste management seemed unimpressive. As they permit the use of generated waste for backfilling, only when it has been experimentally proven. This authorisation is embraced for all waste types except CCA. The following are the primary shortcomings of this permit:

1. Waste would be never reused except for backfilling even when experimentally feasible.
2. Encouraging to dump CCA either formally or informally even when experimentally feasible.

This strategy could be a main hindrance to C&D waste management as confirmed by questionnaire surveys and interviews results. Since it may contribute to the failure of CCA to be repurposed even when empirically viable to be reused.

In terms of landfilling, the research has aided in gaining a better understanding of how governmental restrictions has facilitated to informal dumping including:

1. The absence of legal frameworks and regulations.
2. Lack of oversight, supervision and strictness.
3. Poor management and waste disposal systems.

7.4.1.2 Design Codes

The absence of design codes impedes the use of recyclable waste material and the development of design out waste of projects as indicated by 52.04% and 91.6% of surveys participants respectively (**sections 5.1.3.2.4** and **5.1.3.3.2**).

This absence inhibits the use of recycled waste material in construction. As without official approval of the project's design, a construction permit cannot be acquired. Additionally, design codes can certify quality assurance for actors that recycled waste material are suitable for usage in construction. Particularly actors who are unaware, as seen in **section 5.1.5.2**.

Not acquiring a construction permit is associated with the design codes being legally regarded as the second priority in the documentation hierarchy following contract signing (**section 6.1.1**). Thus, recycled waste material cannot be lawfully used and designers who push for the use of recycled waste material would be met with rejection.

As discussed in **section 5.1.3.3.4**, developing design codes is challenging owing to the associated costs and time constraints. However, the Jordanian National Buildings Council’s reluctance to participate in the research hampered to fully ascertain the hindrances of its development (**section 5.1.3)**.

7.4.1.3 Recycling

Results of surveys as seen in **section 5.1.3.2.4** indicated that recycling of C&D waste could be hindered by several factors including majorly:

1. The lack of demand for recycled waste material:
   This could be attributed to local actors’ poor awareness or the absence of design codes. Including the benefits of C&D waste recycling and the quality assurance of recycled waste material.

2. Inadequate infrastructure, or the scarcity of recycling equipment in the industry:
   This may allow actors to pay more to providing recycling facilities which may make landfilling less expensive than recycling C&D waste.

7.4.1.4 Research and Workshops

According to interview results, a lack of research and workshops is a significant impediment to developing a C&D waste management strategy (**section 6.2.1**). This may serve to highlight the topic's executional importance. This lack has notably a significant impact on majorly the existence of regulations and the establishment of design codes. Additionally, it would exert to keep actors not aware of the know-how of C&D waste management and the environmental, social and economic benefits. Particularly, those with an interest in the management of C&D waste or those with a visualisation that landfilling of C&D waste is a cost-effective and environmentally friendly method (**section 6.2.1**).

7.4.1.5 Procurement Methods

According to the survey findings in **section 5.1.2.3**, low bids were utilised to acquire construction projects, causing an impediment to the current C&D waste management. Confirming that economic interests take precedence above all other considerations. This corroborated the findings of the interviews. As one of the main impediments to C&D waste management strategy is the cost and time loss involved (**section 6.2.1**). Particularly when there is a more affordable legal alternative available (landfilling).

This raises serious concerns about project standards and quality and overlooking less critical tasks as seen below, because low investment compensates for substandard quality and activities:

1. Legal dumping.
2. C&D waste management.

This survey intended to distinguish the procurement practices of construction and demolition projects. The procurement methods for the two activities seemed to be distinct. As noted, before in **section 5.1.2.3**, demolition projects are acquired without regard for selection criterion. This might be related to observing demolition as a trivial activity. Although, demolition only considers two factors mentioned in the next section.

7.4.1.6 Demolition Operations Requirements

Results of interviews indicated that requirements of construction and demolition activities are inadequate to effectively control them. Since both activities require municipal approval prior to commencing work.

These approvals in demolition are accompanied with a deposit that is refundable, only if the estimated volume of C&D waste generated is approximately equivalent to the volume of C&D waste dumped in permitted landfill sites. That seems to be not well-established as per the rates of informal dumping as demonstrated in **sections 5.1.2.3** and **6.1.1**.

In addition to this, the JCCA requires additional obligations including as seen in **section 6.1.1**:

1. Ensuring the demolition activity to be carried out under the supervision of an engineering firm.
2. Ensuring the application of necessary safety precautions and measures.

This indicates that the industry actors will encounter no further restrictions on demolition projects than those mentioned above. This complements those results of **section 5.1.3.3.2**. Indicating that demolition in Jordan is an ineffective technique. That may be strongly correlated to the contractual arrangements of demolition.

7.4.2 Contractors' Perspective

7.4.2.1 Involvement of Informal Workers

The current absence of few activities in C&D waste management do not mean that existing activities such as collection is not hindered by few implications.

According to the results found in **section 5.1.3.2.1**, collection may be hampered by:

1. The involvement of informal labour.
2. A lack of skills and knowledge among local actors.

7.4.2.2 Willingness

According to surveys, the economy is the primary concern of Jordan's industry actors. As stated in **section 5.1.5**, environmental and social concerns are not prioritised above economic concerns. As previously said, industry participants may place financial concerns ahead of all other considerations. As seen by low-bid construction projects or environmental concerns being considered as a component of luxury or prestige. Thus, no economic benefit is likely to have a significant impact on the implementation of C&D waste management.

As seen in **sections 5.1.5.2.2** and **5.1.5.2.3**, industry participants are enthusiastic about the prospect of using recycled aggregates into new concrete mixes. The acceptance of participants is contingent upon the availability of design codes for recycled waste material. Their existence would certify the recycled concrete's quality and performance for use. Their willingness has been constrained by two key constraints:

1. The final product's price.
2. Quality assurance through design codes.

This could be of great recognition, however, if recycled aggregates are priced similarly to or more than virgin aggregates. As mentioned in **section 5.1.5** and **chapter 10-appendix III**, they would not be used by industry actors. Even if recycling occurs, recycled aggregates will be of little use. These findings and studies corroborate previous research indicating that construction sector actors place a premium on economic factors.

According to interviewees, standard materials are inexpensive and there are no set design codes. Local actors' willingness to embrace C&D waste management is contingent on their knowledge, according to respondents in **section 6.3.2**. Thus, without clarity on pricing and quality, C&D waste management implementation may be hindered. Therefore, with information confirming the economic benefits and safety of recycling or incorporating recycled material into new concrete mixes, actors may reconsider their beliefs.

A broad agreement among industry actors indicating their willingness to control C&D waste or recycle discarded waste according to the findings of **section 6.3.2**. Especially if the advantages and feasibility of C&D waste management are fully recognized.

Controversy surrounds the management of C&D waste. As indicated in **section 6.2.1**, actors refer to cost and time waste as significant impediments to implementing a national strategy for managing C&D waste. According to them, C&D waste management may include numerous activities, including waste design, collection, sorting, recycling, and landfilling. Thus, C&D waste management may be hindered, particularly when landfilling is permitted. Which is inexpensive and expedient (**section 2.7)**. If dumped improperly, this procedure is far less costly and time intensive.

Other implications to actors' willingness to adopt C&D waste management as found in **sections 6.1.1** and **6.3.2**:

1. The bulk of today's construction companies that were founded by ancestors. Those ancestors are seemed to disregard developing new technologies such as C&D waste management.
2. The low rates of demolition in Jordan, although it may be adequate for Jordan to help neighbouring countries such as Syria and Iraq, which are ravaged by civil conflicts and devastation.

7.4.2.3 Reasons of Informal Dumping

As indicated in **chapters 5** and **6**, there are several causes for informal C&D waste disposal in Jordan, these include:

- High costs of waste disposal:

  The high expense of waste disposal in Jordan seems to encourage informal dumping of C&D waste (**sections 5.1.3.2.3** and **6.4.1**).

  According to participants, these costs include fees for authorised disposal sites (charging schemes). However, it seems as if participants' understanding of the repercussions of legitimate dumping is imprecise, due to the low operating costs, as seen in **section 4.2.1**. This misunderstanding might be related to transportation expenses. Since there is a limited amount of licensed landfill sites. Therefore, transporting C&D waste to a permitted landfill entails lengthy distances. **Section 4.2.1** outlines the locations of permitted landfill.

  According to the statistics in **section 5.1.3.2.3**, long transportation distances to landfill also impede the delivery of C&D waste. Regardless of landfilling regulations, this has been seen as the primary deterrent. With an average of 84.18% of respondents this causes an increase in the transportation costs of C&D waste disposal. This hindrance may be proved, as seen in section **4.2.1**, comparing the quantity of C&D waste disposed of in private and public landfill.

As indicated in **section 6.4.1**, the long distances to authorised landfill sites results to increase of fuel consumption, expenses, and travel time. This corroborates the finding in **section 4.2.1** that private landfill sites receive a greater proportion of C&D waste than public ones. Indicating that prolonged journey time has a role in informal dumping. Consequently, actors off-load C&D waste to dispose of more waste dumps while spending less money and time on transportation (**section 6.4.1)**.

- Inadequate governmental controls:

As discussed in detail in **sections 5.1.1.3** and **5.1.3.2.3**, survey participants contributed to the conclusion that governmental implications have a significant influence on the informal disposal of C&D waste. These implications have included:

1. Lack of regulatory framework.
2. Lack of monitoring, supervision and strictness.
3. Poor waste disposal systems.

This demonstrates the government's contribution to the growth of informal C&D waste disposal. That seems reasonable given their duty for waste disposal oversight amongst other industry actors. Despite current legislation regulating authorised dumping and greater contractor accountability for waste disposal.

When a government is overthrown, the survey's results indicate a strong correlation between this attitude and the participation of local actors. It is debatable if local actors are involved in this problem due to their current attitudes toward steel and timber recycling. Thus, interviews were conducted to elucidate these aspects further and, where feasible, to integrate other explanations.

According to interviews findings, additional significant factors contributing to informal disposal of C&D waste as seen in **section 6.4.1** include:

1. Lack of supervision and monitoring.
2. Contribution of cost and time savings that is linked to long distances.

Contrary to survey's results, current informal dumping is not the result of a porous regulatory system. Particularly when regulations require actors to utilise permitted landfill. But rather of a deficient oversight, supervision and strictness. This is due to the small number of monitoring personnel in comparison to the number of contractors or transporters. In addition to the short period of monitoring hours that is from 8:00 am to 5:00 pm only. This is consistent with **section 5.1.3.2.3**, which stated that a lack of monitoring over waste disposal systems impedes formal C&D waste dumping.

The research may delve into the constraints of effective C&D waste management and authorised landfilling with a better understanding of the major and minor implications. Enabling it to establish a relationship between various solutions and approaches for overcoming these constraints and implement a proper C&D waste management and formal landfilling. This understanding enabled the study to achieve its output by developing a set of proposals as outlined in the research purpose.

7.5 Proposals for Improving Construction and Demolition Waste Management in Jordan

The analytical procedures and the results obtained from questionnaires and interviews have been firm to identify several problems associated with hindering the C&D waste management in Jordan. Accordingly, the observations of the research suggest that a strong link may exist between several approaches and the enhancement of the current situation.

The research was conducted by the critical need to improve Jordan's national strategy on C&D waste management that the development of a national strategy and protocol for the management of C&D waste may be a reasonable approach to tackle the issue of C&D waste management in Jordan. Although, this could not be achievable in PhD research as it needs an extensive effort by several teams. Therefore, to realise this purpose, the aim of the research has been formulated to “establish a set of proposals aimed at improving the national C&D waste management strategy that should be obtaining a recognition and acceptance from the Jordanian construction industry while also attaining recognition that recycling of C&D waste is both desirable and achievable and that informal dumping of C&D waste should be eliminated”.

This section outlines the output of the research and presents few proposals for further research.

7.5.1 The Key Aspects of Proposals

As previously indicated, these proposals were developed based on data obtained from surveys and interviews. Due to response bias and/or a small sample size, these proposals may be unreliable. Thus, they must be prudently expanded and interpreted with caution. Consequently, these proposals were presented to Jordanian construction industry stakeholders (**section 3.5.6.4.3**). **Chapter 10-appendix V** details the analysis of these proposals that resulted in the presentation of the chapter's final inclusive proposals demonstrated below. As the overall findings reveal to a large extent these proposals are both sensible and effective in Jordan.

Before introducing these proposals, the analysis enables us to appreciate and envision how the Jordanian government might promote C&D waste management by:

1. Altering its current mind-set that depends on developing strategies or regulations only if essentially required based on the extent of the issue.
2. Being the first actor to adopt such a strategy to encourage and convince other actors within the industry.

To better understand the key aspects of proposals, the research classified them into several taxonomies based on their type as follows:

1. Improved Legislation / Government Regulation.
2. Industry and Workforce Development.
3. Improved Planning and Development of Strategies.

The key policies should therefore include the following proposals that assist their initiation:

A. Improved Governmental Legislation and Regulation:

- The government should suggest that governmental requirements include a standard set of primary C&D waste management operations as a necessity (refer to **section 5.1.3, 5.1.5, 6.3.1** and **6.4.2** for further clarifications). As it clarifies for actors which procedures are permissible or prohibited during contract bidding. This might be accomplished in the following ways:
    1. Adding provisions to specifications and bill of quantities to incorporate sorting and C&D waste recovery movements.

    2. Amending a provision in specifications and bill of quantities to include the use of recycled CCA for lower utilisations after experimental testing. As a means of quick commencement that does not need the application of design codes, such as platform and sidewalks (refer to **section 5.1.3.1** and **5.1.4.3** for further clarifications).

- The government's waste regulatory system's obligations should be clarified. By removing any misunderstanding and doubt about obligations and establishing clear norms for accountability in the waste sector (refer to **section 6.1.1** for further clarifications).

B. Industry and Workforce Development:

- Acquiring sorting equipment and recycling facilities or plants for the industry (refer to **section 6.3.1** for further clarifications). This may be accomplished by either acquiring equipment by:
  1. The public sector, which is represented by ministries or municipalities.

  2. The private sector, as represented by businesses. Although the government should provide a few incentives to the private sector for the purchase of such equipment, such as:
     a. Tax breaks for locally manufactured equipment.
     b. Customs exemptions for imported equipment.

  3. Public-private partnerships with non-governmental organisations.

- The government should provide incentives to encourage the industry's numerous suppliers to alter their existing attitudes and mindsets. To provide industry with recycled waste material rather than natural raw material to circumvent monopolies. (For more explanations, **section 5.1.5**).

- The government and the private sector should collaborate to create marketing strategies for the local market to increase the demand for recycled products.

- Encouraging the formation of actors accountable for the whole waste sector through the following measures to reduce the number of actors engaged and liable for waste (for more details, **sections 6.3.1** and **6.4.2**):
  1. Private waste removal firms that operate on an individual basis.
  2. Commission for the management of municipal solid waste by the government.

- Construction industry associations such as the Jordanian Engineers Association (JEA) and the Jordanian Construction Contractors Association (JCCA) should impose strict requirements for well-trained, skilled and formal workers to work in the construction sector (refer to **section 5.1.2** and **5.1.4.3** for further clarifications). This might be accomplished in the following ways:
  1. The creation of on-site Environmental Project Manager (EPM) or Environmental specialist. This job should be obligatory in any construction or demolition project.
  2. Increasing laborers' awareness of the hazards linked with C&D waste.
  3. Strengthening oversight of construction companies' adherence to existing labor laws.

- Increase the price of conventional material while decreasing the price of recycled material at the same low pace.

C. Improved Planning and Development of Strategies:

- The government and the private sector should encourage the elimination of waste from projects by design, whether for prevention, reduction, or deconstruction, by (for more explanations, **sections 5.1.3.1** and **5.1.4.3**):
  1. Delegating guidance and engagement with customers, contractors and material suppliers to designers. In other words, designers should serve as a liaison between industry stakeholders.
  2. Enabling designers to employ Computer-Aided Design to do more precise measurements to minimize excess waste material.

- The government should collaborate with the private sector, university researchers and academics to develop design codes for recycled waste material (refer to **section 5.1.5** and **6.3.1** for further clarifications).

- The government should increase monitoring and oversight of its organisations and municipalities to ensure that construction contractors adhere to their contractual commitments and responsibilities throughout:
  1. Developing a tracking system for waste transporters (refer to **section 6.4.2** for further clarifications).

  2. Expanding the monitoring period to a 24-hour basis (refer to **section 6.4.2** for further clarifications).

  3. Restrict the ability of C&D waste transporters to dump waste at disposal sites to a certain period. For instance, between 8:00 a.m. and 5:00 p.m., depending on the monitoring period.

  4. Increasing the number of employees in charge of monitoring to compensate for the number of contractors in charge of landfilling (refer to **section 6.4.2** for further clarifications).

- The government should incentivize industry actors such as contractors, transporters and investors to recycle C&D waste material via the following measures:
  1. Providing additional built-up area on top of the regulated built-up area. Although the city's design should be considered to minimize degradation (refer to **section 6.3.1** for further clarifications).

  2. Offering tax exemptions or reductions on contractor licensing (refer to **section 5.1.5** for further clarifications).

  3. Augmenting to add an optional parameter to upgrade contractors that recycle C&D waste material from class to another (an upgrade parameter similar to equipment, number of engineers and total expenditure on completed projects) (refer to **section 6.3.1** for further clarifications).

  4. Providing certifications to recyclers and associating them with tax breaks or other recognition (refer to **section 6.3.1** for further clarifications).

  5. Reduce the expenses of C&D waste transportation to licensed landfill sites by providing discount coupons to waste transporters or contractors or reducing the fuel prices (refer to **section 6.4.2** for further clarifications).

6. Impose high fines and penalties on polluters (refer to **section 6.4.2** and **6.1.5** for further clarifications). Under the aspect of polluters must pay which elucidates the greater the amount of waste deposited, the greater the charge to be paid. Thus, greater incentive to recycle. Additionally, the imposition of charges for polluters or non-compliance obliges construction companies to keep track of the generation of waste during the project.

7. Increasing landfill taxation or fees to prevent or reduce this activity on a low pace.

- Increase the number of landfill sites across the country, particularly in the southern area, if only to curb informal dumping (**section 4.2.1** for more details) by either:
  1. The government.

  2. Collaboration between landowners and government to expand the number of landfill (private or reclaimed land) (refer to **section 4.2.1** and **7.2.2** for further clarifications).

- Develop the concept of land reclamation, even only to curb informal dumping, by:
  1. Developing this concept in accordance with environmental and social measures designed to mitigate the effects of land reclamation (refer to **section 4.2.1** for further clarifications).

Chapter 10-appendix V provides examples of how these proposals have been implemented in many places worldwide and in Jordan. To bolster and reinforce the efficacy of these proposals if applied.

The next chapter presents a conclusion that the entire study is summarised and recommendations are made about how the work might be improved in light of the research results and which areas deserve future investigation.

8 Overview and Proposals for Future Research

This chapter outlines an overview of the research and provides further recommendations. It demonstrates how the research aim was achieved through tackling its objectives.

8.1 Research Overview

The basic idea of the research initiated from the need to offer proposals in Jordan to improve the C&D waste management. To realise this purpose, the aim of the research has been formulated and achieved via several objectives as seen in **section 1.2** and **3.5.5**.

Significant literature research was undertaken to accomplish the first, second and third research objectives. Integrating comprehending international waste management best practices and Jordan's unique characteristics construction sector. Including the fundamental activities of design, construction and demolition through an examination of material extraction, production and transportation, as well as regulatory and legal frameworks. Additionally, it illustrates the industry's environmental, social, and economic consequences. It made a distinction between C&D waste generation and its causes throughout design, construction, and demolition activities. Additionally, it emphasizes and discusses potential challenges to C&D waste management adoption as well as strategies.

As seen in the table below, a review of the literature in Jordan revealed a significant dearth of reliable data on C&D waste management. Laying the groundwork for the research to investigate these gaps.

No.	Main Gaps in Knowledge
1	Estimation of the environmental impacts of the Jordanian construction industry including majorly the extraction and manufacturing amounts of construction material (concrete and its components).
2	Quantifying the volume and percentages of C&D waste generated from construction and demolition projects across Jordan either formally or informally dumped.
3	Identifying the contractual arrangements of construction and demolition operations.
4	Recognizing the critical nature of C&D waste management in the country and determine the ramifications of implementing this management and the way forward in Jordan.
5	Identifying the reasons behind the informal dumping of C&D waste, particularly when regulations permit to dump waste formally in landfill sites.
6	Identifying the potential economic value of recycling CCA.

Table 8-1: Identified Main Gaps of the L.R

Following the identification of these gaps, the research employed a nested approach to emphasize main themes and overview research philosophies. It designed a data gathering process to accomplish the research aim and objectives. "The Research Data Collection Process" was the title of the research’s design and methodology.

During the research primary investigation, it was determined that a trustworthy unpublished material had been kept in government and business databases. Included are data on the environmental impacts of the Jordanian construction industry. Contributing to fulfil of gaps in knowledge by examining how this industry used natural resources, energy to manufacture concrete, and formally dump C&D waste in 2019. In addition to answering a part of the research question through estimating the potential economic value of recycling CCA in Jordan. Although it is unfortunate that few required data have not been available in those databases. Thus, they remained to be unknown.

One of the mixed methodologies used to analyse data on C&D waste management and formal landfilling impediments was the questionnaire surveys. By identifying the underlying causes that may be deemed significantly connected with its current failure during the design, construction and demolition activities.

The data were analysed statistically, using percentages or actual numbers. To illustrate the respondent’s distribution across all items of investigation. Additionally, a substantial amount of raw data was summarised and classified using a formal term of analysis known as the frequency distribution (category frequency). To ascertain the number of individuals or cases belonging to each group.

To have a better understanding of the ramifications of C&D waste management. The research examined the limits on effective C&D waste management and formal landfilling approaches and implementation using semi-structured interviews.

Following that, an overview of Jordan's waste management strategy was provided. This data visualization technique enables the presentation of C&D waste management outcomes in more detail. To summarise the investigation's conclusions, the following categories were established:

1. Identifying the barriers to the effectiveness of C&D waste management.
2. Identifying the approaches that could overcome the implications behind ineffective C&D waste management.
3. Assessing the construction industry's perspective including willingness and practicality.
4. Analysing the most likely causes behind informal dumping.
5. Assessing the driving forces that could lead to a reduction in informal dumping.

In summary, the **chapter 2** gaps raised a variety of problems that need more investigation (**chapter 3**). Confronting the research to take a more holistic approach to bridging knowledge gaps and thoroughly investigate the subject, as seen in **chapters 4, 5**, and **6**. To address the issue of C&D waste in Jordan and to identify necessary improvements in the construction sector. Throughout developing a set of proposals targeted at enhancing the present national strategy for managing C&D waste, as detailed in **section 7.5**.

These proposals are based on the results of surveys and interviews and are intended to provide a unified standard benchmark for an effective national C&D waste management strategy. It can be stated that these proposals have found acceptance within the Jordanian construction industry upon their evaluation.

Lastly, the research has established a course of recommendations that provides a basis for others to build on this work. Based on the research gaps discovered and the limited scope of the research that could not entirely cover all the matters related to the Jordanian construction industry.

8.2 Recommendations for Future Research Trends

This study established several recommendations for further research on C&D waste management in Jordan. Due to the limited scope of the investigation, the researcher was unable to investigate all facets of the Jordanian construction industry, notably C&D waste. Thus, further study of additional subjects is required to be expanded upon by others.

Based on extensive discussion of main research streams and scient metric analysis. Future research trends of C&D waste management were proposed in light of the identified research gaps. Prior to introducing these trends, it is important to bear in mind that this was the first comprehensive study and the largest to date. Documenting a delayed onset of C&D waste management in Jordan. The following subjects are recommended to be explored in the future to formulate systematic control measures accordingly:

1. Current studies in Jordan offer no explanation for the distinction between C&D waste management and its benefits. Therefore, further research should be carried out to establish, simulate and analyse the potentials of implementing C&D waste management in Jordan.

2. Previous research ignores the contractual arrangements, stipulations and procurement methods of the industry activities especially the ones related to C&D waste.

3. Existing research on the environmental, social and economic impacts of the construction industry have been descriptive in nature and based upon data from over 10 years.

4. There is a lack of source classification and volume of C&D waste in Jordan. In addition to the problems caused by this type of waste that are overlooked which have become recently increasingly prominent, particularly when C&D waste has relatively a large economic value.

5. The present studies made no attempt to quantify the association between demolition and waste generation. As few of them were only concerned with waste generated from construction activities.

6. The determination methods for contaminants in C&D waste and its toxicities in land reclamation are currently not available in Jordanian studies. Thus, there are still limitations in understanding the complexity of the environmental impacts of C&D waste in land reclamation in Jordan.

7. Present studies have not considered the dynamic nature of the C&D waste disposal in Jordan whether they were dumped formally or informally.

8. Current studies provide a comprehensive assessment of the characteristics of recycled waste material, although they were relatively few.

9. The development of a national C&D waste management strategy, in addition to its hindrances and approaches of implementation have been disregarded in all studies.

10. The current research in Jordan do not take account of the environmental impacts of recycling C&D waste material. If recycling was promoted in Jordan and the application of using recycled products have been continued.

11. Informal dumping has become a new treatment method to quickly dispose C&D waste in Jordan due to several reasons. Which has solved the urgent needs of many transporters and contractors. This informal dumping currently suffers from a lack of research, which is in need for further research to examine several aspects more closely.

12. The existing charging schemes for C&D waste disposal in Jordan is based on the volume of C&D waste only and considered to be very low. Which lacks the important factor of considering its impacts. Therefore, further modelling work will have to be conducted in order develop and improve the current charging system.

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10 Appendices

10.1 Appendix I – Methodology

10.1.1 Research Methodology

Checkland P. (2005), Easterby-Smith M. et al. (2011) and Sherif K.F. (2010) defined the methodology as a combination of techniques for investigating a particular instance comprising solving problems aiming to answer the question of how and what.

According to Hussey J. and Hussey R. (1997) and Bell J. (2005), research methodology is defined as an overarching approach to the research process that encompasses:

1. Defining the problem.
2. Developing the theory.
3. Drawing conclusions based on the research objectives and the research methods. Including the instruments and techniques used to collect and analyse the data.

Numerous taxonomies for research have been created on their foundations by Collis J. and Hussey R. (2003) and Hussey J. and Hussey R. (1997). Including the purpose, process, rationale and outcome, as shown in **table 10-1**.

No	Basis	Type of Research	Description	Example
1	Purpose	Descriptive	This type is used to explain an actual occurrence. By acquiring information and evaluating viewpoints on a certain subject (Naoum S.G., 1998).	Experiments, case studies, surveys and secondary data analysis etc.
		Predictive	This sort of research is used to forecast the possibility of an event occurring with the goal of generalising from the data. By predicting specific events associated with hypothesized general relationships (Ellram L.M., 1996).	Experiments, case studies, surveys and secondary data analysis etc.
		Exploratory	This form of research is appropriate when there are no studies or only a few studies on the subject under investigation (Ellram L.M., 1996). With the objective of diagnosing a situation and generating new ideas, hypotheses and alternatives (Zikmund W., 2003).	Experiments, case studies, surveys and secondary data analysis etc.

No	Basis	Type of Research	Description	Example
		Analytical	This sort of research is used to define, analyse and explain how and why certain traits occur, with the goal of comprehending the occurrence. Through the discovery and measurement of causal relationships between them (Hatmoko J., 2008).	Experiments, case studies, participation observations and grounded theory etc.
2	Process	Qualitative	This type of research is used to amass knowledge and data in such a way that theories can arise (Fellows R. and Liu A., 2008). Thus, in general, this type of research serves as a precursor to quantitative research.	
		Quantitative	This kind of research employs an experimental design. Entailing the testing of hypotheses and the collection of data using statistical techniques for analysis (Ali M.M., 2011).	

No	Basis	Type of Research	Description	Example
3	Logic	Inductive	This method is used to develop thoughts and opinions from data or observations in order to generalise theories (Nachmias C. and Nachmias D., 2000); (Ali M.M., 2011). In contrast to deductive research, this type emphasizes observation and is less constrained, more open-ended and exploratory (Leedy P.D. and Ormrod J.E., 2005); (Ali M.M., 2011); (Trochim W.M., 2006).	Qualitative approaches
		Deductive	This method is used to construct a conceptual and theoretical structure, or an abstract framework, based on secondary data or professionals. Which is then validated through empirical observation or data collecting (Collis J. and Hussey R., 2003); (Fellows R. and Liu A., 2008) (Ali M.M., 2011). According to Trochim W.M. (2006) this type of investigation "is narrower in nature and is concerned with testing or confirming hypotheses".	

No	Basis	Type of Research	Description	Example
4	Outcome	Basic	This kind of research is used to improve general understanding, with the goal of contributing to knowledge and theory. In order to aid in the pursuit of truth; it also represents the most academic method of study (Collis J. and Hussey R., 2003); (Fellows R. and Liu A., 2008).	
		Applied	This method of study is used to address application-related challenges. By utilising scientific knowledge and evaluating its viability (Fellows R. and Liu A., 2008).	

Table 10-1: Research Taxonomies including Purpose, Process, Logic and Outcome

According to Ali M.M. (2011) study that shared of Gameson R.N. (1996) perspective stating that "initially research splits into deductive and inductive but after this early phase, all research becomes an interaction between the two approaches". According to Fellows R. and Liu A. (2008), the great majority of research is a blend of basic and applied research.

10.1.2 Research Macro structure

According to Silverman D. (2005), the way the research provides the analysis and interpretation of data is contextualized within a broader thesis framework. This may be categorised into three fundamental types:

- The hypothesis story which is the standard framework for theses in empirical sciences which this research has adopted that includes:
  - State your hypotheses
  - Test them
  - Discuss the implications
- The analytic story which is a common framework for theses in social sciences that includes:
  - What are the key concepts you have used in this study?
  - How do your 'findings' shed light on these concepts and, through them, on the substantive topics you studied?
  - What, therefore, has become of your original research problem and the literature regarding it?
- The mystery story which is a framework for theses in engineering that includes:
  - Starts from empirical examples
  - Develops the questions by discussing them
  - Gradually leads the reader to interpretations of the material and to more general implications of the results.

10.1.3 Research Philosophy

Kagioglou M. et al. (2000) established a layered research technique that addresses the following three interrelated themes:

1. Research philosophy:
2. Research approaches
3. Research techniques

The research philosophy theme, as depicted in **figure 10-1**, represents the outer pyramid guides. Which directs and develops the inner research methodologies (Kagioglou K. et al., 1998); (Kagioglou K. et al., 2000) (Sexton M.G., 2000); (Thurairajah N. et al., 2006); (Binti N., 2008). The data are consistent since there is widespread agreement on it. But have varying content, as demonstrated by Saunders M. et al. (2009). Who emphasized the challenges surrounding the selection of study procedures and techniques using “the research onion” as demonstrated in **figure 10-2**. Although, this rather to be controversial with what Guba E.G. and Lincoln Y.S. (1998) has argued stating that “questions of research methods are of secondary importance to the questions of which paradigm is applicable to your research”.

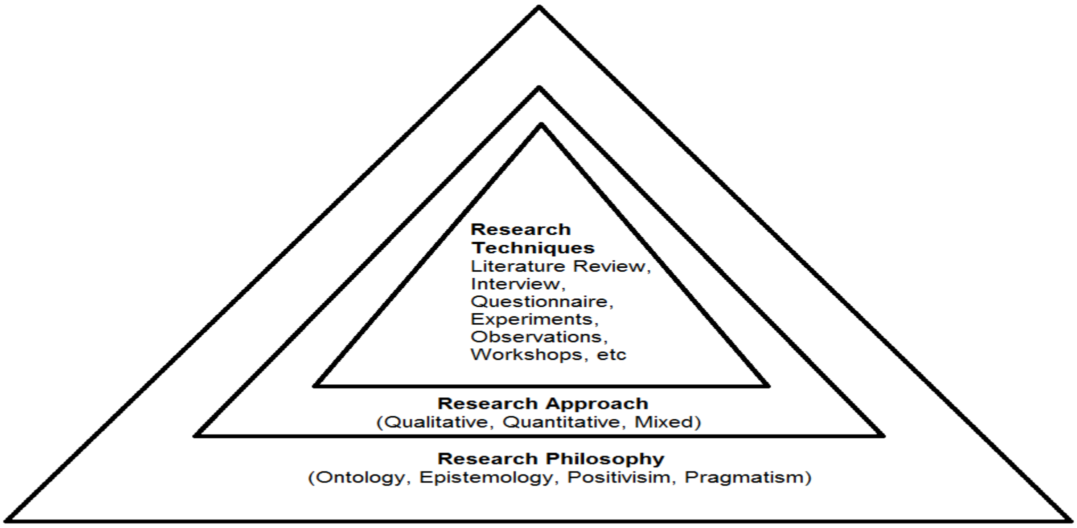

Figure 10-1: A Nested Research Methodology (developed by (Kagioglou K. et al., 2000)

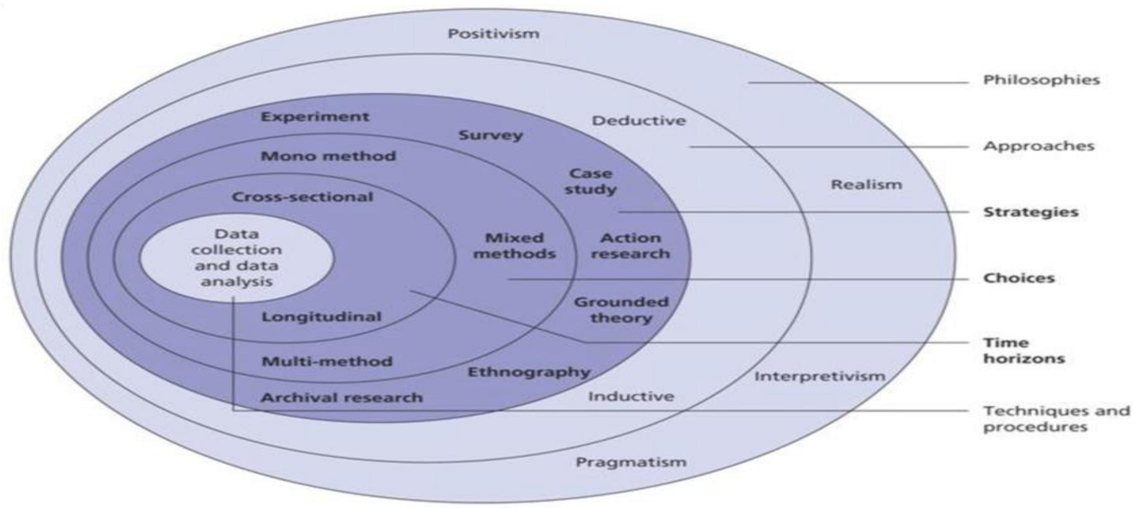

Figure 10-2: The Research Onion (adopted by (Saunders M. et al., 2009)

Numerous studies, such as Creswell J.W. (2013) and Saunders M. et al. (2009), have confirmed that the three fundamental characteristics of research philosophy are as follows:

1. Positivists
2. Realism
3. Naturalists

Although most literatures agree that ontology and epistemology are the two fundamental dimensions of social research philosophy. The dimensions outlined above are inclusive within those schools (Kagioglou K. et al., 2000); (Holden M.T. and Lynch P., 2004); (Thurairajah N. et al., 2006); (Binti N., 2008); (Flowers P., 2009); (Hesse-Biber S.N. and Leavy P., 2011).

As a result of these investigations, the following conclusions can be drawn: the philosophical foundation has a significant impact on the selection (Hesse-Biber S.N. and Leavy P., 2011):

1. The study topic.
2. The study methods.
3. The study sampling.
4. The research designs.

Thus, this part has provided a more in-depth examination of several of the research philosophy approaches commonly used in social research.

10.1.3.1 Ontology – Research Philosophy

Blakie N. (1993) defined ontology as "the science or study of being." This term, derived from the social sciences, encompasses "claims about what exists, what it looks like, what units make it up and how these units interact with each other."

Numerous research has provided insight into the best way to define ontological philosophy. Which is concerned with beliefs or assumptions about the nature of reality (Crotty M., 1998); (Binti N., 2008); (Saunders M. et al., 2009); (Hesse-Biber S.N. and Leavy P., 2011); (Flowers P., 2009). Flowers P. (2009) study aided in our understanding of this by defining ontological philosophy as "is this an objective reality that really exists, or only a subjective reality that is created in our minds."

Holden M.T. and Lynch P. (2004), Hatch M.J. and Cunliffe A.L. (2006); Saunders M. et al. (2009) work contributes to existing knowledge of ontology. By identifying the major philosophical approaches that have adherents and acceptance among business and management researchers as a result of producing valid knowledge which are as follows:

1. Objectivism:
   This demonstrates that reality is regarded as having a distinct structure (Sausman C. , 2013).

   According to Saunders M. et al. (2009), it "portrays the position that social entities exist in reality external to social actors concerned with their existence." To illustrate, Saunders M. et al. (2009) demonstrated objectivism via the lens of the managerial function in an organisation.

2. Subjectivism:
   This is formed by the ongoing process of social contact. Which is based on the experiences, observations and acts of social actors (Saunders M. et al., 2009). They demonstrate this idea succinctly by highlighting customer service.

However, according to Flowers P. (2009), one point that must be addressed is "how is that reality measured and what constitutes the knowledge of that reality." Thus, a stronger emphasis on epistemology may result in more intriguing findings that are more reflective of the research philosophy.

10.1.3.2 Epistemology – Research Philosophy

Numerous works of literature introduce the definition of epistemology from various authors' perspectives.

Crotty M. (1998) defined epistemology as "how we know, what we know,". Whereas Guba E.G. and Lincoln Y.S. (1998) defined it as "the nature of the relationship between the knower or the world-be knower and what can be known." According to the literatures of Easterby-Smith M. et al. (2011) and Flowers P. (2009), epistemology is defined as "what is knowledge and what are the sources and limits of knowledge." Blakie N. (1993) has contributed to our knowledge by expanding on the definition of epistemology, which is "the theory or science of the method or grounds of knowledge," into a set of assumptions about how knowledge of reality might be gained, how existing reality might be known, what might be known and what criteria should be satisfied to be classified as knowledge.

To facilitate comprehension of epistemology, Hussey J. and Hussey R. (1997); Tzortzopoulos P. (2004), Flowers P. (2009), Saunders M. et al. (2009) and Rubin H.J. and Rubin I.S. (2012) categorised it into two distinct approaches which are as follows:

1. Positivism:

   According to Flowers P. (2009), this is drawn from " that of natural science and it's characterised by testing hypothesis developed from existing theory (hence deductive or theory testing) through measurement of observable social realities." This position is devoted to facts that are gathered empirically. Through perceptions and then quantified empirically through quantitative methods such as surveys and statistical analysis (Blakie N., 1993); (Hatch M.J. and Cunliffe A.L., 2006); (Saunders M. et al., 2009); (Lewis T.M. et al., 1996); (Easterby-Smith M. et al., 2011); (Eriksson P. and Kovalainen A. , 2008); (Flowers P., 2009). (Hesse-Biber S.N. and Leavy P., 2011).

   Hesse-Biber S.N. and Leavy P. (2011) claimed that positivism in science is based on several fundamental beliefs about the nature of knowledge that together form the foundation of the quantitative paradigm.

2. Interpretivism:

   Interpretivism has been defined in a variety of ways, including anti-positivism according to Hatch M.J. and Cunliffe A.L. (2006), post positivism according to Blakie N. (1993) and naturalism according to Hatch M.J. and Cunliffe A.L. (2006), or naturalism based on Rubin H.J. and Rubin I.S. (2012).

   Given the fact that academics' definitions of interpretivism vary, it is critical to understand how this concept operates. According to Rubin H.J. and Rubin I.S. (2012), it assumes that reality is continually changing and can only be known indirectly through human interpretations. The work by Saunders M. et al. (2009) contributes to the field of research philosophy. By demonstrating that interpretivism focuses on understanding the meaning and interpretations of actors. To recognise their world through their environment using qualitative data analysis (Eriksson P. and Kovalainen A. , 2008). Additionally, they stated that this type is best suited for specific industries such as marketing and human resource management.

According to Flowers P. (2009), while the prevalence of management research plays a role in the selection of these paradigms. Their usefulness in generating the poles from which other paradigms are developed cannot be discounted.

Fitzgcrald B. and Howcroft D. (1998), Bryman A. and Cramer D. (2008) and Binti N. (2008) provide an explanation for the various philosophical approaches by making the distinctions shown in **table 10-2**.

Philosophical Approaches	**Types**	**Description**
Ontological Considerations	Objectivism	1. Existing and tangible structures. 2. Existed structures are independent on the ability of individuals to obtain knowledge.
	Subjectivism	1. Existence of multiple realities. 2. Society-transmitting terms differentiate across various languages and cultures.
Epistemological Considerations	Positivism	1. Applying natural sciences to study realities. 2. World corresponds to the laws of causality.
	Interpretivism	1. Controversiality as per the absence of general truth and emphasis on realism of context. 2. Interpretations are obtained from the researcher's own frame of reference.

Table 10-2: Different Philosophical Approaches

10.1.3.3 Choosing a Research Philosophy

It is advised that when choosing a philosophy paradigm, three fundamentals should be considered: ontology, epistemology and methodology.

According to Saunders M. et al. (2009), "it would be easy to fall into the trap of thinking that one research approach is better than another. This would miss the point." This implies that any strategy may be superior to another at doing distinct tasks, depending on the research subject. The study of Flowers P. (2009) reaffirmed the notion that choosing one posture over another is practically unrealistic. He ascribed this to the mutual dependence and overlap of various intellectual perspectives and methodologies. To illustrate, epistemology is inextricably linked to ontology (Flowers P., 2009).

This may also be contested in terms of the positivism versus interpretivism paradigms. To gain a better understanding of this, it is necessary to comprehend the distinctions between the two paradigms. Numerous authors have distinguished between positivism and interpretivism perspectives (positivism and interpretivism references). One of which was by Rubin H.J. and Rubin I.S. (2012), who posed the question "which philosophy approach is better and more appropriate?". Concluding that "the answer to this question is usually probably that both are necessary and useful; they supplement each other. Especially if the survey and the in-depth interviews were done separately, each following the assumptions of its own paradigm." This reinforces the finding of Saunders M. et al. (2009) that studies in the management field frequently incorporate elements of both of those paradigms. This is also reinforced by Hughes J. and Sharrock W. (1997). Who made no attempt to provide a guideline for determining the most acceptable method or paradigm.

Dainty A.M., (2008) argues that in the subject of construction management, the theoretical or philosophical foundations for researchers to establish their design are still unknown. Leaving the researcher with the implication of interpreting the many theories of knowledge and paradigms (Higham A.P., 2011). The empirical evidence contained in these literatures has aided in the promotion of alternate options. Pragmatism is a very recent and widespread alternative (Patton M.Q., 2002); (Hughes J. and Sharrock W., 1997); (Tashakkori A. and Teddlie C., 1998); (Holden M.T. and Lynch P., 2004); (Saunders M. et al., 2009).

According to Holden M.T. and Lynch P. (2004), this position favours "applying methods that suit the problem rather than methods that suit philosophy ontology or epistemology concerns." According to another study by Higham A.P. (2011), "in order to know the meaning of a concept, research need to consider its practical consequences rather than adhere to preconceived, theoretical ideas." It is so broad in scope that it is best studied from an epistemological standpoint, as it precludes ontological (Creswell J.W., 2013).

Thus, the findings presented here appear to support the notion that the researcher should view the philosophy embraced as a range rather than an opposite position (Tashakkori A. and Teddlie C., 1998). Additionally, they emphasize that "pragmatism is intuitively appealing largely, because it avoids the researcher engaging in what they see as rather pointless debates about such concepts as truth and reality." The significance of this is amply demonstrated by Holden M.T. and Lynch P. (2004) study. Which contributes to our understanding that it is more pertinent to investigate the problem using an alternative philosophical approach. Also, criticising researchers who "may have unthinkingly slotted themselves into an objectivist or subjectivist position, not realising the methods of an alternative philosophy may suit their research problem better."

Thus far, the clearest finding from the literatures is that a philosophy review has a significant influence on:

1. Opening researchers' minds to new possibilities.
2. Increasing their confidence.

Despite these advantages, data from multiple literatures are rather contentious and there is no broad agreement on which philosophical approach or paradigm is the correct or incorrect one to use in study. As individual approaches may be beneficial in some circumstances. Meanwhile, a combination of approaches may be more appropriate to address the research question in others. Taken together, Tashakkori A. and Teddlie C. (1998) implies a role for examining what interests and is valuable to the researcher and his/her study in a variety of ways. That assists the researcher in thinking appropriately and applying the data in a way that results in positive outcomes.

10.1.4 Research Approaches

As outlined in the main body of the research, the three main research types are as follows:

1. Qualitative Research:

   According to Hussey J. and Hussey R. (1997), qualitative research is "a subjective approach which includes examining and reflecting on perceptions in order to gain understanding of social and human activities." In other words, this sort of research seeks to comprehend people's observations, ideas, points of view and generates descriptive data using people's own written words. In order to obtain a better knowledge of social and human activities (Collis J. and Hussey R., 2003) (Dainty A.M. , 2008); (Binti N., 2008).

   This type of research aims to ascertain why things happen the way they do. To corroborate the meanings individuals attribute to events and structures. In addition to analyse words rather than numerical data (Fellows R. and Liu A., 2008).

2. Quantitative Research:

   According to Creswell J.W. (2013), quantitative research is "an inquiry into a social or human problem, based on testing a hypothesis or a theory composed of variables, measured with numbers and analysed with statistical procedures in order to determine whether the hypothesis or theory holds true."

   Quantitative research differs considerably from qualitative research. In that it is based on previously acquired data that assists in determining the data requirements for a particular research project (Fellows R. and Liu A., 2008). This form of research typically makes use of statistical and mathematical techniques. To evaluate phenomena and establish facts and causal linkages through the collection and analysis of numerical data (Hussey J. and Hussey R., 1997); (Fitzgcrald B. and Howcroft D., 1998); (Creswell J.W., 2013).

   Bryman A. and Cramer D. (2008) emphasized that because the sample size is frequently large and representative in this sort of research. The findings can be generalised to a larger population within acceptable margins of error.

   There are two most frequently used approaches in quantitative research today: experimental research and surveys. Each of these approaches can be combined to form one or more of the three main approaches listed below (Fellows R. and Liu A., 2008). It is important to keep in mind that questionnaire surveys are the most frequently used technique for data collection in comparison to other types of quantitative research:

1. Asking participants via questionnaires and quantitative interviews.
2. Undertaking experiments
3. Desk research via reviewing of previous literatures.

Table 10-3 provides a more complete description of these types of research. This table summarises the characteristics of both research approaches. Including their purpose, objectives, theories, processes, data collection methods, data characteristics, findings, outcomes, strengths and weaknesses (Leedy P.D. and Ormrod J.E., 2005); (Amaratunga D. et al., 2002); (Abdullah A. , 2003); (Neuman W.L., 2006); (Binti N., 2008).

Despite the limitations of each approach, a conclusion can be reached and surely contributes to our understanding. That in some circumstances, combining both approaches in the research may mitigate the drawbacks of each approach, as demonstrated by the third approach of triangulation.

Characteristics	Qualitative Research	Quantitative Research
Purpose	1. Describe and explain. 2. Explore and interpret. 3. Building theories.	1. Explain and predict. 2. Confirm and validate. 3. Testing theories.
Objective	1. Studying issues comprehensively and in-depth. 2. Gaining insights and understanding people's observations.	1. Collecting factual data. 2. Studying relationships between fact and in accordance with theories.
Theory	Inductive in nature	Deductive in nature
Process	1. Universal 2. Flexible guidelines 3. Unknown variables 4. Developing design 5. Personal view	1. Focused 2. Established guidelines 3. Known variables 4. Fixed design 5. Detached view

Characteristics	Qualitative Research	Quantitative Research
Data Collection	1. Procedures are particular and replication is infrequent 2. Informative and small sample size 3. Observations, interviews and documents	1. Procedures are standard and replication is frequent. 2. Representative and large sample size 3. Questionnaires and laboratory experiments.
Suitability	1. Relative new subjects 2. Topics that are criticised to lack in data	1. Previous work
Data Characteristics	1. Soft data, descriptive and less structured. 2. Analysed via non-statistical methods	1. Hard data and structured 2. Analysed via statistical methods
Reporting Findings	1. Words 2. Narrative and individual quotes 3. Personal voices and literary style	1. Numbers 2. Statistics and aggregated data 3. Formal voices and scientific style
Outcome	1. Exploratory 2. Findings are contextual	1. Conclusive findings for the purpose of giving recommendations

Characteristics	Qualitative Research	Quantitative Research
Strengths	1. Data gathering methods are seen natural rather than artificial 2. Allow to look at change processes over time 3. Contribute to theory generation	1. Provide wide coverage of the range of situations 2. Fast and economical 3. Statistics might be relevant to policy decisions
Weaknesses	1. Data collection might be uninteresting and thus, require more resources 2. Data analysis might be difficult 3. Hard to control the progress of the research	1. Data collection might be inflexible and artificial 2. Not effective in understanding the process 3. Not helpful in generating theories

Table 10-3: Types of Research

3. Triangulation Research (Mixed):

   Despite the restrictions described previously, it is argued that combining both approaches to research could help alleviate these constraints.

   The term triangulation has evolved to refer to an investigation that "employs strategies of inquiry that involve collecting data either simultaneously or sequentially and using numeric as well as text-based information" (Hatmoko J., 2008). In other words, it is a method that combines qualitative and quantitative approaches. To overcome the inherent bias and limitation of a single approach. As utilising a single method can have a significant impact on the reliability of the study contribution (Creswell J.W., 2013); (Collis J. and Hussey R., 2003).

   Denzin N.K. (1970), Love P.E.D. et al. (2002), Abdullah A. (2003) and Sherif K.F. (2010) added that adopting this approach results in numerous benefits for the research. Including increased capability to convey knowledge in a substantial form, improved understanding and increased validity of the research results. Combining these factors has an adverse effect on increasing the research's reliability and instilling confidence in its findings (Ali M.M., 2011). He said that this approach enables one technique to compensate for the shortcomings of the others (Ali M.M., 2011). This is consistent with what Amaratunga D. et al. (2002) and Binti N. (2008) have established that qualitative data can assist quantitative research in some cases during the design process by assisting with conceptual development and instrumentation. Whereas quantitative data can assist qualitative research during the design process by selecting a representative sample and specifying the various samples.

   The flowchart below illustrates the triangulation strategy used by Fellows R and and Liu A. (2008).

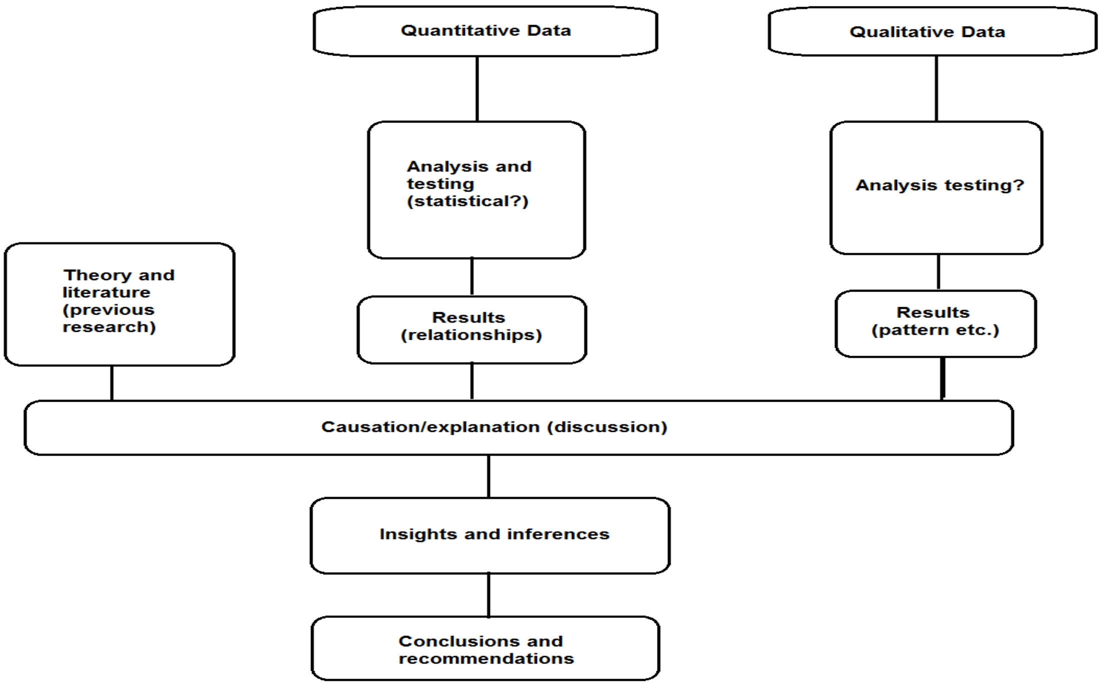

Figure 10-3: Triangulation of Qualitative and Quantitative Data (Fellows R. and Liu A., 2008)

According to Fellow's and Liu's (2008) study, the triangulation method is an extremely effective approach. Since it enables the researcher to investigate each objective from a unique aspect or perspective. Thereby confirming and increasing the trustworthiness of the research data.

The following taxonomies have been constructed for this type of research by Easterby-Smith M. et al. (2011) and Hatmoko J. (2008):

1. Data triangulation:
   The data in this section was gathered throughout a variety of time periods and from a variety of sources.

2. Investigator triangulation:
   Numerous investigators collect similar data independently and then compare their findings.

3. Theoretical triangulation:
   It comes across taking a model or a theory from one area to explain a phenomenon in another.

4. Methodological triangulation:
   It facilitates the use of both aforementioned study methodologies for data collection.

As a result, the following conclusion may be reached and added to our knowledge. That the advantages of combining qualitative and quantitative research surveys would adequately address the research objectives. Thus, this contribution has been to validate that the research meets the criteria for the first and fourth triangulation approaches. Which are data and methodological triangulation, respectively. This relates to the data gathering and analysis processes. That employs both qualitative and quantitative methodologies, as well as the data gathered from a variety of organisations and sources.

The rationale for choosing data triangulation demonstrates that it is beneficial to avoid bias that may exist when collecting data exclusively from one organisation. Which contributes significantly to increasing the level of data generalisability while also enriching and strengthening the range of data collection. Meanwhile, the rationale for methodological triangulation is that it contributes to the upgrading or improvement of the research's robustness.

10.1.5 Research Strategy Decision and Selection Methods

10.1.5.1 Research Philosophy and Methodology Selection – Research Strategy Decision and Selection Methods

The thesis's primary position is epistemological philosophical. Additionally, various methods were necessary to address the research problem and its question, rather of taking a single philosophical perspective.

Thus, the research offers to take a pragmatic approach by employing subjective qualitative and objective quantitative methodologies. Via interviews and questionnaires that are most appropriate for the research problem and question. This is justified by Greenwood's D.J. and Levin's M. (2005) observation that "the real world does not issue problems in neat disciplinary packages". To which certain epistemologies can be applied cleanly.

Pragmatism enables the researcher to shift between epistemologies. Allowing for the most effective selection of tools and techniques for identifying solutions to problems (Higham A.P., 2011). The work of Fellows R. (2010) contributes to the growing body of evidence indicating that this strategy is highly recommended for construction management researchers. As he attests that it produces outcomes that are reflective of the realities of the world we study. According to the advantages of the triangulation-mixed approach, this research utilised it to accomplish the research aim, address the objectives and answer the research question.

To summarise, data collection approaches used in this study include a literature review, interviews and questionnaires. Interviews and questionnaires are mostly used to obtain data necessary to elicit opinions and information for evaluating the effectiveness-measures identified through literature reviews.

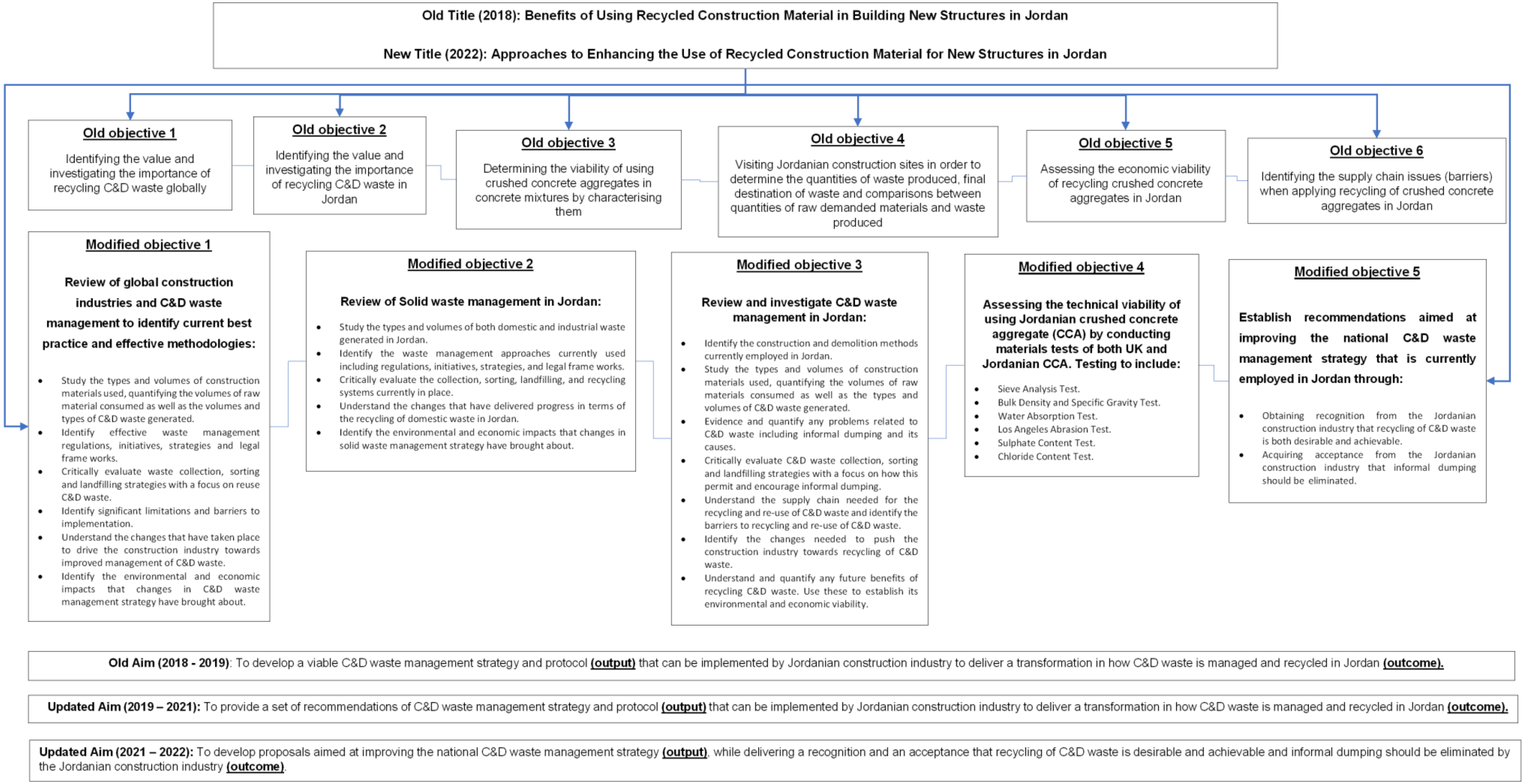

Figure 10-4: Research Aim and Objectives Development Process

<table>
<tr><th colspan="3">Research Chapters</th></tr>
<tr><th colspan="3">1. Introduction</th></tr>
<tr><td colspan="3">Jordan is currently confronted with a significant problem regarding construction and demolition waste (C&D waste) and its management. The majority of C&D waste generated is dumped informally on the sides of roads or in open spaces between residential areas, with no environmental protection measures in place.</td></tr>
<tr><th colspan="3">2. Literature Review</th></tr>
<tr><td colspan="3">A substantial section of the literature analysis was devoted to global construction industries and C&D waste management to identify current best practices and successful methodologies, Jordan's previous solid waste management strategy and Jordan's current C&D waste management. This has been assessed critically in light of the research objectives articulated in the research narrative. As a result, it has been determined that Jordan's waste management has been limited to general solid waste management which is restricted to collection and disposal. As a result, there is a substantial dearth of literature on C&D waste management in the country.</td></tr>
<tr><th colspan="3">Gaps in Knowledge</th></tr>
<tr><td colspan="3">Generally, knowledge gaps are technical and managerial in nature. Which are the causes for this lack and thus need to be examined further using various approaches as detailed below, to establish a set of proposals for a C&D waste management strategy and protocol for Jordan, as illustrated at the conclusion of the table.</td></tr>
<tr><th colspan="3">3. Methodology</th></tr>
<tr><td colspan="3">This chapter discusses the mixed methodologies used in the research and each one has its own chapter devoted to the research's findings, as evidenced by the research's structure above.</td></tr>
<tr><th rowspan="2">Secondary Data Collection
(Literature Review Chapter)</th><th colspan="2">Primary Data Collection</th></tr>
<tr><th>Archival Data
(Collection of Archived Data chapter)</th><th>Questionnaires & Interviews
(Questionnaires & Interviews Chapter)</th></tr>
<tr><td>As detailed in the research narrative and methodological sections above.</td><td>The research proposes to gather data from archival databases maintained by several organisations in Jordan's construction industry. To demonstrate the extent to which recycling could be economically beneficial to Jordan. As it provides the potential economic benefits for the country's C&D waste management, notably CCA management, if adopted.</td><td>This inquiry aims to go deeper into what is missing in the Jordanian local context, with the goal of finding the impediments to the adoption of C&D waste management. This will assist in adding to the research's output and outcome, as shown below.</td></tr>
<tr><th colspan="3">Objectives Distribution on Methodologies</th></tr>
<tr><td>Objectives 1, 2 and 3</td><td>Objective 3</td><td>Objective 3 and 4</td></tr>
<tr><th colspan="3">Discussion of the Main Findings</th></tr>
<tr><td colspan="3">This chapter will summarise all of the preceding chapters in order to demonstrate how the findings or results relate to what is already known in the field. It will do so by analysing the findings and discussing them to deliver the output and outcome of the research by making proposals aimed at Improving the current national C&D waste management in Jordan</td></tr>
<tr><th colspan="3">Overview and Proposals for Future Research</th></tr>
<tr><td colspan="3">This chapter will provide a final impression to the examiners and readers by overviewing the entire research and providing recommendations aimed to address how the work might be enhanced in light of the research findings and which areas require additional investigation.</td></tr>
<tr><th colspan="3">Research Output & Outcome</th></tr>
<tr><td colspan="3">According to the research's aim, it will establish a set of proposals for the purpose of enhancing the current national C&D waste management strategy in Jordan and is capable to gain recognition and acceptance from the Jordanian construction industry that recycling of C&D waste is both desirable and achievable, as well as gaining acceptance from them that informal dumping of C&D waste should be eliminated.</td></tr>
</table>

Table 10-4: Research Structure Outline

10.1.6 Selection of Data Collection Techniques – Research Strategy Decision and Selection Methods

10.1.6.1 Reviewing of Secondary Data – Selection of Data Collection Techniques

The literature review was conducted under the supervision of Anglia Ruskin University. In addition to, the assistance of Anglia Ruskin access for peer-reviewed articles, books and journals from a variety of offline and online resources. Including the University Library, Science Directory, Elsevier, Google Scholar and Conference Proceedings.

It is preferable to remember that the review of literatures was a continuous activity that occurred independently and concurrently with the use of other research methodologies and techniques.

Table 10-5 summarises the literature coupling analysis of publications devoted to the environmental implications of C&D waste. According to Chen K. et al. (2021), the influence of a particular field on output and research is proportional to the number of publications and citations.

Abbreviation	Source	Number of articles published*	Average citations**	Average Normalised Citations***
JCP	“Journal of Cleaner Production”	24	32	1.2
WM	“Waste Management”	18	47	1.2
RCR	“Resources Conservation and Recycling”	13	28	1.5
JMCWM	“Journal of Material Cycles and Waste Management”	5	14	0.6
IJLCA	“International Journal of Life Cycle Assessment”	4	13	0.5
CBM	“Construction and Building Material”	3	50	2.5
EB	“Energy and Buildings”	3	48	1.1
ESPR	“Environmental Science and Pollution Research”	3	10	0.4
RSER	“Renewable & Sustainable Energy Reviews”	3	41	1.1
Sust	“Sustainability”	3	10	0.3
WMR	“Waste Management & Research”	3	49	1.1

Notes	∗:- “The number of articles published represent the production of the journal in the research community”. ∗∗:- “The average citations represent the average number of citations per article published in the journal”. ∗∗∗:- “The average normalised citations represent the average normalised number of citations received by the documents published by a journal source, a scholar and a country. It is calculated by dividing the normalised citations by the document (Normalised Citations were excluded from the table as they were not required in the analysis). Normalisation eliminates the error that earlier publications can obtain more time to receive citations than recent publications” (Eck N.J.V and Waltman L., 2014).

Table 10-5: Summary of Journals Related to C&D Waste Environmental Impacts

10.1.6.2 Questionnaires and Interviews – Selection of Data Collection Techniques

10.1.6.3 Questionnaires

In Jordan, the use of hard copies of questionnaires was prohibited due to the Covid-19 pandemic. This necessitated several restrictive measures to prevent infection spread. Including complete and partial lockdowns, prohibition of the use of hard copies and limiting access to departments and institutions. It has had a limited influence on data collection, however, because the research circumvented these limits and implications by collecting the necessary data digitally and remotely via an online survey tool called JISC.

It has been estimated that questionnaires should be distributed to over 300 participants. Approximately 330 of whom have been randomly selected from various private and public associations and organisations in Jordan's construction industry, as shown in **table 10-6**. These competent participants were enlisted to address the requirement for acquiring required data and providing desired data as indicated or considered by the points of contact (participant's supervisors or managers). This is in addition to the findings of Plemmons J.K. and Bell L.C. (1995), who stated that "the most appropriate application of a survey questionnaire is where conditions indicate that the respondents are uniquely qualified to provide the desired information." It is more prudent to remember that these individuals were conditioned to participate in at least one of the construction industry's operations. Which include design, construction, or demolition, C&D waste generation and C&D waste legal dumping. Although some respondents in Jordan are unfamiliar with the usage of digital survey tools. Thus, only 207 individuals participated in the study surveys.

These 207 respondents accounted for almost 62% of the 330. This return rate is consistent with those of Krejcie V.R. and Morgan W.D. (1970) and Malhorta M.K. and Grover V. (1998), indicating that a return rate of 20%-30% is acceptable. Only four respondents were excluded from the client questionnaire due to incomplete questionnaires and a lack of rationale in most of their responses by selecting the first choice for all questions.

The primary criterion used to select respondents for questionnaires was access to the right people. Who could best inform about the data required via non-randomly selected managers and experts within their departments or organisations. Based on their position and willingness to serve as points of contact for this research. This is consistent with what Voss C. et al. (2000) have defined as "an ideal prime contact should be someone senior enough to be able to open doors where necessary to know who best to access to gather the data required and to provide senior support for the research being conducted."

No. of questionnaire participants	Sampling Selection	Targeted Professional Positions
> 300 At least ten actors from each of the eleven professions listed	Actors randomly sampled from industry associations identified below.	Construction engineers Environmental engineers Supervision specialists Contractors Structural engineers Consultants Architects Academics Quality assurance specialists Clients

Table 10-6: Sampling Selection of Questionnaires

The questionnaires' questions were designed to address the research elements and cover knowledge gaps, as indicated in the tables below, taking into account:

1. The questionnaires' size.
2. The type of questions (closed-ended questions).
3. The sequence of questions.
4. The time allowed to answer them.
5. The ability to obtain the required data.

To accomplish the second and third research objectives, the research developed 13 questionnaires based on the functions of the actors involved, as shown below. However, due to the commonality of some actors' functions, a total of 8 individual questionnaires were distributed to various organisations. Of which 7 returned with responses and 1 did not as referred in the main body of the research.

Prior to conducting the questionnaire surveys, questions were distributed to several professionals and experts in the field, as well as to the first supervisor. To ascertain their effectiveness in producing reliable results. Questions that were deemed unnecessary were removed, while others of equal importance were added.

As mentioned previously over 300 participants were randomly selected from Jordan's construction industry. Including MPWH, GAM, MLA, MoE, JCCA, academics, concrete suppliers and contractors as demonstrated in **table 10-7**. This table contains the respondent's profile sheet and their personal characteristics. Including current position, organisation type and area of competence. This table summarises who completed all questionnaire parts. The diversity of respondents' positions and perspectives results in more realistic and detailed data. Since it increases the validity and reliability of respondents' responses and the entire research.

No.	Current position	Organisation	Area of Expertise
1	Construction engineers	• MPWH • GAM • MLA • Construction companies	Administration/Operations
2	Environmental engineers	• MoE	Administration
3	Supervision specialists	• GAM • MoE	Administration/ Field Control
4	Contractors	• Construction companies	Operations
5	Structural engineers	• MPWH • GAM • MLA • Construction companies	Operations
6	Architects	• MPWH • MLA	Operations
7	Academics	• Universities	Studies
8	Clients	• Locals	Field Control
Total	**207**		

Table 10-7: Questionnaires Respondent Profile Sheet

10.1.6.3.1 Developing process of Questionnaires and Interviews

After identifying knowledge gaps, the research created a process for covering them. Using questionnaires and interviews, as illustrated in the tables below. This highlights the breadth of the study in each identified knowledge gap.

Objectives to be tackled by the questionnaires and the interviews
• **Review of Solid waste management in Jordan:** • Study the types and volume of both domestic and industrial waste generated in Jordan. • Identify the waste management approaches currently used including regulations, initiatives, strategies and legal frame works. • Understand the changes that have delivered progress in terms of the recycling of domestic waste in Jordan. • Identify the environmental and economic impacts that changes in solid waste management strategy have brought about. • **Review and investigate C&D waste management in Jordan:** • Identify the construction and demolition methods currently employed in Jordan. • Study the types and volume of construction material used, quantifying the volume of raw material consumed as well as the types and volume of C&D waste generated. • Evidence and quantify any problems related to C&D waste including informal dumping and its causes. • Critically evaluate C&D waste collection, sorting and landfilling strategies with a focus on how this permit and encourage informal dumping. • Understand the supply chain needed for the recycling and re-use of C&D waste and identify the barriers to recycling and re-use of C&D waste. • Identify the changes needed to push the construction industry towards recycling of C&D waste. • Understand and quantify any future benefits of recycling C&D waste. Use these to establish its environmental and economic viability.

Literature Review sections and sub sections			
Solid Waste Management in Jordan	**Impacts of the Jordanian C&D**	**The Jordanian C&D methods**	**C&D waste management**
• Production of Industrial Material • Exporting and importing rates of domestic material • Types and Volume of Solid Waste • Causes of the Generation of Solid Waste • Collection, Sorting, Landfilling and Recycling	• Environmental, social and economic impacts • Types and Volume of C&D Waste produced • Evidencing the problem of informal dumping of C&D waste and its causes • Causes of C&D Waste Arising	• Design Phase • C&D operations • Extraction of Raw material used in construction • Production of Construction Material • Exporting and importing rates of construction material	• Collection, Sorting, Landfilling and Recycling • Regulations, Strategies and Initiatives • Environmental concerns and economic aspects of C&D waste • Benefits of C&D waste management • Limitations and

Objectives to be tackled by the questionnaires and the interviews			
• Regulations, Strategies and Initiatives • Variations pushed towards recycling • Environmental and social concerns and economic aspects • Benefits of Solid waste management including recycling			barriers to C&D waste management • Variations done
Gaps in Knowledge based on the literature Review to be covered in the questionnaires and Interviews			
Solid Waste Management in Jordan	**Impacts of the Jordanian C&D**	**The Jordanian C&D methods**	**C&D waste management**

• Production of Industrial Material
• Sorting
	• Environmental, social and economic impacts of the construction industry
	• Types and Volume of C&D waste produced
	• Evidencing the problem of informal dumping of C&D waste and its causes
	• Causes of Construction Waste Arising
		• Design
		• C&D operations
		• Extraction of Raw material for construction
		• Production of Construction Material
			• Limitations and barriers to C&D waste management
			• Environmental, social and economic concerns of C&D waste
			• Variations needed:
			  • Collection, Sorting, Landfilling and Recycling
			  • Regulations, Strategies and Initiatives

Questionnaires and Interviews Categories and Introductory		
1. C&D waste management	**2. Design, construction and demolition operations**	**3. Improvements**
The objective of this section is to update the fact on the prevalence of informal dumping of C&D waste and the factors that contribute to it, particularly when regulations require collection and proper landfilling. This contributes to the research's purpose by evidencing the issue. Additionally, it will aid in identifying barriers to C&D waste management so that they can be further mitigated when developing a set of proposals for the research.	The purpose of this section is to demystify design, construction and demolition operations in Jordan by outlining their activities and contractual arrangements and stipulations. As this will aid in comprehending the local context when designing, constructing and demolition operations. To be considered further when creating the research output that hopefully	This section will look at ways to improve solid waste management by adding sorting, which is currently not an option in comparison to collecting and landfilling. Second, in the design, building and demolition processes, opportunities to reduce C&D waste exist. Thirdly, in C&D waste management, including collection, disposal and recycling of C&D waste. All of

<table>
<tr><th colspan="6">Objectives to be tackled by the questionnaires and the interviews</th></tr>
<tr>
<td colspan="2">Additionally, the survey will assist in understanding the composition of C&D waste, the quantities generated and the reasons for construction waste generation. To provide a comprehensive overview of C&D waste in Jordan and to determine the extent to which recycling could be advantageous depending on the types and quantities of waste (chapter 4). This will be determined after the Jordanian construction industry's environmental, social and economic concerns, including C&D waste, are identified. As a result, this section will contain the following gaps:

• Evidencing the problem of informal dumping of C&D waste and its causes

• Types and Volume of C&D waste produced.

• Causes of construction waste arising

• Limitations and barriers to reuse</td>
<td colspan="2">be adopted by Jordanian building firms as an outcome, this includes the following gaps:

• Design
• C&D operations</td>
<td colspan="2">this will be considered when establishing the research output, with the goal of mitigating as many constraints and impediments as feasible in Jordan. In other words, it will look for ways to promote recycling of C&D waste (CCA) by improving its management and it will also assist in improving design, construction and demolition operations in order to develop an effective C&D waste management strategy, as illustrated below:
• Sorting of solid waste
• Design
• C&D operations
• Variations needed for C&D waste management:
  • Collection, Sorting and landfilling
  • Regulations, Strategies and Initiatives
• Encouragements and incentives</td>
</tr>
<tr><th colspan="3">New Information</th><th colspan="3">Information Needs Updating</th></tr>
<tr>
<td colspan="3">• Sorting of solid waste
• Design operations
• C&D operations
• Limitations and barriers to C&D waste management
• Environmental, social and economic impacts of the construction industry particularly C&D waste
• Variations needed for C&D waste management:
  • Collection, sorting, landfilling and recycling
  • Regulations, strategies and Initiatives
  • Encouragements and incentives</td>
<td colspan="3">• Evidencing the problem of informal dumping of C&D waste and its causes
• Causes of construction waste arising</td>
</tr>
<tr><td colspan="6">Sampling selection as mentioned in the methodology chapter</td></tr>
</table>

Table 10-8: Developing Process of Questionnaires and Interviews

10.1.6.3.2 Questionnaires Actors Involvement

Table 10-9 summarises the actors who participated in the research.

Questionnaire Actors Involvement	
1. Ministry of Public Works and Housing and Greater Amman Municipality	• Evidencing the problem of informal dumping of C&D waste and its causes • Environmental, social and economic concerns of C&D waste • Sorting of solid waste. • Limitations and barriers to C&D waste management • Design, Construction and demolition operations • Variations needed for C&D waste management: a. Regulations, Strategies and Initiatives b. Encouragements and incentives
2. Ministry of Local Administration for local municipalities excluding Greater Amman Municipality	• Design, Construction and demolition operations • Sorting of solid waste. • Variations needed for C&D waste management: a. Encouragements and incentives
3. Greater Amman Municipality	• Evidencing the problem of informal dumping of C&D waste and its causes • Environmental, social and economic concerns of C&D waste • Sorting of solid waste. • Limitations and barriers to C&D waste management • Design, Construction and demolition operations • Variations needed for C&D waste management: a. Regulations, Strategies and Initiatives b. Encouragements and incentives
4. Ministry of Environment	• Evidencing the problem of informal dumping of C&D waste. • Environmental, social and economic impacts of the construction industry. • Limitations and barriers to C&D waste management • Variations needed for C&D waste management: a. Regulations, Strategies and Initiatives b. Encouragements and incentives
5. Concrete Suppliers	• Environmental, social and economic concerns • Costs of Concrete Components • Willingness
6. Jordan Contractor Association for construction Contractors	• Limitations and barriers to C&D waste management

Questionnaire Actors Involvement	
	• Variations needed for C&D waste management: a. Collection, Sorting and landfilling b. Encouragements and incentives
7. Academics	• Evidencing the problem of informal dumping of C&D waste and its causes • Causes of construction waste arising • Limitations and barriers to C&D waste management • Environmental, social and economic concerns of C&D waste • Variations needed for C&D waste management: a. Collection, Sorting, Landfilling and recycling b. Encouragements and incentives
8. Clients	• Interests • Awareness • Willingness • Variations needed for C&D waste management: a. Encouragements and incentives

Table 10-9: Questionnaire Actors Involvement

10.1.6.3.2.1 The Departments of Legal Frameworks and Regulations

The Department of Legal Frameworks and Regulations surveys at GAM and the Ministry of Environment are divided into four sections as follows:

1. Section 1:
   This contains the PCF and directions for completing the questionnaire.

2. Section 2:
   This assesses current legal frameworks governing solid waste. Particularly those governing sorting, as well as their future concerns and visions.

3. Section 3:
   This identifies legal frameworks governing C&D waste, quantifies informal dumping and the reasons causing it. Additionally, it evaluates possible approaches and incentives for reducing informal dumping or adopting a nation-wide strategy.

4. Section 4:
   This incorporates the Likert scale questions. Which allows participants to select the option that best represents their assessment through these measures (1=Strongly

Disagree, 2=Disagree, 3=Neither Agree nor Disagree, 4=Agree and 5=Strongly Agree) to:

- The adequacy of current C&D waste regulations.
- The compliance of construction actors.
- The strictness of governmental organisations regarding C&D waste.

The figures below depict the survey questions as they were designed in the survey tool.

PARTICIPANT CONSENT FORM

Name of participant:

Title of the project: The benefits of using recycled construction mateial in building new structures in Jordan.

Main investigator and contact details: Abdullah Al-Khraisha / ahia103@student.anglia.ac.uk / +0962798003444 / 00447470778364.

Members of the research team: There are no members in the team, as the research is an individual work.

Please tick the following statements if applicable:

Statement	Yes/No
I agree to take part in the above research. I haveread the Participant Information Sheet for the study.	
I understand what my role will be in this research and all my questions have been answered to my satisfaction.	
I understand that I am free to withdraw from the research at any time, without giving a reason.	
I am free to ask any questions at any time beforeand during the study.	
I understand what will happen to the data collected from me for the research.	
I have been provided with a copy of this form and the Participant Information Sheet.	

Data Protection: I agree to the University[1] processing personal datawhich I have supplied. I agree to the processing of such data for any purposes connected with the Research Project as outlined to me*

Name of participant: .... Signed .... Date ....

Name of person witnessing consent: .... Signed: .... Date: ....

PARTICIPANTSMUST BE GIVEN A COPY OF THIS FORM TO KEEP

ADD DATEAND VERSION NUMBER OF CONSENT FORM.

I WISH TO WITHDRAW FROM THIS STUDY.

If you wish to withdraw from the research, please speak to the researcher or email them at ahia103@student.anglia.ac.uk or reuben.brambleby@anglia.ac.uk stating the title of the research.
You do not haveto give a reason for why you would like to withdraw
Please let the researcher know whether you are/are not happy for them to use any data from you collected to date in the write up and dissemination of the research.

Date 24.10.16
V1.2

[1] "The Universiy" includes Anglia Ruskin University and its Associate Colleges.

Figure 10-5: Participant Consent Form

Page 2: Solid Waste

5. According to the current legal frameworks and regulations to date, the sorting process at source has not been included in national solid waste management, Can you please scale the reasons behind not embedding it in national strategies from 1 to 5 (1 strongly disagree and 5 is strongly agree)? وفقًا للأطر والقوانين القانونية الحالية حتى الآن، لم يتم تضمين عملية فرز النفايات عند المصدر في الإدارة الوطنية للنفايات الصلبة، هل يمكنك من فضلك قياس الأسباب الممكنة وراء عدم تضمينها في الاستراتيجيات الوطنية من 1 إلى 5 (1 لا أوافق بشدة و 5 غير موافق موافق بشدة)؟ * *Required*

Please don't select more than 1 answer(s) per row.

Please select at least 7 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Solid Waste contains lots of types that cannot be recycled تحتوي النفايات الصلبة على العديد من الأنواع التي لا يمكن إعادة تدويرها	☐	☐	☐	☐	☐
Lack in Legal Frameworks and Regulations نقص في الأطر والانظمة القانونية	☐	☐	☐	☐	☐
Local Context willingness قابلية المحليين للفرز	☐	☐	☐	☐	☐
Cost Concerns مخاوف من التكلفة	☐	☐	☐	☐	☐
Time Concerns مخاوف من الوقت	☐	☐	☐	☐	☐

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Figure 10-6: Solid Waste Section

No beneficial gains from sorting لا مكاسب مفيدة من الفرز	☐	☐	☐	☐	☐
Solid Waste contains dangerous materials تحتوي المخلفات الصلبة على مواد خطرة	☐	☐	☐	☐	☐

5.a. If possible, can you please state other reasons you find more reasonable behind not embedding it in national strategies if not mentioned above? إذا أمكن ، هل يمكنك ذكر الأسباب الأخرى التي تجدها أكثر منطقية لعدم تضمينها في الاستراتيجيات الوطنية إذا لم يتم ذكرها أعلاه؟

6. Is there a vision towards embedding sorting at source of solid waste in governmental strategies, legal frameworks and regulations? هل هناك رؤية مستقبلية لتضمين الفرز لنفايات الصلبة من المصدر في الاستراتيجيات الحكومية والأطر والانظمة القانونية الجديدة؟ * *Required*

- ○ Yes نعم
- ○ No لا

6.a. If possible, can you please state briefly what this future will be including: اذا امكن, يرجى بيان ما ستكون عليه هذه الرؤية بإيجاز

6.b. if possible, can you please state the most 3 reasons that is going to lead this transformation into such a vision? إذا كان ذلك ممكنًا ، هل يمكنك من فضلك ذكر أكثر ثلاثة أسباب رئيسية

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Figure 10-7: Solid Waste Section

ستقود هذا التحول إلى مثل هذه الرؤية؟

6.c. Can you scale the following approaches that could best implement the sorting of solid waste in Jordan from 1 to 5 (1 strongly disagree and 5 is strongly agree): قم من فضلك بقياس الأساليب التالية التي يمكن أن تُطبق عملية الفرز لنفايات الصلبة في الأردن على أفضل وجه من 1-5 (1 لا أوافق بشدة و 5 موافق بشدة * Required

Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Modifying the regulations and legal frameworks to restraint the sorting of solid waste تعديل الأطر والانظمة القانونية لضبط فرز النفايات الصلبة	☐	☐	☐	☐	☐
Incentives such as providing taxation exemptions when adopting sorting حوافز مثل تقديم إعفاءات ضريبية عند اعتماد الفرز	☐	☐	☐	☐	☐
Provide sorting facilities for sorting alike separate bins توفير مرافق للفرز مثل حاويات النفايات منفصلة	☐	☐	☐	☐	☐

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Figure 10-8: Solid Waste Section

Provide the local market with markets for recyclable materials تزويد السوق المحلي بأسواق للمواد القابلة لإعادة التدوير	☐	☐	☐	☐	☐
Apply high disposal fees if solid waste is not sorted تطبيق رسوم مرتفعة في حالة عدم فرز النفايات الصلبة	☐	☐	☐	☐	☐
Penalties مخالفات و عقوبات	☐	☐	☐	☐	☐

6.c.i. If possible, can you please state other approaches you find more effective to implement the sorting of solid waste if not mentioned above? إذا كان ذلك ممكنًا ، هل يمكنك ذكر الأساليب الأخرى التي تجدها أكثر فاعلية لتنفيذ فرز النفايات الصلبة إذا لم يتم ذكرها أعلاه؟

6.d. According to the local context, can you choose by whome should this process be implemented in order to have better results in Jordan? وفقًا للسياق المحلي ، هل يمكنك اختيار خلال من يجب تنفيذ هذه عملية فرز النفايات الصلبة لتحقيق نتائج أفضل في الأردن؟

	By هل عن طريق * Required	
	Yes	No
Locals with the government at source of solid waste prior collection in residential, commercials and industrial areas السكان المحليون مع الحكومة في مصدر النفايات الصلبة قبل جمعها في المناطق السكنية والتجارية والصناعية	○	○
Locals with the private sector at source of solid waste prior collection in residential, commercials and industrial areas السكان المحليون مع القطاع الخاص في مصدر النفايات الصلبة قبل الجمع في المناطق السكنية والتجارية والصناعية	○	○

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Figure 10-9: Solid Waste Section

Government in landfills after collection الحكومة في مكبات النفايات بعد الجمع	○	○
Government in recycling plants after collection الحكومة في اماكن مخصصة لإعادة التدوير بعد الجمع	○	○
Private sector in landfills after collection القطاع الخاص في مكبات النفايات بعد الجمع	○	○
Private sector in recycling plants after collection القطاع الخاص في اماكن مخصصة لإعادة التدوير بعد الجمع	○	○

6.d.i. Can you please state if there are other actors you think that they should be involved in the sorting process of solid waste: هل يمكنك أن تذكر ما إذا كانت هناك جهات فاعلة أخرى تعتقد أنه ينبغي إشراكها في عملية فرز النفايات الصلبة:

Figure 10-10: Solid Waste Section

Page 3: C&D Waste

7. Can solid waste management legal frameworks and regulations be applied on C&D waste? هل يمكن تطبيق الأطر والانظمة القانونية لإدارة النفايات الصلبة نفسها على مخلفات البناء والهدم؟ * Required

- ○ Yes نعم
- ○ No لا

8. According to the current regulations, C&D waste has been excluded from them. Can you scale the reasons that might be behind excluding C&D waste from these regulations from 1 to 5 (1 strongly disagree and 5 strongly agree): وفقًا للقوانيين الحالية ، تم استبعاد مخلفات البناء والهدم منها. هل يمكنك قياس الأسباب التي قد تكون وراء استبعادها من هذه القوانين من 1 إلى 5 (1 لا أوافق بشدة و 5 أوافق بشدة): * Required

Please don't select more than 1 answer(s) per row.

Please select at least 7 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Poor infrastructure ضعف البنية التحتية	☐	☐	☐	☐	☐
No further uses for recycled C&D waste as per there is no design codes لا مزيد من الاستخدامات لمخلفات البناء والهدم المعاد تدويرها حيث لا توجد رموز تصميم و كودات لها	☐	☐	☐	☐	☐

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Figure 10-11: C&D Waste Section

Lack of awareness among the construction actors towards C&D waste قلة الوعي بين ممثلي قطاع البناء تجاه مخلفات البناء والهدم	☐	☐	☐	☐	☐
Planned to be included later when studying it extensively مخطط لإدراجه في وقت لاحق عند دراسته على نطاق واسع	☐	☐	☐	☐	☐
Not considering C&D waste as an issue لا تعتبر مخلفات البناء والهدم مشكلة	☐	☐	☐	☐	☐
Construction actors willingness towards C&D waste management قابلية ممثلي قطاع البناء تجاه إدارة مخلفات البناء والهدم	☐	☐	☐	☐	☐
C&D waste is considered to be a special type of waste, thus it needs special and individual regulations تعتبر مخلفات البناء والهدم نوعًا خاصًا من النفايات وتحتاج الى قوانين منفردة وخاصة	☐	☐	☐	☐	☐

8.a. If possible, can you please state other reasons you find more reasonable behind excluding C&D waste from current solid waste regulations if not mentioned above? إذا

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Figure 10-12: C&D Waste Section

أمكن ، هل يمكنك ذكر الأسباب الأخرى التي تجدها أكثر منطقية لاستبعاد مخلفات البناء والهدم من قوانين النفايات الصلبة الحالية إذا لم يتم ذكرها أعلاه؟

9. It is known that informal dumping of C&D waste occurs in Jordan, do you have data regarding the quantity of C&D waste that is informally dumped? هل تعتقد أن هناك سلوك غير رسمي من التخلص من مخلفات المباني في منطقتك من قبل أمن قبل جهات البناء (مقاولون ، مقاولون الفرعي وشركات بناء)؟ * Required

☐ Yes ☐ No

9.a. It is known that informal dumping of C&D waste occurs in Jordan, can you approximately quantify the percentage of the informal dumping of C&D waste (for example as a percentage of total C&D waste generated in Jordan): من المعروف أن الإلقاء غير الرسمي لمخلفات البناء والهدم يحدث في الأردن، هل يمكنك تحديد النسبة المئوية التقريبية للإلقاء الغير رسمي للمخلفات (على سبيل المثال كنسبة مئوية من إجمالي المخلفات الناشئة في الأردن):

- ○ 1% - 20% informally dumped ١% الى ٢٠% ملقاة بشكل غير رسمي
- ○ 20% - 40% informally dumped ٢٠% الى ٤٠% ملقاة بشكل غير رسمي
- ○ 40% - 60% informally dumped ٤٠% الى ٦٠% ملقاة بشكل غير رسمي
- ○ 60% - 80% informally dumped ٦٠% الى ٨٠% ملقاة بشكل غير رسمي
- ○ 80% - 100% informally dumped ٨٠% الى ١٠٠% ملقاة بشكل غير رسمي

9.a.i. Can you please scale the following reasons behind this informal dumping of C&D waste from 1 to 5 (1 strongly disagree and 5 strongly agree): قم من فضلك بقياس الأسباب التالية وراء هذا الإلقاء غير الرسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة

Please don't select more than 1 answer(s) per row.

Please select at least 12 answer(s).

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Figure 10-13: C&D Waste Section

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Lack in Legal Frameworks and Regulations الافتقار إلى الأطر واللوائح القانونية	☐	☐	☐	☐	☐
Lack in Local Actors Awareness in respect to C&D waste impacts نقص الوعي لدى المحليين فيما يتعلق بتأثيرات مخلفات المباني	☐	☐	☐	☐	☐
Lack in Local Actors Awareness in respect to benefits of reusing C&D waste نقص في وعي المحليين فيما يتعلق بفوائد إعادة استخدام مخلفات المباني	☐	☐	☐	☐	☐
Lack in Governmental supervision and strictness قلة الإشراف الحكومي والصرامة	☐	☐	☐	☐	☐
High Costs for legal dumping including dumping fees ارتفاع تكاليف الطمر القانوني في المكبات	☐	☐	☐	☐	☐

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Figure 10-14: C&D Waste Section

Involvement of the informal workers within the industry إشراك العمال غير مهنيين وقوانيين في قطاع البناء	☐	☐	☐	☐	☐
Lack of necessary skills and knowledge amongst construction practitioners to C&D waste نقص المعرفة والمهارات اللازمة اتجاه مخلفات الباء والهدم من قبل ممارسي مهنة البناء	☐	☐	☐	☐	☐
Long Transportation Distances to dumpsites مسافات طويلة لنقل المخلفات إلى المكبات	☐	☐	☐	☐	☐
Lack of management system عدم وجود نظام إدارة لمخلفات البناء والهدم	☐	☐	☐	☐	☐
Low supervisions on waste disposal behaviors ضعف الإشراف على سلوكيات التخلص من المخلفات البناء والهدم	☐	☐	☐	☐	☐

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Figure 10-15: C&D Waste Section

Incomplete waste disposal system نظام التخلص من المخلفات البناء والهدم غير مكتمل	☐	☐	☐	☐	☐
Time Concerns مخاوف من الوقت	☐	☐	☐	☐	☐

9.a.i.a. If possible, can you please state other factors you find more reasonable if not mentioned above behind the informal dumping of C&D waste: اذا امكن, يرجى ذكر العوامل الأخرى التي تجدها أكثر منطقية وراء الإلقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

9.a.ii. Can you please scale the following approaches that could contribute in mitigating the informal dumping of C&D waste from 1 to 5 (1 is strongly disagree and 5 strongly agree): قم من فضلك بقياس الأساليب التالية التي يمكن أن تساهم في التخفيف من الإلقاء الغير رسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة): * Required

Please don't select more than 1 answer(s) per row.

Please select at least 9 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Modify and add Legal Frameworks and Regulation in respect to C&D waste تعديل وإضافة الأطر واللوائح القانونية فيما يتعلق بمخلفات البناء والهدم	☐	☐	☐	☐	☐

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Figure 10-16: C&D Waste Section

Improve the awareness of the construction industry actors in Jordan تحسين وعي الجهات المعنية في قطاع البناء في الاردن	☐	☐	☐	☐	☐
Increase the governmental supervision and strictness on C&D waste زيادة الرقابة الحكومية والصرامة على مخلفات البناء والهدم	☐	☐	☐	☐	☐
Decrease the legal dumping fees of C&D waste تخفيض رسوم الإلقاء/الطمر القانونية لمخلفات البناء والهدم	☐	☐	☐	☐	☐
Provide taxation exemptions تقديم إعفاءات ضريبية	☐	☐	☐	☐	☐
Improve the skills and knowledge among construction practitioners to C&D waste تحسين المهارات والمعرفة لمنسبي قطاع البناء في مجال مخلفات البناء والهدم	☐	☐	☐	☐	☐
Decrease the distances to dumpsites تقليل المسافات إلى المكبات	☐	☐	☐	☐	☐

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Figure 10-17: C&D Waste Section

Provide markets for recycled waste materials to initiate recycling of C&D waste توفير اسواق لمخلفات البناء والهدم المعاد تدويرها لبدء إعادة التدوير	☐	☐	☐	☐	☐
Facilitate recycling plants تسهيل مصانع لإعادة التدوير مخلفات البناء والهدم	☐	☐	☐	☐	☐

9.a.ii.a. If possible, can you please state other approaches you find more effective to mitigate the informal dumping of C&D waste if not mentioned above: اذا امكن، يرجى ذكر الأساليب الأخرى التي تجدها أكثر فعالية للتخفيف من الإلقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

10. Can you please scale the following encouragements that can transform the construction industry towards adopting a C&D waste management strategy from 1 to 5 (1 is strongly disagree and 5 is strongly agree)? قم من فضلك بقياس التشجيعات التالية التي يمكن أن تحول قطاع الانشاءات نحو تبني استراتيجية إدارة مخلفات البناء والهدم من ١ إلى ٥ (١ لا أوافق بشدة و ٥ موافق بشدة)؟ * *Required*

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)

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Figure 10-18: C&D Waste Section

Modifying the regulations and legal frameworks to facilitate the reuse of C&D waste within the construction industry تعديل اللوائح والأطر القانونية لتسهيل إعادة استخدام مخلفات البناء والهدم في قطاع الانشاءات	☐	☐	☐	☐	☐
Provide the local market with markets for recycled C&D waste تزويد السوق المحلي بأسواق لمخلفات البناء والهدم المعاد تدويرها	☐	☐	☐	☐	☐
Provide Tax exemptions تقديم إعفاءات ضريبية	☐	☐	☐	☐	☐
Increase the disposal fees زيادة رسوم الطمر في المكبات	☐	☐	☐	☐	☐
Fines or penalties for Polluters الغرامات والعقوبات على الملوثين	☐	☐	☐	☐	☐

10.a. If possible, Can you please state other encouragements you find more effective to transform the construction industry towards adopting a C&D waste management if not mentioned above? إذا كان ذلك ممكنًا ، هل يمكنك ذكر تشجيعات/محفزات أخرى تجدها أكثر فاعلية لتحويل قطاع الانشاءات نحو اعتماد إدارة لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه؟

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Figure 10-19: C&D Waste Section

Page 4: Likert Scale

11. Can you please scale the following from 1 to 5 (1 is strongly disagree and 5 is strongly agree): (هل يمكنك قياس ما يلي من 1 إلى 5 (1 لا أوافق بشدة و 5 موافق بشدة ✱ Required

Please don't select more than 1 answer(s) per row.

Please select at least 7 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم تجميعها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم فرزها الصحيح؟	☐	☐	☐	☐	☐

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Figure 10-20: Evaluation Section

I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم طمرها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها االصحيحين؟	☐	☐	☐	☐	☐
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐

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Figure 10-21: Evaluation Section

I consider the municipality/ies to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الامانة/و البلديات صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐
I consider the other internal governmental departments to be strict in respect to the current C&D waste regulations? أنا أعتبر الإدارات الحكومية الداخلية الاخرى صارمة فيما يتعلق بقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐

11.a. Can you please justify the following according to your previous answers if you scale them below 3 (Neither agree nor Disagree): هل يمكنك تبرير ما يلي وفقًا لإجاباتك السابقة إذا قمت بقياسها إلى أقل من 3 (لا أوافق ولا أعارض):

	Please justify briefly why you scaled that below 3: يرجى توضيح بإيجاز سبب قياسك ذلك بأقل من 3 *Optional*

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Figure 10-22: Evaluation Section

I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم تجميعها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم فرزها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم طمرها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها االصحيحين؟	
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء والهدم؟	
I consider the municipality/ies to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الامانة/و البلديات صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين الحالية لمخلفات البناء والهدم؟	

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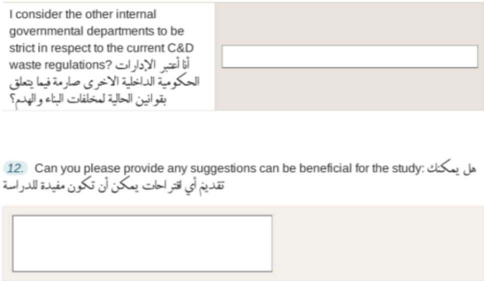
Figure 10-23: Evaluation Section


I consider the other internal governmental departments to be strict in respect to the current C&D waste regulations? أنا أعتبر الإدارات الحكومية الداخلية الاخرى صارمة فيما يتعلق بقوانين الحالية لمخلفات البناء و الهدم؟

12. Can you please provide any suggestions can be beneficial for the study: هل يمكنك تقديم أي اقتراحات يمكن أن تكون مفيدة للدراسة

Figure 10-24: Evaluation Section

10.1.6.3.2.2 The Department of Construction

The Department of Construction questionnaires at GAM, MPWH and MLA are divided into four sections as follows:

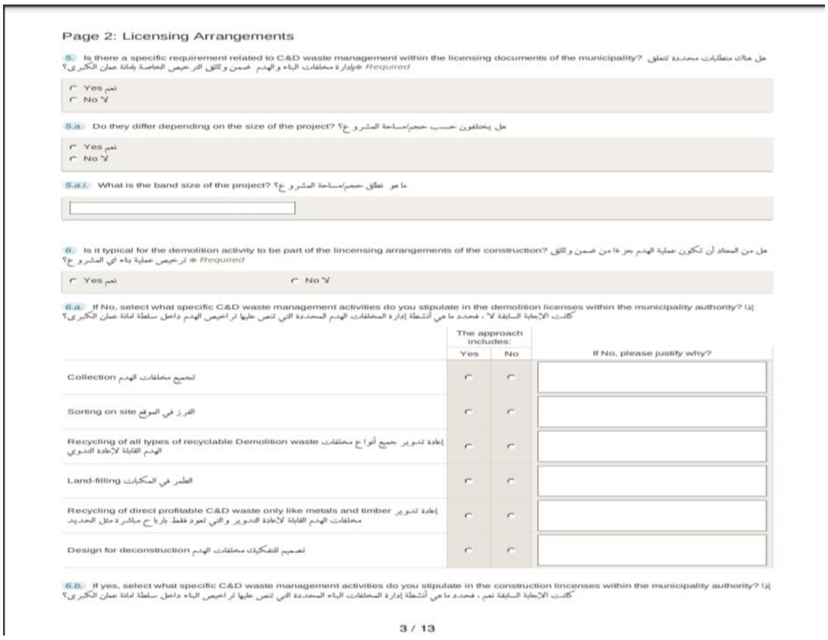
1. Section 1:
   This contains the PCF and directions for completing the questionnaire.

2. Section 2:
   This includes licensing arrangements of construction and demolition activities regarding C&D waste.

3. Section 3:
   This quantifies informal dumping and the factors that contribute to it, identifies barriers to C&D waste management adoption. In addition to evaluating the possible approaches and incentives that could reduce informal dumping or lead to the adoption of a national C&D waste management strategy.

4. Section 4:
   As in the previous survey, this section includes the questions of Likert scale.

The figures below depict the survey questions as they were created in the survey tool.



Page 2: Licensing Arrangements

5. Is there a specific requirement related to C&D waste management within the licensing documents of the municipality? * Required

Yes نعم
No لا

5.a. Do they differ depending on the size of the project?

Yes نعم
No لا

5.a.i. What is the band size of the project?

6. Is it typical for the demolition activity to be part of the lincensing arrangements of the construction? * Required

Yes نعم
No لا

6.a. If No, select what specific C&D waste management activities do you stipulate in the demolition licenses within the municipality authority?

	The approach includes: Yes	No	If No, please justify why?
Collection			
Sorting on site			
Recycling of all types of recyclable Demolition waste			
Land-filling			
Recycling of direct profitable C&D waste only like metals and timber			
Design for deconstruction			

6.b. If yes, select what specific C&D waste management activities do you stipulate in the construction lincenses within the municipality authority?

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Figure 10-25: Licensing Arrangements Section

	The approach includes:		
	Yes	No	If no, please justify why?
Collection تجميع مخلفات البناء			
Sorting on site الفرز في الموقع			
Recycling of all types of recyclable Construction waste إعادة تدوير جميع مخلفات البناء القابلة لإعادة التدوير			
Land-filling الطمر في المكبات			
Recycling of direct profitable C&D waste only like metals and timber إعادة تدوير مخلفات البناء القابلة لإعادة التدوير والتي تعود فقط بارباح مباشرة مثل الحديد			
Design for reduction/prevention of C&D waste تصميم للتقليل/منع نشئت مخلفات البناء			

Figure 10-26: Licensing Arrangements Section

Page 3: C&D Waste

7. It is known that informal dumping of C&D waste occurs in Jordan, do you have data regarding the quantity of C&D waste that is informally dumped? هل تعتقد أن هنالك سلوك غير رسمي من التخلص من مخلفات المباني في منطقتك من قبل أمن قبل جهات البناء (مقاولون ، مقاولون الفرعي وشركات بناء)؟ * Required

Yes No

7.a. It is known that informal dumping of C&D waste occurs in Jordan, can you approximately quantify the percentage of the informal dumping of C&D waste (for example as a percentage of total C&D waste generated in Jordan): من المعروف أن الالقاء غير الرسمي لمخلفات البناء والهدم يحدث في الأردن، هل بإمكانك تحديد النسبة المئوية التقريبية للالقاء الغير رسمي للمخلفات (على سبيل المثال كنسبة مئوية من إجمالي المخلفات الناشئة في الأردن):

- 1% - 20% informally dumped ١% الى ٢٠% ملقاة بشكل غير رسمي
- 20% - 40% informally dumped ٢٠% الى ٤٠% ملقاة بشكل غير رسمي
- 40% - 60% informally dumped ٤٠% الى ٦٠% ملقاة بشكل غير رسمي
- 60% - 80% informally dumped ٦٠% الى ٨٠% ملقاة بشكل غير رسمي
- 80% - 100% informally dumped ٨٠% الى ١٠٠% ملقاة بشكل غير رسمي

7.a.i. Can you please scale the following reasons behind this informal dumping of C&D waste from 1 to 5 (1 strongly disagree and 5 strongly agree): قم(من فضلك بقياس الأسباب التالية وراء هذا الالقاء غير الرسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة

Please don't select more than 1 answer(s) per row.

Please select at least 12 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Lack in Legal Frameworks and Regulations الافتقار إلى الأطر واللوائح القانونية					
Lack in Local Actors Awareness in respect to C&D waste impacts نقص الوعي لدى المحليين فيما يتعلق بتأثيرات مخلفات المباني					
Lack in Local Actors Awareness in respect to benefits of reusing C&D waste نقص في وعي المحليين فيما يتعلق بفوائد إعادة استخدام مخلفات المباني					
Lack in Governmental supervision and strictness قلة الإشراف الحكومي والصرامة					
High Costs for legal dumping including dumping fees ارتفاع تكاليف الطمر القانوني في المكبات					
Involvement of the informal workers within the industry إشراك العمال غير مهنيين وقوانيين في قطاع البناء					
Lack of necessary skills and knowledge amongst construction practitioners to C&D waste نقص المعرفة والمهارات اللازمة اتجاه مخلفات البناء والهدم من قبل ممارسي مهنة البناء					
Long Transportation Distances to dumpsites مسافات طويلة لنقل المخلفات إلى المكبات					
Lack of management system عدم وجود نظام إدارة لمخلفات البناء والهدم					

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Figure 10-27: C&D Waste Section

Low supervisions on waste disposal behaviors ضعف الاشراف على سلوكيات التخلص من المخلفات البناء والهدم					
Incomplete waste disposal system نظام التخلص من المخلفات البناء والهدم غير مكتمل					
Time Concerns مخاوف من الوقت					

7.a.i.a. If possible, can you please state other factors you find more reasonable if not mentioned above behind the informal dumping of C&D waste: اذا امكن، يرجى ذكر العوامل الأخرى التي تجدها أكثر منطقية وراء الالقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

7.a.ii. Can you please scale the following approaches that could contribute in mitigating the informal dumping of C&D waste from 1 to 5 (1 is strongly disagree and 5 strongly agree): قم من فضلك بقياس الأساليب التالية التي يمكن أن تساهم في التخفيف من الالقاء الغير رسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة) * Required

Please don't select more than 1 answer(s) per row.

Please select at least 9 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Modify and add Legal Frameworks and Regulation in respect to C&D waste تعديل وإضافة الأطر واللوائح القانونية فيما يتعلق بمخلفات البناء والهدم					
Improve the awareness of the construction industry actors in Jordan تحسين وعي الجهات المعنية في قطاع البناء في الاردن					
Increase the governmental supervision and strictness on C&D waste زيادة الرقابة الحكومية والصرامة على مخلفات البناء والهدم					
Decrease the legal dumping fees of C&D waste تخفيض رسوم الالقاء/الطمر القانونية لمخلفات البناء والهدم					
Provide taxation exemptions تقديم إعفاءات ضريبية					
Improve the skills and knowledge among construction practitioners to C&D waste تحسين المهارات والمعرفة لمنتسبي قطاع البناء في مجال مخلفات البناء والهدم					
Decrease the distances to dumpsites تقليل المسافات إلى المكبات					
Provide markets for recycled waste materials to initiate recycling of C&D waste توفير اسواق لمخلفات البناء والهدم المعاد تدويرها لبدء إعادة التدوير					
Facilitate recycling plants تسهيل مصانع لاعادة التدوير مخلفات البناء والهدم					

7.a.ii.a. If possible, can you please state other approaches you find more effective to mitigate the informal dumping of C&D waste if not mentioned

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Figure 10-28: C&D Waste Section

اذا امكن، يرجى ذكر الاساليب الاخرى التي تجدها أكثر فعالية للتخفيف من الالقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه above:

7.b. According to the landfill departement, a huge percentage of C&D waste is excavation waste, Could you please scale the following types of projects that generate this huge amount of excavation waste? وفقا لقسم المكبات ، فإن نسبة كبيرة من مخلفات البناء والهدم هي مخلفات حفر .هل يمكنك من فضلك قياس الأنواع التالية من المشاريع التي تولد هذه الكمية الضخمة من مخلفات الحفريات؟

	Scale the projects from 1 to 5 (1 strongly disagree and 5 strongly agree) قياس المشاريع من 1 إلى 5 (1 لا أوافق بشدة و 5 أوافق بشدة * Required				
	1 Strongly Disagree لا أوافق بشدة	2 Disagree لا أوافق	3 Neither Agree Nor Disagree لا أوافق ولا أرفض	4 Agree أوافق	5 Strongly Agree أوافق بشدة
Tunnels الأنفاق					
Bridges الجسور					
Residential Buildings عمارات سكنية					
Commercial Buildings مباني تجارية					
Streets and Highways الشوارع والطرق السريعة					

7.c. Please scale the following activties in assending order based on C&D waste generation in Jordan from 1 to 3? (1 least waste generated and 3 most waste generated) يرجى قياس الأنشطة التالية في ترتيب تصاعدي من الاعلى الى الادنى من ناحية انتاجها لمخلفات البناء والهدم في الأردن؟ (1 أقل توليداً للمخلفات و 3 اكثر توليداً للمخلفات)

	Scale the activities * Required		
	1 least waste generated أقل توليداً للمخلفات	2 moderate waste generated توليداً للمخلفات معتدل	3 most waste generated اكثر توليداً للمخلفات
Construction اعمال بناء			
Demolition هدم			
Renovation التجديد وإعادة التأهيل			

8. Select the most 3 **reasons** behind preventing each process from happening within the C&D waste management on site as below: ما السبب / الأسباب التي تقف وراء عدم تنفيذ إدارة مناسبة لمخلفات البناء والهدم في الأردن في المراحل التالية

	Reasons * Required										
	No enough equipment لا توجد معدات كافية	Involvement of the informal workers within the industry إشراك العمال الغير المهنيين في قطاع الانشاءات	No codes for recycled materials لا وجود للكودات للمواد المعاد تدويرها	Lack of necessary skills and knowledge among construction practitioners to C&D waste نقص المعرفة والمهارات اللازمة بين منتسبي قطاع البناء اتجاه مخلفات البناء والهدم	Long Transportation Distances to dumpsites مسافات طويلة لنقل المخلفات إلى المكبات	High Dumping Fees رسوم الطمر للمخلفات عالية	Low dumping fees رسوم الطمر للمخلفات منخفضة	Small portions of C&D waste generated كميات صغيرة من مخلفات البناء والهدم يتم انتاجها	Lack of management system in the construction industry عدم وجود/نقص في نظم الادارة	Lack of Regulations and legal frameworks عدم وجود/نقص في الأنظمة وأطر قانونية	[illegible]

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Figure 10-29: C&D Waste Section

Collection on site التجميع في الموقع										
Sorting on site الفرز في الموقع										
Transporting to landfill النقل إلى المكب										
Recycling and Reusing إعادة التدوير وإعادة الاستخدام										

9. Can you please scale the reasons preventing the C&D waste management in landfill or dumpsites from 1 to 5 (1 is strongly disagree and 5 strongly agree)? قم من فضلك بقياس أسباب منع إدارة مخلفات البناء والهدم في المكبات القانونية من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة): * Required

Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
C&D waste comprises many types of waste المخلفات البناء والهدم تشمل العديد من المواد (انواع)					
No sorting on site لا يوجد فرز في الموقع					
C&D waste contains hazardous or harmful materials تحتوي المخلفات البناء والهدم على مواد خطرة أو ضارة					
Large quantities of C&D waste dumped at once, thus hard to implement a C&D waste management يتم إلقاء كميات كبيرة من مخلفات البناء والهدم مرة واحدة ، وبالتالي يصعب تنفيذ إدارتها					
Small quantities of C&D waste dumped in landfill, thus there is no need for C&D waste management كميات صغيرة من مخلفات البناء والهدم يتم القائها في المكبات ، وبالتالي ليست هناك حاجة لإدارتها					
Land-filling costs less than C&D waste management تكاليف طمر مخلفات البناء والهدم في المكبات أقل من تكلفة إدارتها					

9.a. If possible, Can you please state other factors you find more reasonable to prevent the C&D waste management in landfill if not mentioned above? يرجى ذكر العوامل الأخرى التي تجدها أكثر منطقية لمنع إدارة المخلفات البناء والهدم في المكب إذا لم يتم ذكرها أعلاه؟

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Figure 10-30: C&D Waste Section

10. Do you think that the municipality would you consider using recycled aggregates in new concrete mixes in new projects if designed by specific codes and specifications? هل تعتقد أن الامانة قد تفكر في استخدام الحصمة المعاد تدويره في الخلطات الخرسانية الجديدة في مشاريع الامانة جديدة إذا تم تصميمها وفقًا لأكواد ومواصفات محددة؟ * Required

- Yes نعم
- No لا

11. Tick the possible concerns that the municipality takes into consideration and scale them from 1 to 5 (1 strongly disagree and 5 stongly agree): ضع علامة على المخاوف المحتملة التي يأخذها الامانة بعين الاعتبار وقم بقياسها من ١ إلى ٥ (١ لا أوافق بشدة و ٥ موافق بشدة)؟

	Taken into consideration تأخذ بعين الاعتبار * Required		Scale * Required				
	Yes	No	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Environmental Concerns مخاوف بيئية							
Social Concerns مخاوف الاجتماعية							
Economic Concerns مخاوف اقتصادية							

12. Can you please state any example or current practice that does happen by the municipality in reusing C&D waste? هل يمكنك من فضلك ذكر أي مثال أو ممارسة حالية تحدث من قبل الامانة في إعادة استخدام لمخلفات البناء والهدم؟ * Required

12.a. Can you please state the most 3 reasons behind this transformation into this/these current practices of reusing C&D waste? هل يمكنك من فضلك ذكر أكثر ٣ أسباب رئيسية وراء هذا التحول إلى مثل هكذا ممارسات (لإعادة استخدام مخلفات البناء والهدم)؟ * Required

13. Can you please scale the following encouragements that can transform the construction industry towards adopting a C&D waste management strategy from 1 to 5 (1 is strongly disagree and 5 is strongly agree)? قم من فضلك بقياس التشجيعات التالية التي يمكن أن تحول قطاع الانشاءات نحو تبني استراتيجية إدارة مخلفات البناء والهدم من ١ إلى ٥ (١ لا أوافق بشدة و ٥ موافق بشدة)؟ * Required

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)

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Figure 10-31: C&D Waste Section

Modifying the regulations and legal frameworks to facilitate the reuse of C&D waste within the construction industry تعديل اللوائح والأطر القانونية لتسهيل إعادة استخدام مخلفات البناء والهدم في قطاع الانشاءات	☐	☐	☐	☐	☐
Provide the local market with markets for recycled C&D waste تزويد السوق المحلي بأسواق لمخلفات البناء والهدم المعاد تدويرها	☐	☐	☐	☐	☐
Provide Tax exemptions تقديم إعفاءات ضريبية	☐	☐	☐	☐	☐
Increase the disposal fees زيادة رسوم الطمر في المكبات	☐	☐	☐	☐	☐
Fines or penalties for Polluters الغرامات والعقوبات على الملوثين	☐	☐	☐	☐	☐

13.a. If possible, Can you please state other encouragements you find more effective to transform the construction industry towards adopting a C&D waste management if not mentioned above? إذا كان ذلك ممكنًا، هل يمكنك ذكر تشجيعات/محفزات أخرى تجدها أكثر فاعلية لتحويل قطاع الانشاءات نحو اعتماد إدارة لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه؟

Figure 10-32: C&D Waste Section

Page 4: Likert Scale

14. Can you please scale the following from 1 to 5 (1 is strongly disagree and 5 is strongly agree): هل يمكنك قياس ما يلي من 1 إلى 5 (1 لا أوافق بشدة و 5 موافق بشدة) * Required

Please don't select more than 1 answer(s) per row.

Please select at least 7 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم تجميعها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم فرزها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم طمرها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها االصحيحين؟	☐	☐	☐	☐	☐
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐
I consider the municipality to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الامانة صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐
I consider the other internal governmental departments to be strict in respect to the current C&D waste regulations? أنا أعتبر الادارات الحكومية الداخلية الاخرى صارمة فيما يتعلق بقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐

14.a. Can you please justify the following according to your previous answers if you scale them below 3 (Neither agree nor Disagree): هل يمكنك تبرير ما يلي وفقًا لإجاباتك السابقة إذا قمت بقياسها إلى أقل من 3 (لا أوافق ولا أعارض):

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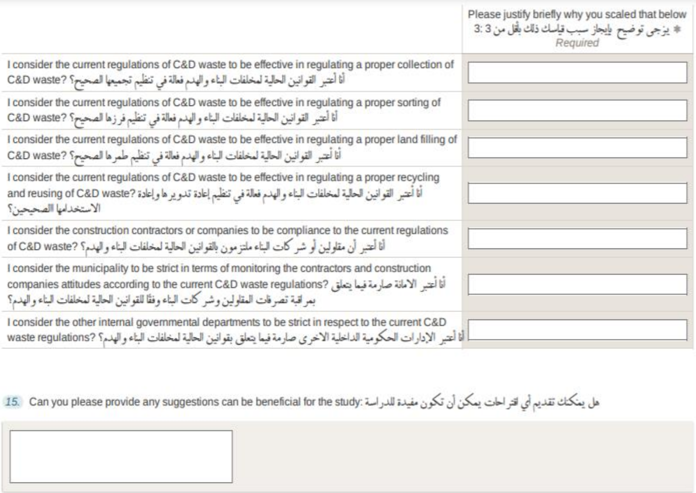
Figure 10-33: Evaluation Section



	Please justify briefly why you scaled that below يرجى توضيح بإيجاز سبب قياسك ذلك بأقل من 3: 3 * Required
I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم تجميعها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم فرزها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم طمرها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها االصحيحين؟	
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء والهدم؟	
I consider the municipality to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الامانة صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين الحالية لمخلفات البناء والهدم؟	
I consider the other internal governmental departments to be strict in respect to the current C&D waste regulations? أنا أعتبر الإدارات الحكومية الداخلية الاخرى صارمة فيما يتعلق بقوانين الحالية لمخلفات البناء والهدم؟	

15. Can you please provide any suggestions can be beneficial for the study: هل يمكنك تقديم أي اقتراحات يمكن أن تكون مفيدة للدراسة

Figure 10-34: Evaluation Section

10.1.6.3.2.3 The Department of Design and Studies

The Department of Design and Studies at MPWH and MLA surveys are divided into three sections:

1. Section 1:
   This contains the PCF and directions for completing the questionnaire.

2. Section 2:
   This pertains to the design phase of constructing or demolishing structures in Jordan.

3. Section 3:
   As in the previous survey, this section includes the questions of Likert scale.

The figures below depict the survey questions as they were created in the survey tool.

Page 2: Design Phase

5. Can you please select the **phases** that take place within the **design stage** of projects? هل يمكنك تحديد **المراحل** التي تحدث في مرحلة **تصميم المشاريع** من فضلك؟ * *Required*

- Programming Phase
- Schematic Design Phase
- Design Development Phase
- Construction Document Phase
- Other

5.a. If you selected Other, please specify: إذا اخترت أخرى ، يرجى التحديد

5.b. Select the tasks that take place within this phase: تحدد المهام التي تحدث في هذه المرحلة

- Estimating realistic project cost تقدير تكلفة المشروع الواقعية
- Determining the building and user requirements تحديد متطلبات المبنى والمستخدم
- Establishing a total building area إنشاء مساحة بناء كاملة
- Refining the scope of work تنقيح نطاق العمل
- Other

5.b.i. If you selected Other, please specify: إذا اخترت أخرى ، يرجى التحديد

5.c. Select the tasks that take place within this phase: تحدد المهام التي تحدث في هذه المرحلة

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Figure 10-35: Design Section

- Building systems (structural, mechanical, HVAC, plumbing and electrical) بناء ع أنظمة البناء (الهيكلية والميكانيكية والتكييف والسباكة والكهرباء
- Interior and exterior finishes التشطيبات الداخلية والخارجية
- Building site بناء
- Other

5.c.i. If you selected Other, please specify: إذا اخترت أخرى ، يرجى التحديد

5.d. Select the tasks that take within this phase: تحدد المهام التي تحدث في هذه المرحلة

- Interior and exterior building materials and finishes مواد البناء والتشطيبات الداخلية والخارجية
- Furniture and equipment selection and layouts اختيار الأثاث والمعدات والتصميمات
- Cabinetry and custom fabrications المفروشات
- Lighting and technology designs تصاميم الإضاءة والتكنولوجيا
- Mechanical, electrical and plumbing systems الأنظمة الميكانيكية والكهربائية والسباكة
- Other

5.d.i. If you selected Other, please specify: إذا اخترت أخرى ، يرجى التحديد

5.e. Select the tasks that take place within this phase: تحدد المهام التي تحدث في هذه المرحلة

- Compliance with all applicable codes and statutes الامتثال لجميع القوانين والكودات المعمول بها .

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Figure 10-36: Design Section

- Compliance with universal standards الامتثال للمعايير العالمية
- Verification of the building site conditions التحقق من ظروف موقع البناء
- Quality controls during the Construction Phase ضوابط الجودة خلال مرحلة البناء
- Estimates of all associated costs تقديرات لجميع التكاليف المرتبطة
- Other

5.e.i. If you selected Other, please specify:

6. Is it typical for the **demolition to be part of the construction** when **desiging of structures**? هل من المعتاد أن يكون الهدم جزءًا من البناء عند تصميم المشاريع؟ * Required

- Yes نعم
- No لا

6.a. Can you please state what phases take place when desiging a structure for demolition? هل يمكنك من فضلك تحديد المراحل التي تحدث عند تصميم اي مشروع للهدم؟

7. Does the ministry **use** any approach for **deisging waste out** of projects (design for reduction/prevention/deconstruction)? هل تقوم الوزارة **باتباع** أي نهج له علاقة بتصميم المباني**لازالة مخلفات البناء والهدم من المشاريع** عن طريق تصميم لتقليل / منع / تفكيك؟ * Required

- Yes نعم

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Figure 10-37: Design Section

- No لا

7.a. Can you please scale the **reasons preventing the adoption** of such approaches in the country from 1 to 5 (**1 strongly disagree and 5 is strongly agree**)? قم من فضلك بقياس **الأسباب التي تمنع تبني** مثل هذه الأساليب (تصميم لتقليل/منع/تفكيك) في الاردن من ١ إلى ٥ (**١ غير موافق بشدة و ٥** موافق بشدة)؟

Please don't select more than 1 answer(s) per row.

Please select at least 8 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
No codes for recycled materials to be used لا وجود لكودات معنية باستخدام المواد المعاد تدويرها	☐	☐	☐	☐	☐
Technical concerns مخاوف فنية	☐	☐	☐	☐	☐
Local context awareness and willingness الوعي المحلي وقابليته لاستخدام المخلفات المعاد تدويرها	☐	☐	☐	☐	☐
Time concerns مخاوف من الوقت	☐	☐	☐	☐	☐
Cost concerns مخاوف من التكلفة	☐	☐	☐	☐	☐
Poor demolition techniques تقنيات الهدم الضعيفة	☐	☐	☐	☐	☐

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Figure 10-38: Design Section

In-existence of Regulations and legal frameworks عدم وجود أنظمة وأطر قانونية	⌜	⌜	⌜	⌜	⌜
Inadequacy of regulations and legal frameworks عدم كفاية الأنظمة والأطر القانونية	⌜	⌜	⌜	⌜	⌜

7.a.i. If possible, can you please state other reasons you find more reasonable behind preventing these approaches from being applied if not mentioned above? اذا امكن, هل يمكنك ذكر أسباب أخرى تجدها أكثر منطقية وراء منع تطبيق هذه الأساليب (تصميم لتقليل/منع/تفكيك) إذا لم يتم ذكرها أعلاه؟

7.b. Can you please scale the **reasons hindering** the existence of recycled materials design codes from 1 to 5 (**1 strongly disagree and 5 is strongly agree**)? قم من فضلك بقياس **الأسباب التي تعيق** وجود كودات تصميم المواد المعاد تدويرها من ١ إلى ٥ **(١ غير موافق بشدة و ٥ موافق بشدة)**؟

Please don't select more than 1 answer(s) per row.

Please select at least 4 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)

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Figure 10-39: Design Section

C&D waste is generated in small portions, thus there is no need for recycling حجم مخلفات البناء والهدم التي يتم إنشاءها في أجزاء صغيرة ، وبالتالي ليست هناك حاجة لإعادة التدوير	⌜	⌜	⌜	⌜	⌜
Recycling is relatively a new technology إعادة التدوير تقنية جديدة نسبيًا	⌜	⌜	⌜	⌜	⌜
Establishing design codes needs time due to many reasons such as experimental testing يحتاج إنشاء كودات التصميم إلى وقت لأسباب عديدة منها عمل التجارب	⌜	⌜	⌜	⌜	⌜
Establishing design codes costs much إنشاء كودات التصميم يكلف الكثير	⌜	⌜	⌜	⌜	⌜

7.b.i. If possible, can you please state other reasons you find more reasonable in hindering the existence of recycled materials codes if not mentioned above? هل يمكنك ذكر الأسباب الأخرى التي تجدها أكثر منطقية تعرقل وجود كودات للمواد المعاد تدويرها إذا لم يتم ذكرها أعلاه؟

7.c. Can you please scale the following approaches that could **contribute in**

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Figure 10-40: Design Section

implementing or adopting the design of C&D waste out of projects from 1 to 5 (**1 strongly disagree and 5 is strongly agree**): قم من فضلك بقياس الأساليب التالية التي يمكن أن **تسهم في تنفيذ أو اعتماد** تصميم التقليل / منع / تفكيك لمخلفات البناء والهدم من المشاريع من ١ إلى ٥ (**١** غير موافق بشدة و **٥** موافق بشدة):

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Establish codes for recycled materials إنشاء كودات للمواد المعاد تدويرها	☐	☐	☐	☐	☐
Regulate C&D waste management when designing of projects تنظيم إدارة مخلفات البناء والهدم عند تصميم المشاريع	☐	☐	☐	☐	☐
Provide facilities for recycling C&D waste توفير مرافق لإعادة تدوير مخلفات البناء والهدم	☐	☐	☐	☐	☐
Encourage design companies by taxation exemptions تشجيع شركات التصميم من خلال الإعفاءات الضريبية	☐	☐	☐	☐	☐

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Figure 10-41: Design Section

Provide the market (designers) with proper training and acknowledgment تزويد السوق (المصممين) بالتدريب والتأهيل المناسبين	☐	☐	☐	☐	☐

7.c.i. If possible, can you please state other approaches you find more effective in implementing the design of waste out if not mentioned above: اذا امكن, هل يمكنك تحديد أساليب أخرى تجدها أكثر فعالية في تصميم للمشاريع عن طريق تقليل / منع / تفكيك لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

8. Is there a **plan or vision to establish design codes** for recycled materials in the near future? هل هناك **خطة أو رؤية لوضع أكواد تصميم** للمواد المعاد تدويرها في المستقبل القريب؟ * *Required*

○ Yes نعم
○ No لا

9. Can you please answer the following questions: من فضلك قم بالإجابة على الأسئلة التالية:

	Yes/No * *Required*		
	Yes	No	If no, can you please breifly justify why? إذا كانت الإجابة "لا" ، هل يمكنك أن تبرر بإيجاز لماذا؟ *Optional*

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Figure 10-42: Design Section

Do you believe that the ministry would use recycled materials if recycled materials codes were existed? هل تعتقد أن الوزارة ستستخدم المواد المعاد تدويرها في حالة وجود كودات للمواد المعاد تدويرها؟	○	○	
Do you believe that the ministry would use recycled materials if recycled materials shown good behavior with no codes for recycled materials were existed? هل تعتقد أن الوزارة ستستخدم المواد المعاد تدويرها إذا أظهرت المواد المعاد تدويرها حسن السلوك مع عدم وجود كودات للمواد المعاد تدويرها؟	○	○	
Do you believe that the ministry would use recycled materials if recycled materials shown good behavior with codes for recycled materials were existed? هل تعتقد أن الوزارة ستستخدم المواد المعاد تدويرها إذا كانت المواد المعاد تدويرها تظهر سلوكًا جيدًا مع وجود كودات المواد المعاد تدويرها؟	○	○	

10. Would the **ministry** consider **designing governmental projects** with recycled aggregates in new concrete mixes? هل من الممكن ان تقوم **الوزارة** في **تصميم** باستخدام مواد المعاد التدويره في الخلطات الخرسانية الجديدة في **المشاريع الحكومية الجديدة؟** * *Required*

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Figure 10-43: Design Section

○ Yes نعم
○ No لا

11. Can you please scale the following **encouragements** that can **transform** the construction industry towards **adopting a C&D waste management strategy** from 1 to 5 (**1 is strongly disagree and 5 is strongly agree**)? قم من فضلك بقياس **التشجيعات** التالية التي يمكن أن **تحول** قطاع الانشاءات نحو **تبني استراتيجية إدارة مخلفات البناء والهدم** من ١ إلى ٥ (**١** لا أوافق بشدة و **٥ موافق بشدة**)؟ * *Required*

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Modifying the regulations and legal frameworks to facilitate the reuse of C&D waste within the construction industry تعديل اللوائح والأطر القانونية لتسهيل إعادة استخدام مخلفات البناء والهدم في قطاع الانشاءات	☐	☐	☐	☐	☐
Provide the local market with markets for recycled C&D waste تزويد السوق المحلي بأسواق لمخلفات البناء والهدم المعاد تدويرها	☐	☐	☐	☐	☐

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Figure 10-44: Design Section

Provide Tax exemptions تقديم إعفاءات ضريبية	☐	☐	☐	☐	☐
Increase the disposal fees زيادة رسوم الطمر في المكبات	☐	☐	☐	☐	☐
Fines or penalties for Polluters الغرامات والعقوبات على الملوثين	☐	☐	☐	☐	☐

11.a. If possible, Can you please state other encouragements you find more effective to transform the construction industry towards adopting a C&D waste management if not mentioned above? إذا كان ذلك ممكنًا ، هل يمكنك ذكر تشجيعات/محفزات أخرى تجدها أكثر فاعلية لتحويل قطاع الانشاءات نحو اعتماد إدارة لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه؟

Figure 10-45: Design Section

Page 3: Likert Scale

12. Tick the possible **concerns** that the **departement of design** in the ministry takes into **consideration** when desiging governmental projects and scale them from 1 to 5 (**1 strongly disagree and 5 stongly agree**): ضع علامة على **المخلوف** المحتملة التي تأخذها **قسم التصميم** في الوزارة بعين **الاعتبار** عند تصميم المشاريع الحكومية وقم بقياسها من 1 إلى 5 (**1** لا أوافق بشدة و **5** أوافق بشدة)

	Taken into **consideration** يؤخذ بعين **الاعتبار** * Required		Scale * Required				
	Yes	No	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Environmental Concerns مخاوف بيئية	◯	◯	◯	◯	◯	◯	◯
Social Concerns مخاوف الاجتماعية	◯	◯	◯	◯	◯	◯	◯
Economic Concerns مخاوف اقتصادية	◯	◯	◯	◯	◯	◯	◯

13. Can you please **scale** the following from 1 to 5 (1 is strongly disagree and 5 is strongly agree): (هل يمكنك قياس ما يلي من 1 إلى 5 (1 لا أوافق بشدة و 5 موافق بشدة * Required

Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

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Figure 10-46: Evaluation Section

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم تجميعها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم فرزها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم طمرها الصحيح؟	☐	☐	☐	☐	☐

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Figure 10-47: Evaluation Section

I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها االصحيحين؟	☐	☐	☐	☐	☐
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐
I consider the ministry to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الامانة صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين الحالية لمخلفات البناء والهدم؟	☐	☐	☐	☐	☐

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Figure 10-48: Evaluation Section

13.a. Can you please **justify** the following according to your previous answers if you scale them **below 3** (Neither agree nor Disagree): هل يمكنك تبرير ما يلي وفقًا لإجاباتك السابقة إذا قمت بقياسها إلى أقل من 3 (لا أوافق ولا أعارض):

	Please justify briefly why you scaled that below 3: يرجى توضيح بإيجاز سبب قياسك ذلك بأقل من 3 *Optional*
I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم تجميعها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم فرزها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم طمرها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها االصحيحين؟	
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء والهدم؟	

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Figure 10-49: Evaluation Section

I consider the ministry to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الامانة صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين الحالية لمخلفات البناء والهدم؟	

14. Can you please provide any suggestions can be beneficial for the study: هل يمكنك تقديم أي اقتراحات يمكن أن تكون مفيدة للدراسة

Figure 10-50: Evaluation Section

10.1.6.3.2.4 Construction Contractors and Companies

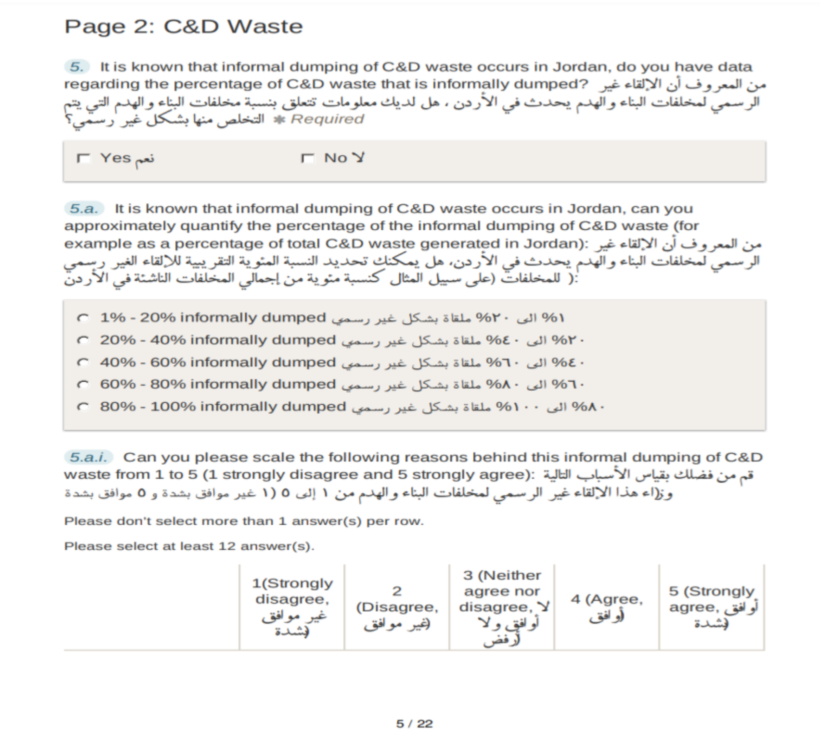
Construction contractors and companies' questions are divided into three sections:

1. Section 1:
   This contains the PCF and instructions for completing the questionnaire.

2. Section 2:
   This contains the rank of companies, their types of projects and the current C&D waste management practices. It also measures informal dumping and its causes, identifies the barriers to C&D waste management adoption and evaluates possible approaches and incentives.

3. Section 3:
   As in the previous survey, this section includes the questions of Likert scale.

The figures below depict the survey questions as they were created in the survey tool.



Page 2: C&D Waste

5. It is known that informal dumping of C&D waste occurs in Jordan, do you have data regarding the percentage of C&D waste that is informally dumped? من المعروف أن الإلقاء غير الرسمي لمخلفات البناء والهدم يحدث في الأردن ، هل لديك معلومات تتعلق بنسبة مخلفات البناء والهدم التي يتم التخلص منها بشكل غير رسمي؟ * Required

- Yes نعم
- No لا

5.a. It is known that informal dumping of C&D waste occurs in Jordan, can you approximately quantify the percentage of the informal dumping of C&D waste (for example as a percentage of total C&D waste generated in Jordan): من المعروف أن الإلقاء غير الرسمي لمخلفات البناء والهدم يحدث في الأردن، هل يمكنك تحديد النسبة المئوية التقريبية للإلقاء الغير رسمي للمخلفات (على سبيل المثال كنسبة مئوية من إجمالي المخلفات الناشئة في الأردن):

- 1% - 20% informally dumped ١% الى ٢٠% ملقاة بشكل غير رسمي
- 20% - 40% informally dumped ٢٠% الى ٤٠% ملقاة بشكل غير رسمي
- 40% - 60% informally dumped ٤٠% الى ٦٠% ملقاة بشكل غير رسمي
- 60% - 80% informally dumped ٦٠% الى ٨٠% ملقاة بشكل غير رسمي
- 80% - 100% informally dumped ٨٠% الى ١٠٠% ملقاة بشكل غير رسمي

5.a.i. Can you please scale the following reasons behind this informal dumping of C&D waste from 1 to 5 (1 strongly disagree and 5 strongly agree): قم من فضلك بقياس الأسباب التالية وراء هذا الإلقاء غير الرسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة

Please don't select more than 1 answer(s) per row.

Please select at least 12 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)

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Figure 10-51: C&D Waste Section

Lack in Legal Frameworks and Regulations الافتقار إلى الأطر واللوائح القانونية	☐	☐	☐	☐	☐
Lack in Local Actors Awareness in respect to C&D waste impacts نقص الوعي لدى المحليين فيما يتعلق بتأثيرات مخلفات المباني	☐	☐	☐	☐	☐
Lack in Local Actors Awareness in respect to benefits of reusing C&D waste نقص في وعي المحليين فيما يتعلق بفوائد إعادة استخدام مخلفات المباني	☐	☐	☐	☐	☐
Lack in Governmental supervision and strictness قلة الإشراف الحكومي والصرامة	☐	☐	☐	☐	☐
High Costs for legal dumping including dumping fees ارتفاع تكاليف الطمر القانوني في المكبات	☐	☐	☐	☐	☐
Involvement of the informal workers within the industry إشراك العمال غير مهنيين وقوانيين في قطاع البناء	☐	☐	☐	☐	☐

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Figure 10-52: C&D Waste Section

Lack of necessary skills and knowledge amongst construction practitioners to C&D waste نقص المعرفة والمهارات اللازمة اتجاه مخلفات الباء والهدم من قبل ممارسي مهنة البناء	☐	☐	☐	☐	☐
Long Transportation Distances to dumpsites مسافات طويلة لنقل المخلفات إلى المكبات	☐	☐	☐	☐	☐
Lack of management system عدم وجود نظام إدارة لمخلفات البناء والهدم	☐	☐	☐	☐	☐
Low supervisions on waste disposal behaviors ضعف الإشراف على سلوكيات التخلص من المخلفات البناء والهدم	☐	☐	☐	☐	☐
Involvement of Sub-contractors إشراك المقاولين الفرعين	☐	☐	☐	☐	☐
Incomplete waste disposal system نظام التخلص من المخلفات البناء والهدم غير مكتمل	☐	☐	☐	☐	☐

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Figure 10-53: C&D Waste Section

Time Concerns مخاوف من الوقت	☐	☐	☐	☐	☐

5.a.i.a. If possible, can you please state other factors you find more reasonable if not mentioned above behind the informal dumping of C&D waste: اذا امكن, يرجى ذكر العوامل الأخرى التي تجدها أكثر منطقية وراء الإلقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

5.a.ii. Can you please scale the following approaches that could contribute in mitigating the informal dumping of C&D waste from 1 to 5 (1 is strongly disagree and 5 strongly agree): قم من فضلك بقياس الأساليب التالية التي يمكن أن تساهم في التخفيف من الإلقاء الغير رسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة):

Please don't select more than 1 answer(s) per row.

Please select at least 9 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Modify and add Legal Frameworks and Regulation in respect to C&D waste تعديل وإضافة الأطر واللوائح القانونية فيما يتعلق بمخلفات البناء والهدم	☐	☐	☐	☐	☐

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Figure 10-54: C&D Waste Section

Improve the awareness of the construction industry actors in Jordan تحسين وعي الجهات المعنية في قطاع البناء في الاردن	☐	☐	☐	☐	☐
Increase the governmental supervision and strictness on C&D waste زيادة الرقابة الحكومية والصرامة على مخلفات البناء والهدم	☐	☐	☐	☐	☐
Decrease the legal dumping fees of C&D waste تخفيض رسوم الإلقاء/الطمر القانونية لمخلفات البناء والهدم	☐	☐	☐	☐	☐
Provide taxation exemptions تقديم إعفاءات ضريبية	☐	☐	☐	☐	☐
Improve the skills and knowledge among construction practitioners to C&D waste تحسين المهارات والمعرفة لمنسبي قطاع البناء في مجال مخلفات البناء والهدم	☐	☐	☐	☐	☐
Decrease the distances to dumpsites تقليل المسافات إلى المكبات	☐	☐	☐	☐	☐

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Figure 10-55: C&D Waste Section

Provide markets for recycled waste materials to initiate recycling of C&D waste توفير اسواق لمخلفات البناء والهدم المعاد تدويرها لبدء إعادة التدوير					
Facilitate recycling plants تسهيل مصانع لإعادة التدوير مخلفات البناء والهدم					

5.a.ii.a. If possible, can you please state other approaches you find more effective to mitigate the informal dumping of C&D waste if not mentioned above: اذا امكن، يرجى ذكر الأساليب الأخرى التي تجدها أكثر فعالية للتخفيف من الإلقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

6. Tick the materials as listed if existed in the composition of C&D waste ضع علامة على المواد كما هي مدرجة إذا كانت موجودة في تكوين مخلفات المباني ؟

	C&D waste composition تكوين مخلفات المباني * Required	
	Existed موجود	Not Existed موجود غير
Crushed Concrete Aggregates الخرسانة		
Masonry and Bricks الطوب		
Sand رمال		
Cement الاسمنت		
Steel Reinforcement حديد التسليح		

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Figure 10-56: C&D Waste Section

Timber الأخشاب		
Other Metals معادن أخرى		
Other Waste مخلفات أخرى		

6.a. Answer the following question أجب على السؤال التالي

	Select the **percentage** genertaed from Demolition for each type and **only once** and dont repeat the percentages you select حدد **النسبة المئوية** التي تم إنشاؤها من الهدم لكل **نوع واحدة فقط لا تكرر النسب** * Required									
	< 10	10-20%	21-30%	31%-40%	41-50%	51%-60%	61-70%	71-80%	81%-90%	> 90%
Crushed Concrete Aggregates الخرسانة										
Masonry and Bricks الطوب										
Sand رمال										
Cement الاسمنت										
Steel Reinforcement حديد التسليح										
Timber الأخشاب										
Other Metals معادن أخرى										
Other Waste مخلفات أخرى										

6.b. Answer the following question أجب على السؤال التالي

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Figure 10-57: C&D Waste Section

	Select the percentage generated from Construction for each type and **only once and dont repeat the percentages you select** حدد النسبة المئوية التي تم إنشاؤها من الإنشاء لكل نوع واحدة فقط لا تكرر النسب * Required									
	< 10	10-20%	21-30%	31%-40%	41-50%	51%-60%	61-70%	71-80%	81%-90%	> 90%
Crushed Concrete Aggregates الخرسانة										
Masonry and Bricks الطوب										
Sand رمال										
Cement الاسمنت										
Steel Reinforcement حديد التسليح										
Timber الأخشاب										
Other Metals معادن أخرى										
Other Waste مخلفات أخرى										

6.c. Depending on your work, what is the approximate volume of C&D waste generated each year by your company? اعتمادًا على عملك ، ما هو الحجم التقريبي لمخلفات البناء والهدم التي تنتجها شركتك كل عام؟ *Optional*

6.d. What is the classification of your company as classified by the Construction Contractors Association? ما هو تصنيف شركتك حسب تصنيف نقابة مقاولي البناء؟ * *Required*

- Class 1

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Figure 10-58: C&D Waste Section

- Class 2
- Class 3
- Class 4
- Class 5
- Class 6

6.e. What are the most 3 types of projects your company construct in Jordan? ما هي أكثر 3 أنواع من المشاريع التي تقوم شركتك بإنشائها في الأردن؟ * *Required*

- Residential Buildings عمارات سكنية
- Commercial Buildings مباني تجارية
- Car Tunnels أنفاق السيارات
- Car Bridges جسور السيارات
- Streets and Highways الشوارع والطرق السريعة
- Other

6.e.i. If you selected Other, please specify:

7. Do you use any approach for construction waste management when constructing a project by your company? هل تستخدم أي نهج لإدارة مخلفات البناءعند إنشاءك لمشروع من قبل شركتك؟
* *Required*

- Yes نعم
- No لا

7.a. If yes, select what does this approach include? إذا كانت الإجابة بنعم ، فحدد ماذا يتضمن هذا النهج؟

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Figure 10-59: C&D Waste Section

	The approach includes: النهج يشمل : *Optional*	
	Yes	No
Collection تجميع مخلفات البناء	○	○
Sorting on site الفرز لمخلفات البناء بالموقع	○	○
Land-filling طمر لمخلفات البناء في المكبات المخصصة	○	○
Recycling of all types of C&D waste اعادة تدوير لجميع مخلفات البناء	○	○
Recycling of profitable waste only like metals and timber اعادة تدوير لمخلفات البناء التي تعود بربح مباشر مثل الحديد	○	○
Design for reduction/prevention of C&D waste / تصميم للتقليل منع نشأت مخلفات البناء	○	○

7.b. Is it typical for your company to do a demolition activity? هل من المعتاد او الطبيعي أن تقوم شركتك بنشاط هدم الابنية؟ * *Required*

○ Yes نعم ○ No لا

7.b.i. Do you use any approach for C&D waste management when demolition a project by your company? هل تستخدم أي نهج لإدارة مخلفات الهدم عند هدم مشروع من قبل شركتك؟

○ Yes نعم
○ No لا

7.b.i.a. If yes, select what does this approach include? إذا كانت الإجابة بنعم ، فحدد ما الذي يتضمنه هذا النهج؟

	The approach includes: *Optional*		
	Yes	No	Justify your previous answer:

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Figure 10-60: C&D Waste Section

Collection تجميع مخلفات الهدم	○	○	
Sorting on site فرز مخلفات الهدم جميعها في الموقع	○	○	
Land-filling طمر لمخلفات الهدم في المكبات المخصصة	○	○	
Recycling of all types of C&D اعادة تدوير لمخلفات الهدم جميعها	○	○	
Recycling of profitable waste only like metals and timber اعادة تدوير لمخلفات الهدم التي تعود بربح مباشر مثل الحديد	○	○	
Design for Deconstruction and disassembling تصميم لتفكيك مخلفات الهدم	○	○	

8. As a contractor, would you consider using recycled aggregates in new concrete mixes in new projects if designed by specific codes and specifications? كمقاول محلي، هل من الممكن ان تفكر في استخدام الحصمة المعاد تدويره (GCA) في الخلطات الخرسانية الجديدة المطلوبة لمشاريعك الجديدة وتحت الموصفات والمعايير الاردنية؟ * *Required*

○ Yes نعم
○ No لا

8.a. Can you please scale the reasons behind your previous answer from 1 to 5 (1 strongly disagree and 5 is strongly agree): قم بقياس الأسباب الممكنة وراء إجابتك من 0 إلى 10 (0 غير موافق و 10 موافق بشدة):

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Figure 10-61: C&D Waste Section

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Quality Issues مشاكل في الجودة	☐	☐	☐	☐	☐
Costs/Prices of recycled waste materials are closer to standard materials اسعار مخلفات البناء والهدم المعاد تدويرها قريبة من اسعار المواد الاساسية الجديدة	☐	☐	☐	☐	☐
Prefer to use standard new materials in new projects افضل استخدام مواد جديدة في المشاريع الجديدة	☐	☐	☐	☐	☐
Avoiding hazardous materials in recycled waste materials تجنب المواد الخطرة في مخلفات البناء والهدم المعاد تدويرها	☐	☐	☐	☐	☐

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Figure 10-62: C&D Waste Section

The lifespan of recycled waste materials is shorter than the standard ones العمر الافتراضي لمخلفات البناء والهدم المعاد تدويرها أقصر من العمر الافتراضي للمواد الجديدة	☐	☐	☐	☐	☐
I do not mind using recycled aggregates but that depends on client's desire لا أمانع في استخدام الحصمة المعاد تدويرها ولكن هذا يعتمد على رغبة العميل	☐	☐	☐	☐	☐

8.a.i. If possible, can you please state other aspects you find more reasonable to your previous answer if not mentioned above? اذا امكن, هل يمكنك ذكر أسباب أخرى التي تجدها أكثر منطقية لاجابتك السابقة إذا لم يتم ذكرها أعلاه؟

Figure 10-63: C&D Waste Section

Page 3: Likert Scale

9. Can you please scale the following from 1 to 5 (1 is strongly disagree and 5 is strongly agree): (هل يمكنك قياس ما يلي من 1 إلى 5 (1 لا أوافق بشدة و 5 موافق بشدة) * *Required*

Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء و الهدم فعالة في تنظيم تجميعها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء و الهدم فعالة في تنظيم فرزها الصحيح؟	☐	☐	☐	☐	☐

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Figure 10-64: Evaluation Section

I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء و الهدم فعالة في تنظيم طمرها الصحيح؟	☐	☐	☐	☐	☐
I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء و الهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها االصحيحين؟	☐	☐	☐	☐	☐
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء و الهدم؟	☐	☐	☐	☐	☐

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Figure 10-65: Evaluation Section

I consider the governmental departments to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الدوائر الحكومية صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين مخلفات البناء والهدم الحالية؟					

9.a. Can you please justify the following according to your previous answers if you scale them below 3 (Neither agree nor Disagree): هل يمكنك تبرير ما يلي وفقًا لإجاباتك السابقة إذا قمت بقياسها إلى أقل من 3 (لا أوافق ولا أعارض):

	Please justify briefly why you scaled that below 3: يرجى توضيح بإيجاز سبب قياسك ذلك بأقل من 3 *Optional*
I consider the current regulations of C&D waste to be effective in regulating a proper collection of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم تجميعها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper sorting of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم فرزها الصحيح؟	

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Figure 10-66: Evaluation Section

I consider the current regulations of C&D waste to be effective in regulating a proper land filling of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم طمرها الصحيح؟	
I consider the current regulations of C&D waste to be effective in regulating a proper recycling and reusing of C&D waste? أنا أعتبر القوانين الحالية لمخلفات البناء والهدم فعالة في تنظيم إعادة تدويرها وإعادة الاستخدامها الصحيحين؟	
I consider the construction contractors or companies to be compliance to the current regulations of C&D waste? أنا أعتبر أن مقاولين أو شركات البناء ملتزمون بالقوانين الحالية لمخلفات البناء والهدم؟	
I consider the governmental departments to be strict in terms of monitoring the contractors and construction companies attitudes according to the current C&D waste regulations? أنا أعتبر الدوائر الحكومية صارمة فيما يتعلق بمراقبة تصرفات المقاولين وشركات البناء وفقًا للقوانين مخلفات البناء والهدم الحالية؟	

10. Can you please provide any suggestions can be beneficial for the study: هل يمكنك تقديم أي اقتراحات يمكن أن تكون مفيدة للدراسة

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Figure 10-67: Evaluation Section

10.1.6.3.2.5 Concrete Suppliers

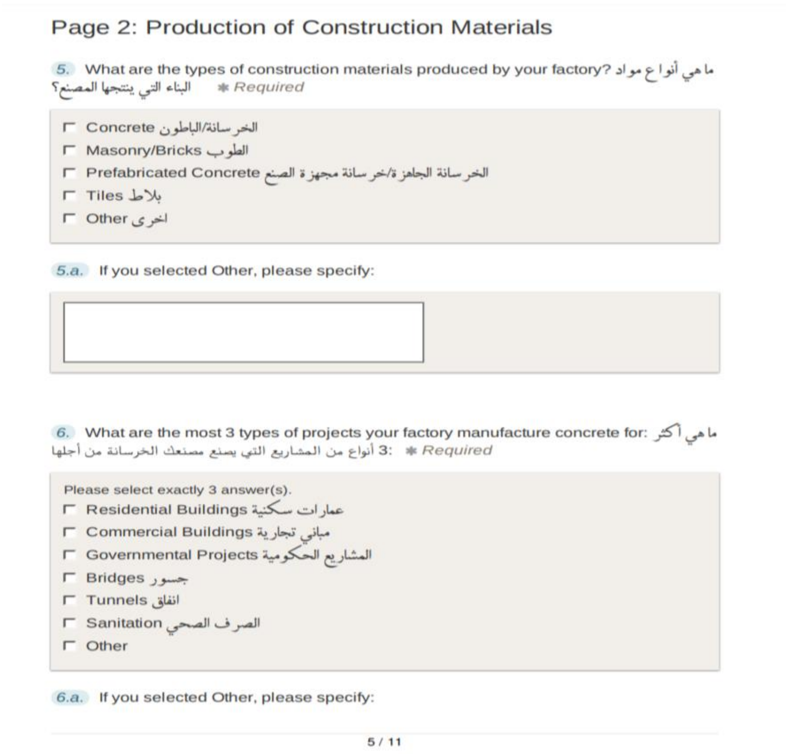
Concrete Suppliers' surveys are divided into three sections:

1. Section 1:
   This contains the PCF and directions for completing the questionnaire.

2. Section 2:
   This denotes the manufacture of construction material.

3. Section 3:
   This denotes waste created by factories and quantifies the waste management strategy chosen.

The figures below depict the survey questions as they were created in the survey tool.



Page 2: Production of Construction Materials

5. What are the types of construction materials produced by your factory? ماهي أنواع مواد البناء التي ينتجها المصنع؟ * Required

- Concrete الخرسانة/الباطون
- Masonry/Bricks الطوب
- Prefabricated Concrete الخرسانة الجاهزة/خرسانة مجهزة الصنع
- Tiles بلاط
- Other اخرى

5.a. If you selected Other, please specify:

6. What are the most 3 types of projects your factory manufacture concrete for: ماهي أكثر 3 أنواع من المشاريع التي يصنع مصنعك الخرسانة من أجلها: * Required

Please select exactly 3 answer(s).

- Residential Buildings عمارات سكنية
- Commercial Buildings مباني تجارية
- Governmental Projects المشاريع الحكومية
- Bridges جسور
- Tunnels انفاق
- Sanitation الصرف الصحي
- Other

6.a. If you selected Other, please specify:

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Figure 10-68: Production of Construction Material Section

Page 3: Factory Waste

7. Does the factory generate waste from the production of concrete? هل يتتج المصنع مخلفات من إنتا ج الخرسانة؟ * Required

- Yes
- No

7.a. Select what types of waste does it produce? حدد أنوا ع المخلفات التي تنتجها؟

	Generated or Not? تنتج ام لا * Required		
	Yes نعم	No لا	Approximate Quanitity per month الكمية التقريبية المنتجة في شهر Optional
Concrete خرسانة			
Aggregates الحصمة			
Cement اسمنت			
Sand رمال			
Water مياه			

7.a.i. What is your adopted approach for such waste? ما هو نهجك المعتمد لمثل هذه المخلفات؟ * Required

- Formal Dumping in proper landfills االتخلص الرسمي في مكبات المخلفات المناسبة
- Informal Dumping التخلص منها بشكل غير رسمي
- Recycling to be used in new concrete إعادة التدوير لاستخدامها في الخرسانة الجديدة
- Reusing in other uses apart from concrete إعادة الاستخدام في استخدامات أخرى غير الخرسانة
- Company owned dumpsites
- Other آخر

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Figure 10-69: Factory Waste Section

7.a.i.a. If you selected Other, please specify:

7.a.i.b. Can you please scale the follwoing reasons behind your previous reason from 1 to 5 (1 strongly disagree and 5 strongly agree) قم من فضلك بقياس الأسباب التالية وراء اجابتك السابقة من 1 إلى 5 (1 لا أوافق بشدة و 5 أوافق بشدة)

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Land-filling is environmentally friendly طمر المخلفات في المكبات يعتبر صديقة للبيئة					
No recycling facilities available لا توجد مرافق إعادة تدوير متاحة					
The amount of waste generated is very small, thus recycling is not feasible كمية المخلفات المتولدة صغيرة جدًا ، وبالتالي فإن إعادة التدوير غير مجدية					

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Figure 10-70: Factory Waste Section

Transportation distances to landfills is very short مسافات النقل إلى المكبات قصيرة جدًا	☐	☐	☐	☐	☐
Local market is not willing to use recycled materials السوق المحلي ليس على استعداد لاستخدام المواد المعاد تدويرها	☐	☐	☐	☐	☐

7.a.i.b.i. If possible, can you please state other aspects you find more reasonable to your previous answer if not mentioned above: إذا أمكن ، هل يمكنك ذكر الجوانب الأخرى التي تجدها أكثر منطقية لإجابتك السابقة إذا لم يتم ذكرها أعلاه

8. Do you think that constructions actors as below would use recycled materials if designed under recycled materials codes? هل تعتقد أن الجهات المعنية في الإنشاءات على النحو التالي ستستخدم المواد المعاد تدويرها إذا تم تصميمها بموجب كودات خاصة للمواد المعاد تدويرها

	Yes/No * Required		
	Yes	No	Why if no? لماذا اذا لا؟
The factory المصنع	○	○	
Contractors/Construction Companies / المقاولون شركات المقاولات	○	○	

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Figure 10-71: Factory Waste Section

Locals السكان المحليون	○	○	

9. Please provide any suggestions that could be beneficial for the study: يرجى تقديم أي اقتراحات يمكن أن تكون مفيدة للدراسة

Figure 10-72: Factory Waste Section

10.1.6.3.2.6 Academic

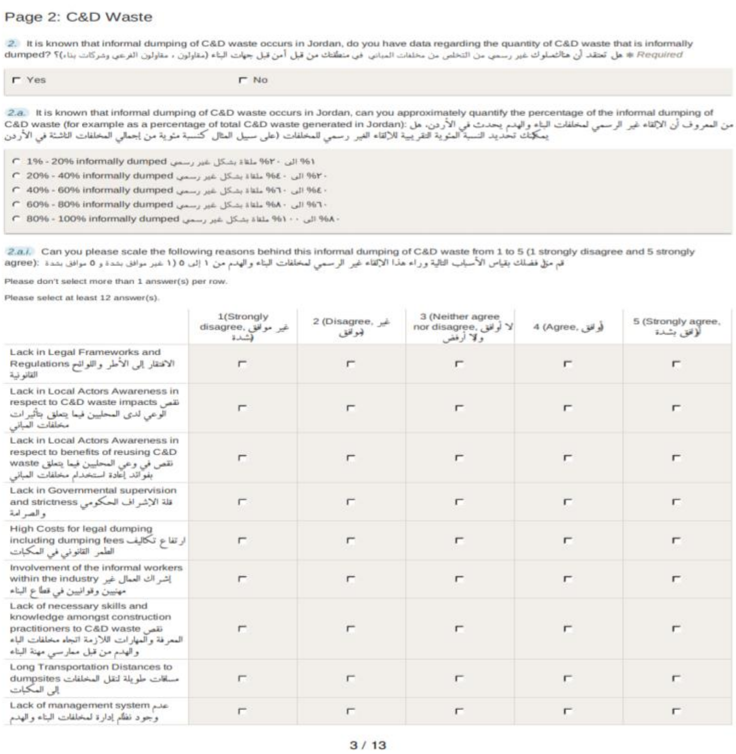
Academic surveys are divided into three sections:

1. Section 1:
   This contains the PCF and instructions for completing the questionnaire.

2. Section 2:
   This quantifies informal dumping and its causes, identifies barriers to C&D waste management adoption. In addition to evaluating the possible approaches and incentives to reduce informal dumping or to adopt a national C&D waste management strategy.

3. Section 3:
   As in the previous survey, this section includes the questions of Likert scale.

The figures below depict the survey questions as they were created in the survey tool.



Page 2: C&D Waste

2. It is known that informal dumping of C&D waste occurs in Jordan, do you have data regarding the quantity of C&D waste that is informally dumped? هل تعتقد أن هالتسلوك غير رسمي من التخلص من مخلفات المباني في منطقتك من قبل أمن قبل جهات البناء (مقاولون ، مقاولون الفرعي وشركات بناء)؟ * Required

- Yes
- No

2.a. It is known that informal dumping of C&D waste occurs in Jordan, can you approximately quantify the percentage of the informal dumping of C&D waste (for example as a percentage of total C&D waste generated in Jordan): من المعروف أن الإلقاء غير الرسمي لمخلفات البناء والهدم يحدث في الأردن، هل يمكنك تحديد النسبة المئوية التقريبية للإلقاء الغير رسمي للمخلفات (على سبيل المثال كنسبة مئوية من إجمالي المخلفات الناشئة في الأردن

- 1% - 20% informally dumped ١% الى ٢٠% ملقاة بشكل غير رسمي
- 20% - 40% informally dumped ٢٠% الى ٤٠% ملقاة بشكل غير رسمي
- 40% - 60% informally dumped ٤٠% الى ٦٠% ملقاة بشكل غير رسمي
- 60% - 80% informally dumped ٦٠% الى ٨٠% ملقاة بشكل غير رسمي
- 80% - 100% informally dumped ٨٠% الى ١٠٠% ملقاة بشكل غير رسمي

2.a.i. Can you please scale the following reasons behind this informal dumping of C&D waste from 1 to 5 (1 strongly disagree and 5 strongly agree): قم من فضلك بقياس الأسباب التالية وراء هذا الإلقاء غير الرسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة

Please don't select more than 1 answer(s) per row.

Please select at least 12 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Lack in Legal Frameworks and Regulations الافتقار إلى الأطر واللوائح القانونية					
Lack in Local Actors Awareness in respect to C&D waste impacts نقص الوعي لدى المحليين فيما يتعلق بتأثيرات مخلفات المباني					
Lack in Local Actors Awareness in respect to benefits of reusing C&D waste نقص في وعي المحليين فيما يتعلق بفوائد إعادة استخدام مخلفات المباني					
Lack in Governmental supervision and strictness قلة الإشراف الحكومي والصرامة					
High Costs for legal dumping including dumping fees ارتفاع تكاليف الطمر القانوني في المكبات					
Involvement of the informal workers within the industry إشراك العمال غير مهنيين وقوانيين في قطاع البناء					
Lack of necessary skills and knowledge amongst construction practitioners to C&D waste نقص المعرفة والمهارات اللازمة اتجاه مخلفات البناء والهدم من قبل ممارسي مهنة البناء					
Long Transportation Distances to dumpsites مسافات طويلة لنقل المخلفات إلى المكبات					
Lack of management system عدم وجود نظام إدارة لمخلفات البناء والهدم					

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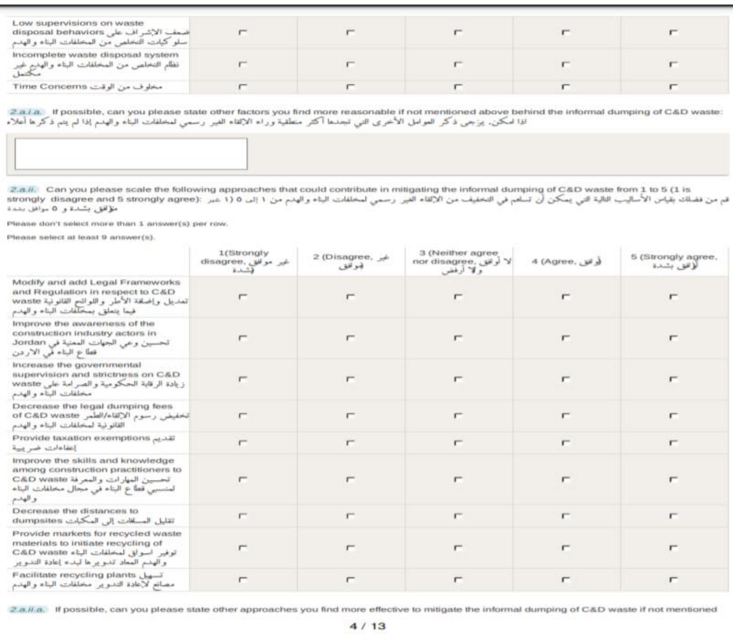
Figure 10-73: C&D Waste Section



Low supervisions on waste disposal behaviors ضعف الإشراف على سلوكيات التخلص من المخلفات البناء والهدم					
Incomplete waste disposal system نظام التخلص من المخلفات البناء والهدم غير مكتمل					
Time Concerns مخاوف من الوقت					

2.a.i.a. If possible, can you please state other factors you find more reasonable if not mentioned above behind the informal dumping of C&D waste: اذا امكن، يرجى ذكر العوامل الأخرى التي تجدها أكثر منطقية وراء الإلقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

2.a.ii. Can you please scale the following approaches that could contribute in mitigating the informal dumping of C&D waste from 1 to 5 (1 is strongly disagree and 5 strongly agree): قم من فضلك بقياس الأساليب التالية التي يمكن أن تساهم في التخفيف من الإلقاء الغير رسمي لمخلفات البناء والهدم من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة

Please don't select more than 1 answer(s) per row.

Please select at least 9 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Modify and add Legal Frameworks and Regulation in respect to C&D waste تعديل وإضافة الأطر واللوائح القانونية فيما يتعلق بمخلفات البناء والهدم					
Improve the awareness of the construction industry actors in Jordan تحسين وعي الجهات المعنية في قطاع البناء في الاردن					
Increase the governmental supervision and strictness on C&D waste زيادة الرقابة الحكومية والصرامة على مخلفات البناء والهدم					
Decrease the legal dumping fees of C&D waste تخفيض رسوم الإلقاء/الطمر القانونية لمخلفات البناء والهدم					
Provide taxation exemptions تقديم إعفاءات ضريبية					
Improve the skills and knowledge among construction practitioners to C&D waste تحسين المهارات والمعرفة لمنتسبي قطاع البناء في مجال مخلفات البناء والهدم					
Decrease the distances to dumpsites تقليل المسافات إلى المكبات					
Provide markets for recycled waste materials to initiate recycling of C&D waste توفير اسواق لمخلفات البناء والهدم المعاد تدويرها لبدء إعادة التدوير					
Facilitate recycling plants تسهيل مصانع لإعادة التدوير مخلفات البناء والهدم					

2.a.ii.a. If possible, can you please state other approaches you find more effective to mitigate the informal dumping of C&D waste if not mentioned

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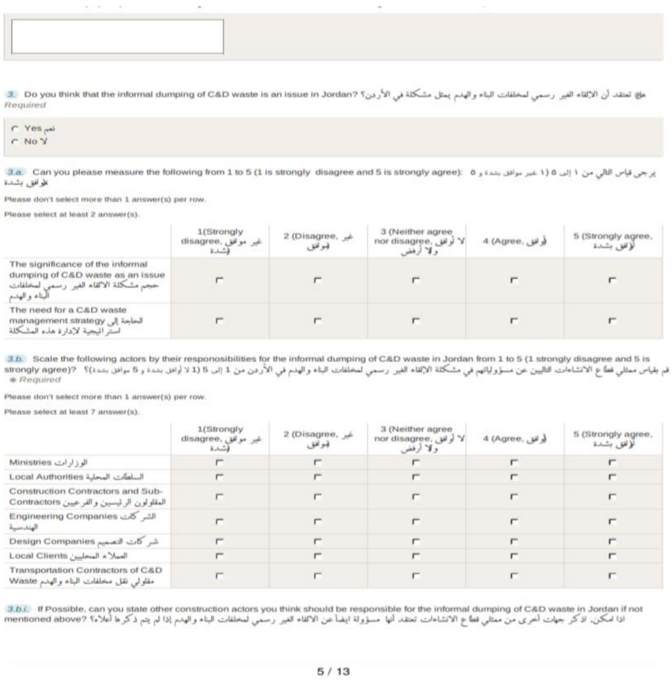
Figure 10-74: C&D Waste Section



3. Do you think that the informal dumping of C&D waste is an issue in Jordan? هل تعتقد أن الإلقاء الغير رسمي لمخلفات البناء والهدم يمثل مشكلة في الأردن؟
Required

Yes نعم
No لا

3.a. Can you please measure the following from 1 to 5 (1 is strongly disagree and 5 is strongly agree): يرجى قياس التالي من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة

Please don't select more than 1 answer(s) per row.

Please select at least 2 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
The significance of the informal dumping of C&D waste as an issue حجم مشكلة الالقاء الغير رسمي لمخلفات البناء والهدم					
The need for a C&D waste management strategy الحاجة إلى استراتيجية لإدارة هذه المشكلة					

3.b. Scale the following actors by their responosibilities for the informal dumping of C&D waste in Jordan from 1 to 5 (1 strongly disagree and 5 is strongly agree)? قم بقياس ممثلي قطاع الانشاءات التاليين عن مسؤولياتهم في مشكلة الإلقاء الغير رسمي لمخلفات البناء والهدم في الأردن من 1 إلى 5 (1 لا أوافق بشدة و 5 موافق بشدة)؟
* Required

Please don't select more than 1 answer(s) per row.

Please select at least 7 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Ministries الوزارات					
Local Authorities السلطات المحلية					
Construction Contractors and Sub-Contractors المقاولون الرئيسين والفرعيين					
Engineering Companies الشركات الهندسية					
Design Companies شركات التصميم					
Local Clients العملاء المحليين					
Transportation Contractors of C&D Waste مقاولي نقل مخلفات البناء والهدم					

3.b.i. If Possible, can you state other construction actors you think should be responsible for the informal dumping of C&D waste in Jordan if not mentioned above? اذا امكن، اذكر جهات أخرى من ممثلي قطاع الانشاءات تعتقد أنها مسؤولة ايضاً عن الالقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه؟

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Figure 10-75: C&D Waste Section

3.c. Can you please scale the following reasons behind the arise of construction waste only in Jordan from 1 to 5 (1 strongly disagree and 5 is strongly agree)? هل من فضلك بقياس الأسباب الممكنة وراء نشئت مخلفات البناء فقط في الأردن من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة)؟ Required

Please don't select more than 1 answer(s) per row.

Please select at least 7 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Lack of skilled workers, contractors and subcontractors قلة المهارة لدى العمالة والمقاولين والمقاولين الفرعيين	☐	☐	☐	☐	☐
Reworks because of workers errors إعادة العمل بسبب أخطاء العمال	☐	☐	☐	☐	☐
Lack of quality management system عدم كفاءة نظام لإدارة الجودة للمواد المستخدمة	☐	☐	☐	☐	☐
Design changes تغييرات في التصميم	☐	☐	☐	☐	☐
Change orders during construction stage أوامر التغيير خلال مرحلة البناء	☐	☐	☐	☐	☐
Unsuitable cutting for building materials قطع غير مناسب لمواد البناء	☐	☐	☐	☐	☐
Poor and old construction techniques تقنيات البناء الضعيفة والقديمة	☐	☐	☐	☐	☐

3.c.i. If possible, can you please state other aspects you find more reasonable behind the construction waste arising if not mentioned above? اذا امكن، هل يمكنك ذكر أسباب أخرى تجدها أكثر منطقية وراء نشأت مخلفات البناء فقط إذا لم يتم ذكرها أعلاه؟

4. Do design companies in Jordan design waste out of projects (design for reduction/prevention/deconstruction)? هل تقوم شركات الهندسية بتصميم المباني البناء أو الهدم لتخلص من المخلفات عن طريق تصميم (لتقليل / منع / تفكيك) مخلفات؟ Required

☐ Yes نعم
☐ No لا

4.a. Can you please scale the reasons preventing the adoption of such approaches in the country from 1 to 5 (1 strongly disagree and 5 is strongly agree)? قم من فضلك بقياس الأسباب التي تمنع تبني مثل هذه الأساليب (تصميم لتقليل/منع/تفكيك) في الأردن من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة)؟

Please don't select more than 1 answer(s) per row.

Please select at least 8 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
No codes for recycled materials to be used لا وجود لكودات معنية باستخدام المواد المعاد تدويرها	☐	☐	☐	☐	☐

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Figure 10-76: C&D Waste Section

Technical concerns مخاوف فنية	☐	☐	☐	☐	☐
Local context awareness and willingness الوعي المحلي وقابليته لاستخدام المخلفات المعاد تدويرها	☐	☐	☐	☐	☐
Time concerns مخاوف من الوقت	☐	☐	☐	☐	☐
Cost concerns مخاوف من التكلفة	☐	☐	☐	☐	☐
Poor demolition techniques تقنيات الهدم الضعيفة	☐	☐	☐	☐	☐
In-existence of Regulations and legal frameworks عدم وجود أنظمة وأطر قانونية	☐	☐	☐	☐	☐
Inadequacy of regulations and legal frameworks عدم كفاية الأنظمة والأطر القانونية	☐	☐	☐	☐	☐

4.a.i. If possible, can you please state other reasons you find more reasonable behind preventing these approaches from being applied if not mentioned above? اذا امكن، هل يمكنك ذكر أسباب أخرى تجدها أكثر منطقية وراء منع تطبيق هذه الأساليب (تصميم لتقليل/منع/تفكيك) إذا لم يتم ذكرها أعلاه؟

4.b. Can you please scale the reasons hindering the existence of recycled materials design codes from 1 to 5 (1 strongly disagree and 5 is strongly agree)? قم من فضلك بقياس الأسباب التي تعيق وجود كودات تصميم المواد المعاد تدويرها من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة)؟

Please don't select more than 1 answer(s) per row.

Please select at least 4 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
C&D waste is generated in small portions, thus there is no need for recycling حجم مخلفات البناء والهدم التي يتم إنشاؤها أجزاء صغيرة ، وبالتالي ليست هناك حاجة لإعادة التدوير	☐	☐	☐	☐	☐
Recycling is relatively a new technology إعادة التدوير تقنية جديدة نسبيا	☐	☐	☐	☐	☐
Establishing design codes needs time due to many reasons such as experimental testing يحتاج إنشاء كودات التصميم إلى وقت لأسباب عديدة منها عمل التجارب	☐	☐	☐	☐	☐
Establishing design codes costs much إنشاء كودات التصميم يكلف الكثير	☐	☐	☐	☐	☐

4.b.i. If possible, can you please state other reasons you find more reasonable in hindering the existence of recycled materials codes if not mentioned above? هل يمكنك ذكر الأسباب الأخرى التي تجدها أكثر منطقية تعرقل وجود كودات للمواد المعاد تدويرها إذا لم يتم ذكرها أعلاه؟

4.c. Can you please scale the following approaches that could contribute in implementing or adopting the design of C&D waste out of projects from 1 to 5 (1 strongly disagree and 5 is strongly agree): قم من فضلك بقياس الأساليب التالية التي يمكن أن تسهم في تنفيذ أو اعتماد تصميم التقليل / منع / تفكيك لمخلفات البناء والهدم (من المشاريع من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة):

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Figure 10-77: C&D Waste Section

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Establish codes for recycled materials إنشاء كودات للمواد المعاد تدويرها					
Regulate C&D waste management when designing of projects تنظيم إدارة مخلفات البناء والهدم عند تصميم المشاريع					
Provide facilities for recycling C&D waste توفير مرافق لإعادة تدوير مخلفات البناء والهدم					
Encourage design companies by taxation exemptions تشجيع شركات التصميم من خلال الإعفاءات الضريبية					
Provide the market (designers) with proper training and acknowledgment تزويد السوق (المصممين) بالتدريب والتأهيل المناسبين					

4.c.i. If possible, can you please state other approaches you find more effective in implementing the design of waste out if not mentioned above: اذا امكن، هل يمكنك تحديد أساليب أخرى تجدها أكثر فعالية في تصميم للمشاريع عن طريق تقليل / منع / تفكيك لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه

5. Select the most 3 **reasons** behind preventing each process from happening within the C&D waste management on site as below: ما السبب / الأسباب التي تقف وراء عدم تنفيذ إدارة مناسبة لمخلفات البناء والهدم في الأردن في المراحل التالية

Reasons * Required

	No enough equipment لا توجد معدات كافية	Involvement of the informal workers within the industry إشراك العمال الغير المهنيين في قطاع الانشاءات	No codes for recycled materials لا وجود للكودات للمواد المعاد تدويرها	Lack of necessary skills and knowledge among construction practitioners to C&D waste نقص المعرفة والمهارات اللازمة بين منتسبي قطاع البناء اتجاه مخلفات البناء والهدم	Long Transportation Distances to dumpsites مسافات طويلة لنقل المخلفات إلى المكبات	High Dumping Fees رسوم الطمر للمخلفات عالية	Low dumping fees رسوم الطمر للمخلفات منخفضة	Small portions of C&D waste generated كميات صغيرة من مخلفات البناء والهدم يتم انتاجها	Lack of management system in the construction industry عدم وجود/نقص في نظم الإدارة	Lack of Regulations and legal frameworks عدم وجود/نقص في الأنظمة وأطر قانونية	[illegible]
Collection on site التجميع في الموقع											
Sorting on site الفرز في الموقع											
Transporting to landfill النقل إلى المكب											
Recycling and Reusing إعادة التدوير وإعادة الاستخدام											

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Figure 10-78: C&D Waste Section

6. Can you please scale the reasons preventing the C&D waste management in landfill or dumpsites from 1 to 5 (1 is strongly disagree and 5 strongly agree)? من فضلك قم بقياس أسباب منع إدارة مخلفات البناء والهدم في المكبات القانونية من ١ إلى ٥ (١ غير موافق بشدة و ٥ موافق بشدة) * Required

Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
C&D waste comprises many types of waste المخلفات البناء والهدم تشمل العديد من المواد (انواع)					
No sorting on site لا يوجد فرز في الموقع					
C&D waste contains hazardous or harmful materials تحتوي المخلفات البناء والهدم على مواد خطرة أو ضارة					
Large quantities of C&D waste dumped at once, thus hard to implement a C&D waste management يتم إلقاء كميات كبيرة من مخلفات البناء والهدم مرة واحدة ، وبالتالي يصعب تنفيذ إدارتها					
Small quantities of C&D waste dumped in landfill, thus there is no need for C&D waste management كميات صغيرة من مخلفات البناء والهدم يتم القائها في المكبات ، وبالتالي ليست هناك حاجة لإدارتها					
Land-filling costs less than C&D waste management تكاليف طمر مخلفات البناء والهدم في المكبات أقل من تكلفة إدارتها					

6.a. If possible, Can you please state other factors you find more reasonable to prevent the C&D waste management in landfill if not mentioned above? يرجى ذكر العوامل الأخرى التي تجدها أكثر منطقية لمنع إدارة المخلفات البناء والهدم في المكب إذا لم يتم ذكرها أعلاه؟

7. Based on your knowledge in the Jordanian construction market, please select the percentage of each type of waste generated from the demolition processes? بناءً على معرفتك في قطاع البناء الأردني ، يرجى تحديد النسبة المئوية لكل نوع من أنواع المخلفات الناتجة عن عمليات الهدم؟

Select the **percentage** genertaed from Demolition for each type and **only once** حدد **النسبة المئوية** التي تم إنشاؤها من الهدم لكل نوع ولمرة واحدة فقط * Required

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Figure 10-79: C&D Waste Section

	< 10	10-20%	21-30%	31%-40%	41-50%	51%-60%	61-70%	71-80%	81%-90%	> 90%
Crushed Concrete Aggregates الخرسانة										
Masonry and Bricks الطوب										
Sand رمال										
Cement الاسمنت										
Steel Reinforcement حديد التسليح										
Timber الأخشاب										
Other Metals معادن أخرى										
Other Waste مخلفات أخرى										

8. Based on your knowledge in the Jordanian construction market, please select the percentage of each type of waste generated from the construction processes? بناءً على معرفتك في قطاع البناء الأردني ، يرجى تحديد النسبة المئوية لكل نوع من أنواع المخلفات الناتجة عن عمليات البناء؟

	Select the percentage generated from Construction for each type and **only once** حدد النسبة المئوية التي تم إنشاؤها من الإنشاء لكل نوع **مرة واحدة فقط** * Required									
	< 10	10-20%	21-30%	31%-40%	41-50%	51%-60%	61-70%	71-80%	81%-90%	> 90%
Crushed Concrete Aggregates الخرسانة										
Masonry and Bricks الطوب										
Sand رمال										
Cement الاسمنت										
Steel Reinforcement حديد التسليح										
Timber الأخشاب										
Other Metals معادن أخرى										
Other Waste مخلفات أخرى										

9. Can you please scale the following aspects that are needed to be furtherly studied to promote a proper C&D waste management in Jordan from 1 to 5 (1 strongly disagree and 5 is strongly agree)? قم من فضلك بقياس الجوانب التالية التي يجب دراستها بشكل أكبر لتعزيز إدارة مخلفات البناء والهدم في الأردن من ١ إلى ٥ (١ لا أوافق بشدة و ٥ موافق بشدة)؟ * Required

Please don't select more than 1 answer(s) per row.

Please select at least 3 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Managerial aspects الجوانب الإدارية					
Technical aspects including the behavior of new concrete with CCA (Physical properties) الجوانب الفنية بما في ذلك سلوك الخرسانة الجديدة باستخدام الخرسانة المعاد تدويرها(الخصائص الفيزيائية)					
Technical aspects including the behavior of new concrete with CCA (Chemical properties) الجوانب الفنية بما في ذلك سلوك الخرسانة الجديدة باستخدام الخرسانة المعاد تدويرها (الخصائص الكيميائية)					

9.a. If possible, can you please state other aspects you find more essential to be furtherly studied if not mentioned above? هل يمكنك تحديد الجوانب

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Figure 10-80: C&D Waste Section

الأخرى التي تجدها أكثر أهمية لتتم دراستها بشكل أكبر إذا لم يتم ذكرها أعلاه؟

10. Scale the following actors by their importance in participating in such a survey in Jordan from 1 to 5 (1 strongly disagree and 5 is strongly agree)? يرجى قياس الجهات الفاعلة التالية حسب أهميتها في المشاركة في مثل هذه دراسة في الأردن من 1 إلى 5 (1 لا أوافق بشدة و 5 موافق بشدة)؟ * Required

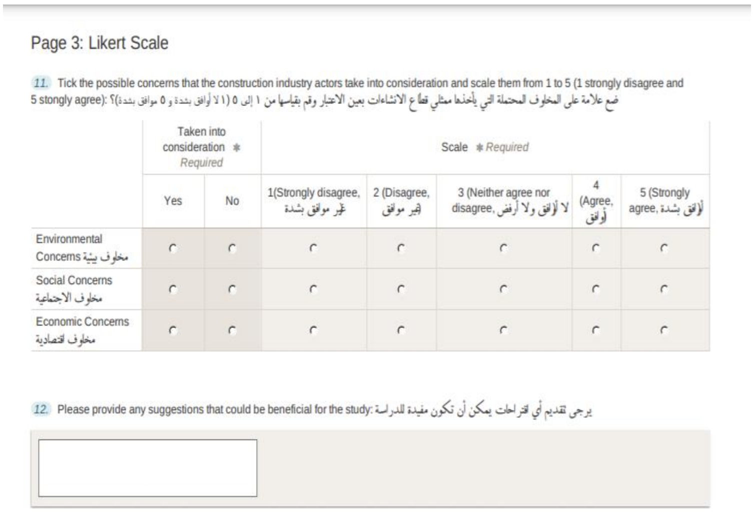
Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Ministries الوزارات					
Local Authorities/Municipalities السلطات المحلية					
Construction Contractors and Companies المقاولون والشركات					
Design Companies شركات التصميم					
Concrete suppliers موردي الخرسانة					
Locals السكان المحليون					

10.a. If possible, can you please state other actors that you find should be participated in such a survey if not mentioned above? اذا امكن، هل يمكنك ذكر ممثلين الغير المذكورين اعلاه ويتوجب مشاركتهم عند إجراء دراسة متعلقة ادارة مخلفات البناء والهدم

Figure 10-81: C&D Waste Section



Page 3: Likert Scale

11. Tick the possible concerns that the construction industry actors take into consideration and scale them from 1 to 5 (1 strongly disagree and 5 stongly agree): ضع علامة على المخلوف المحتملة التي يأخذها ممثلي قطاع الانشاءات بعين الاعتبار وقم بقياسها من ١ إلى ٥ (١ لا أوافق بشدة و ٥ موافق بشدة)؟

	Taken into consideration * Required		Scale * Required				
	Yes	No	1(Strongly disagree, غير موافق بشدة	2 (Disagree, غير موافق	3 (Neither agree nor disagree, لا أوافق ولا أرفض	4 (Agree, أوافق	5 (Strongly agree, أوافق بشدة
Environmental Concerns مخلوف بيئية							
Social Concerns مخلوف الاجتماعية							
Economic Concerns مخلوف اقتصادية							

12. Please provide any suggestions that could be beneficial for the study: يرجى تقديم أي اقتراحات يمكن أن تكون مفيدة للدراسة

Figure 10-82: Evaluation Section

10.1.6.3.2.7 Clients

Client questionnaires are divided into four sections:

1. Section 1:
   This contains the PCF and directions for completing the questionnaire.

2. Section 2:
   It evaluates the client's considerations.
3. Section 3:
   It quantifies the issue of informal dumping and its accompanying consequences, as well as identifies the parties accountable for such an issue.

4. Section 4:
   It assesses the clients' receptivity to implementing a C&D waste management strategy.

The figures below depict the survey questions as they were created in the survey tool.

Page 2: Clients Considerations

5. As a **client** can you please scale the following considerations when **constructing** a project in Jordan from 1 to 5 (**1 strongly disagree and 5 is strongly agree**)? من فضلك قم بقياس الاعتبارات التالية **كعميل محلي** عند**إنشاءك** لمشروع في الأردن من ١ إلى ٥ (**١** غير موافق بشدة و **٥** موافق **بشدة**)؟ * *Required*

Please don't select more than 1 answer(s) per row.

Please select at least 8 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Cost of the project كلفة المشروع	☐	☐	☐	☐	☐
Time period of construction الفترة الزمنية للبناء	☐	☐	☐	☐	☐
Design التصميم	☐	☐	☐	☐	☐
Types of materials used أنواع المواد المستخدمة	☐	☐	☐	☐	☐
Quality of materials used جودة المواد المستخدمة	☐	☐	☐	☐	☐
Supervision إشراف	☐	☐	☐	☐	☐
Construction Waste Management ادارة لمخلفات البناء	☐	☐	☐	☐	☐
Classification of Contractors تصنيف المقاولين	☐	☐	☐	☐	☐

5.a. If possible, can you state other aspects you take more into consideration when

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Figure 10-83: Clients Considerations Section

constructing a project if not mentioned above? اذا امكن, هل يمكنك ذكر جوانب أخرى تضعها بعين الاعتبار أكثر عند إنشاءك لمشروعك إذا لم يتم ذكرها أعلاه؟

6. As a **client** can you please scale the following considerations when **demolishing** a project in Jordan from 1 to 5 (**1 strongly disagree and 5 is strongly agree**): من فضلك قم بقياس الاعتبارات التالية **كعميل محلي** عند**هدمك** لمشروع في الأردن من ١ إلى ٥ (**١** غير موافق بشدة و **٥** موافق **بشدة**)؟ * *Required*

Please don't select more than 1 answer(s) per row.

Please select at least 9 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Cost of the project كلفة المشروع	☐	☐	☐	☐	☐
Time period of demolition الفترة الزمنية للهدم	☐	☐	☐	☐	☐
Design التصميم	☐	☐	☐	☐	☐
Health and safety الصحة و السلامة	☐	☐	☐	☐	☐
Demolition techniques تقنيات الهدم	☐	☐	☐	☐	☐
Demolition Waste management ادارة مخلفات الهدم	☐	☐	☐	☐	☐

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Figure 10-84: Clients Considerations Section

Types of equipment used in demolishing أنواع المعدات المستخدمة في الهدم	☐	☐	☐	☐	☐
Classification of Contractors تصنيف المقاولين	☐	☐	☐	☐	☐
Supervision إشراف	☐	☐	☐	☐	☐

6.a. If possible, can you state other aspects you take more into consideration when demolishing a project if not mentioned above? اذا امكن. هل يمكنك ذكر جوانب أخرى تضعها بعين الاعتبار أكثر عند هدمك لمشروعك إذا لم يتم ذكرها أعلاه؟

Figure 10-85: Clients Considerations Section

Page 3: C&D Waste

7. Do you think that the informal dumping of C&D waste is an **issue** in Jordan? هل تعتقد بأن الإلقاء الغير الرسمي لمخلفات البناء والهدم يمثل مشكلة في الأردن؟ * *Required*

- Yes نعم
- No لا

7.a. Please scale the following from 1 to 5 (**1 strongly disagree and 5 is strongly agree**): يرجى قياس ما يلي من ١ إلى ٥ (**١** غير موافق بشدة و **٥** موافق بشدة):

Please don't select more than 1 answer(s) per row.

Please select at least 2 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
The significance of the informal dumping of C&D waste as an issue حجم مشكلة الإلقاء الغير رسمي لمخلفات البناء والهدم	☐	☐	☐	☐	☐
The need for a C&D waste management strategy الحاجة إلى استراتيجية لإدارة مخلفات البناء والهدم	☐	☐	☐	☐	☐

7.b. Scale the following **actors** by their responosibilities for the informal dumping of C&D waste in Jordan from 1 to 5 (**1 strongly disagree and 5 is strongly agree**)? قم بقياس **ممثلي قطاع الانشاءات** التاليين عن مسؤولياتهم في مشكلة الإلقاء الغير رسمي لمخلفات البناء والهدم في الأردن من 1 إلى 5 (**1** لا أوافق بشدة و **5** موافق بشدة)؟ * *Required*

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Figure 10-86: C&D Waste Section

Please don't select more than 1 answer(s) per row.

Please select at least 7 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Ministries الوزارات	☐	☐	☐	☐	☐
Local Authorities السلطات المحلية	☐	☐	☐	☐	☐
Construction Contractors and Sub-Contractors المقاولون الرئيسين والفرعيين	☐	☐	☐	☐	☐
Engineering Companies الشركات الهندسية	☐	☐	☐	☐	☐
Design Companies شركات التصميم	☐	☐	☐	☐	☐
Local Clients العملاء المحليين	☐	☐	☐	☐	☐
Transportation Contractors of C&D Waste مقاولي نقل مخلفات البناء والهدم	☐	☐	☐	☐	☐

7.b.i. If Possible, can you state other construction actors you think should be responsible for the informal dumping of C&D waste in Jordan if not mentioned above? اذا امكن, اذكر جهات أخرى من ممثلي قطاع الانشاءات تعتقد أنها مسؤولة ايضاً عن الالقاء الغير رسمي لمخلفات البناء والهدم إذا لم يتم ذكرها أعلاه؟

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Figure 10-87: C&D Waste Section

7.c. Can you please scale the following **impacts** of the informal dumping of C&D waste on the society from 1 to 5 (**1 strongly disagree and 5 is strongly agree**): قم من فضلك بقياس تأثيرات الإلقاء الغير رسمي لمخلفات البناء والهدم على المجتمع من ١ إلى ٥ (**١ غير :موافق بشدة و ٥ موافق بشدة**

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Property Value decrease انخفاض قيمة الممتلكات	☐	☐	☐	☐	☐
Health issues مشاكل صحية	☐	☐	☐	☐	☐
Block drainage systems causing diseases and flooding انسداد شبكات الصرف الصحي المسببة للأمراض والفيضانات	☐	☐	☐	☐	☐
Locals takes on clean up costs تحمل السكان المحليون تكاليف التنظيف	☐	☐	☐	☐	☐
Rising taxes for clean up ارتفاع الضرائب للتنظيف	☐	☐	☐	☐	☐

7.c.i. If possible, can you state other impacts you find more effectual on social from the informal dumping of C&D waste in Jordan if not mentioned above? اذا امكن, هل يمكنك تحديد تأثيرات أخرى من الإلقاء الغير رسمي لمخلفات البناء والهدم تجدها أكثر تأثيرًا على المجتمع إذا لم يتم ذكرها أعلاه؟

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Figure 10-88: C&D Waste Section

Page 4: Clients Willingness

8. As a **client**, would you consider adopting any approach for design waste out of **construction or demolition projects** to properly manage C&D waste (design for reduction/prevention/deconstruction)? كعميل محلي, هل من الممكن ان تتبع أي نهج لتصميم المشاريع من اجل التخلص الصحيح من مخلفات البناء والهدم عن طريق التصميم لتقليل / منع / تفكيك المخلفات عند عمليات البناء أو الهدم؟ * *Required*

○ Yes نعم
○ No لا

8.a. Can you please scale the **reasons behind your previous answer** from 1 to 5 (**1 strongly disagree and 5 is strongly agree**): قم من فضلك بقياس الأسباب الممكنة وراء إجابتك السابقة من ١ إلى ٥ (**١** غير موافق بشدة و **٥** موافق بشدة):

Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Profit from selling recyclable waste materials الربح من بيع مخلفات البناء والهدم القابلة لإعادة التدوير	☐	☐	☐	☐	☐
Protect the environment حماية البيئة	☐	☐	☐	☐	☐

Figure 10-89: Clients Willingness Section

Savings in construction costs by using recycled waste material التوفير في تكاليف البناء باستخدام مواد النفايات المعاد تدويرها	☐	☐	☐	☐	☐
Savings in demolition costs by considering the recyclable waste materials and subtract them from the final prices التوفير في تكاليف الهدم عن طريق الاخذ بعين الاعتبار مخلفات الهدم القابلة لإعادة التدوير وطرحها من الأسعار النهائية للهدم	☐	☐	☐	☐	☐
Avoid land-filling disposal تجنب التخلص من طمر مخلفات البناء والهدم في المكبات	☐	☐	☐	☐	☐
Avoid informal dumping تجنب الإلقاء الغير رسمي لمخلفات البناء والهدم	☐	☐	☐	☐	☐

8.a.i. If possible, can you state other aspects you find more reasonable to your previous answer if not mentioned above? اذا امكن, هل يمكنك ذكر أسباب أخرى التي تجدها أكثر منطقية لاجابتك السابقة إذا لم يتم ذكرها أعلاه؟

Figure 10-90: Clients Willingness Section

8.b. Please scale the **reasons behind your previous answer** from 1 to 5 (**1 strongly disagree and 5 is strongly agree**): قم من فضلك بقياس الأسباب الممكنة وراء إجابتك السابقة من ١ إلى ٥ (**١** غير موافق بشدة و **٥** موافق بشدة):

Please don't select more than 1 answer(s) per row.

Please select at least 6 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Design waste out is time consuming تصميم المباني للتقليل / منع / تفكيك مخلفات البناء والهدم يستغرق وقتا كبيراً					
Design waste out costs a lot تصميم المباني للتقليل / منع / تفكيك مخلفات البناء والهدم يكلف مادياً					
No intentions towards C&D waste management لا نية تجاه ادارة مخلفات البناء والهدم					
No intentions towards using recycled waste materials لا نية لاستخدام المخلفات البناء والهدم المعاد تدويرها					

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Figure 10-91: Clients Willingness Section

Land-filling of C&D waste is more efficient in terms of costs and time يعتبر طمر مخلفات البناء والهدم في مكبات أكثر كفاءة من حيث التكلفة والوقت					
Land-filling of C&D waste is environmentally friendly يعتبر طمر مخلفات البناء والهدم في مكبات صديق للبيئة					

8.b.i. Can you state other aspects you find more reasonable to your previous answer if not mentioned above? اذا امكن. هل يمكنك ذكر أسباب أخرى التي تجدها أكثر منطقية لاجابتك السابقة إذا لم يتم ذكرها أعلاه؟

9. As a **client**, would you consider using recycled aggregates in new concrete mixes in new projects if designed by specific codes and specifications? **كعميل محلي** هل من الممكن في الخلطات الخرسانية الجديدة المطلوبة لمشاريعك الجديدة (RCA) تفكر في استخدام الحصمة المعاد تدويره تحت الموصفات والمعايير الاردنية؟ * *Required*

- Yes نعم
- No لا

9.a. Can you please scale the **reasons behind your previous answer** from 1 to 5 (1 strongly disagree and 5 is strongly agree): قم بقياس الأسباب الممكنة وراء إجابتك من 0 إلى 10 (0 غير موافق و 10 موافق بشدة):

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Figure 10-92: Clients Willingness Section

Please don't select more than 1 answer(s) per row.

Please select at least 5 answer(s).

	1(Strongly disagree, غير موافق بشدة)	2 (Disagree, غير موافق)	3 (Neither agree nor disagree, لا أوافق ولا أرفض)	4 (Agree, أوافق)	5 (Strongly agree, أوافق بشدة)
Quality Issues مشاكل في الجودة	☐	☐	☐	☐	☐
Costs/Prices of recycled waste materials are closer to standard materials اسعار مخلفات البناء والهدم المعاد تدويرها قريبة من اسعار المواد الاساسية الجديدة	☐	☐	☐	☐	☐
Prefer to use standard new materials in new projects افضل استخدام مواد جديدة في المشاريع الجديدة	☐	☐	☐	☐	☐
Avoiding hazardous materials in recycled waste materials تجنب المواد الخطرة في مخلفات البناء والهدم المعاد تدويرها	☐	☐	☐	☐	☐

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Figure 10-93: Clients Willingness Section

The lifespan of recycled waste materials is shorter than the standard ones العمر الافتراضي لمخلفات البناء والهدم المعاد تدويرها أقصر من العمر الافتراضي للمواد الجديدة	☐	☐	☐	☐	☐

9.a.i. If possible, can you please state other aspects you find more reasonable to your previous answer if not mentioned above? اذا امكن، هل يمكنك ذكر أسباب أخرى التي تجدها أكثر منطقية لاجابتك السابقة إذا لم يتم ذكرها أعلاه؟

10. Please answer this question by considering the **following cases** below, As a **client** would you consider using recycled aggregates in new concrete mixes in new projects: يرجى الاجابة على هذا السؤال من خلال النظر الى **الحالات التالية** أدناه ، **كعميل محلي**، هل يمكنك التفكير في استخدام الحصمة المعاد تدويرها في الخلطات الخرسانية الجديدة المطلوبة في مشاريعك الجديدة

	Yes/No نعم / لا * *Required*	
	Yes نعم	No لا
If you knew that using up to 20% of recycled aggregates is equivalent in terms of properties compared to the standard concrete (100%)? إذا كنت تعلم أن استخدام ما يصل إلى 20% من الحصمة المعاد تدويرها يعادل من حيث الخصائص مقارنة بالخرسانة القياسية/العادية (100%)؟	○	○

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Figure 10-94: Clients Willingness Section

If you knew that using up to 20% of recycled aggregates is equivalent in terms of properties and costs compared to the standard concrete (100%)? إذا كنت تعلم أن استخدام ما يصل إلى 20٪ من الحصمة المعاد تدويرها يعادل من حيث الخصائص والتكاليف مقارنة بالخرسانة القياسية/العادية (100٪)؟		
If you knew that using up to 20% of recycled aggregates is equivalent in terms of properties compared to the standard concrete (100%) and lower in terms of costs? إذا كنت تعلم أن استخدام ما يصل إلى 20٪ من الحصمة المعاد تدويرها يعادل من حيث الخصائص مقارنة بالخرسانة القياسية/العادية (100٪) وأقل من حيث التكاليف؟		
If you knew that using more than 20% of recycled aggregates with additives is equivalent in terms of properties compared to the standard concrete (100%)? إذا كنت تعلم أن استخدام أكثر من 20٪ من الحصمة المعاد تدويرها مع الإضافات يعادل من حيث الخصائص مقارنة بالخرسانة القياسية/العادية (100٪)؟		
If you knew that using more than 20% of recycled aggregates with additives is equivalent in terms of properties and costs compared to the standard concrete (100%)? إذا كنت تعلم أن استخدام أكثر من 20 ٪ من الحصمة المعاد تدويرها مع الإضافات يعادل من حيث الخصائص والتكاليف مقارنة بالخرسانة القياسية/العادية (100٪)؟		
If you knew that using more than 20% of recycled aggregates with additives is equivalent in terms of properties compared to the standard concrete (100%) and lower in terms of costs? إذا كنت تعلم أن استخدام أكثر من 20٪ من الحصمة المعاد تدويرها مع الإضافات يعادل من حيث الخصائص مقارنة بالخرسانة القياسية/العادية (100٪) وأقل من حيث التكاليف؟		

11. Please provide any suggestions that could be beneficial for the study: يرجى تقديم أي اقتراحات يمكن أن تكون مفيدة للدراسة

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Figure 10-95: Clients Willingness Section

10.1.6.4 Interviews

Several authors have revealed the rational of using semi-structured interviews as follows (Binti N., 2008); (Kvale S. , 2007):

1. The conversation in the Arab culture should be two-way communication.
2. The participants are highly experienced and acknowledge in the research topic, which contributes the researcher to learn more and allows him to ask for explanations especially in controversial subjects.
3. The limited knowledge in the research topic made deep discussions to ensure that participant's responses reflect their perspectives and points of view.
4. The un-structured questions in these interviews may be of assistance to confirm what is already known and allows to explore more specific details about the topic, thus enriching the in-depth discussions.
5. The capacity of semi-structured interviews allows to gather rich data that enables the researcher to understand what things work in the real world.

Involvement of highly experienced persons, particularly in contentious issues, provides a more in-depth investigation of the subject and enriches the in-depth discourse. To collect the necessary data, the researcher has chosen participants using the following criteria:

1. Preference towards actors in high positions which interviewees to be chosen following review of questionnaire responses.
2. Experience, expertise and knowledge in the field of construction with at least 8 years' experience.
3. Interviewees should be involved in at least one of construction industry activities comprising design, construction or demolition activities, C&D waste generation and C&D waste legal dumping.
4. Capability to easily communicate either in English or Arabic.
5. Willingness towards sharing their experience and knowledge with the field of construction.

Although it was anticipated that up to 50 participants would be interviewed, only 25 high-ranking participants take part in the interviews. These underestimated participant numbers have been linked to the presence of the Covid-19 epidemic. Due to lockdowns and restricted access to departments and institutions. This pandemic has had a detrimental influence on conducting face to face interviews. As it was planned to conduct the interviews at workplaces during office working hours. A possible solution to this issue would have been to interview a group of respondents concurrently. Although, this appeared to be difficult given the country's pandemic restrictions. **Table 10-10** below details the professions represented in these interviews.

No. of interview participants	Sampling Selection	Targeted Professional Positions
< 50	Preference towards actors in high positions. Interviewees to be chosen following review of questionnaire responses	Stakeholders Owners CEO's Managers Head of Engineering Departments Academics

Table 10-10: Sampling Selection of Interviews

Those interviews as previously outlined included 25 participants from different backgrounds as seen in **table 10-11**.

No.	Position	Department	Organisation	Participants Information
1	4 Members of Contractors Syndicate	Managerial Department	Contractors Syndicate	Participants have high managerial experience and knowledge in: 1. Regulations and legislations of contractors construction and demolition projects. 2. Construction and demolition activities.
2	2 Contractors (rank 1)	Owner - Engineer	Construction Company	Participants have high experience in: 1. Regulations and legislations of contractors construction and demolition projects. 2. Construction and demolition activities. 3. C&D waste.
3	1 Contractor (rank 2)			
4	2 Contractors (rank 3)			
5	1 Contractor (rank 5)			
6	1 Contractor (rank 6)			
7	5 members of MPWH	Specifications and Quantities Renovation Construction Works Execution Studies and Design	MPWH	Participants have high managerial experience in: 1. Regulations and legislations of governmental projects (design/construction/demolition). 2. Design, construction and demolition activities. 3. C&D waste.
8	4 members of GAM	Construction Work Studies Construction Monitoring	GAM	Participants have high managerial experience in: 1. Regulations and legislations of governmental projects (design/construction/demolition). 2. Construction and demolition activities. 3. C&D waste.
9	1 member of JGBC	Managerial Department	JGBC	Participants have high managerial experience in: 1. Regulations and legislations of contractors and governmental projects (design/construction/demolition). 2. Design, construction and demolition activities. 3. C&D waste. 4. Environmental aspects.

No.	Position	Department	Organisation	Participants Information
10	3 members of MoE	Monitoring and Inspection	MoE	Participants have high managerial experience in: 1. C&D waste. 2. Environmental aspects.
		Solid Waste	MoE	
		Managerial Department	MoE	
11	1 member of MLA	Studies and Design	MLA	Participants have high managerial experience in: 1. Regulations and legislations of governmental projects (design). 2. Design activity.
Total	25 members			

Table 10-11: Actors Involved in the Research Interviews

The interviews were conducted with 25 individuals from a variety of backgrounds, as detailed in the table above. **Table 10-12** demonstrates these representatives with contractors from various ranked firms were the most frequently interviewed (28%), followed by MPWH (20%), the contractors syndicate (16%), GAM (16%), MoE (12%) and JGBC (4%) and MLA (4%) respectively.

For ethical reasons, the respondent's profile sheet and employment history should be anonymised. However, **table 10-12** below details their current employers, specialties and years of experience. It illustrates that all participants had at least eight years of experience as based on the researcher's preference. As those with extensive experience working in the Jordanian construction industry, may have more favourable encounters with C&D waste management. Thus, providing a greater understanding and perspective of superior execution findings. Therefore, it could be reasonable to conclude that the information received was reliable because of their considerable professional competence.

No.	Department/Organisation	Frequency/Percentage	Years of experience	Area of expertise
1	Managerial Department/ Contractors Syndicate	4/16%	≥ 15	Participants have high managerial experience and knowledge in: 3. Regulations and legislations of contractor’s construction and demolition projects. 4. Construction and demolition activities.
2	Owner – Engineer/ Construction Company	7/28%	≥ 8	Participants have high experience and knowledge in: 4. Regulations and legislations of contractor’s construction and demolition projects. 5. Construction and demolition activities. 6. C&D waste.
3	Specifications and Quantities/ MPWH Renovation/ MPWH Construction Works Execution/ MPWH Studies and Design/ MPWH	5/20%	≥ 12	Participants have high managerial experience and knowledge in: 4. Regulations and legislations of governmental projects (design/construction/demolition). 5. Design, construction and demolition activities. 6. C&D waste.
4	Construction Work/ GAM Studies/ GAM	4/16%	≥ 12	Participants have high managerial experience and knowledge in:

No.	Department/Organisation	Frequency/Percentage	Years of experience	Area of expertise
	Construction Monitoring/ GAM			4. Regulations and legislations of governmental projects (design/construction/demolition). 5. Construction and demolition activities. 6. C&D waste.
5	Managerial Department/ JGBC	1/4%	≥ 8	Participants have high managerial experience and knowledge in: 5. Regulations and legislations of contractors and governmental projects (design/construction/demolition). 6. Design, construction and demolition activities. 7. C&D waste. 8. Environmental aspects.
6	Monitoring and Inspection/ MoE Solid Waste/ MoE Managerial Department/ MoE	3/12%	≥ 8	Participants have high managerial experience and knowledge in: 3. C&D waste. 4. Environmental aspects.
7	Studies and Design/ MLA	1/4%	≥ 8	Participants have high managerial experience and knowledge in: 3. Regulations and legislations of governmental projects (design). 4. Design activity.
Total	25 members			

Table 10-12: Actors Involved in the Research Interviews

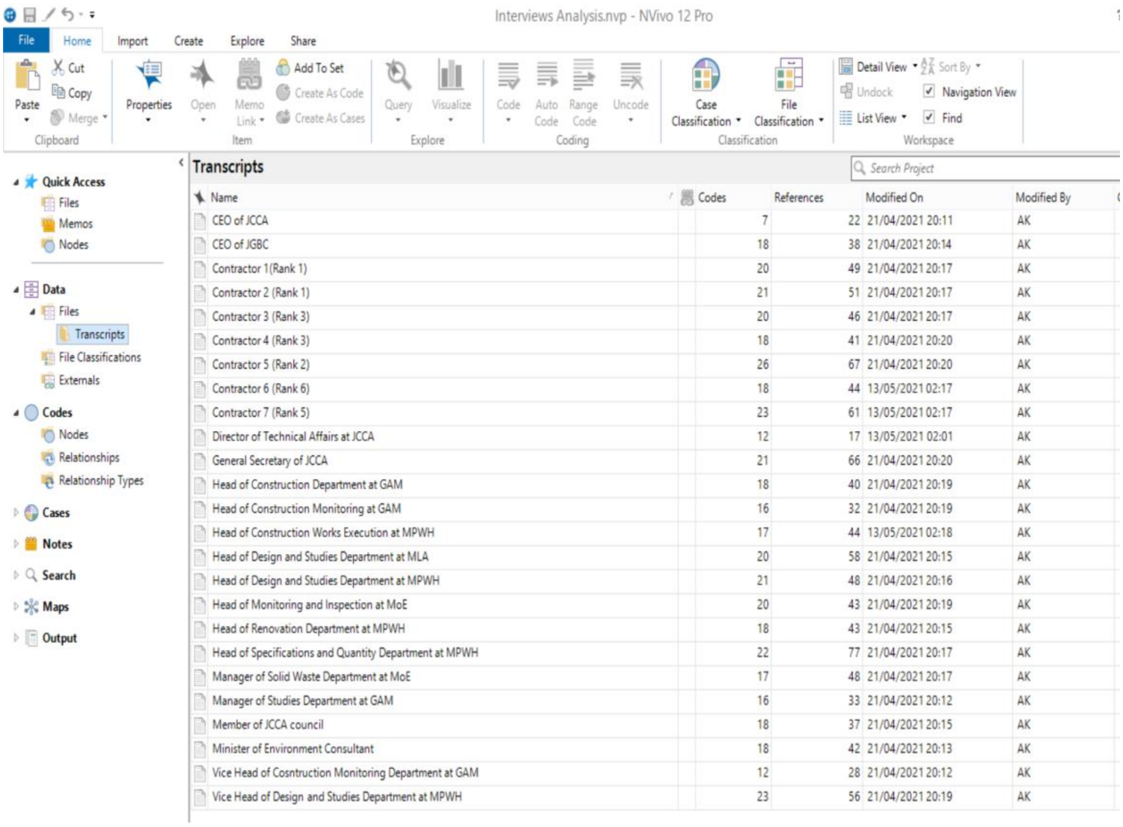


Figure 10-96: Actors Involved in the Interviews on NVIVO Screen

This number has been reduced to 25 in accordance with participants' current office hours, which have been cut to 25% or 75% working from home. These 25 interviews were carefully done one-on-one in accordance with current guidance regarding "social distance." It should be noted that these interviews were conducted in Arabic to avoid any miscommunication and therefore to minimise corrupted data. Although, the researcher attempted to conduct these interviews in English. This proved problematic due to participants' tendency to avoid conducting them in English.

The NVIVO software enabled the researcher to code the responses of participants according to their data and responses. Based on their expertise and knowledge in the field of construction in Jordan, as shown in **table 10-13**. It should be noted that these codes did not all have the same phrase in all interviews. But they all had the same meaning in terms of the common data to be compiled.

Thematic analysis was employed in this study as one of the most common used methods for analysing semi-structured interviews (The Interaction Design Foundation, 2021). This method strives to uncover patterns of themes in interview data that can be used in both exploratory and deductive studies (The Interaction Design Foundation, 2021). This analysis procedure consists of six steps that assist researchers in transitioning from messy data to more amicable data analysis (The Interaction Design Foundation, 2021):

1. Familiarization of data: This entails accurately transcribing data in its original form.
2. Assign preliminary codes to your data: This step entails assigning codes to the data to define its content and group it meaningfully, as illustrated in **table 10-13**.
3. Search for themes based on the codes across different interviews: This step requires active interpretation of the coded data by combining the codes into themes that best represent the data, as described in chapter 6 of the main body.
4. Review themes: This step entails examining and refining the themes in order to determine whether the codes and data support and match the themes, until the themes are coherent and distinct.
5. Define and name themes: This comprises describing and naming the identified themes descriptively, as indicated in chapter 6's introduction.
6. Produce your report: This summarises the findings from the data analysis described in chapter 6 of the main body.

The code of C&D waste management includes a sub-code that reflects the current situation and aims to clarify design, construction and demolition operations in Jordan. By making their activities and contract arrangements more transparent. As these aids in comprehending the local context for design, construction and demolition operations involving C&D waste. To provide solutions to improve the current situation.

Additionally, it includes a sub-code for impediments to C&D waste management. Which helps to provide a broader understanding of how C&D waste is managed in Jordan. Thus, identifying the potential impediments to this management. In order to mitigate them when preparing a national C&D waste management strategy. By looking for variations necessary to promote recycling of C&D waste (CCA) via approaches, encouragements and incentives as sub-coded as promoting a C&D waste management.

This also includes the willingness and practicality of C&D waste management. Showing the extent to which recycling could be helpful to the country's ecology and economy. In terms of the code of C&D waste informal dumping, it contains a sub-code devoted to identifying the causes of informal dumping or the barriers to legal dumping. Particularly when regulations require construction actors to do so but waste is still dumped informally. As well as a sub-code devoted to providing efficient and useful approaches to reducing this illegal attitude.

Number	Code
1	C&D Waste Management
A	Current situation
B	Hindrances to C&D waste management
B1	Absence of Clear Responsibilities and Regulations
B2	Absence of Competitors
B3	Absence of Design Codes
B4	Additional Reasons
B5	Cost and Time Wastage
B6	Lack of Studies and Workshops
B7	Land Reclamation
B8	No Further Use for Recycled C&D Waste
B9	Shortage or Absence of Recycling Facilities
B10	Willingness of Local Actors towards Adoption of CDWM
C	Promoting C&D waste management
C1	Approaches, Improvements and Encouragements
C11	Additional Approaches
C12	Certificates or Upgrading for Recyclers
C13	Clarified Regulations
C14	Establishing Design Codes
C15	Further Detailed Studies and Workshops
C16	Incentives
C17	Recycling Facilities
C18	Waste Disposal Companies
C2	Feasibility and Willingness
C21	Feasible and Willing
C22	Not-feasible and Not-Willing
2	Informal Dumping of C&D Waste
A	Approaches to Reduce the Informal Dumping
A1	Apply Fines and Penalties
A2	Apply Intensive Monitoring
A3	Decrease the Landfill Distances
A4	Develop a Tracking System
A5	Enhance the Current Regulations
A6	Facilitate Recycling Stations
A7	Increase the Awareness
A8	Licensing Arrangements
A9	Provide Incentives
A10	Reduce the Generation of C&D Waste
A11	Reducing the Costs
A12	Waste Disposal Companies
B	Reasons of the Informal Dumping

Number	Code
B1	Commitment of Contractors
B2	Cost and Time Savings
B3	Easiness and Accelerating of Work
B4	Involvement of the Informal Workers
B5	Lack of Monitoring
B6	Lack of Regulations.
B7	Long Distances to Landfills
B8	Low Awareness
B9	Low Bidding Procurement Method
B10	Shortage of Landfills in the Country

Table 10-13: Codes of Interviews Sections

The interview questions were developed to address the research elements and address the knowledge gaps identified in **table 10-14** and in the process of developing them above. Considering the time allowed to answer them and the capacity to obtain the relevant data.

Prior to completing the interviews, these questions were distributed to numerous professionals and experts in the field. To validate their usefulness in producing accurate and reliable results. Questions that were deemed unnecessary were eliminated, while others of equal relevance were included.

These inquiries are divided into two broad categories:

1. C&D waste management.
2. Informal dumping of C&D waste.

The figures below illustrate the entirety of NVIVO's screen display.

Interviews Actors Involvement	
Actor	**Gaps**

Ministry of Public Works and Housing, Ministry of Local Administration and Greater Amman Municipality	• Causes of the informal dumping of C&D waste.
	• Limitations and barriers to the implementation of C&D waste management.
	• Benefits of C&D waste management
	• Variations needed for C&D waste management:
	  • Regulations, Strategies and Initiatives
	  • Encouragements and incentives
	• Design
	• C&D operations

Ministry of Environment	• Causes of the informal dumping of C&D waste.
	• Benefits of C&D waste management
	• Environmental, social and economic concerns of the construction industry including C&D waste
	• Variations needed for C&D waste management:
	  • Regulations, Strategies and Initiatives
	  • Encouragements and incentives

Jordan Contractors Association	• Causes of the informal dumping of C&D waste.
	• Limitations and barriers to the implementation of C&D waste management.
	• Benefits of C&D waste management
	• Variations needed for C&D waste management:
	  • Regulations, Strategies and Initiatives
	  • Encouragements and incentives
	• C&D operations

Construction Companies and Contractors	• Causes of the informal dumping of C&D waste.
	• Limitations and barriers to the implementation of C&D waste management.
	• Benefits of C&D waste management
	• Variations needed for C&D waste management:
	  • Regulations, Strategies and Initiatives
	  • Encouragements and incentives

Jordan Green Building Council	• Causes of the informal dumping of C&D waste.
	• Benefits of C&D waste management
	• Environmental, social and economic concerns of the construction industry including C&D waste
	• Variations needed for C&D waste management:
	  • Regulations, Strategies and Initiatives
	  • Encouragements and incentives

Table 10-14: Interviews Actors Involvement based on the Gaps in Knowledge

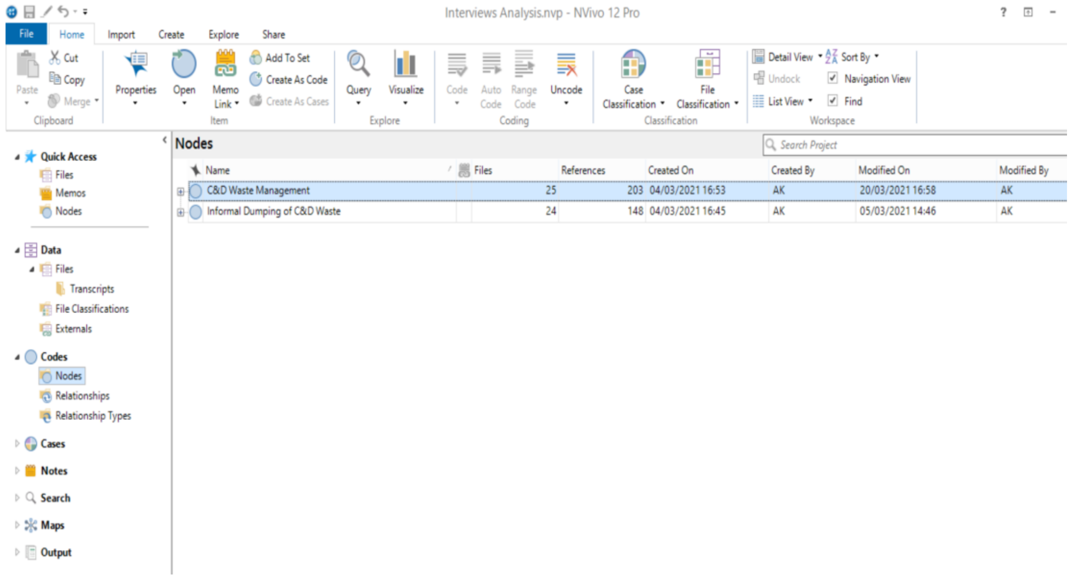


Figure 10-97: Interviews Main Sections on NVIVO Screen

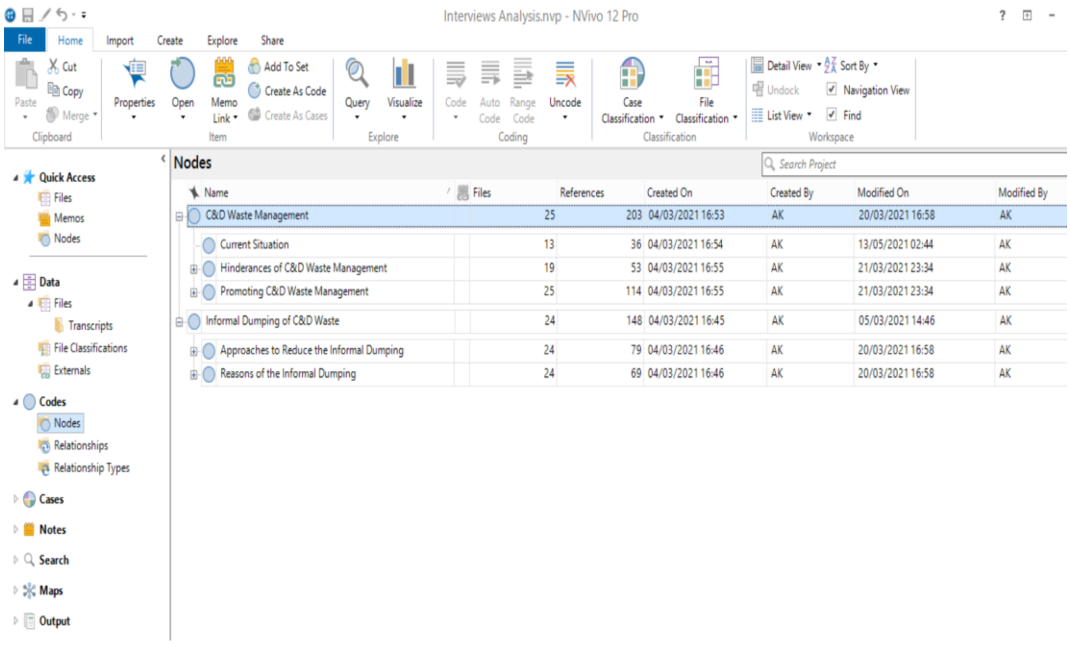


Figure 10-98: Interviews Sub-Sections on NVIVO Screen

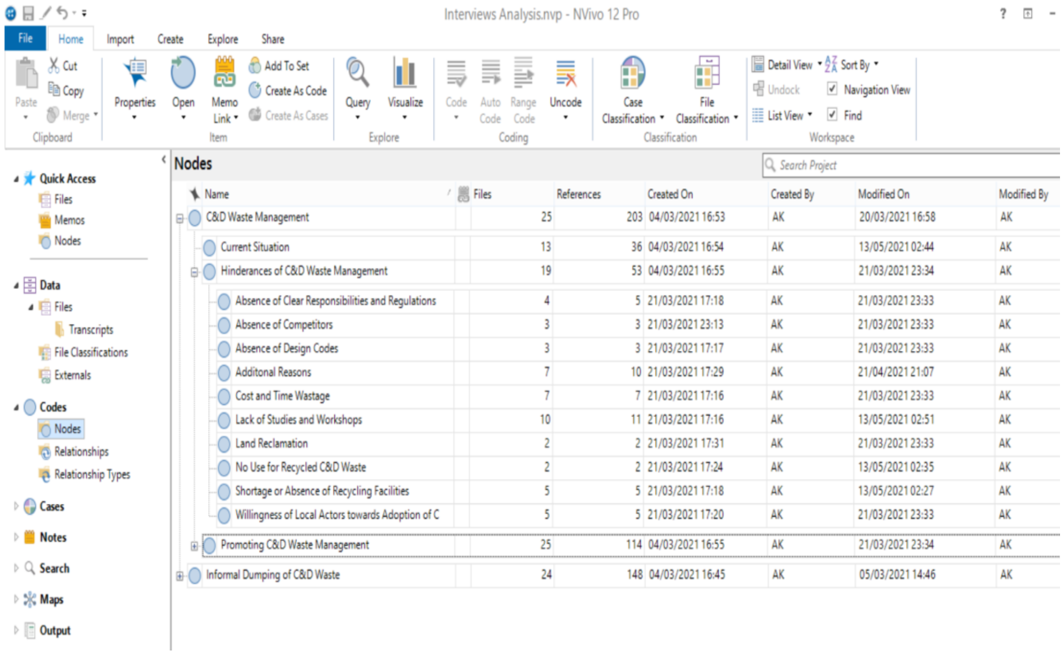


Figure 10-99: Interviews Sub-Sections on NVIVO Screen

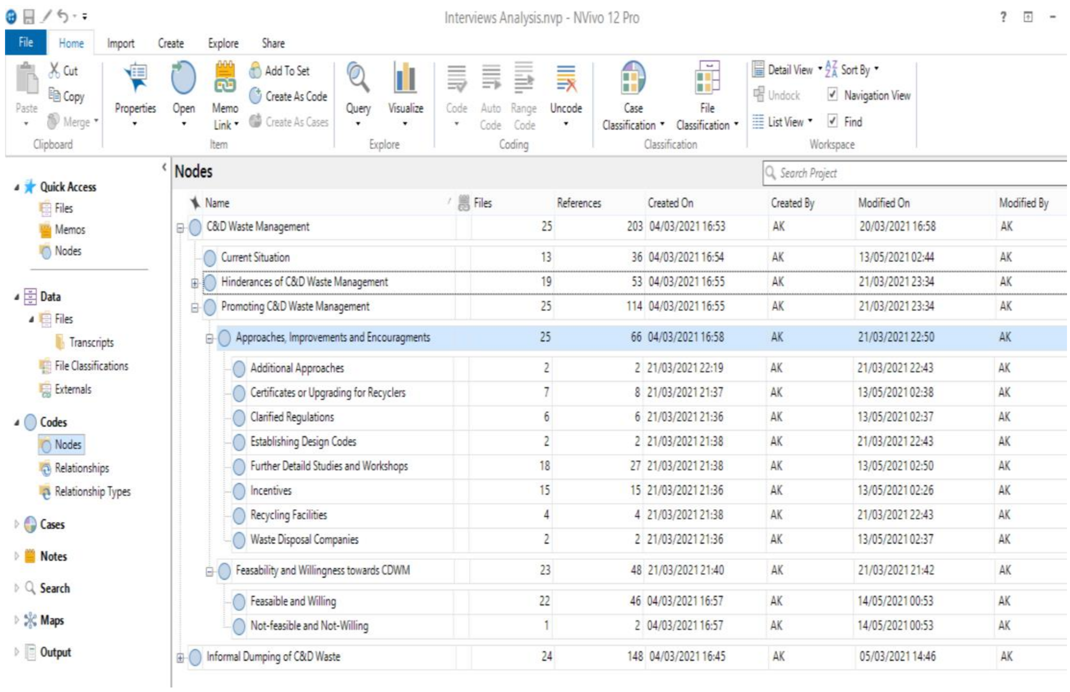


Figure 10-100: Interviews Sub-Sections on NVIVO Screen

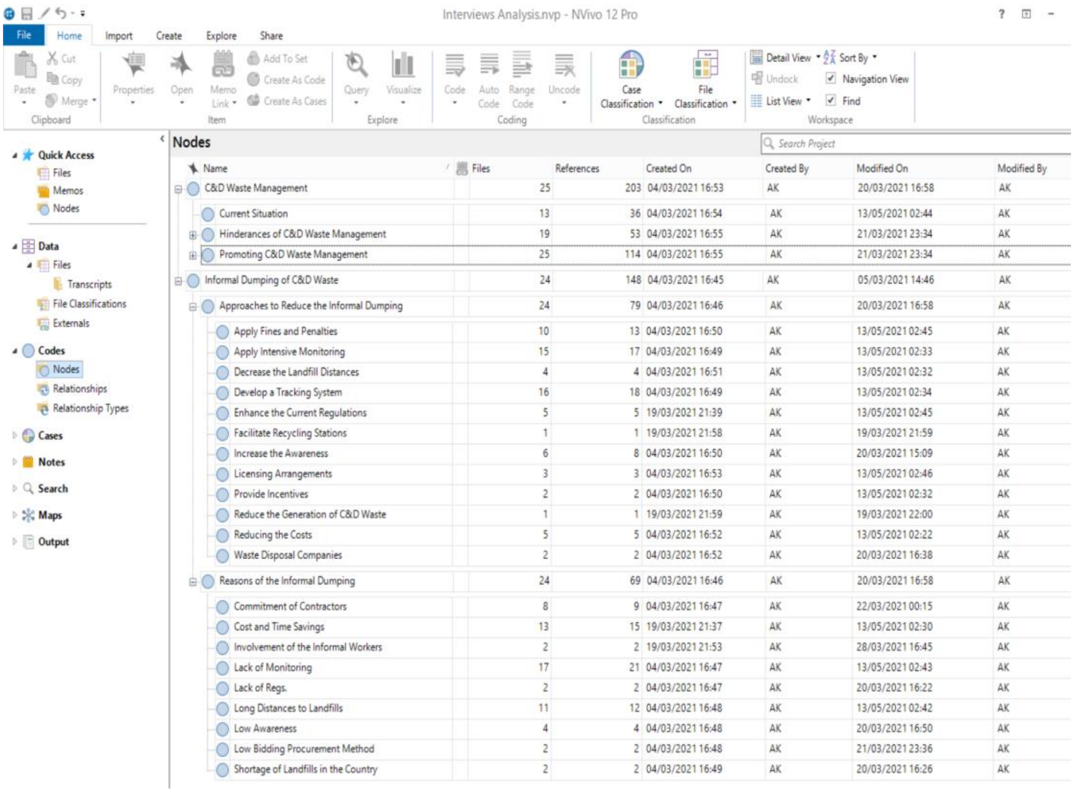


Figure 10-101: Interviews Sub-Sections on NVIVO Screen

10.1.6.4.1 The current situation

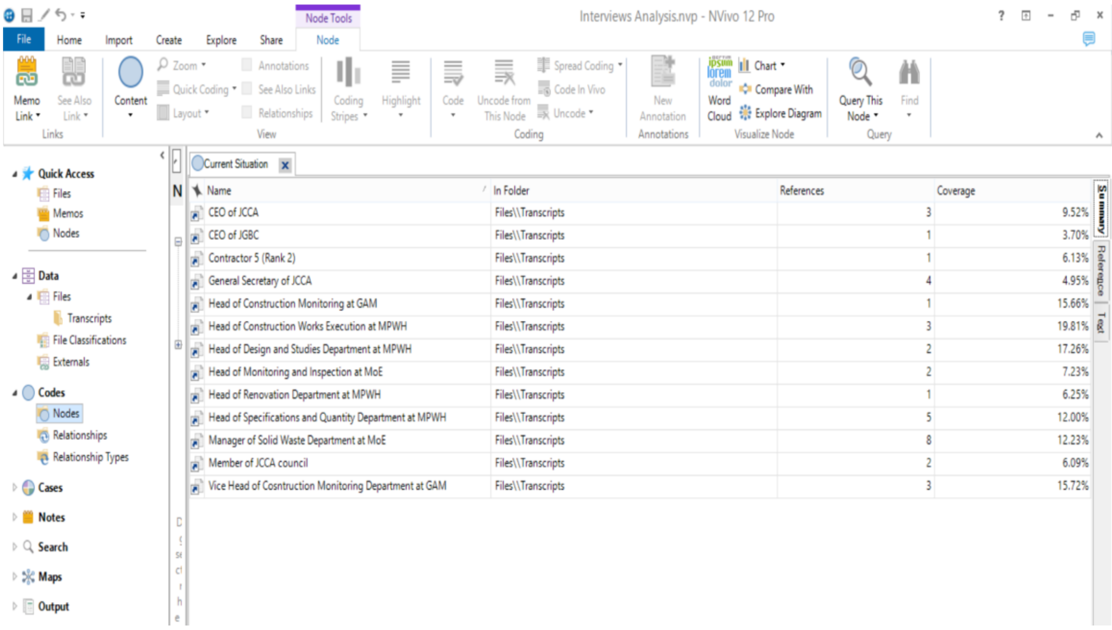


Figure 10-102: Actors Responses on the Current Situation Section NVIVO Screen

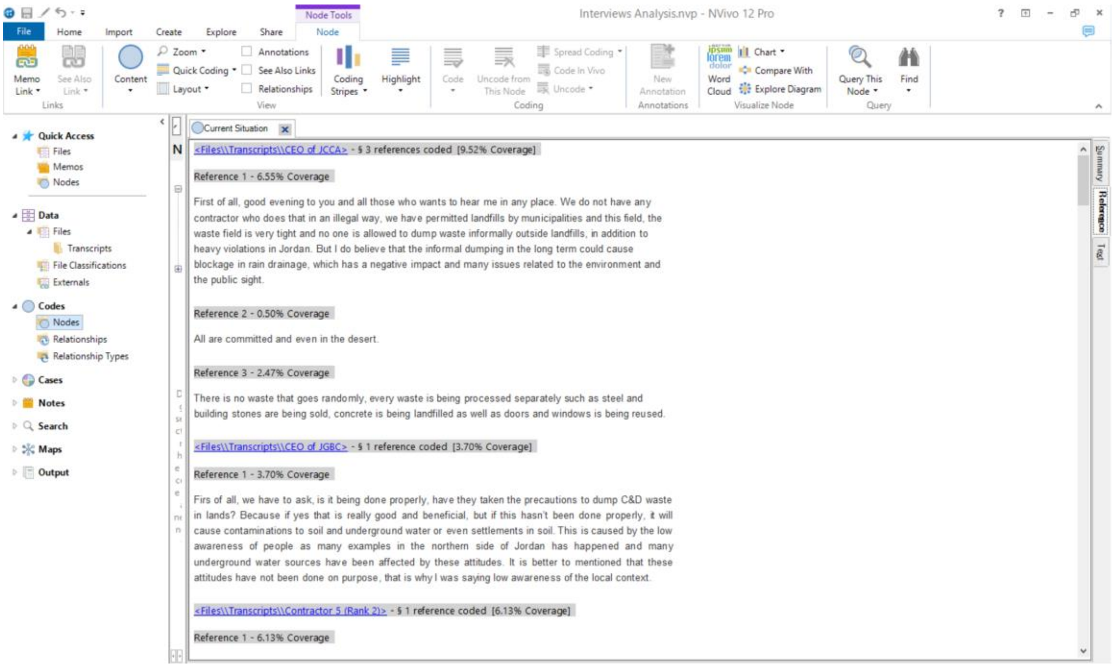


Figure 10-103: Actors Responses on the Current Situation Section NVIVO Screen

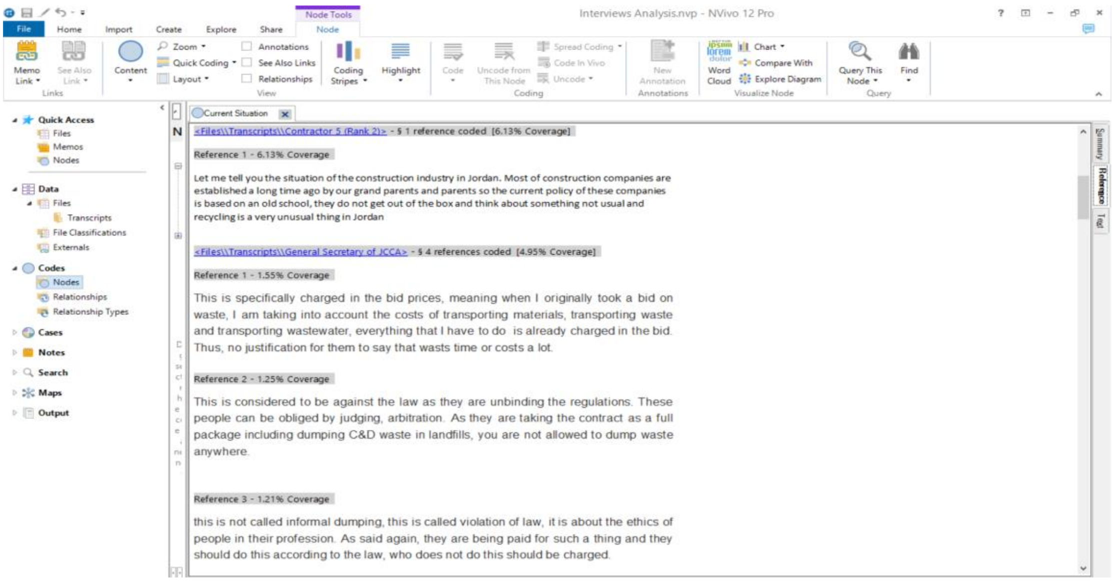


Figure 10-104: Actors Responses on the Current Situation Section NVIVO Screen

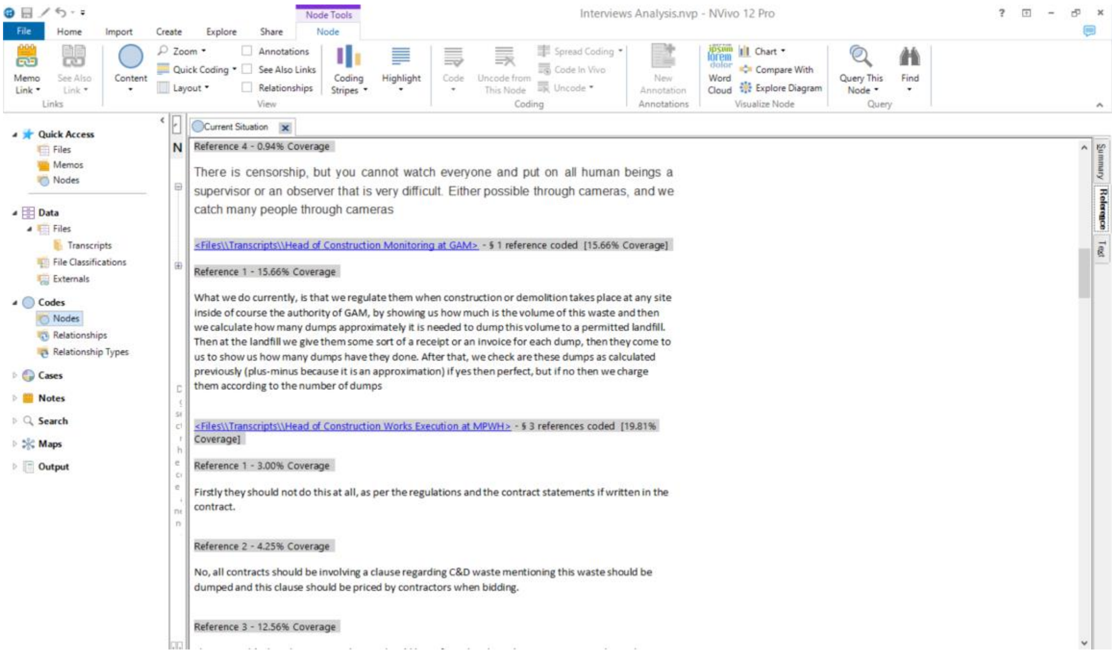


Figure 10-105: Actors Responses on the Current Situation Section NVIVO Screen

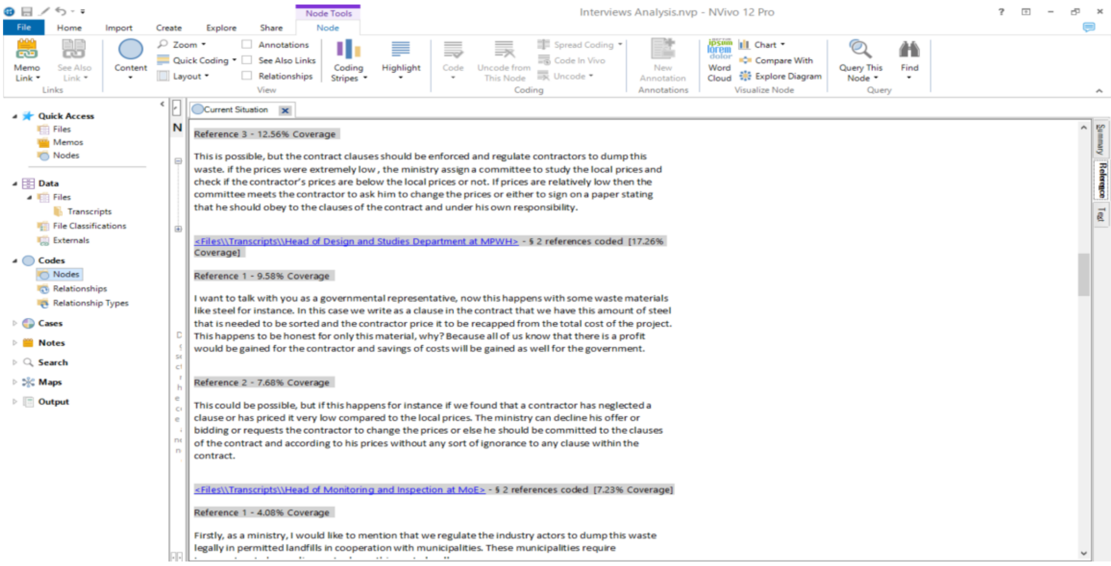


Figure 10-106: Actors Responses on the Current Situation Section NVIVO Screen

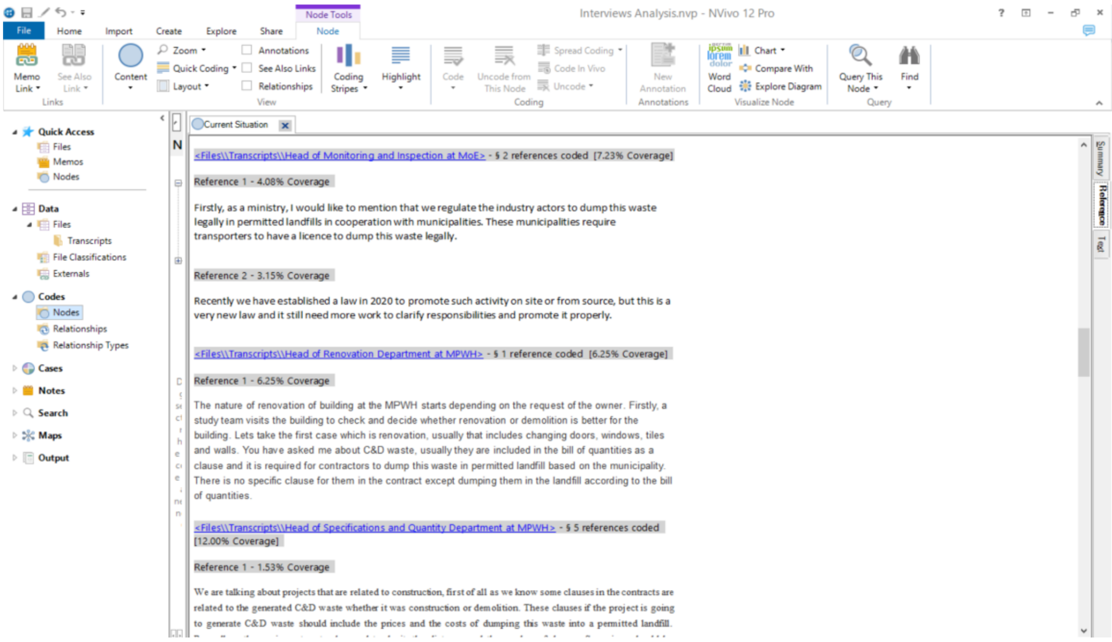


Figure 10-107: Actors Responses on the Current Situation Section NVIVO Screen

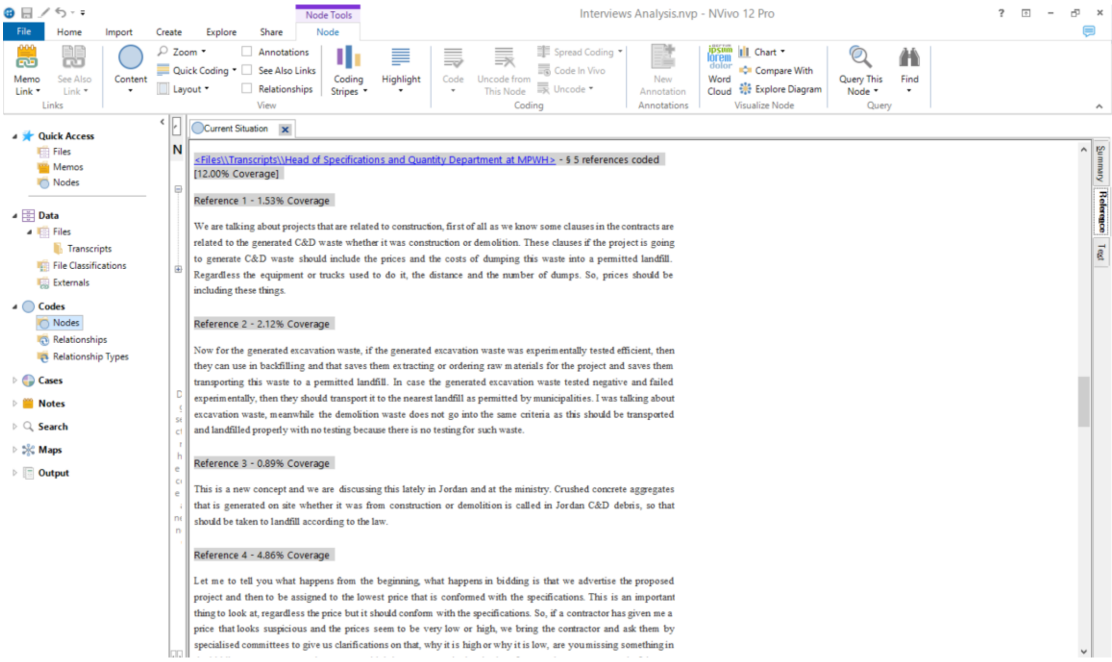


Figure 10-108: Actors Responses on the Current Situation Section NVIVO Screen

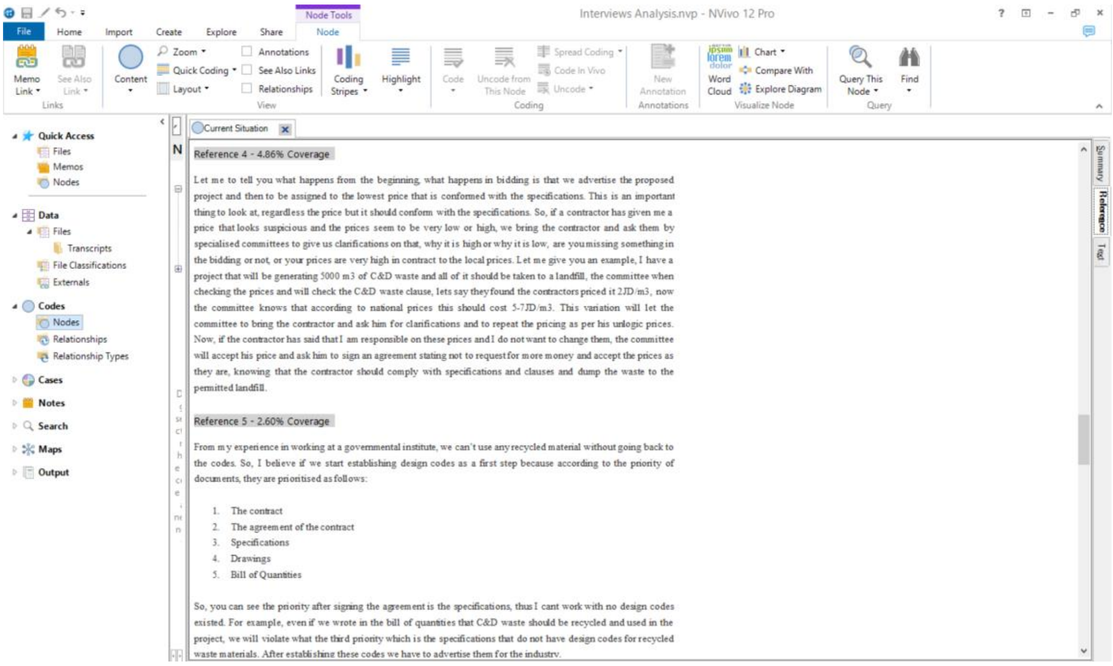


Figure 10-109: Actors Responses on the Current Situation Section NVIVO Screen

Figure 10-110: Actors Responses on the Current Situation Section NVIVO Screen

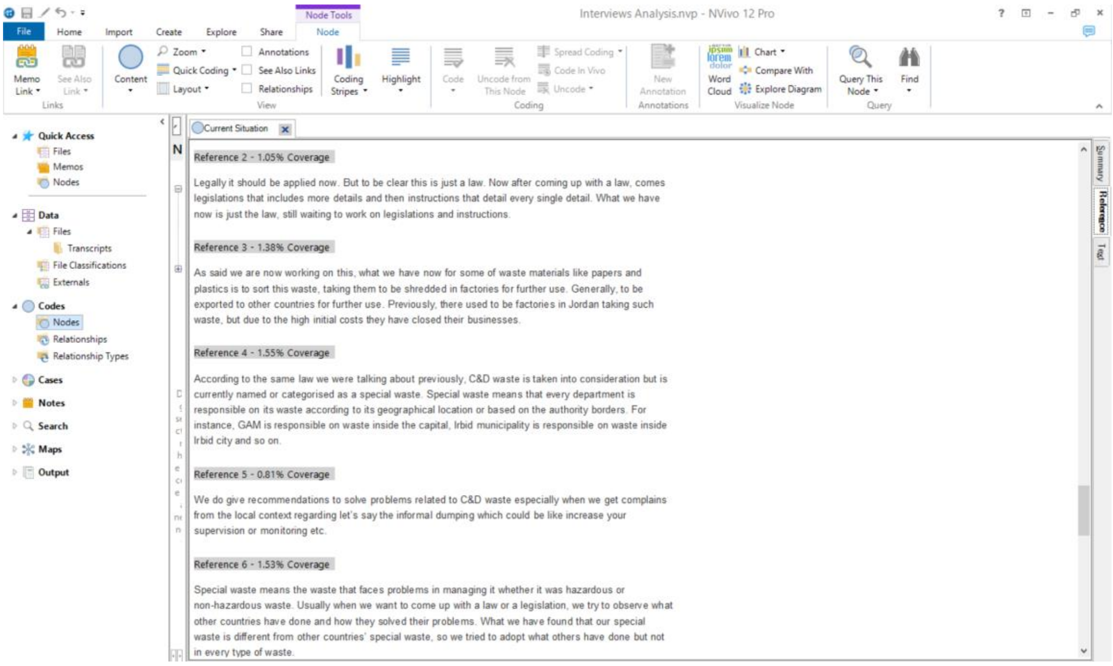


Figure 10-111: Actors Responses on the Current Situation Section NVIVO Screen

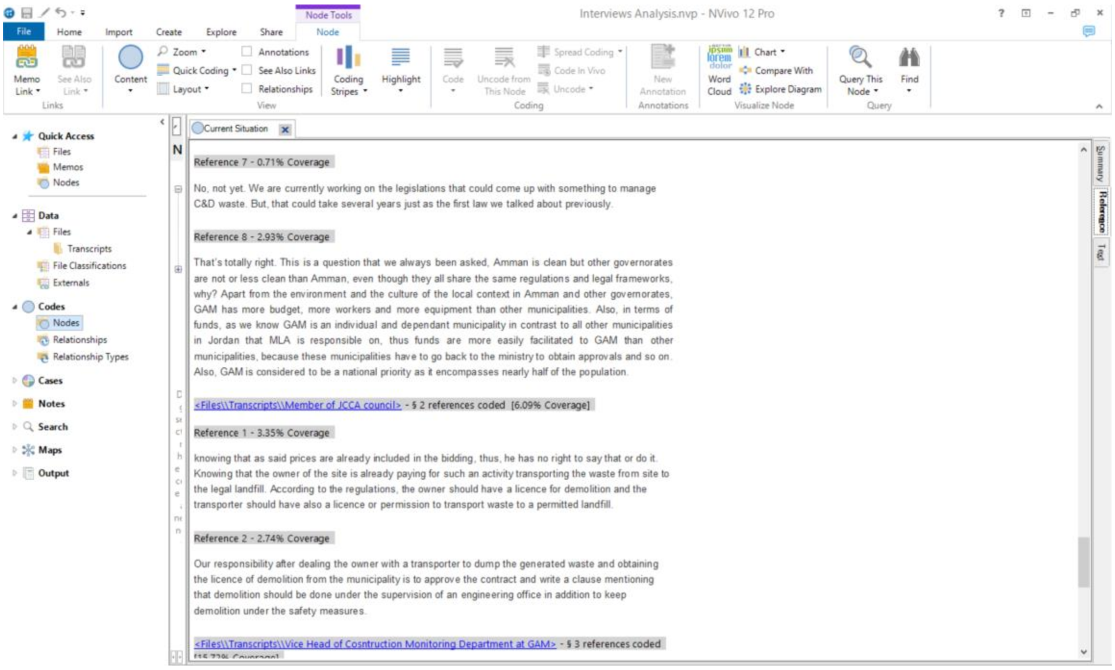


Figure 10-112: Actors Responses on the Current Situation Section NVIVO Screen

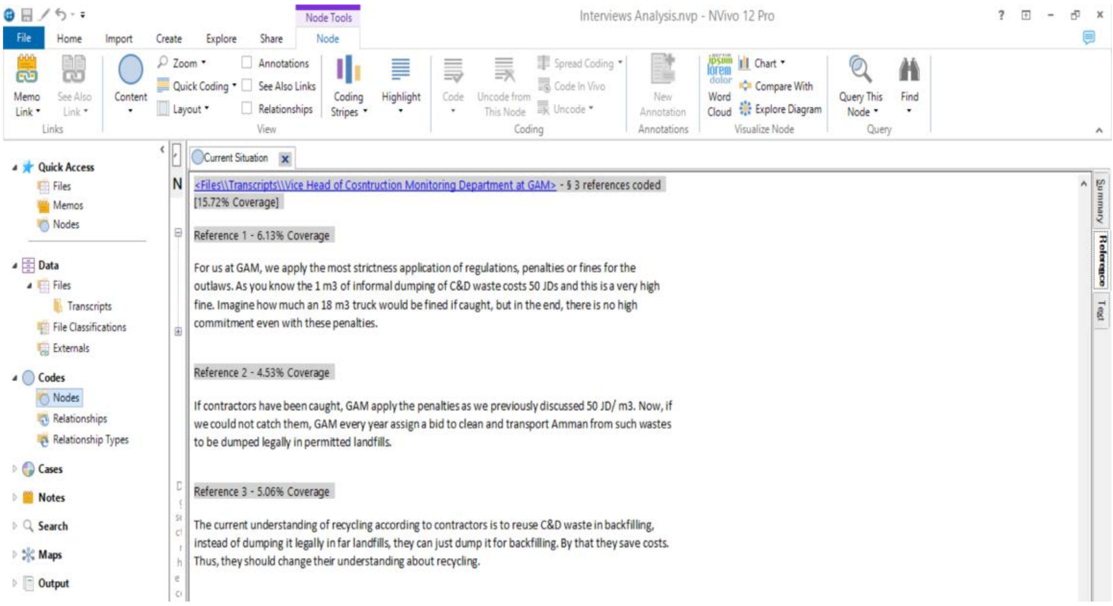


Figure 10-113: Actors Responses on the Current Situation Section NVIVO Screen

10.1.6.4.2 Hindrances to C&D Waste Management

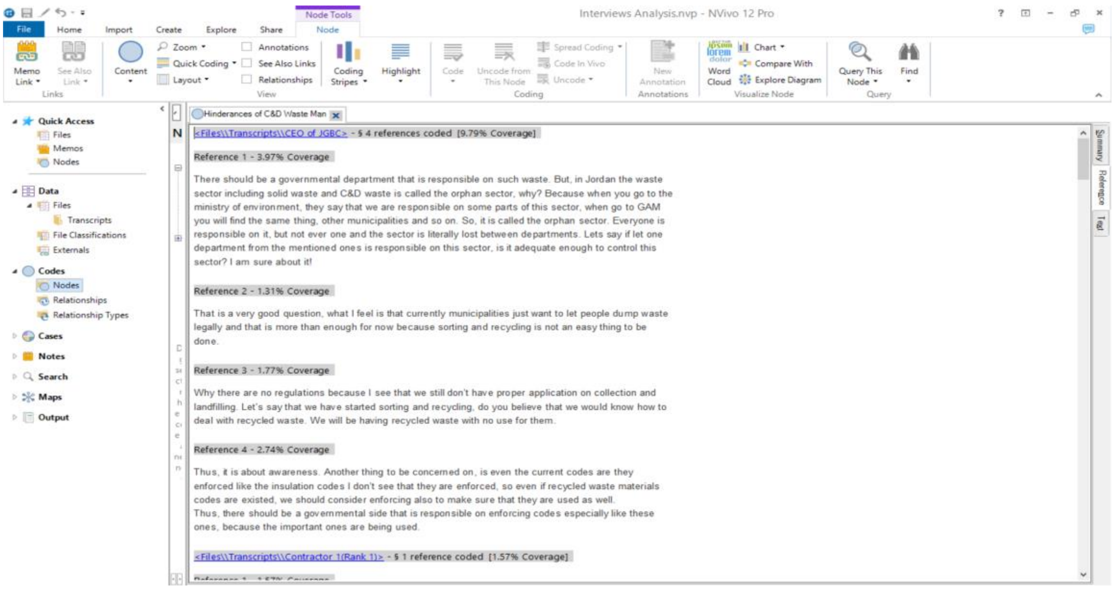


Figure 10-114: Actors Responses on the Hindrances Section NVIVO Screen

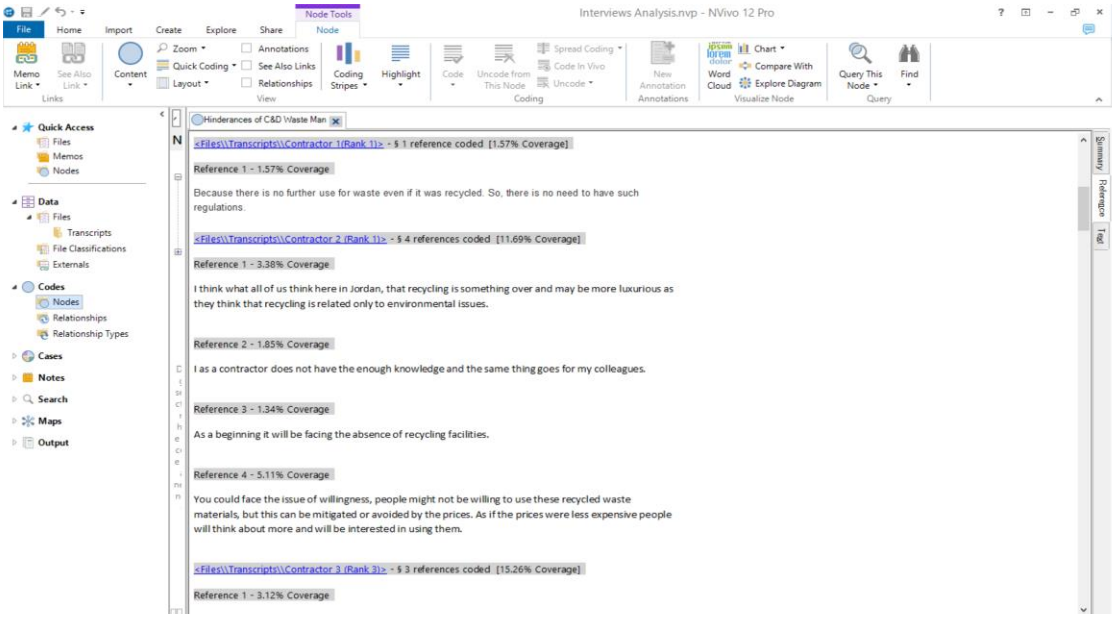


Figure 10-115: Actors Responses on the Hindrances Section NVIVO Screen

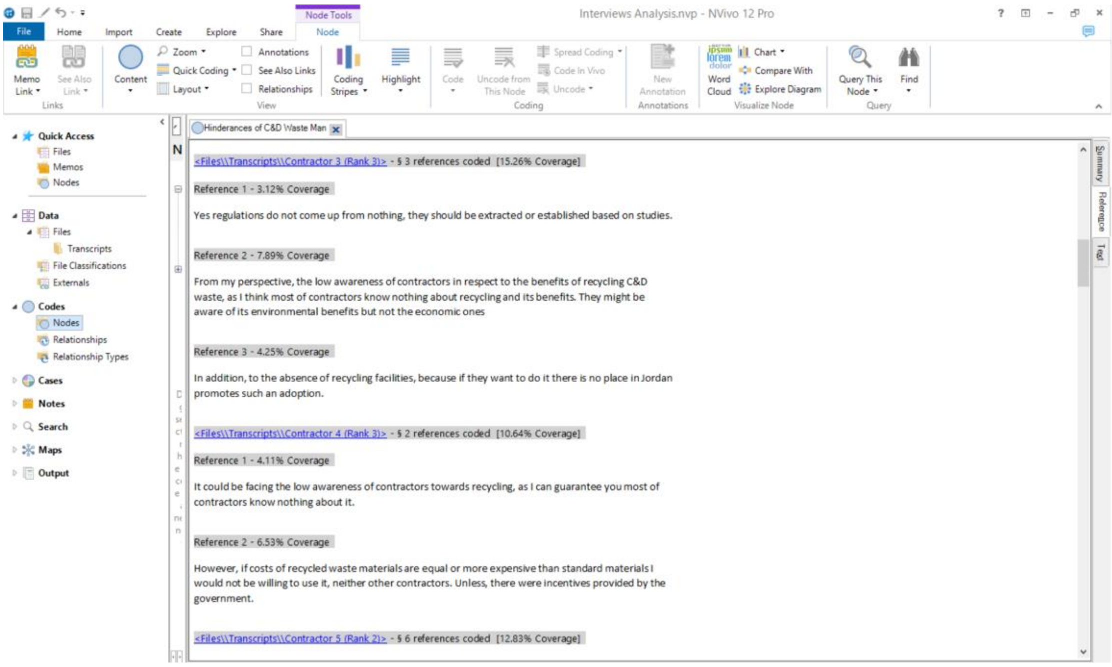


Figure 10-116: Actors Responses on the Hindrances Section NVIVO Screen

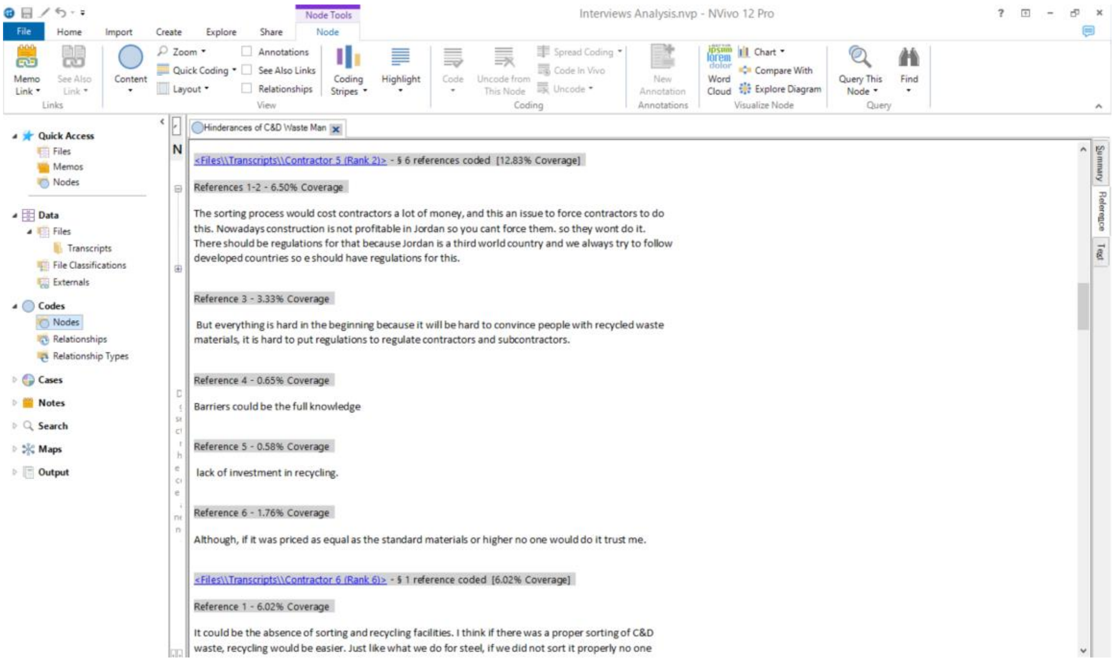


Figure 10-117: Actors Responses on the Hindrances Section NVIVO Screen

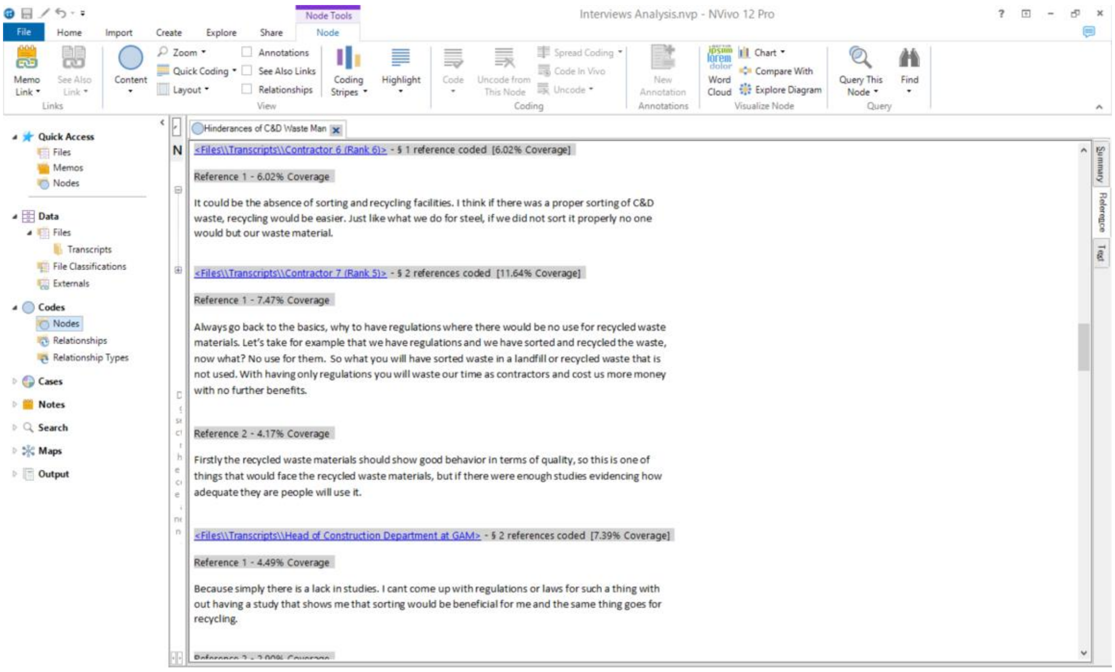


Figure 10-118: Actors Responses on the Hindrances Section NVIVO Screen

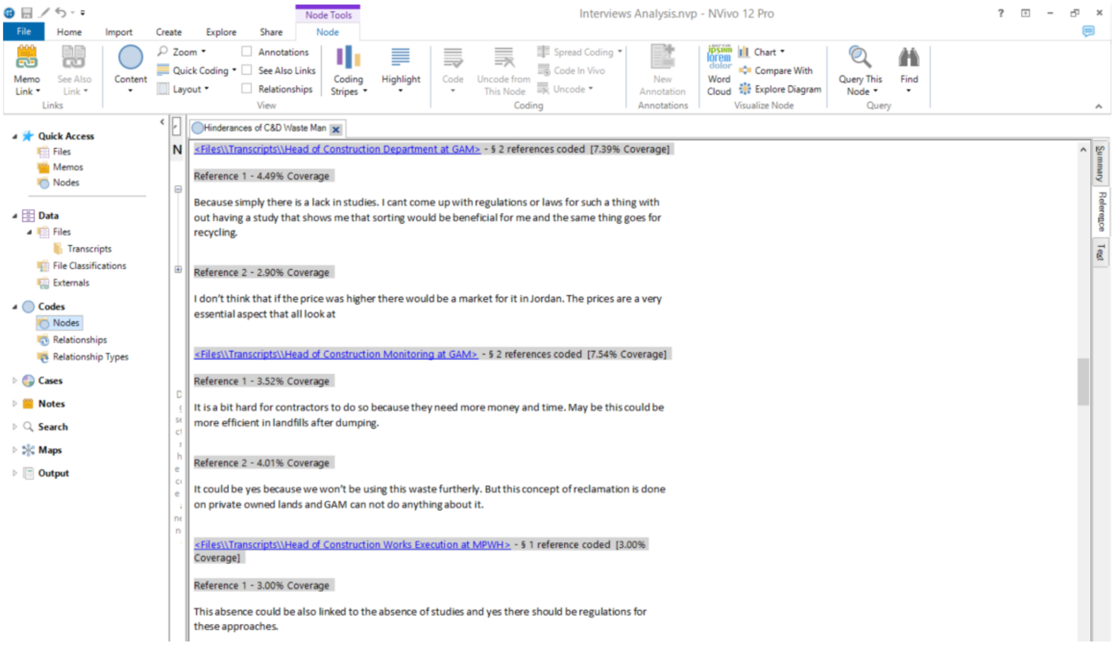


Figure 10-119: Actors Responses on the Hindrances Section NVIVO Screen

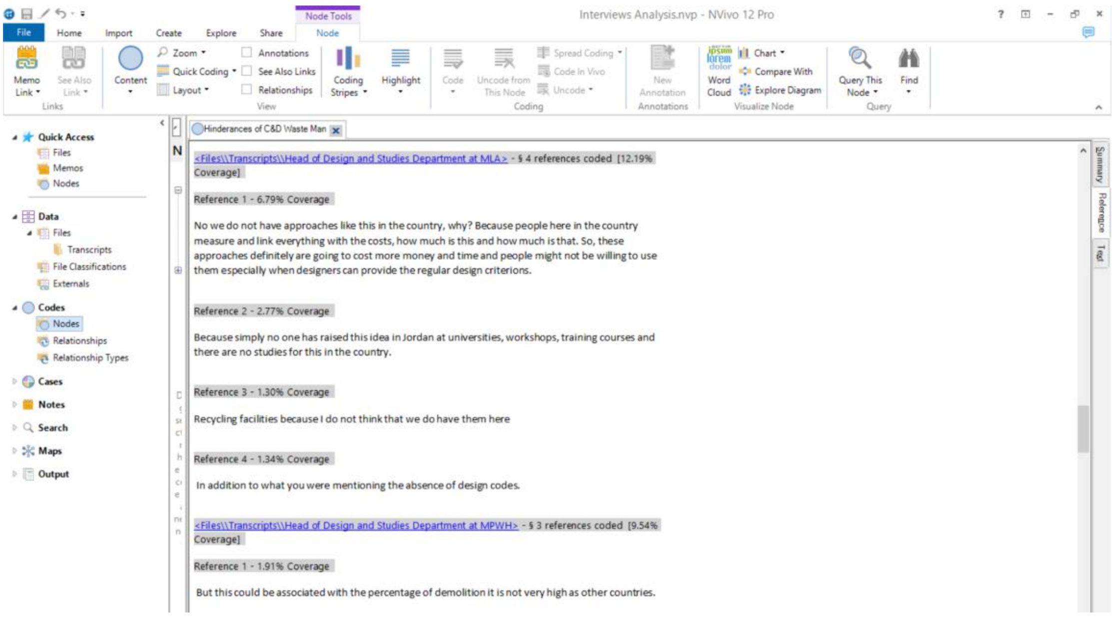


Figure 10-120: Actors Responses on the Hindrances Section NVIVO Screen

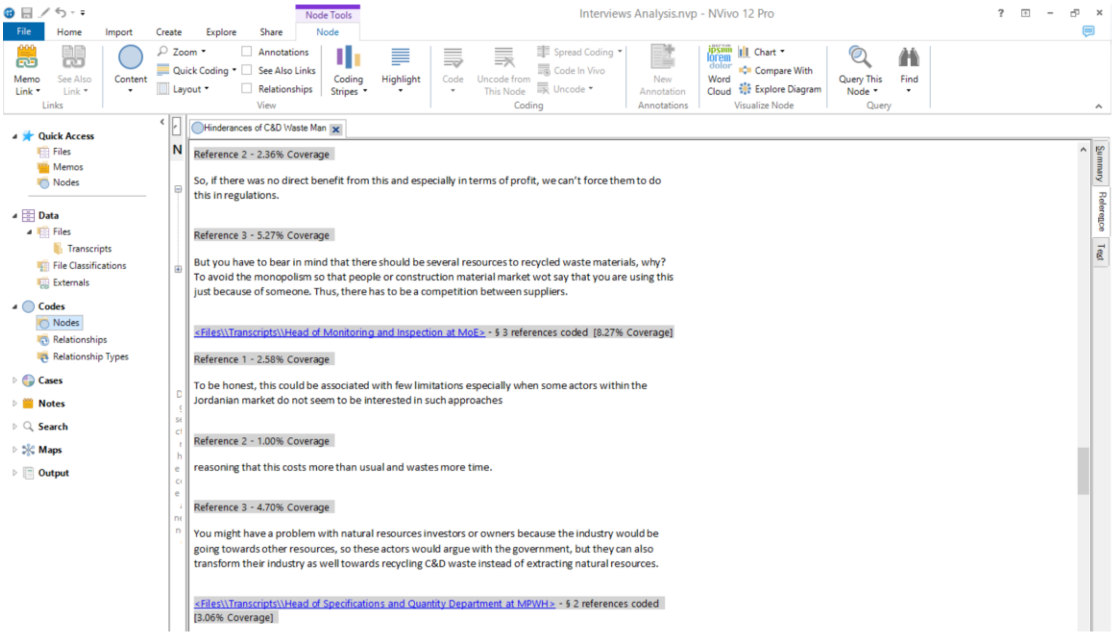
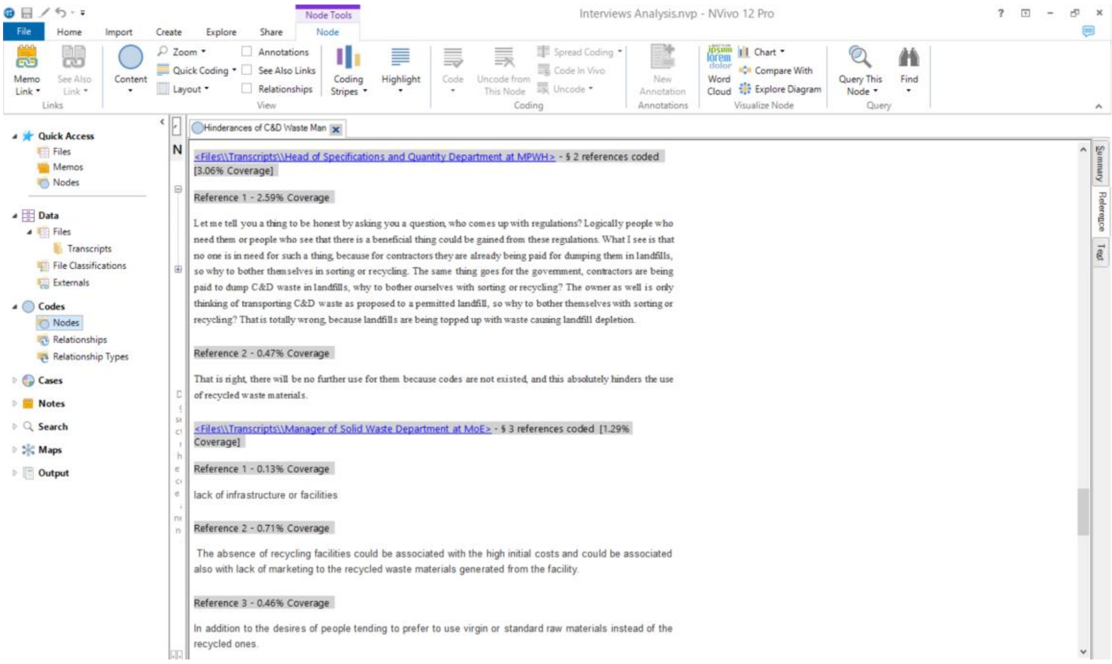


Figure 10-121: Actors Responses on the Hindrances Section NVIVO Screen



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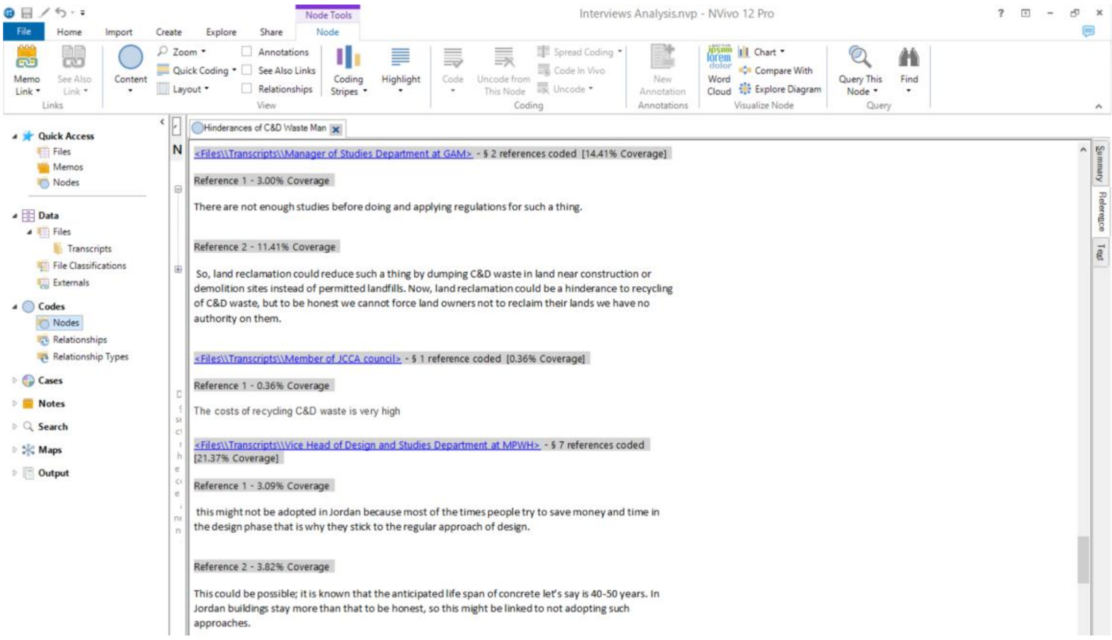


Figure 10-123: Actors Responses on the Hindrances Section NVIVO Screen

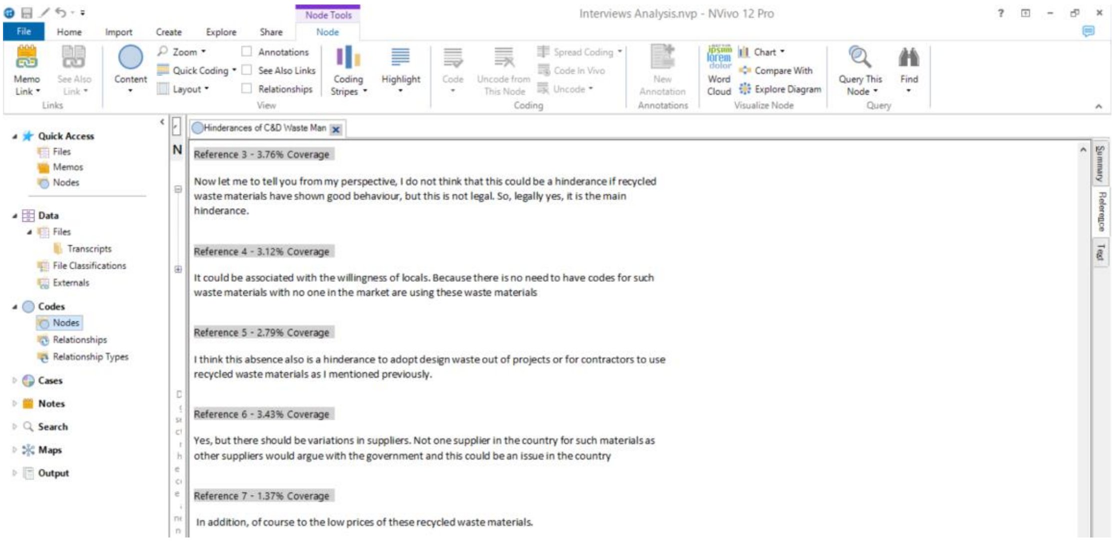


Figure 10-124: Actors Responses on the Hindrances Section NVIVO Screen

10.1.6.4.3 Promoting a C&D Waste Management

10.1.6.4.3.1 Approaches, improvements and encouragements

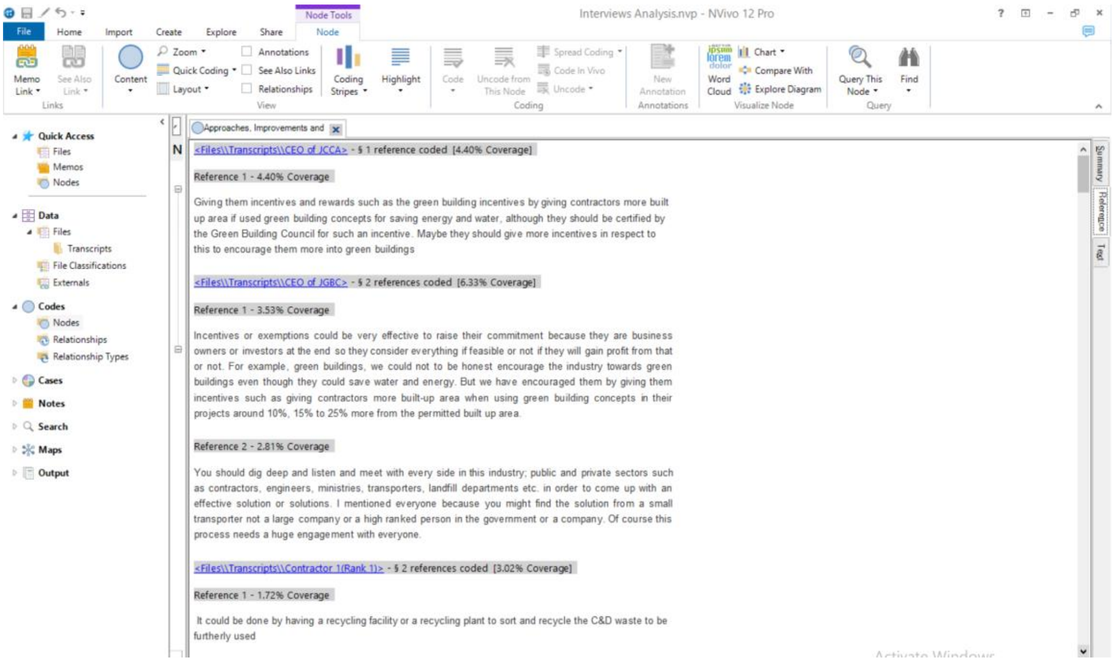


Figure 10-125: Actors Responses on the Promotion Section NVIVO Screen

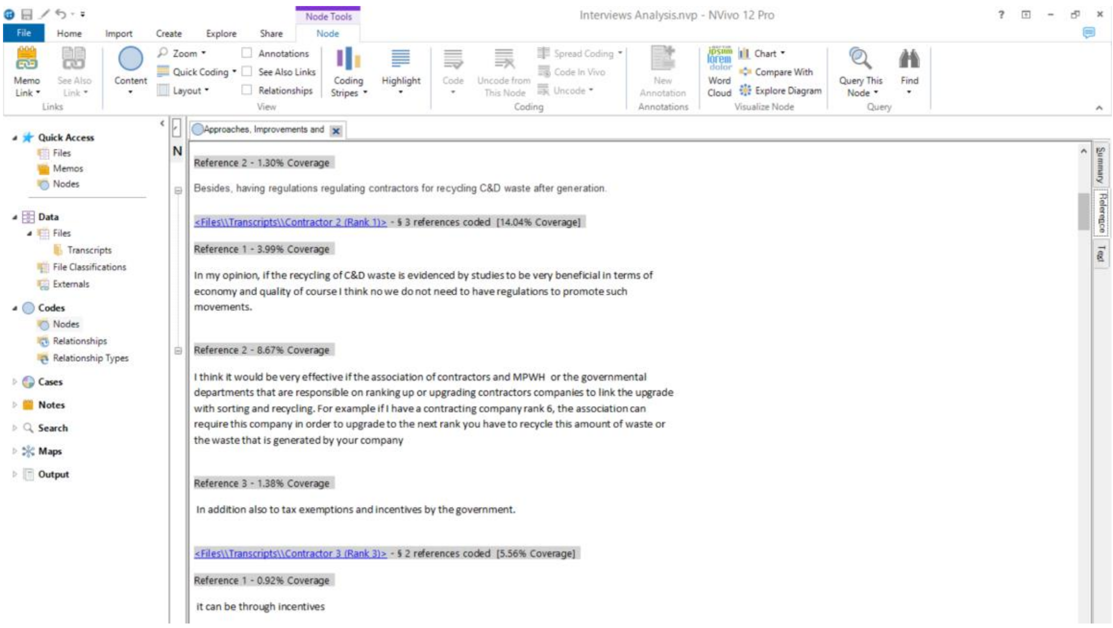
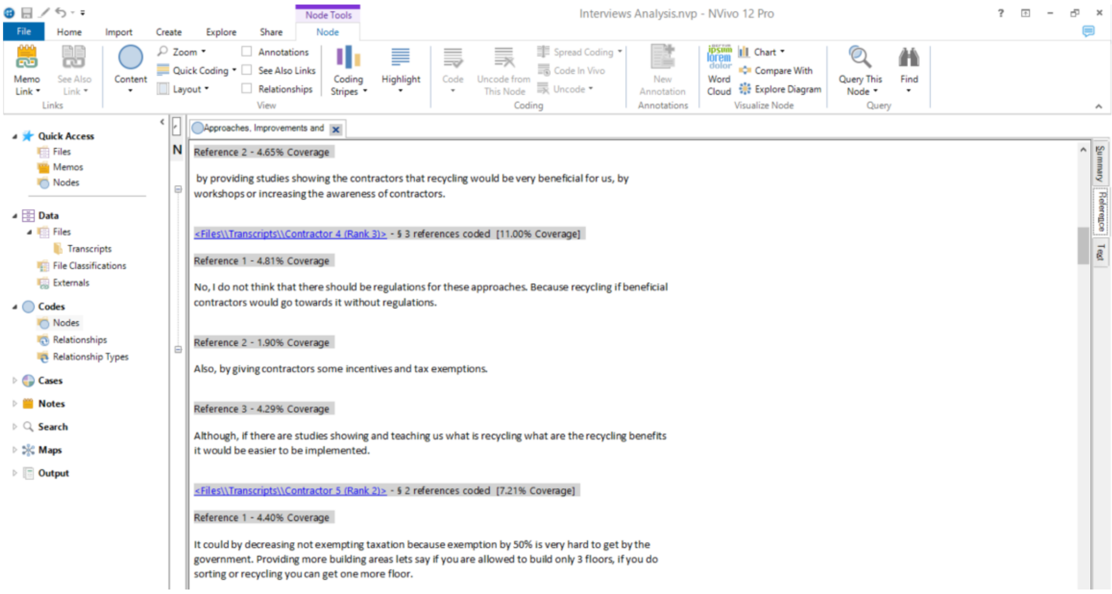


Figure 10-126: Actors Responses on the Promotion Section NVIVO Screen



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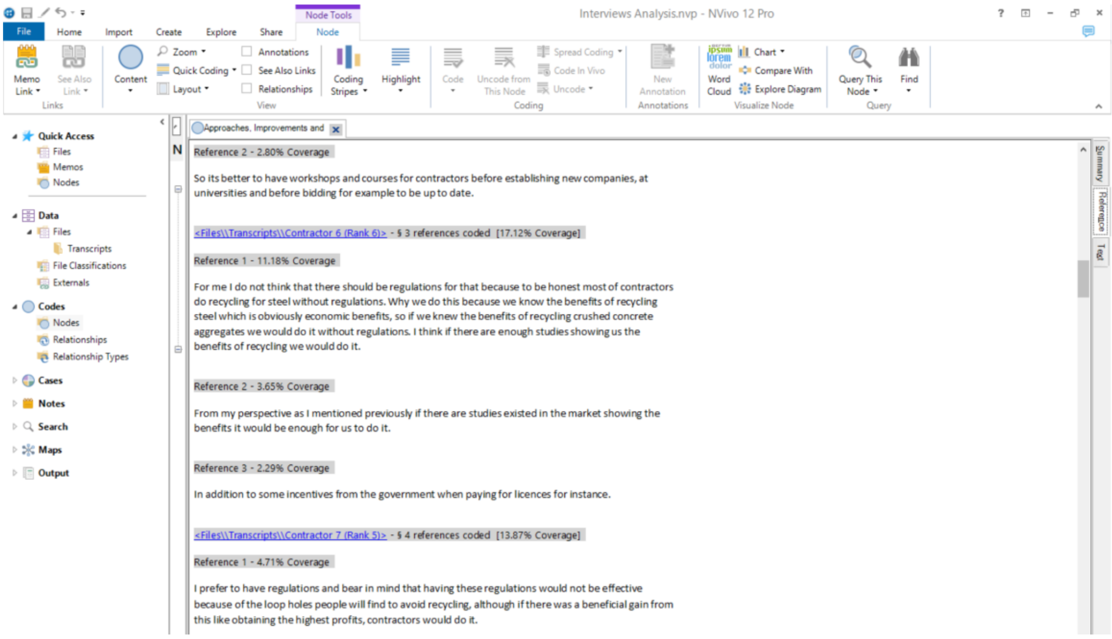
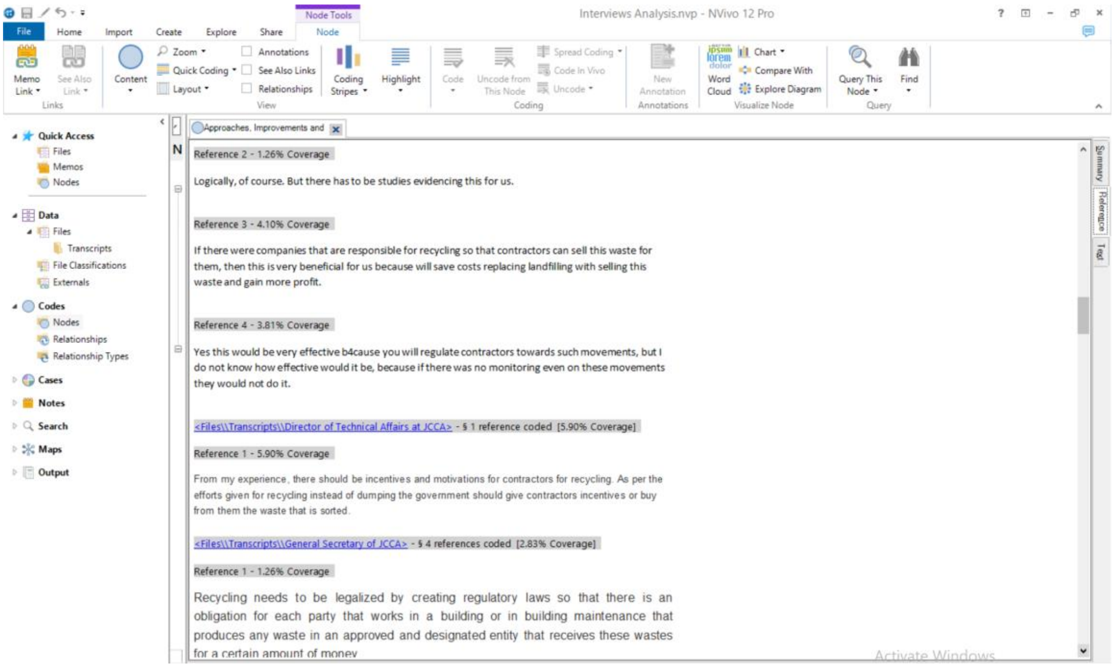


Figure 10-128: Actors Responses on the Promotion Section NVIVO Screen



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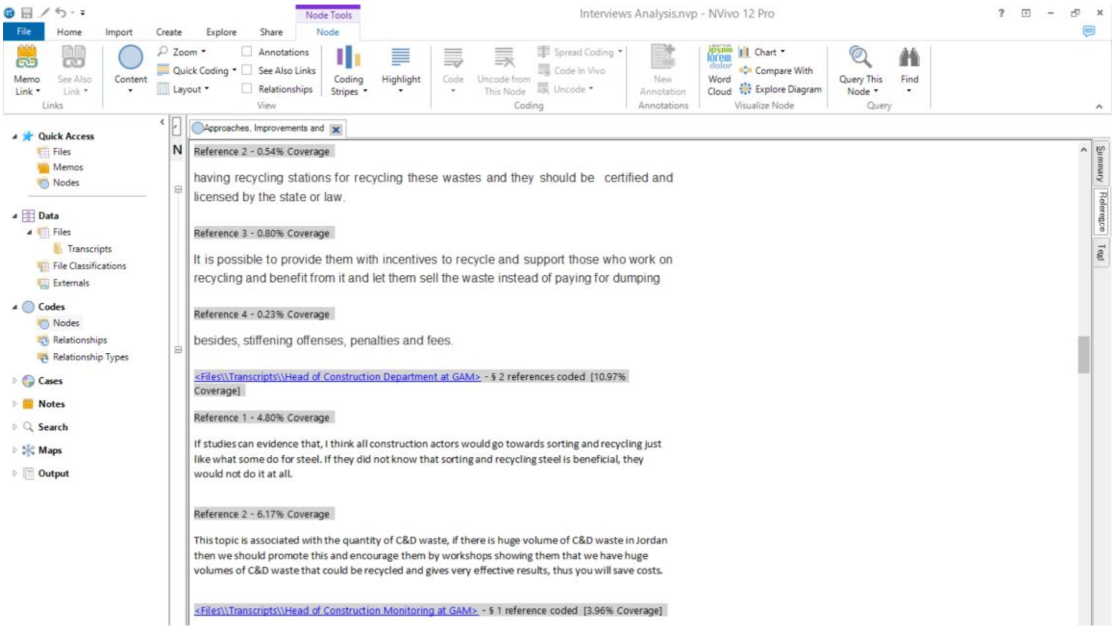


Figure 10-130: Actors Responses on the Promotion Section NVIVO Screen

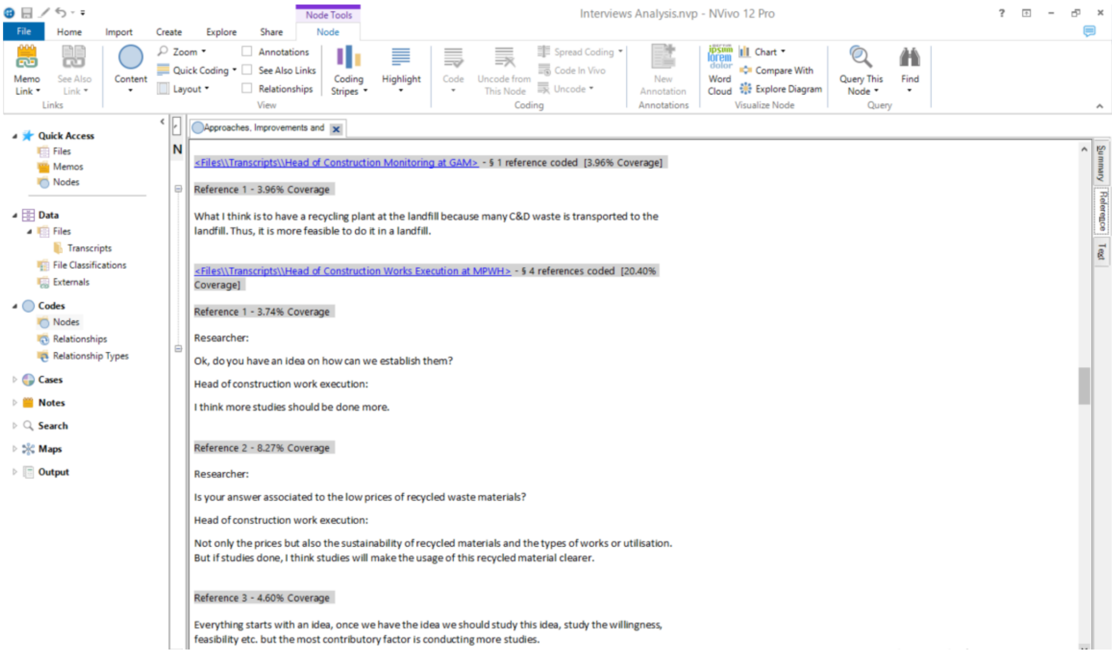


Figure 10-131: Actors Responses on the Promotion Section NVIVO Screen

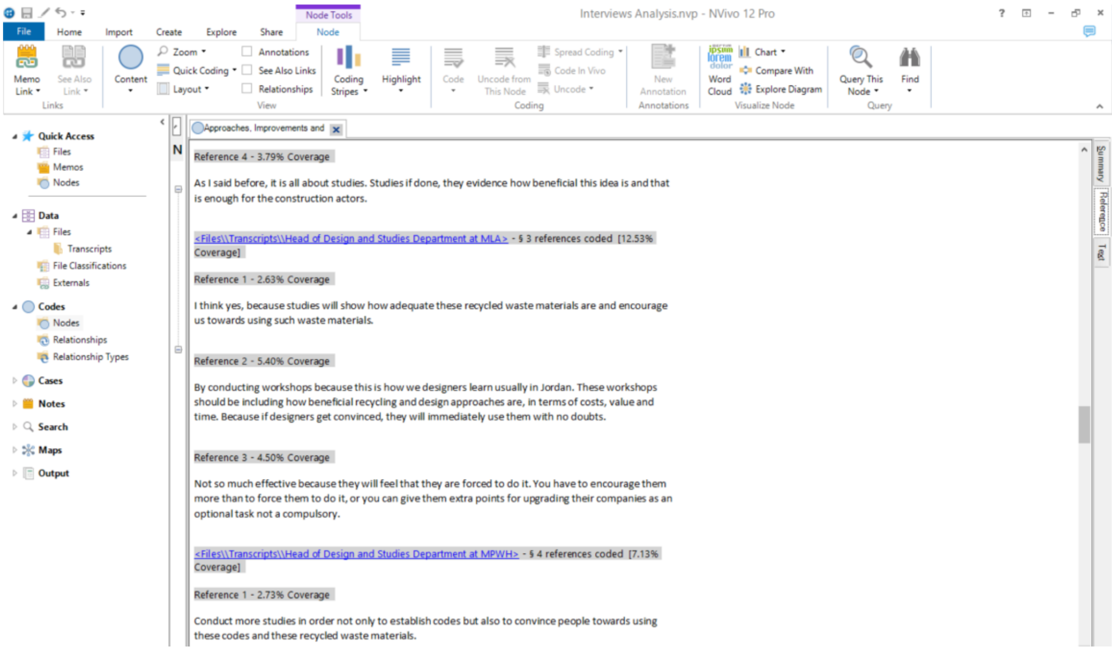


Figure 10-132: Actors Responses on the Promotion Section NVIVO Screen

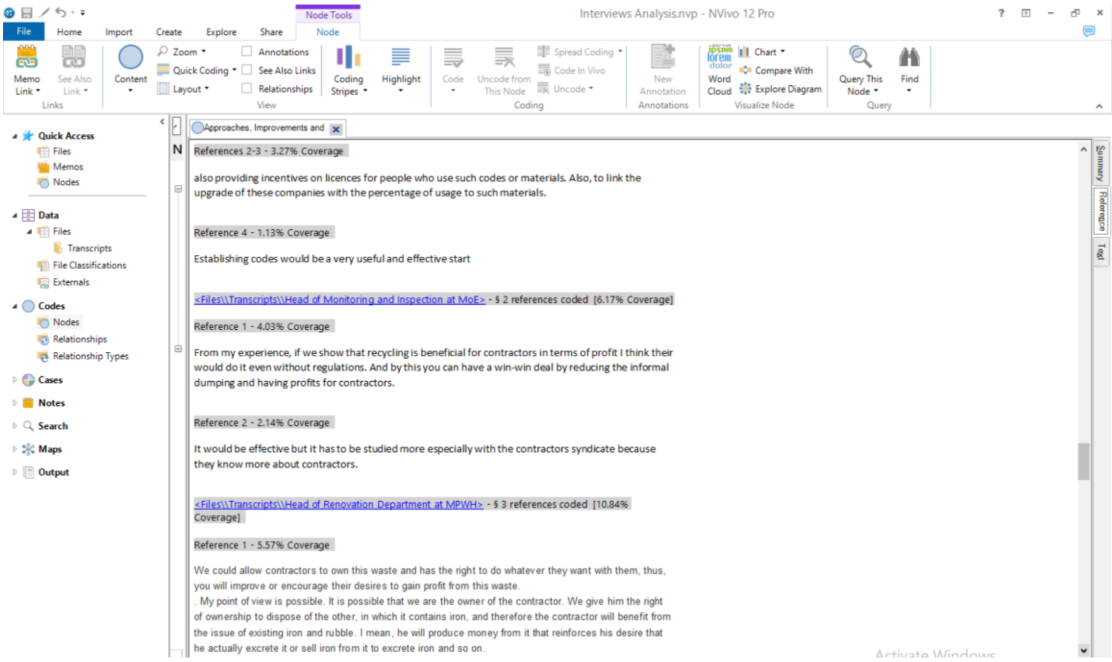


Figure 10-133: Actors Responses on the Promotion Section NVIVO Screen

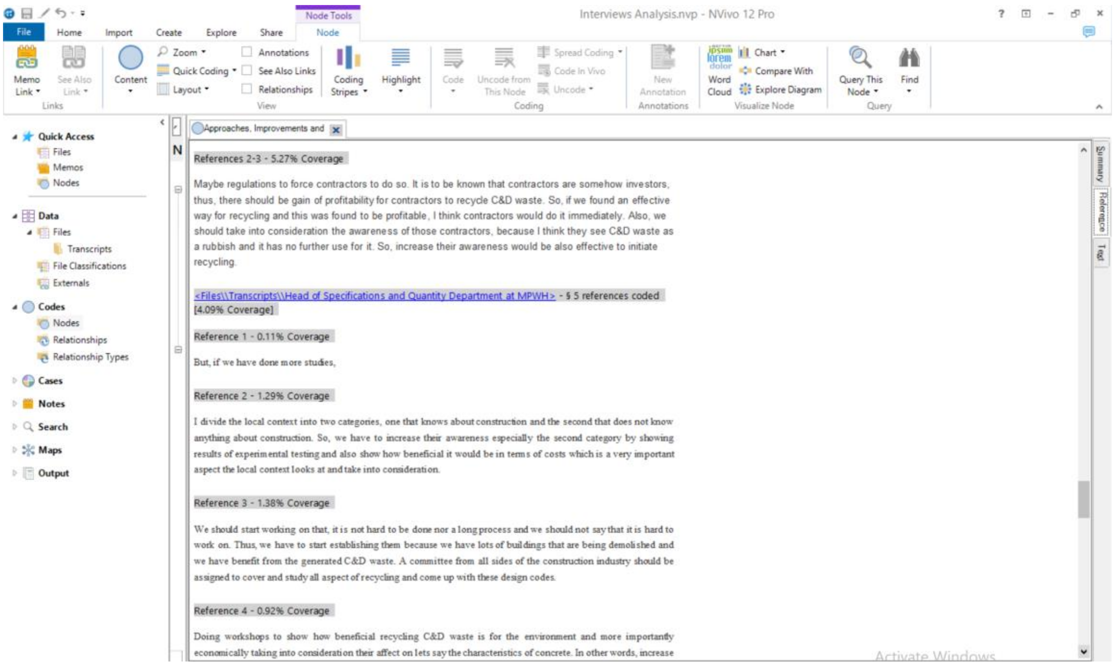


Figure 10-134: Actors Responses on the Promotion Section NVIVO Screen

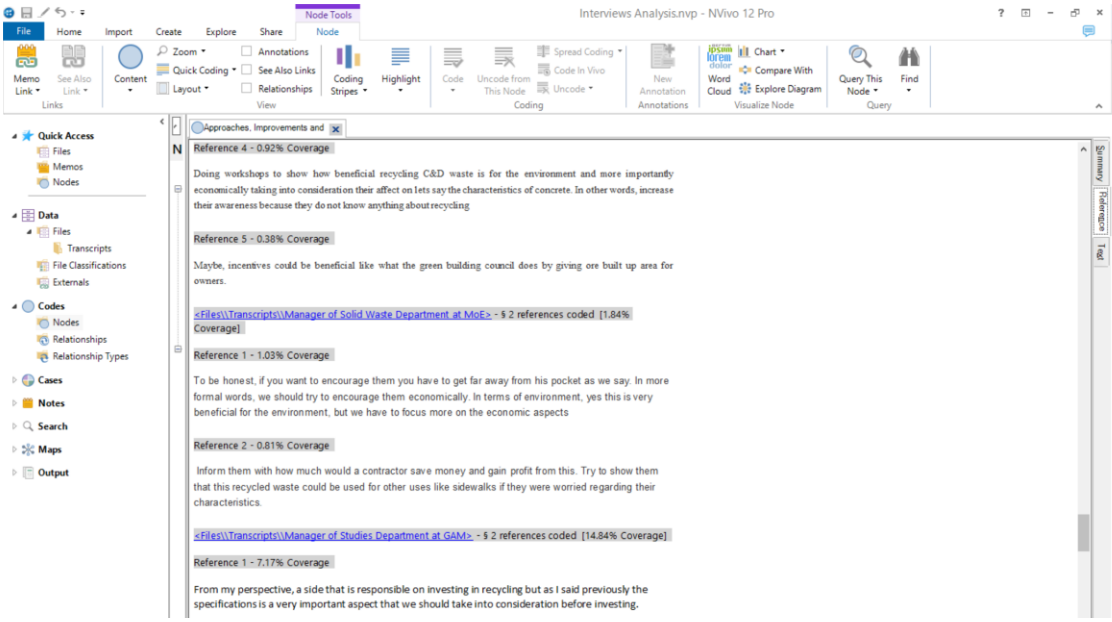


Figure 10-135: Actors Responses on the Promotion Section NVIVO Screen

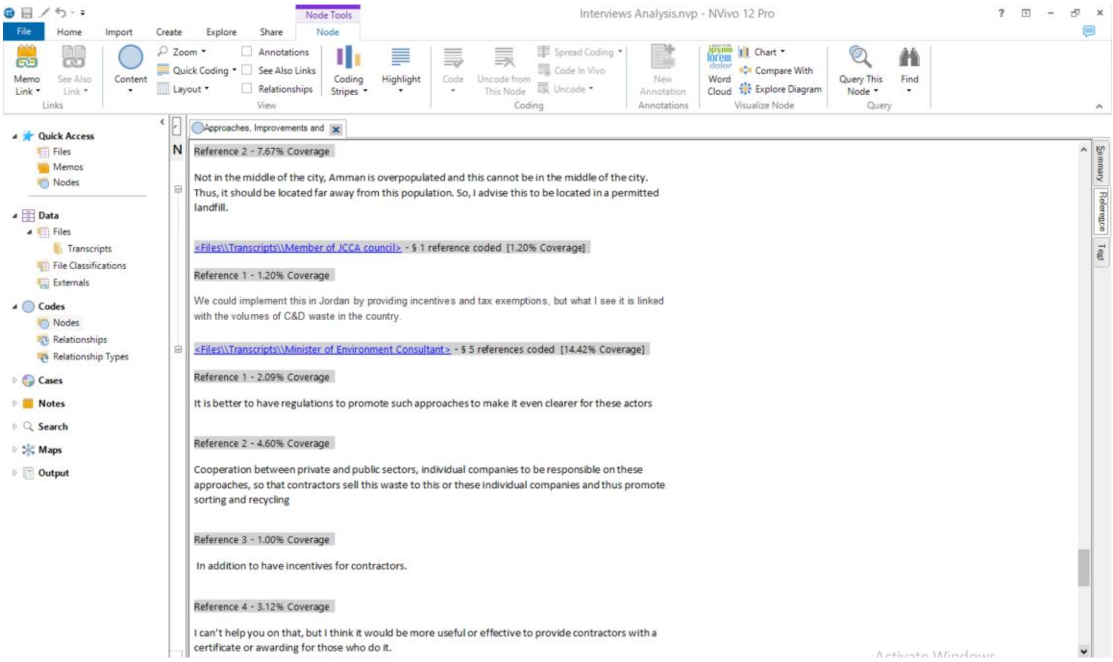


Figure 10-136: Actors Responses on the Promotion Section NVIVO Screen

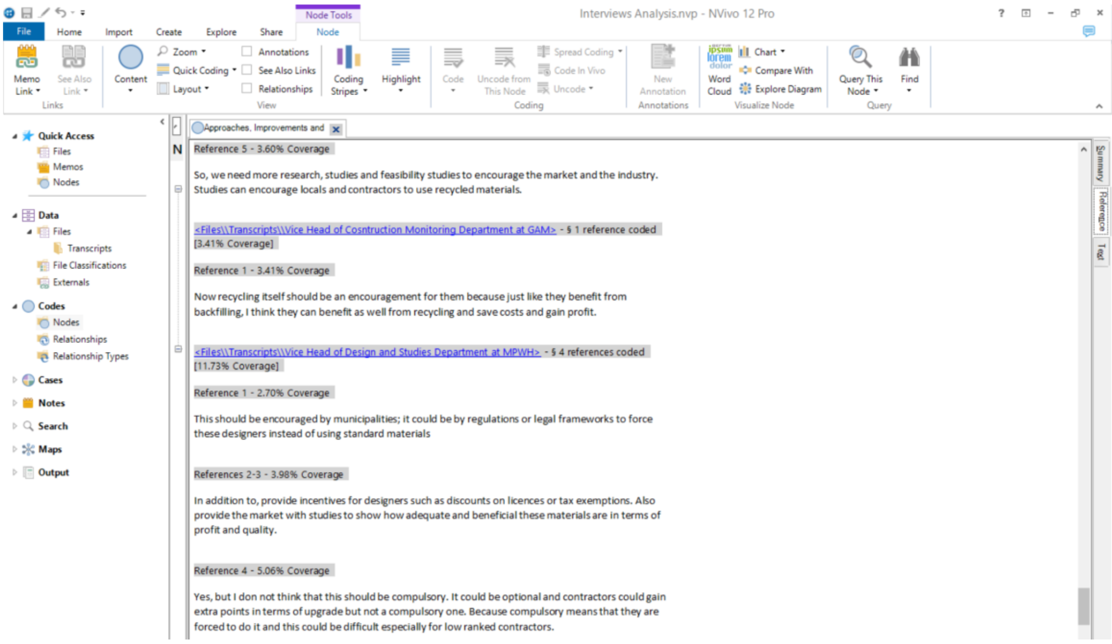


Figure 10-137: Actors Responses on the Promotion Section NVIVO Screen

10.1.6.4.3.2 Feasibility and willingness

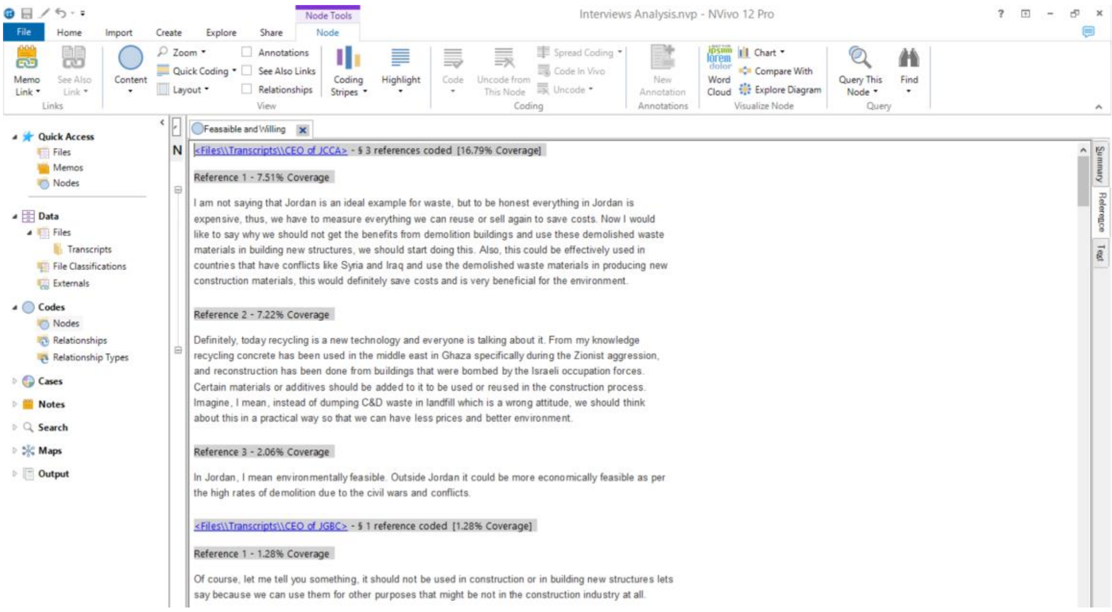


Figure 10-138: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

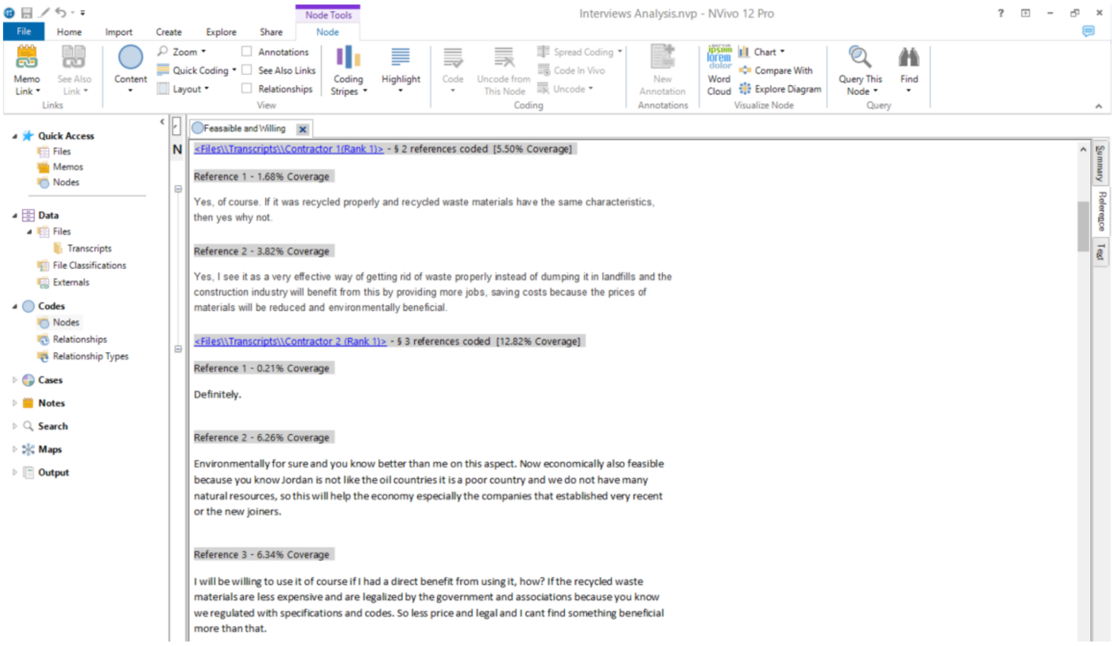


Figure 10-139: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

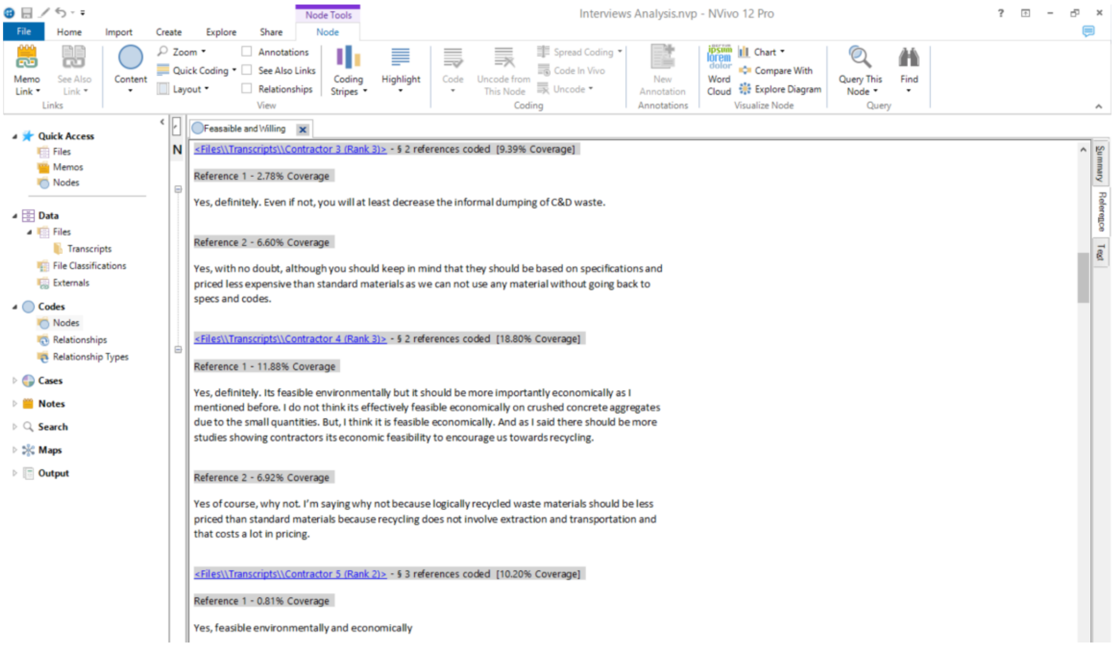


Figure 10-140: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

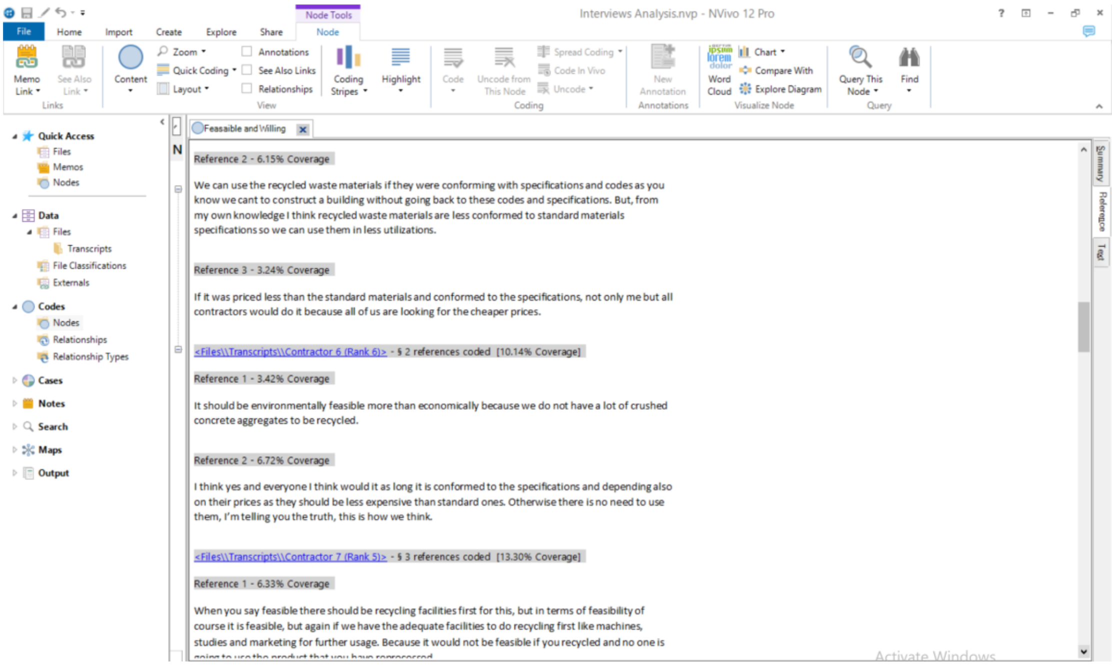


Figure 10-141: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

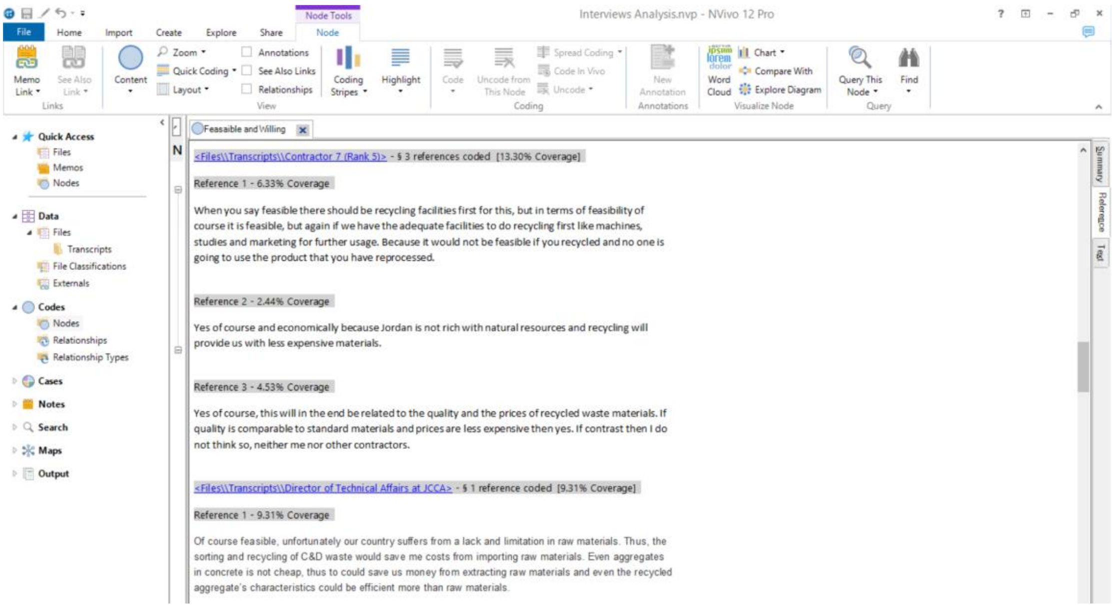


Figure 10-142: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

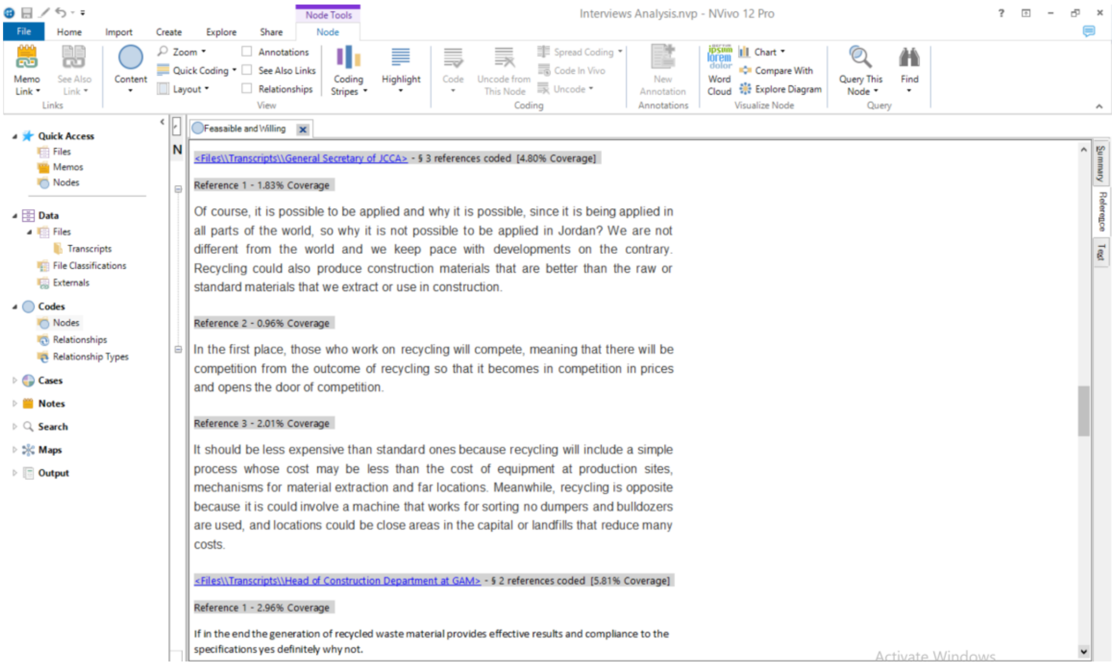


Figure 10-143: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

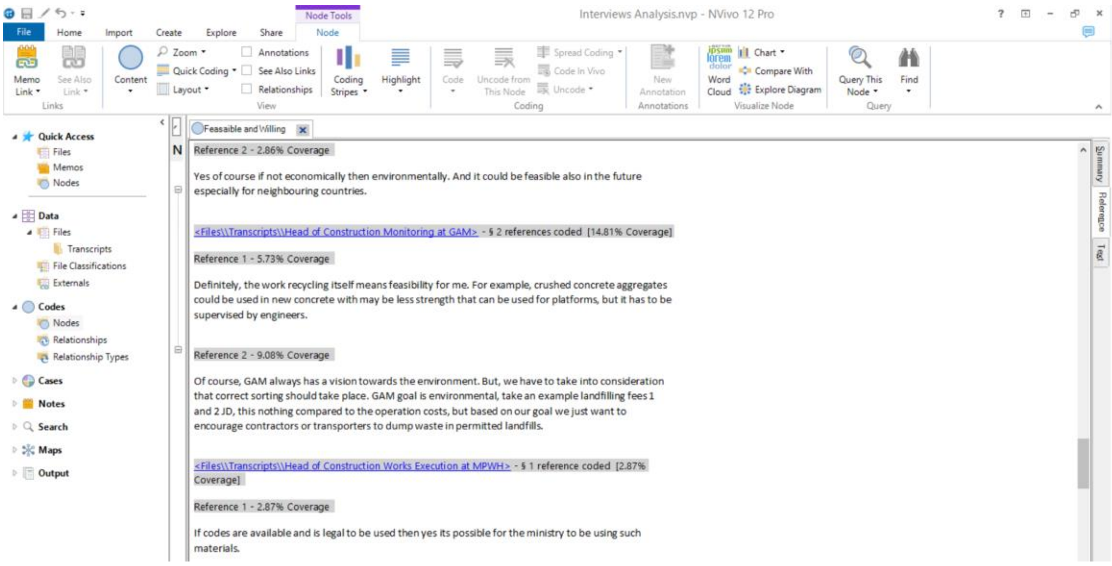


Figure 10-144: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

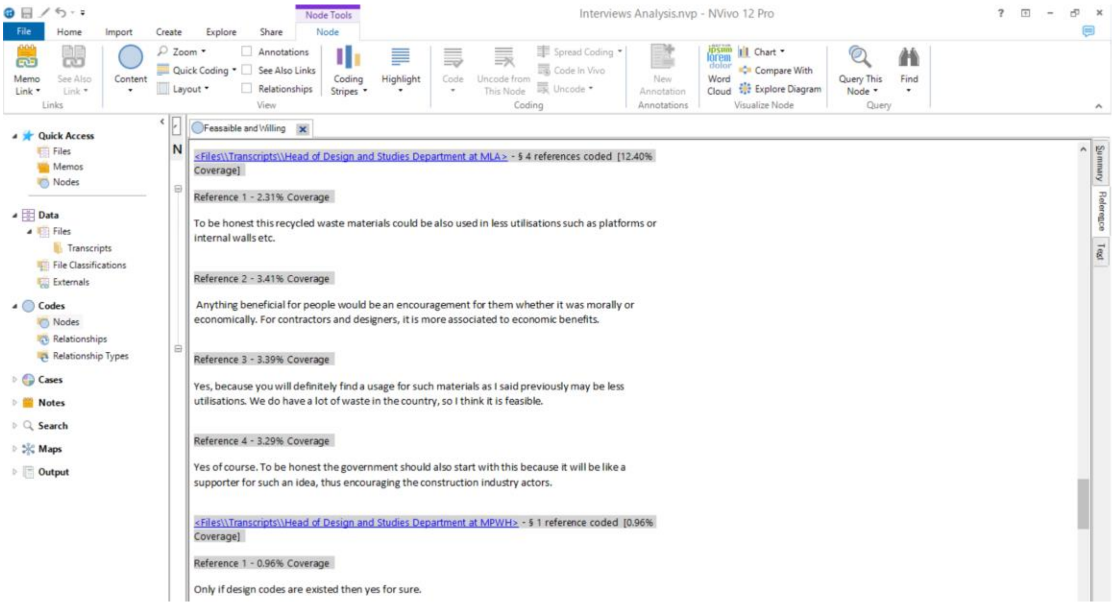


Figure 10-145: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

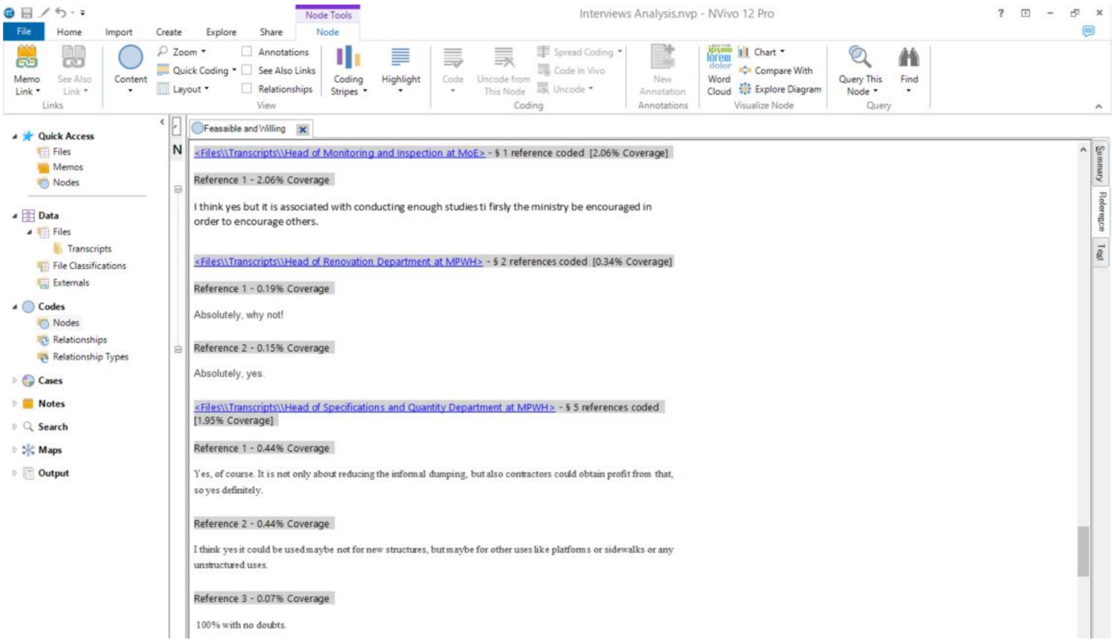


Figure 10-146: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

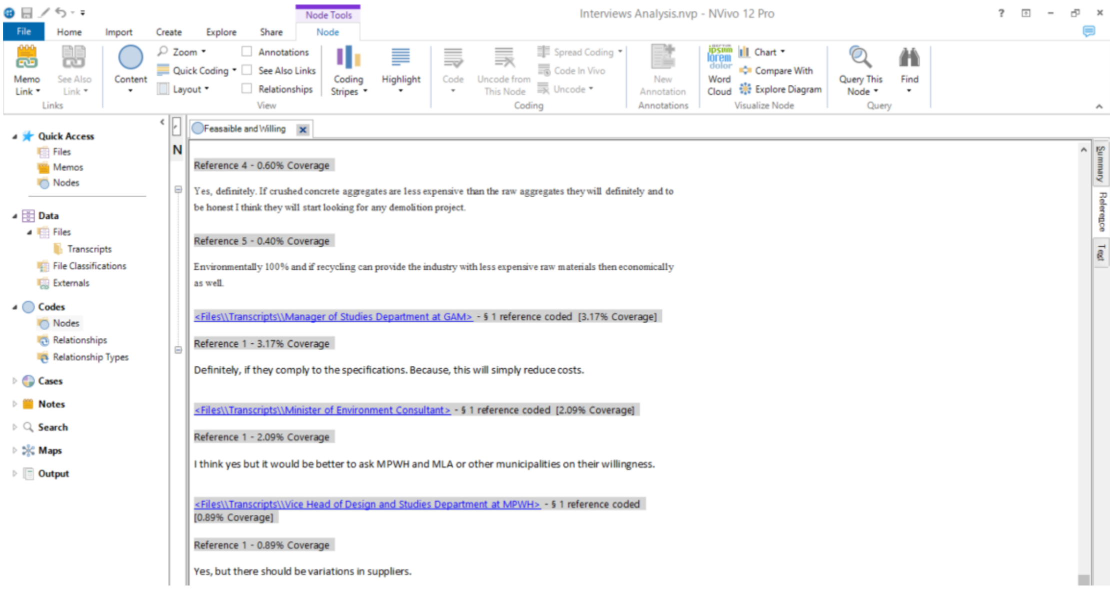


Figure 10-147: Actors Responses on the Feasibility and Willingness Section NVIVO Screen

10.1.6.4.3.3 Unfeasibility and unwillingness

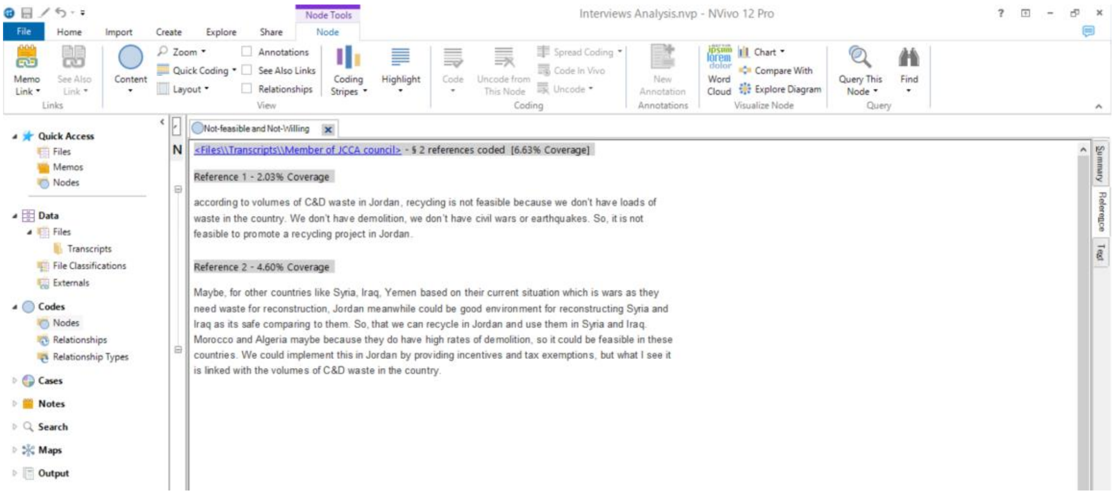


Figure 10-148: Actors Responses on the Unfeasibility and Unwillingness Section NVIVO Screen

10.1.6.4.3.4 Approaches to reduce the informal dumping of C&D waste

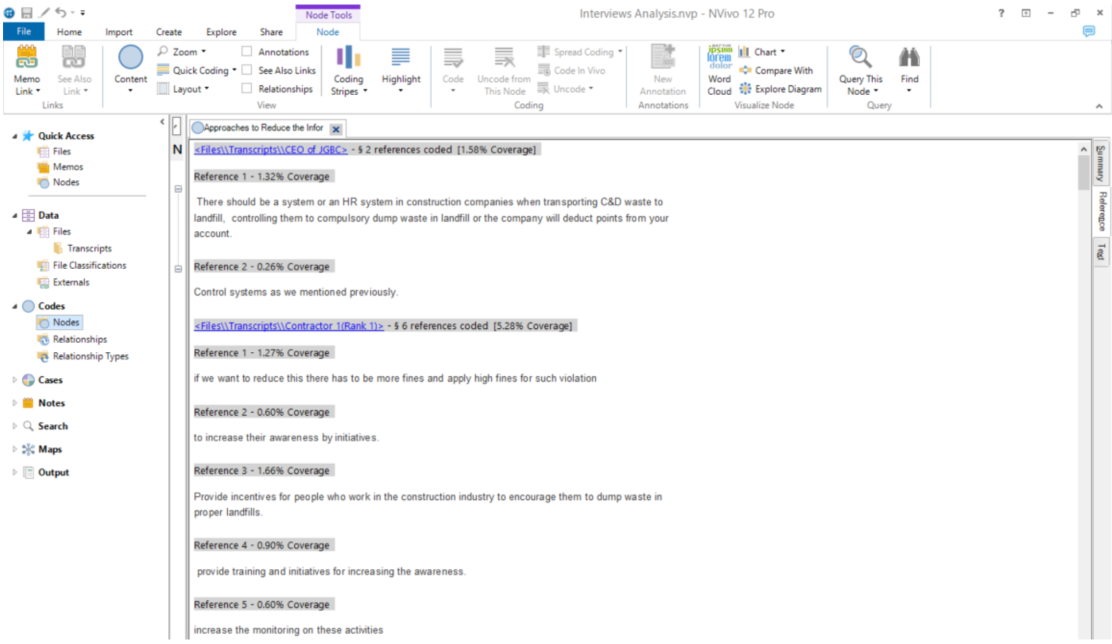


Figure 10-149: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

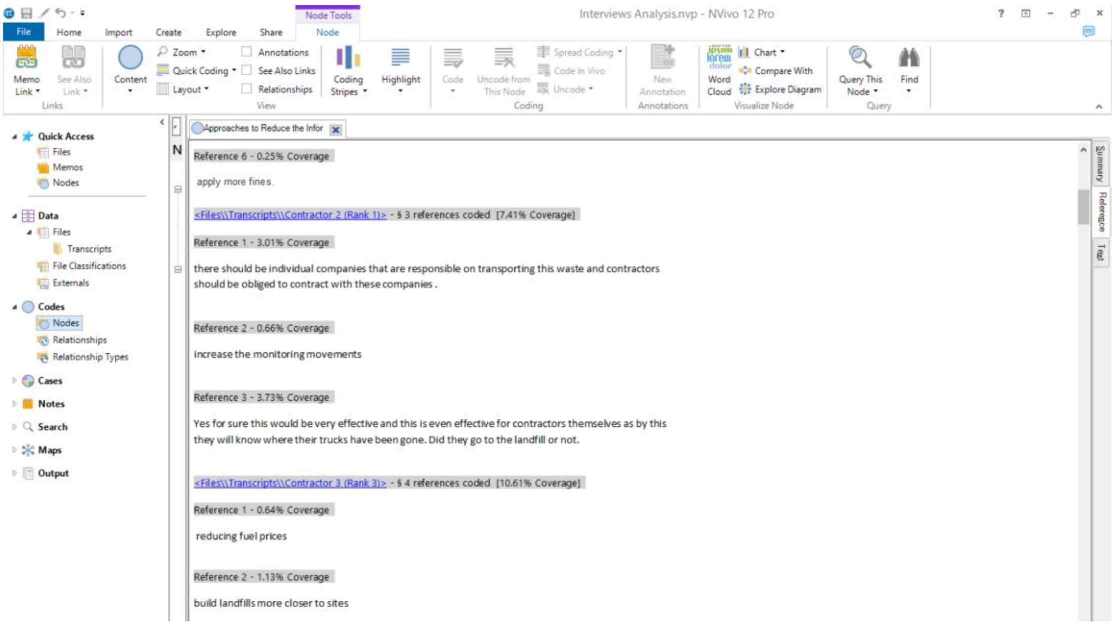


Figure 10-150: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

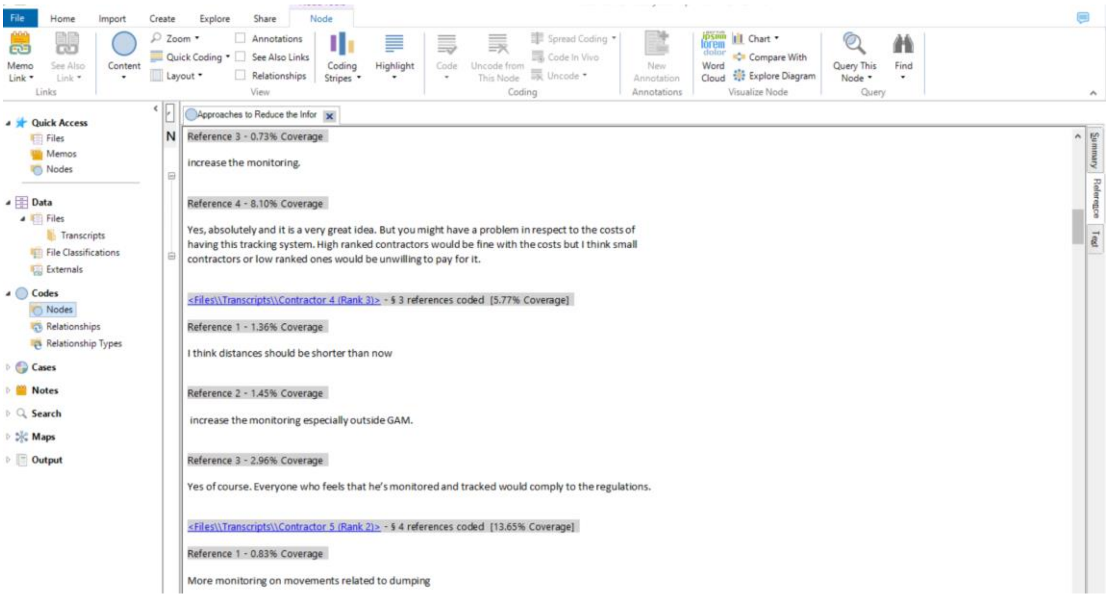


Figure 10-151: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

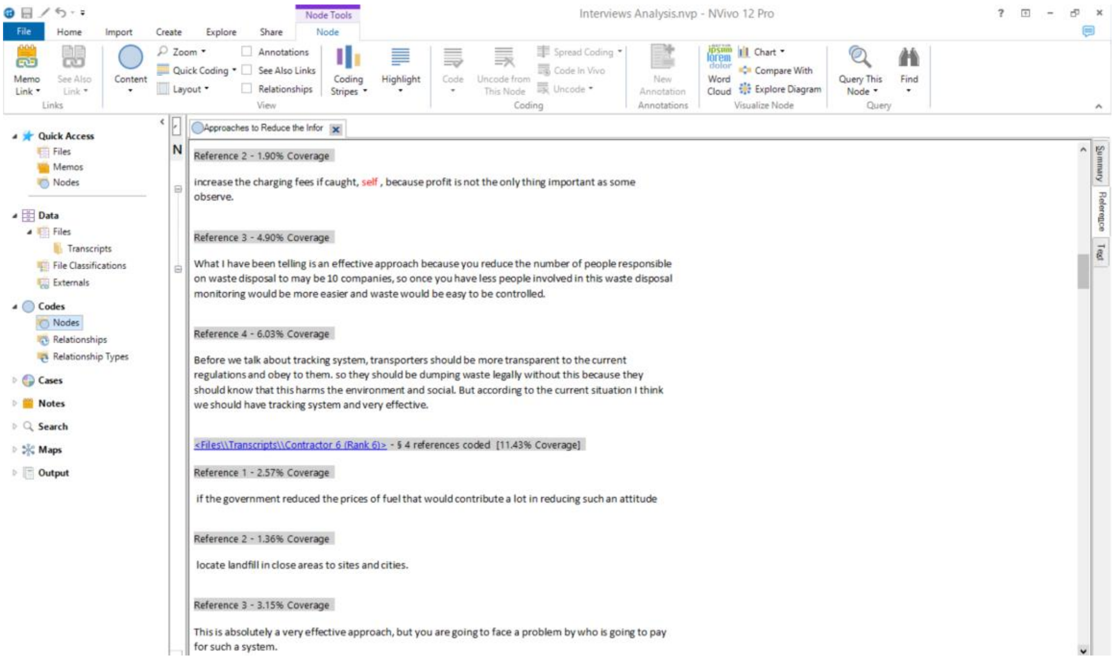


Figure 10-152: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

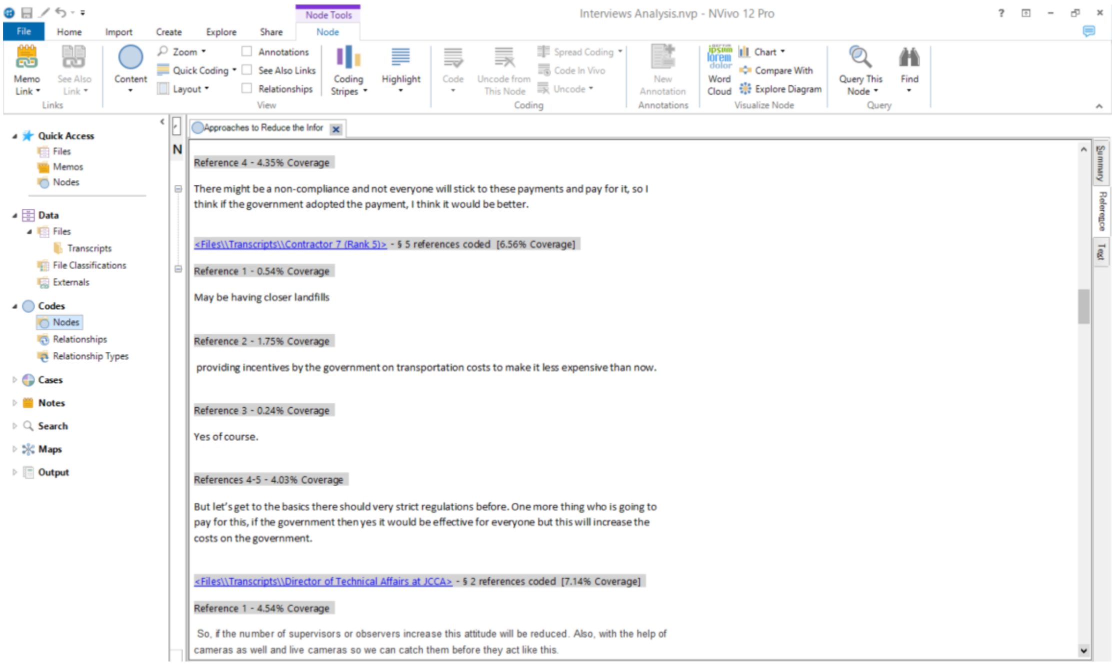


Figure 10-153: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

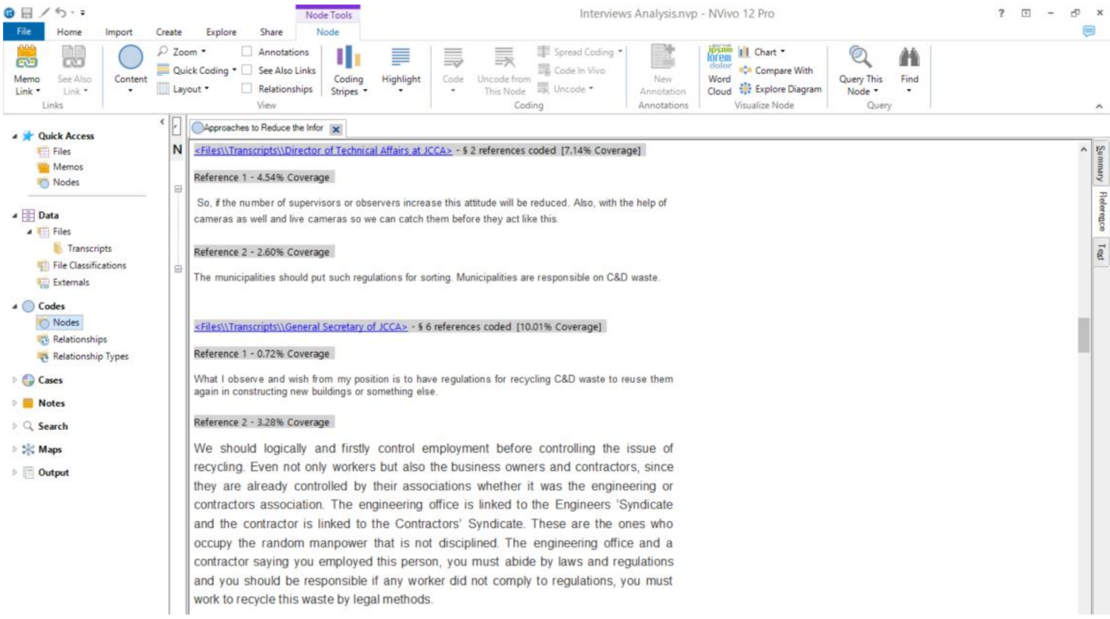


Figure 10-154: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

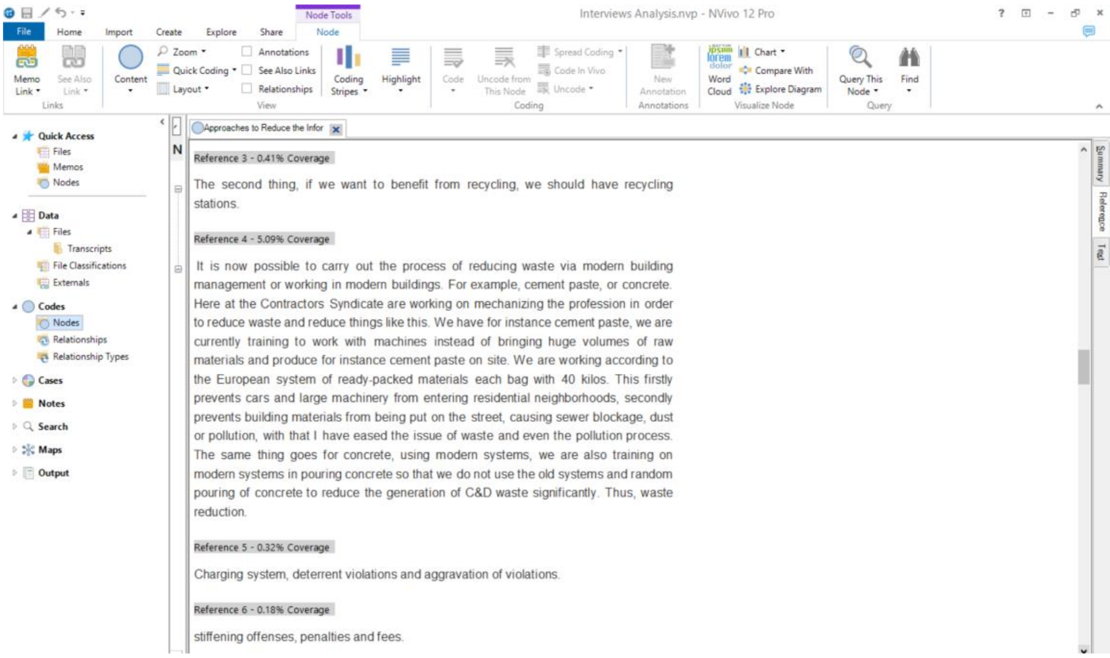


Figure 10-155: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

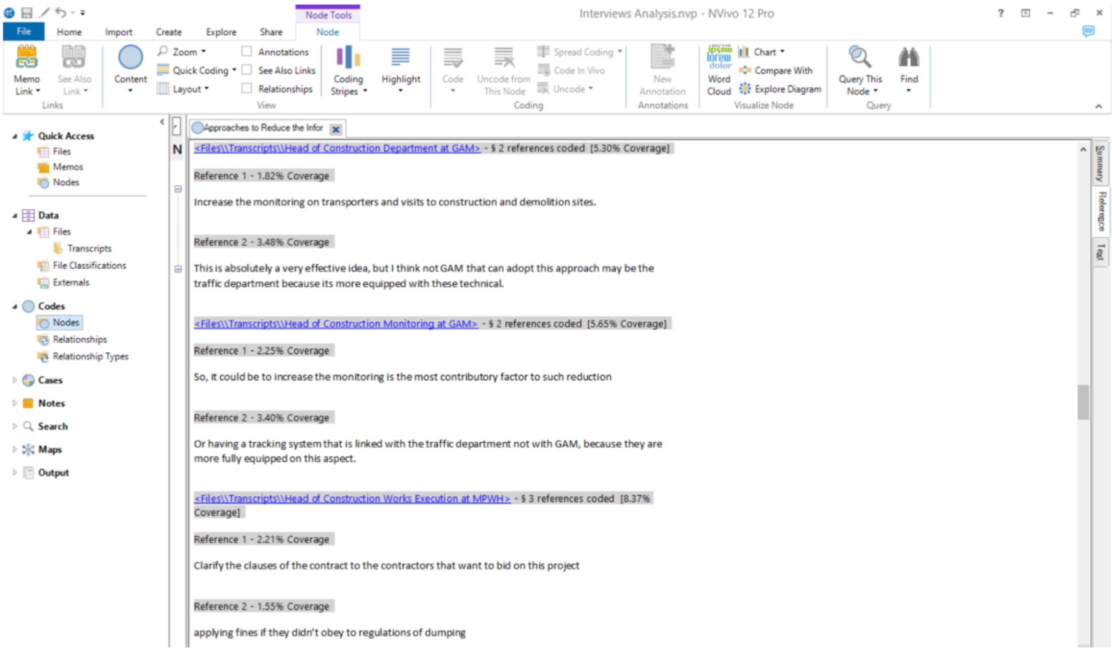


Figure 10-156: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

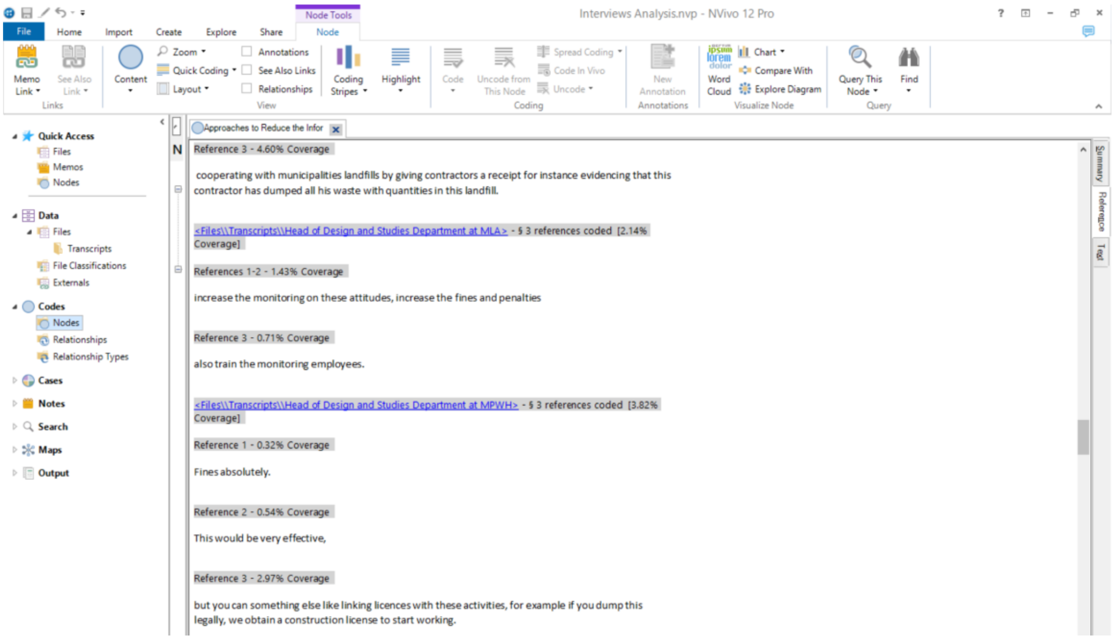


Figure 10-157: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

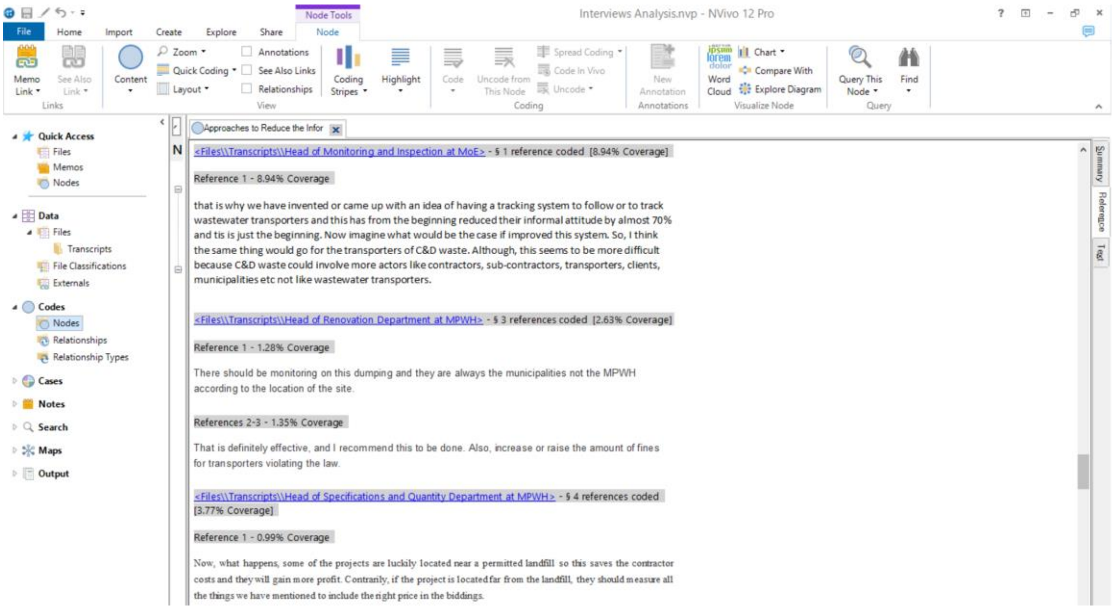


Figure 10-158: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

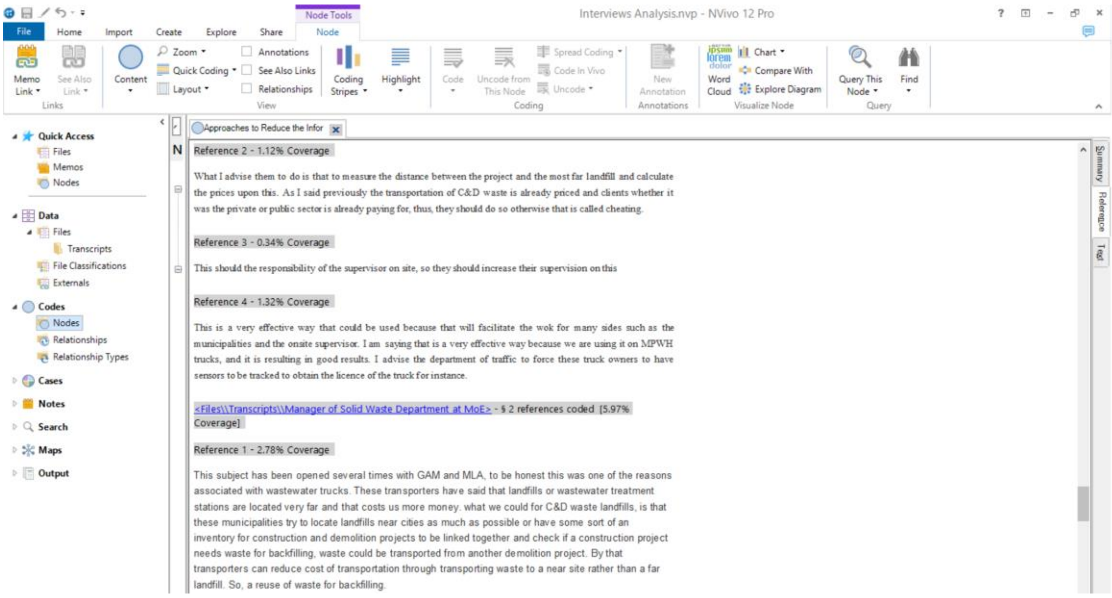


Figure 10-159: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

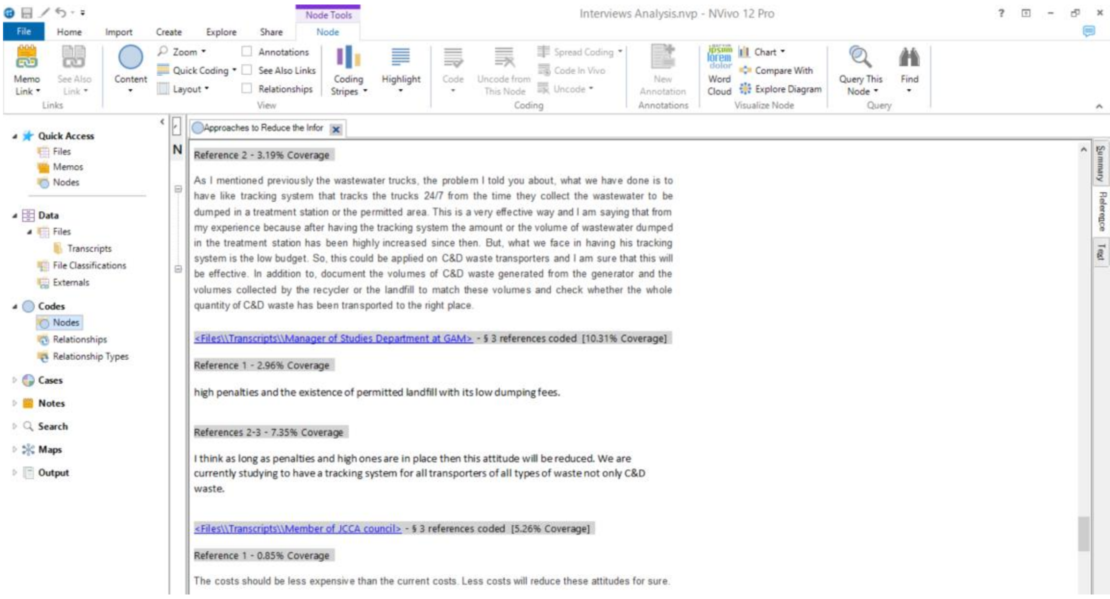


Figure 10-160: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

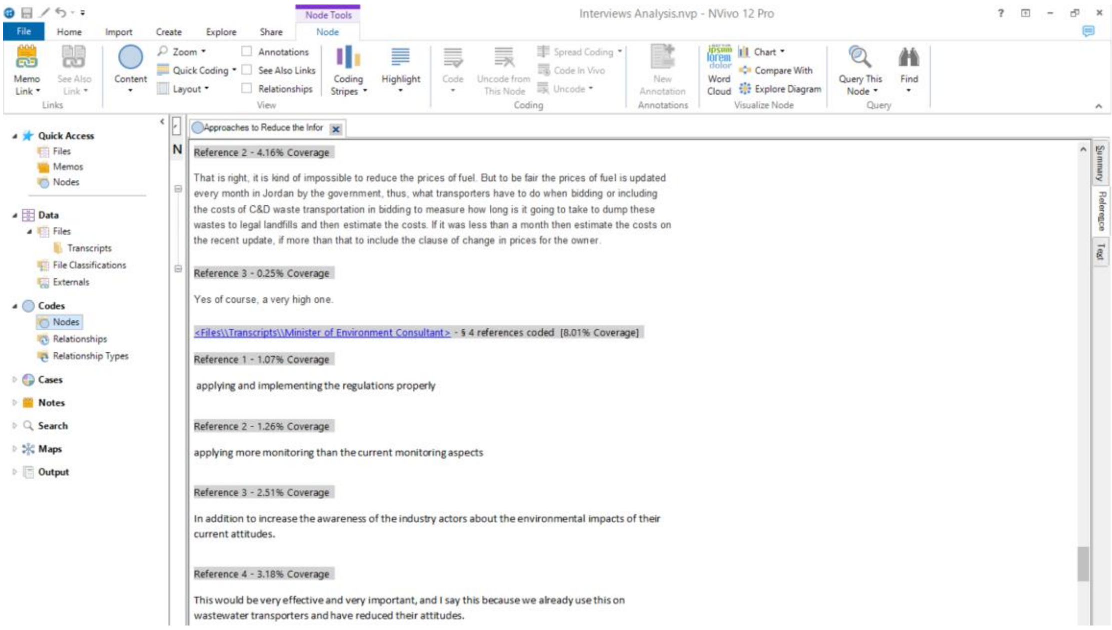


Figure 10-161: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

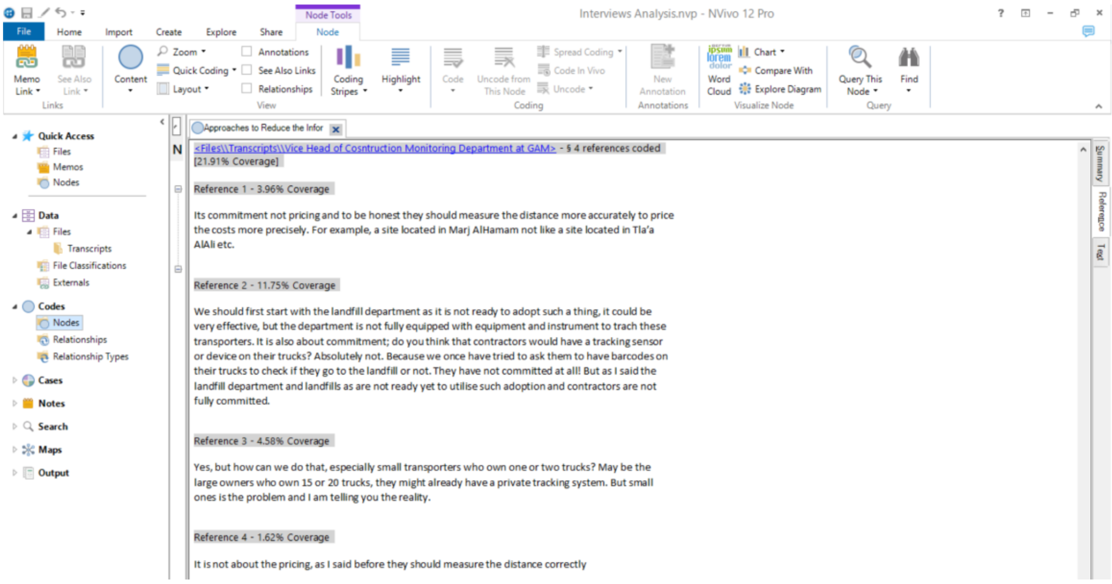


Figure 10-162: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

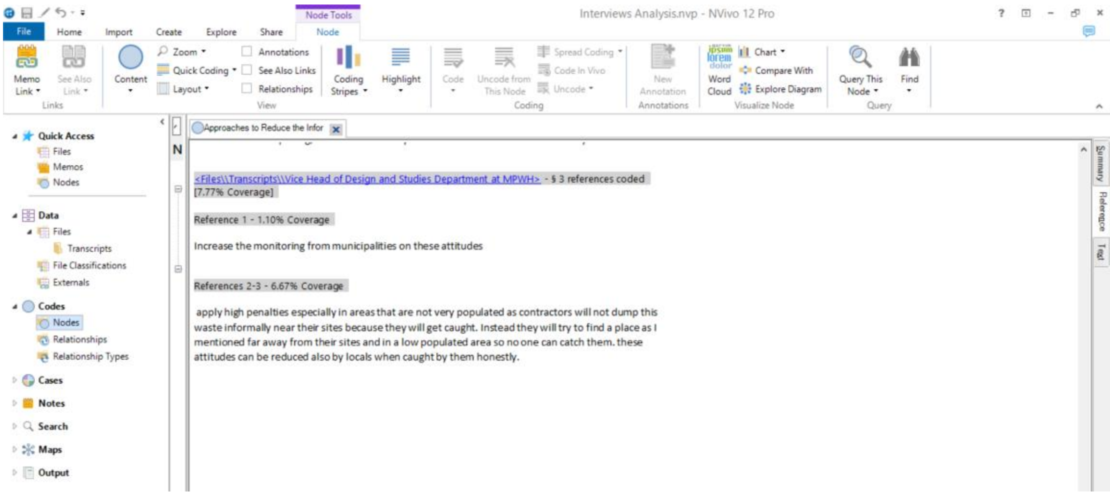


Figure 10-163: Actors Responses on Reduction Approaches of Informal Dumping Section NVIVO Screen

10.1.6.4.4 Interviews of Proposals Recognition

As described before in **section 3.5.6** of the main body, the proposals for C&D waste management were established. The study advocated doing several interviews with the same participants who had already been interviewed, as shown in **table 10-12**. Aiming to get acceptance for such proposals from people with extensive knowledge and expertise in the Jordanian construction sector. To confirm the reliability of these proposals for improving Jordan's present national C&D waste management.

Similar to prior interviews, these interviews have been analysed using NVIVO software. These interviews lasted roughly two hours and were done in Arabic. They were recorded using a voice recorder application. They were then loaded and transcribed in Arabic on the researcher's laptop using Microsoft Word; and last, translated into English by the researcher and an online independent translator.

Although only 9 of the 25 interviewees participated in the interviews because to the Covid-19 epidemic's restriction of access to departments and institutions. The following tables outline the professions represented during the assessment interviews.

No. of interview participants	Sampling Selection	Targeted Professional Positions
< 25	Preference towards actors from high ranked positions to be chosen following review of interviewees responses.	Stakeholders Owners CEO's Managers Head of Engineering Departments Academics

Table 10-15: Sampling Method of Proposals Evaluation Participants

No.	Department/Profession	Organisation
1	Construction Monitoring Department	GAM
2	Owner of Contracting Company (rank 1)	Contractors Syndicate
3	Professor	Amman Ahlia University
4	Professor	AlBalqa Applied University
5	Construction Works Execution	MPWH
6	Specifications and Quantities – Department of Construction	MPWH
7	Solid Waste Department	MoE
8	Monitoring and Inspection Department	MoE
9	Studies and Design	MLA
Percentage of Participants from the total number of interviewees		**36%**

Table 10-16: Profession's Details Participated in Evaluating the Proposals

As previously stated, the interviews questions were devised to elicit acceptance of the suggested proposals. Aimed to enhance Jordan's present national strategy for managing C&D waste.

Prior to the completion of the interviews, these proposals were supported with fishbone diagrams to help participants visualize the issues associated with C&D waste management in Jordan. To validate their usefulness in producing accurate and reliable results. Consequently, proposals judged superfluous or inefficient were omitted, while others of comparable importance were included.

The figures below illustrate the entirety of NVIVO's screen display of recognition of proposals.

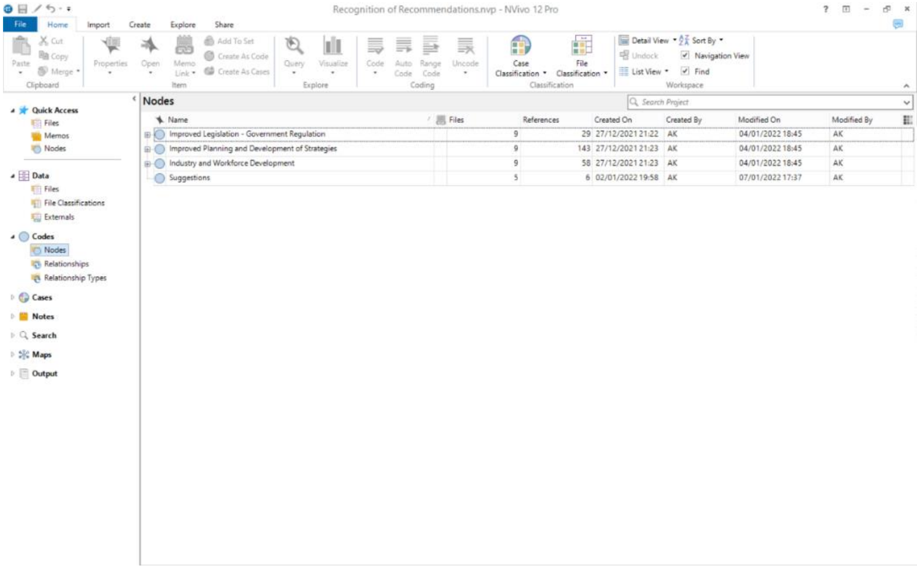


Figure 10-164: Taxonomies of Proposals

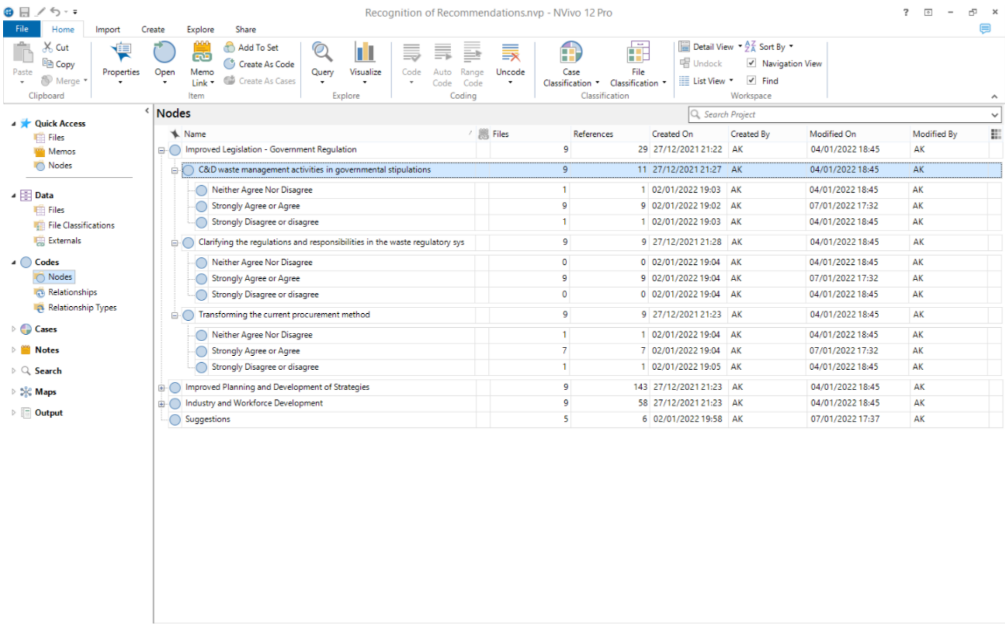


Figure 10-165: Sub-Categories of Proposals Taxonomies

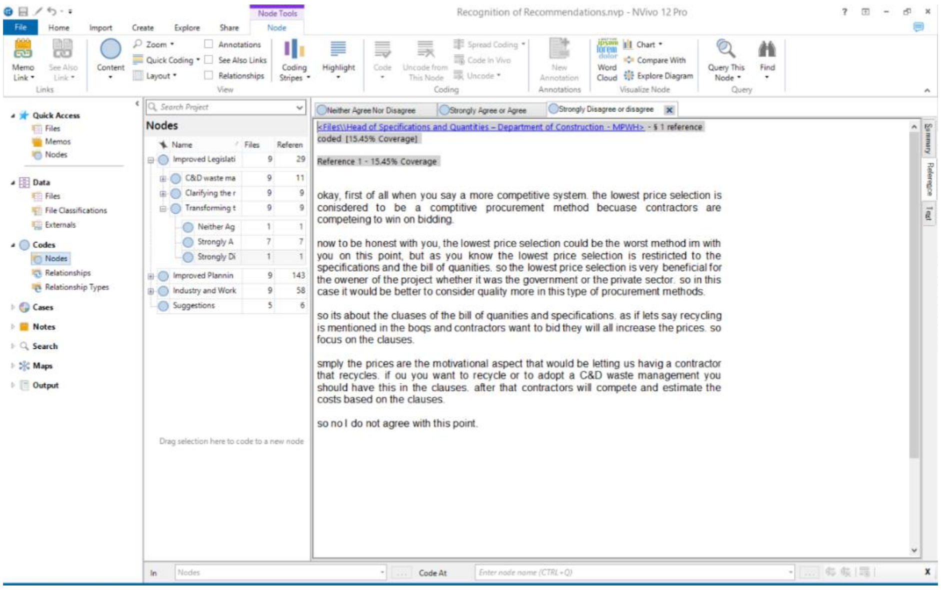


Figure 10-166: Responses of Participants

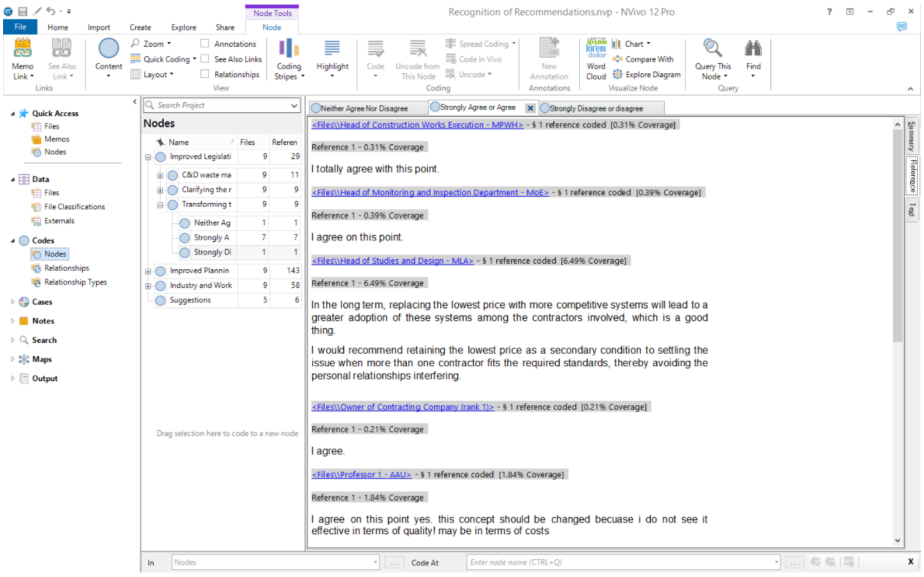


Figure 10-167: Responses of Participants

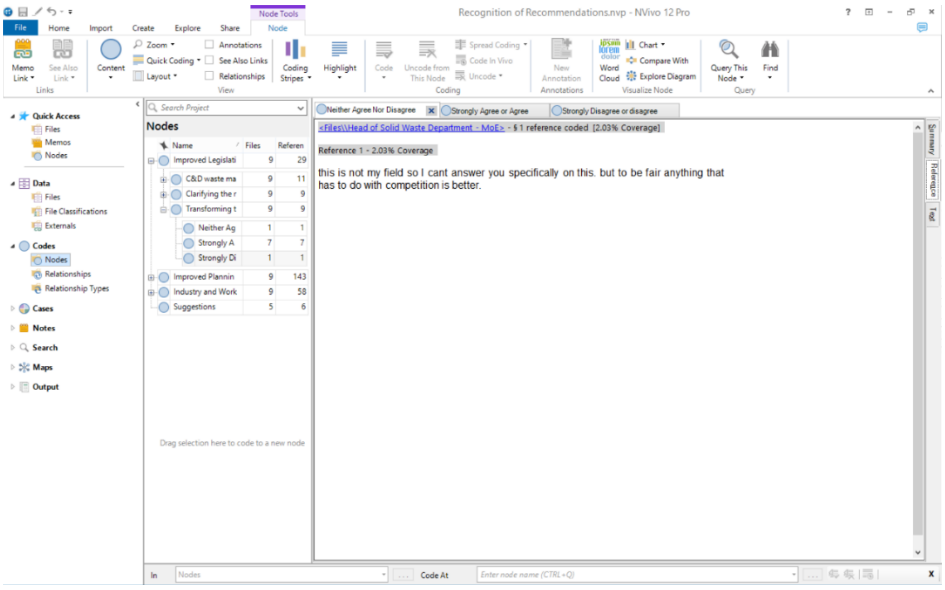


Figure 10-168: Responses of Participants

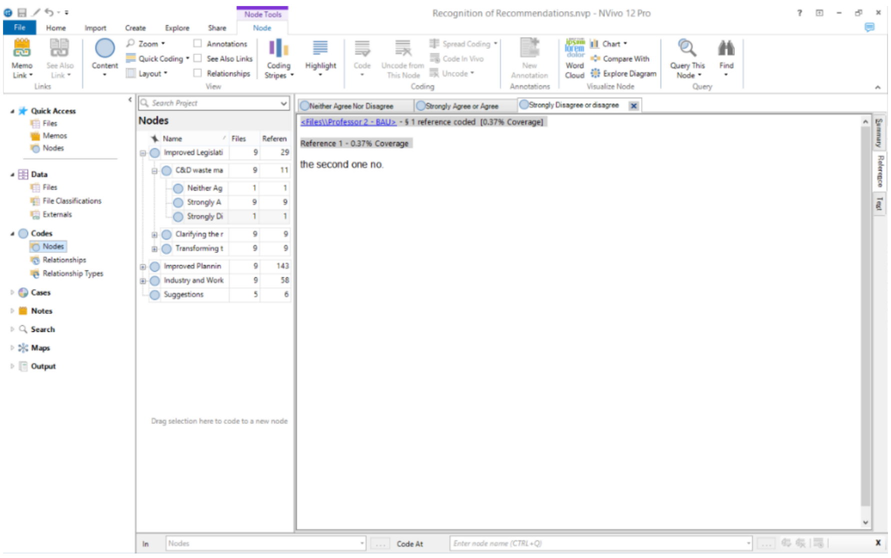


Figure 10-169: Responses of Participants

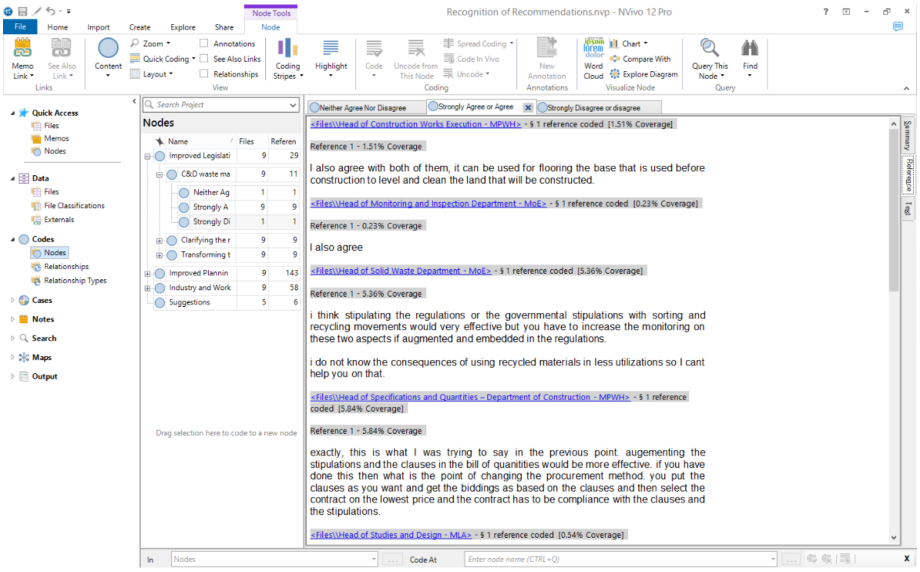


Figure 10-170: Responses of Participants

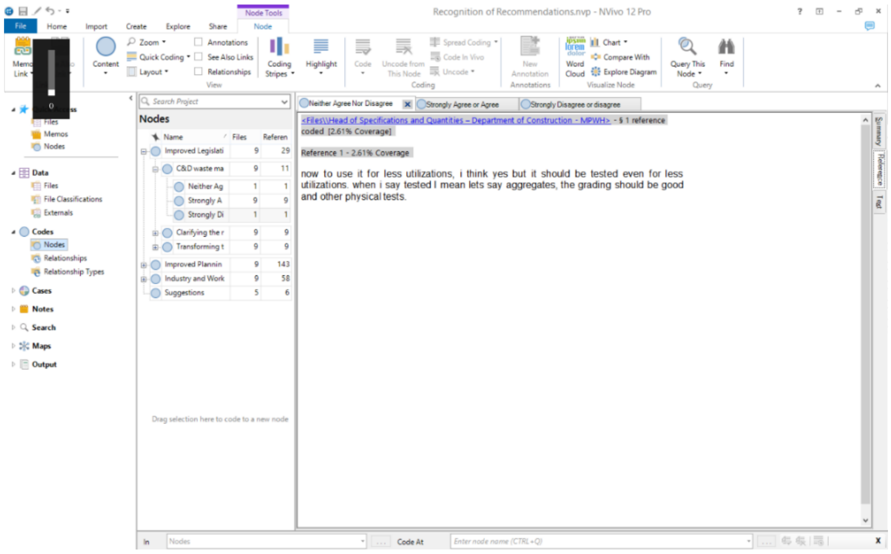


Figure 10-171: Responses of Participants

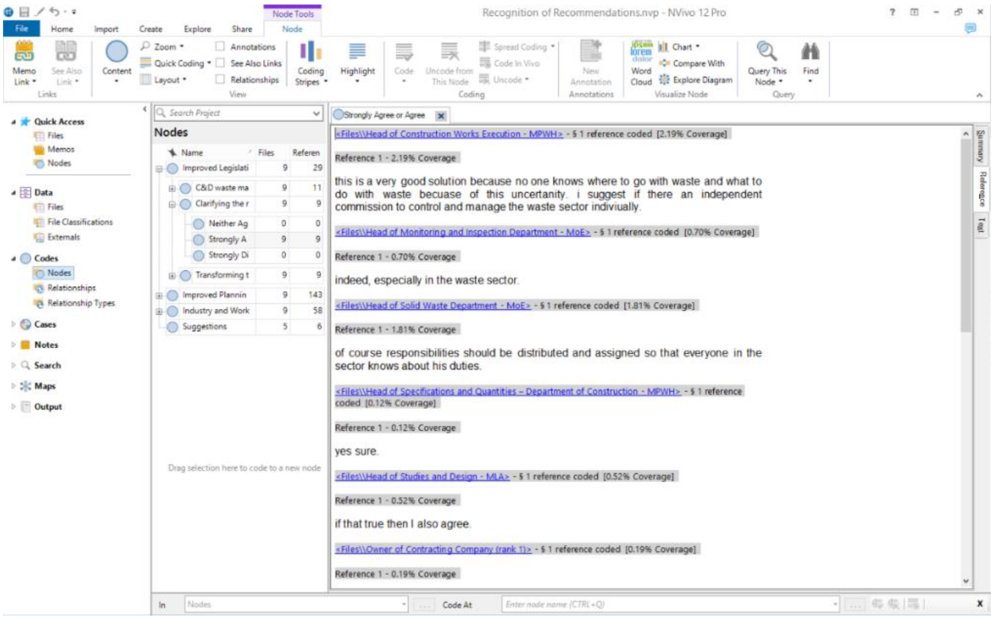


Figure 10-172: Responses of Participants

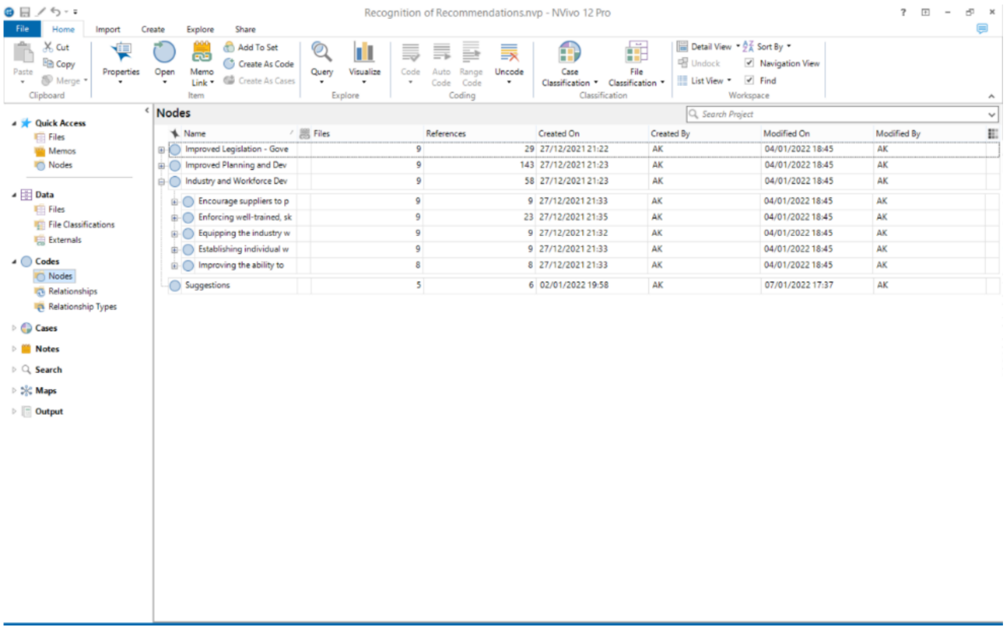


Figure 10-173: Responses of Participants

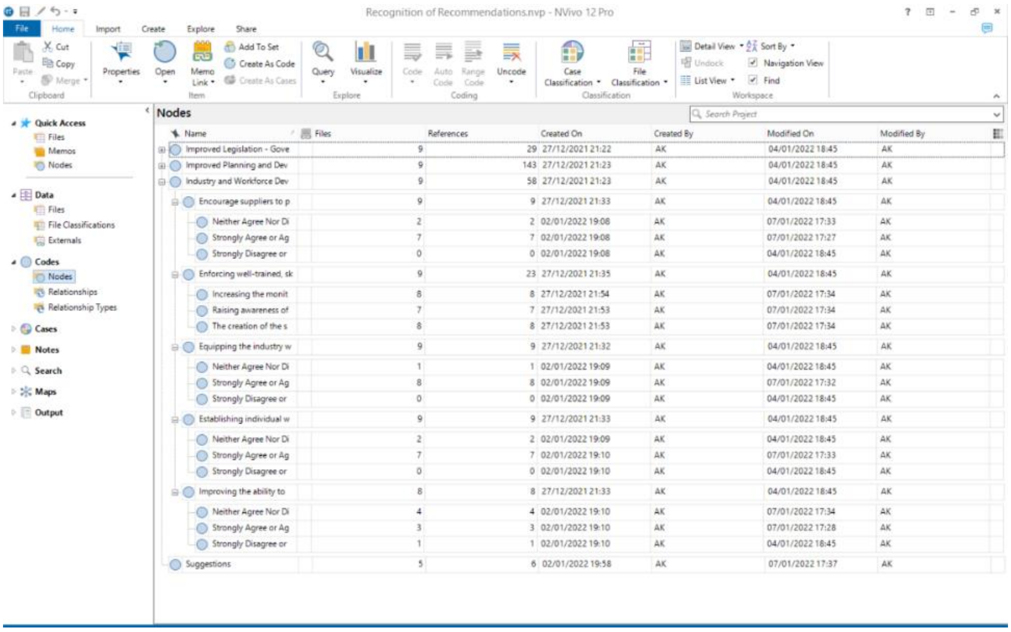


Figure 10-174: Responses of Participants

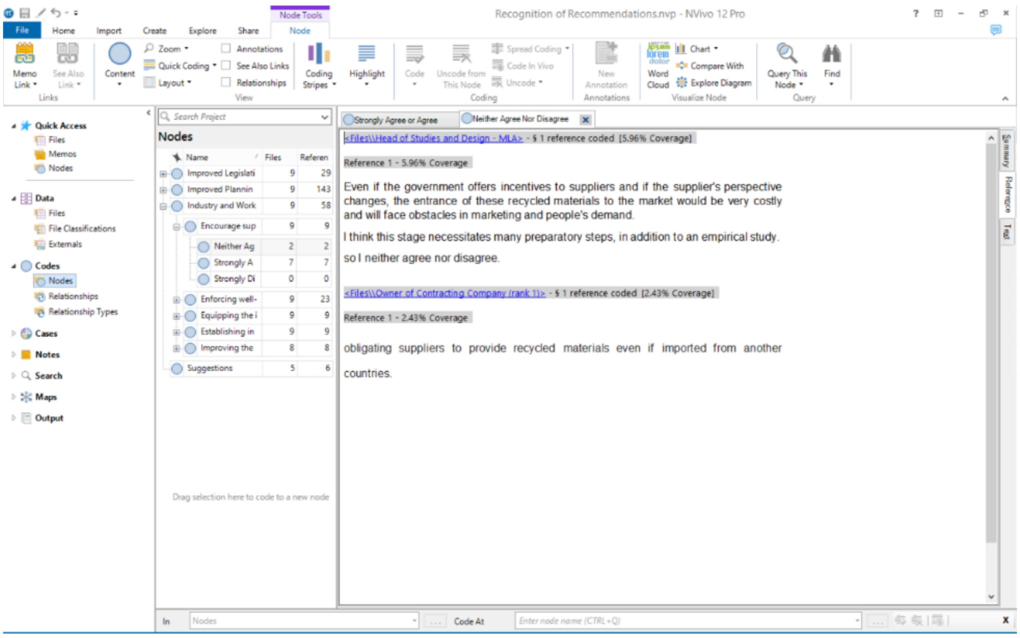


Figure 10-175: Responses of Participants

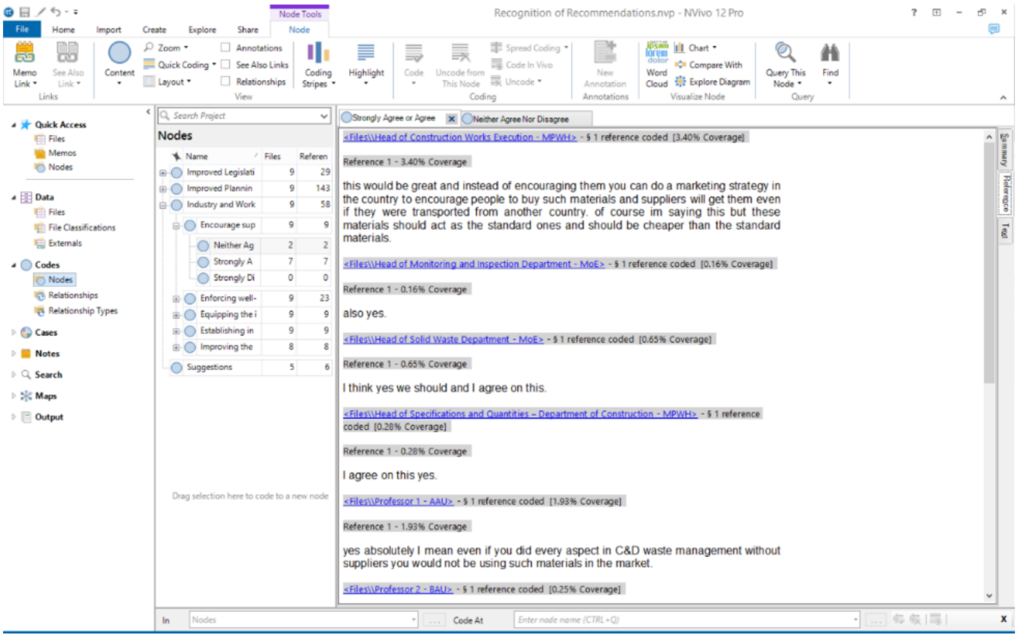


Figure 10-176: Responses of Participants

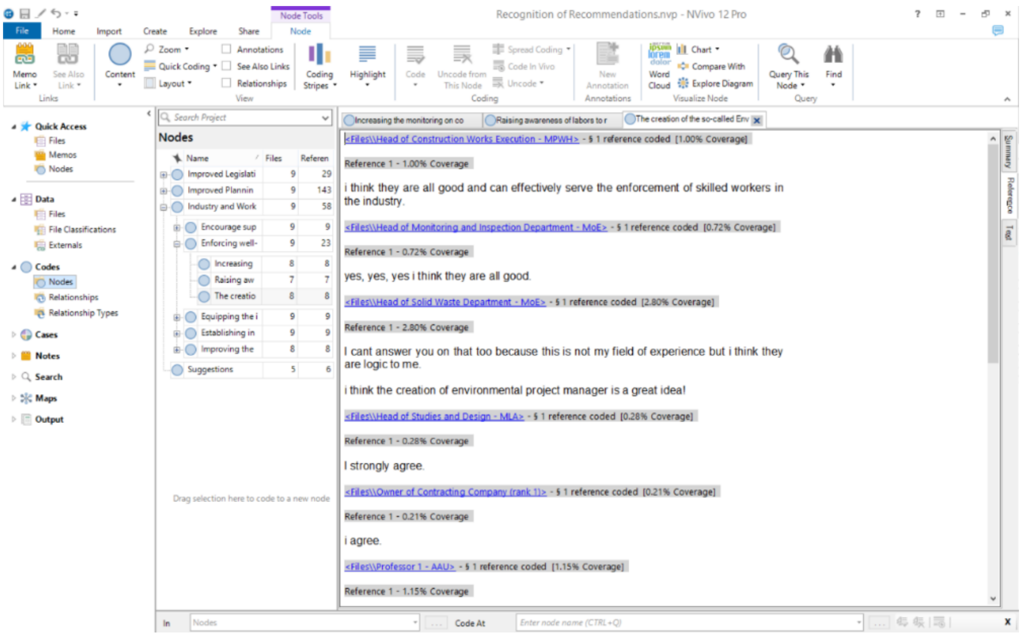


Figure 10-177: Responses of Participants

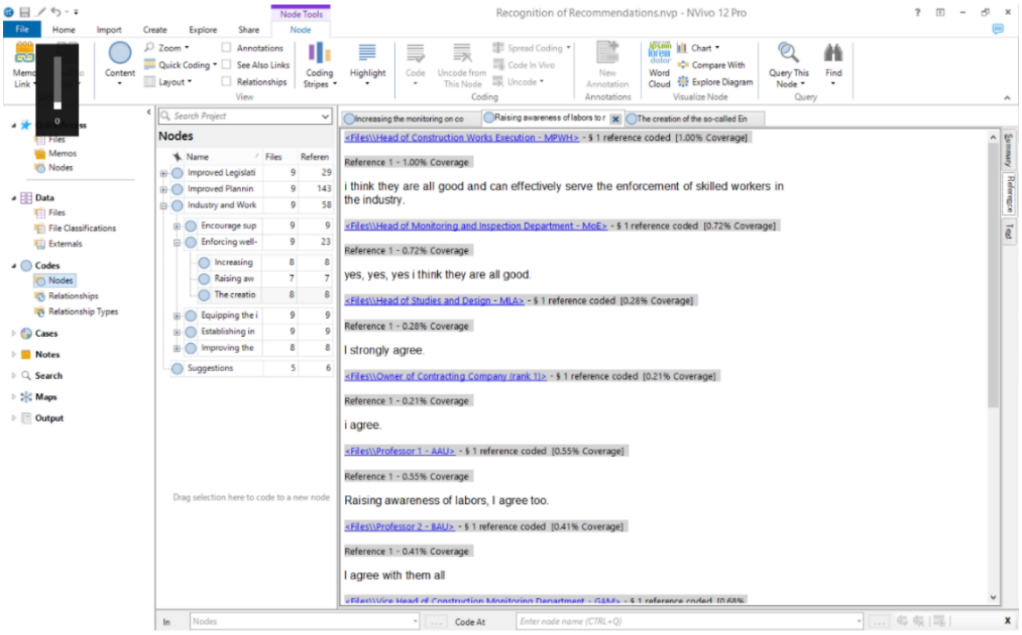


Figure 10-178: Responses of Participants

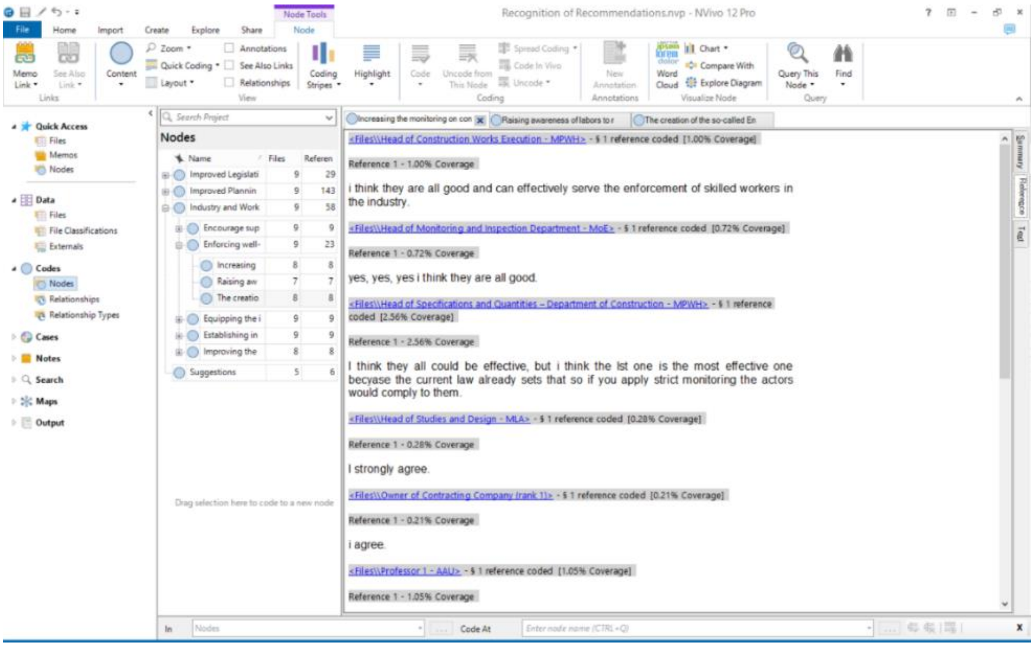


Figure 10-179: Responses of Participants

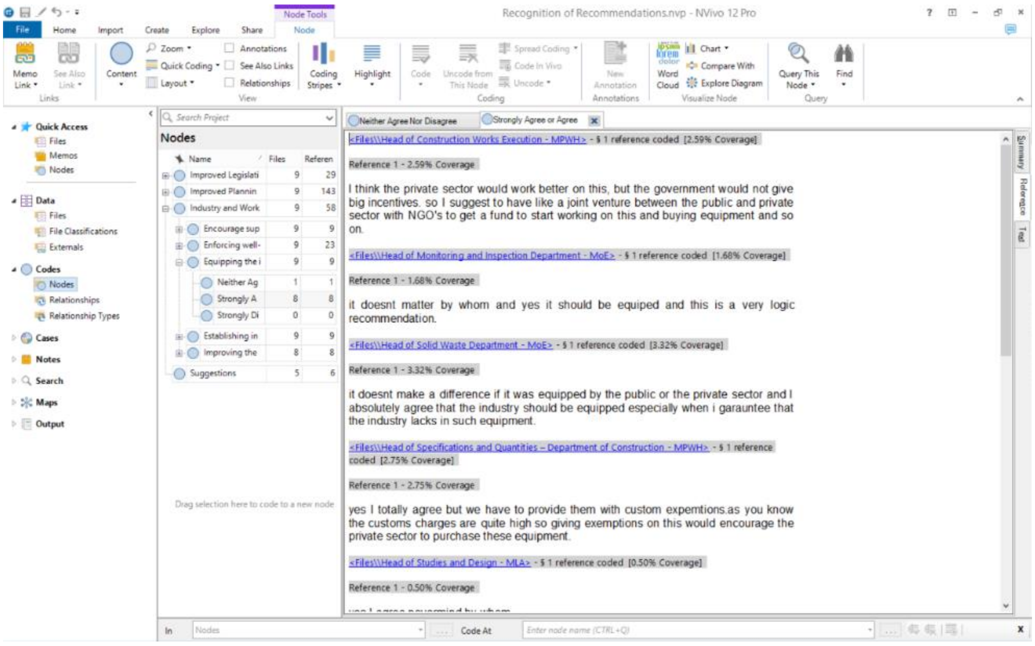


Figure 10-180: Responses of Participants

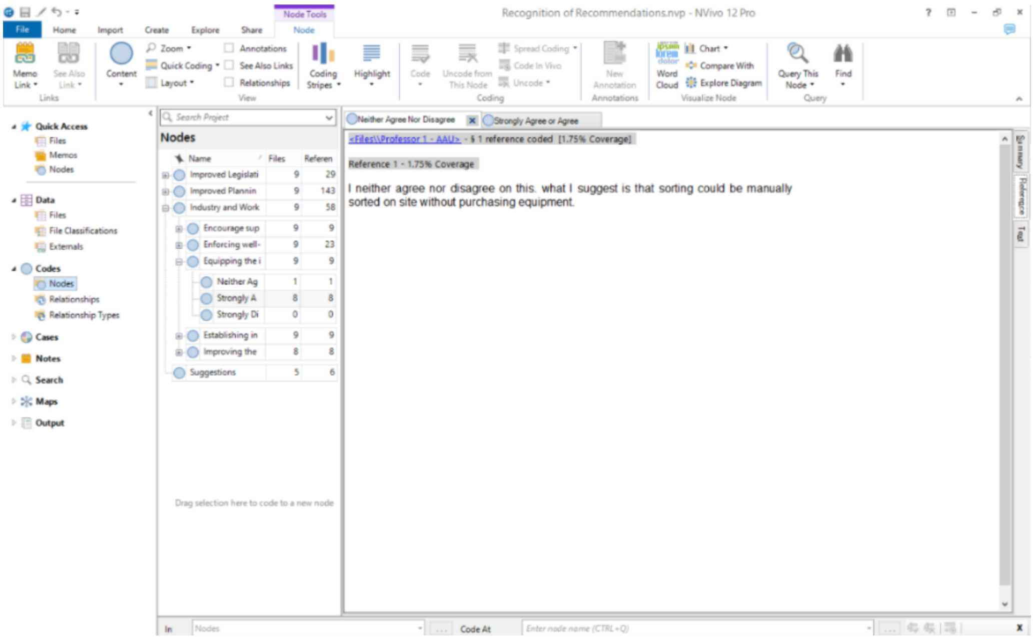


Figure 10-181: Responses of Participants

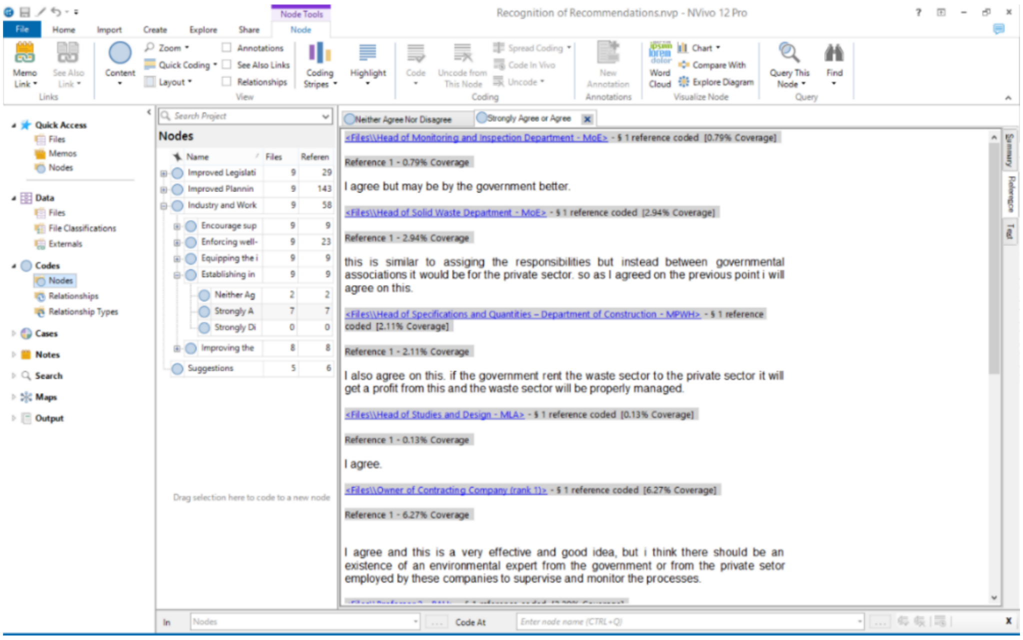


Figure 10-182: Responses of Participants

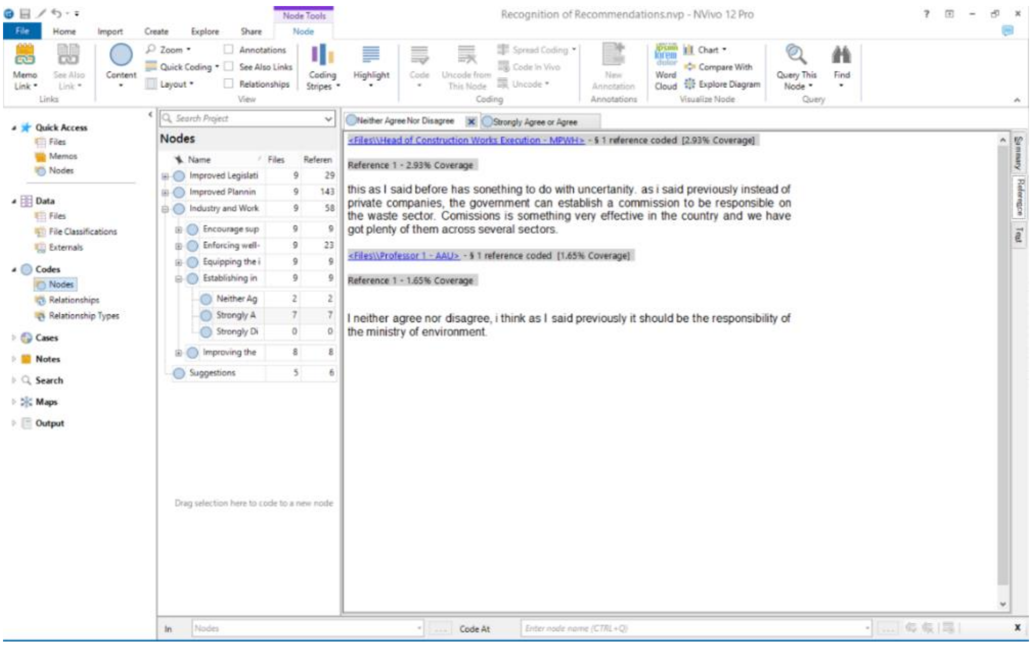


Figure 10-183: Responses of Participants

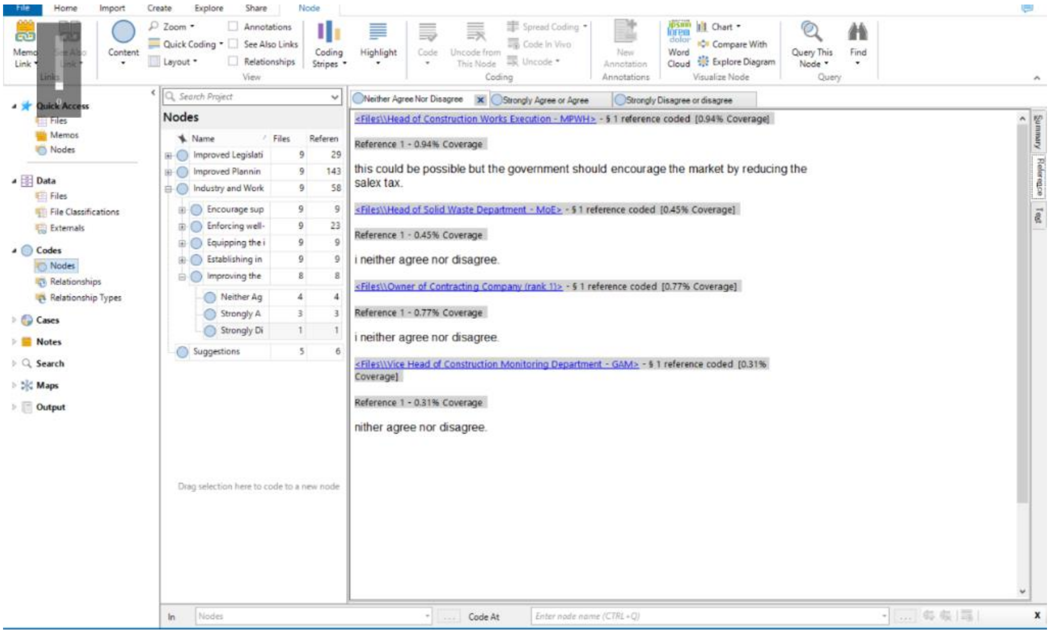


Figure 10-184: Responses of Participants

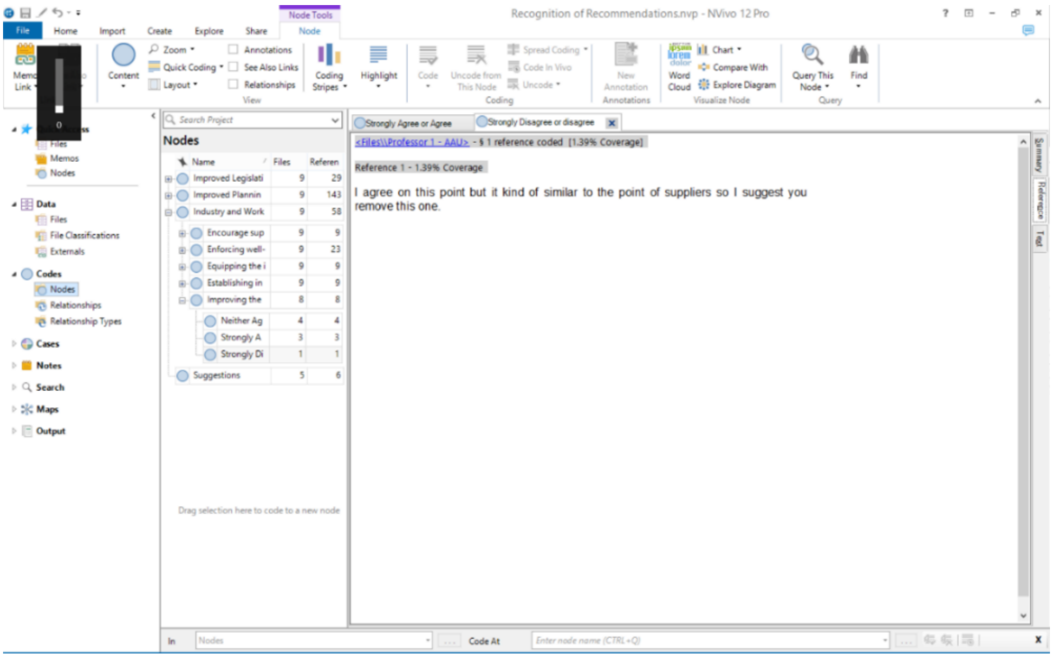


Figure 10-185: Responses of Participants

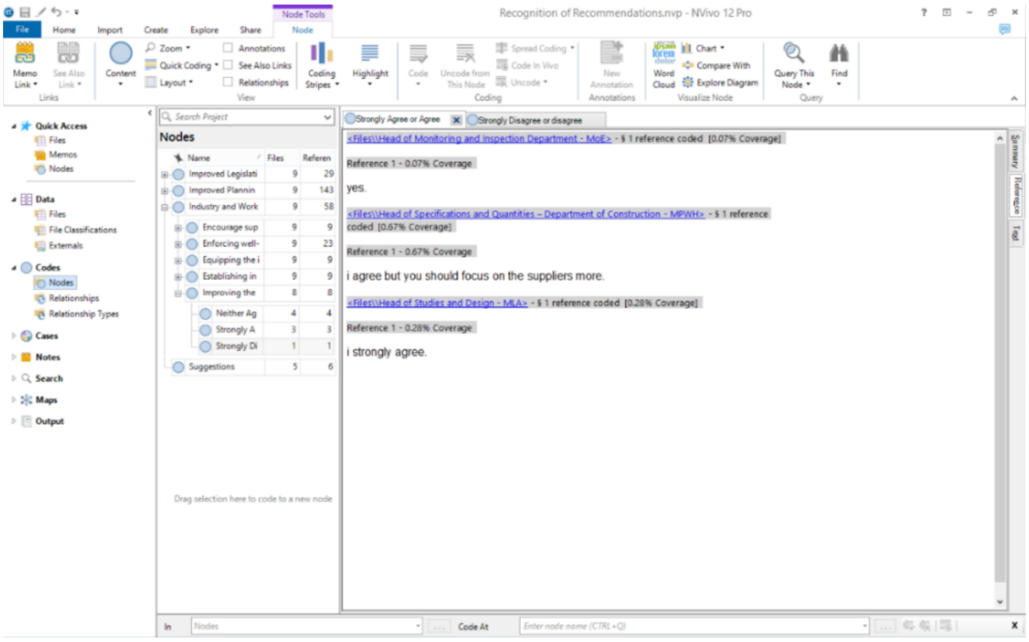


Figure 10-186: Responses of Participants

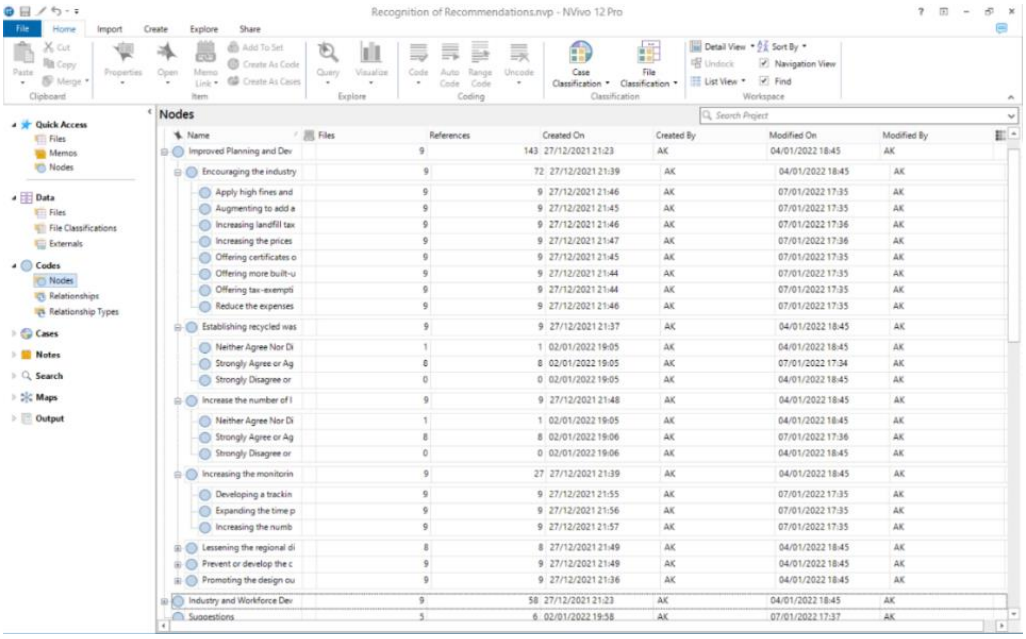
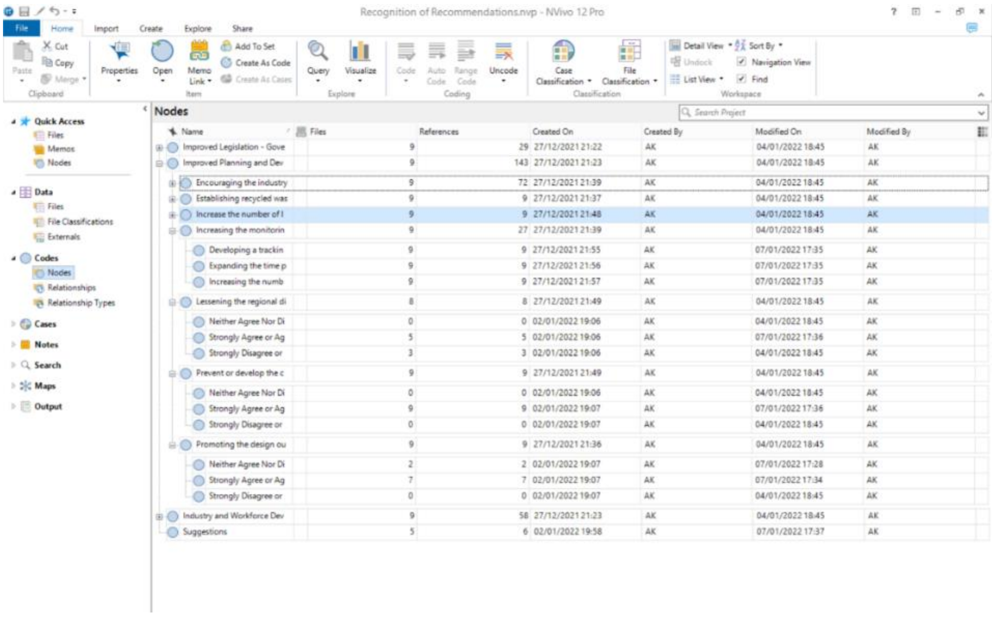


Figure 10-187: Responses of Participants



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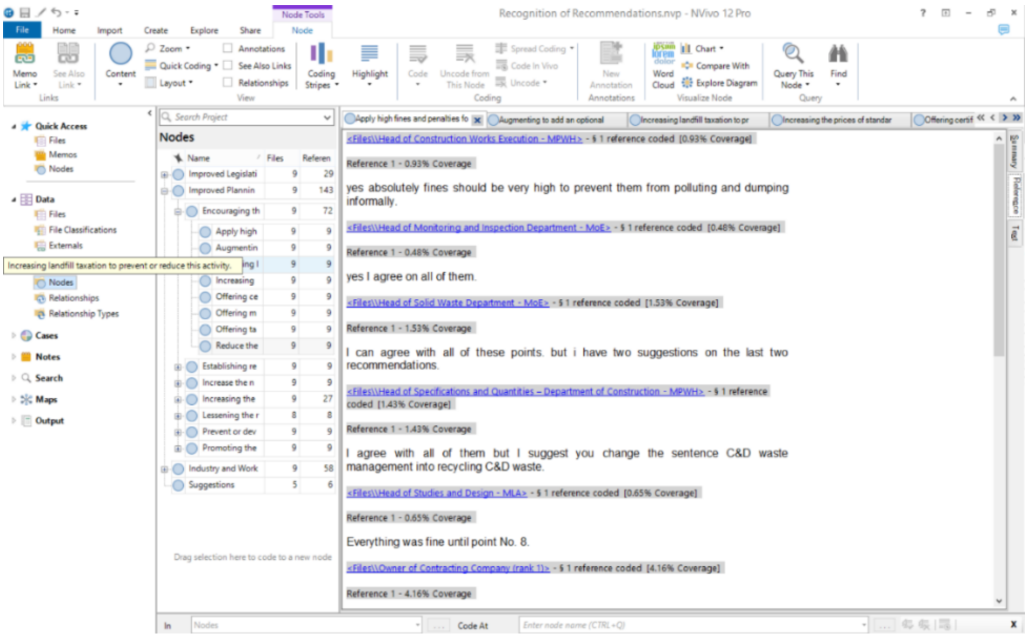


Figure 10-189: Responses of Participants

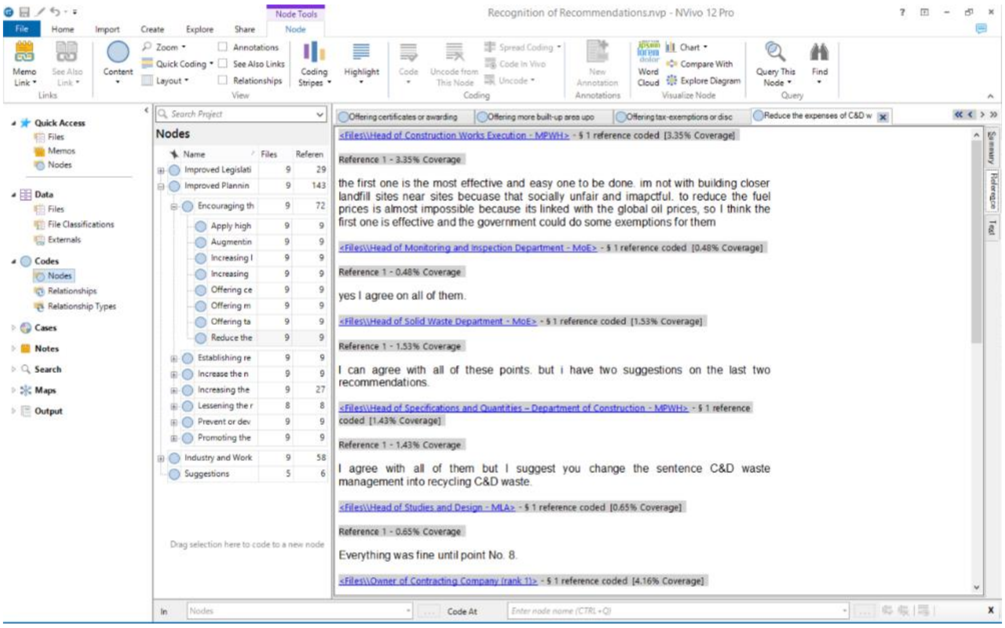


Figure 10-190: Responses of Participants

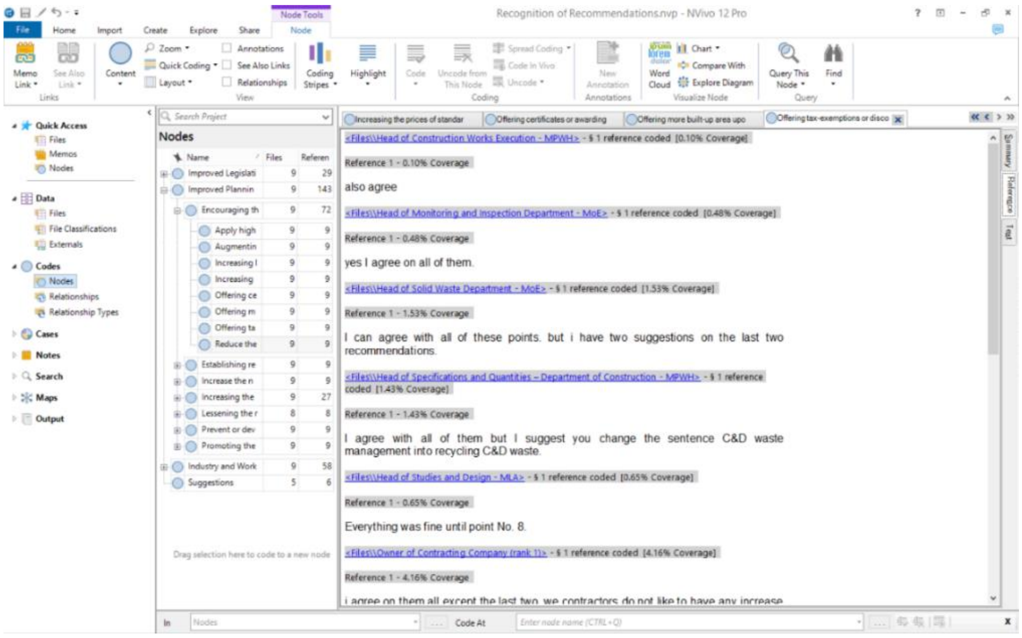


Figure 10-191: Responses of Participants

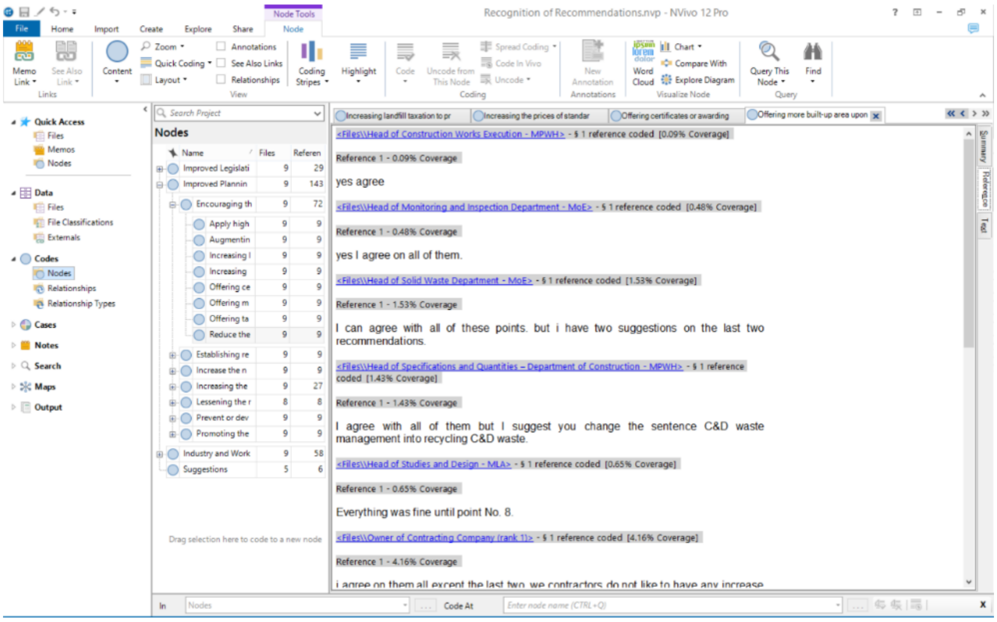


Figure 10-192: Responses of Participants

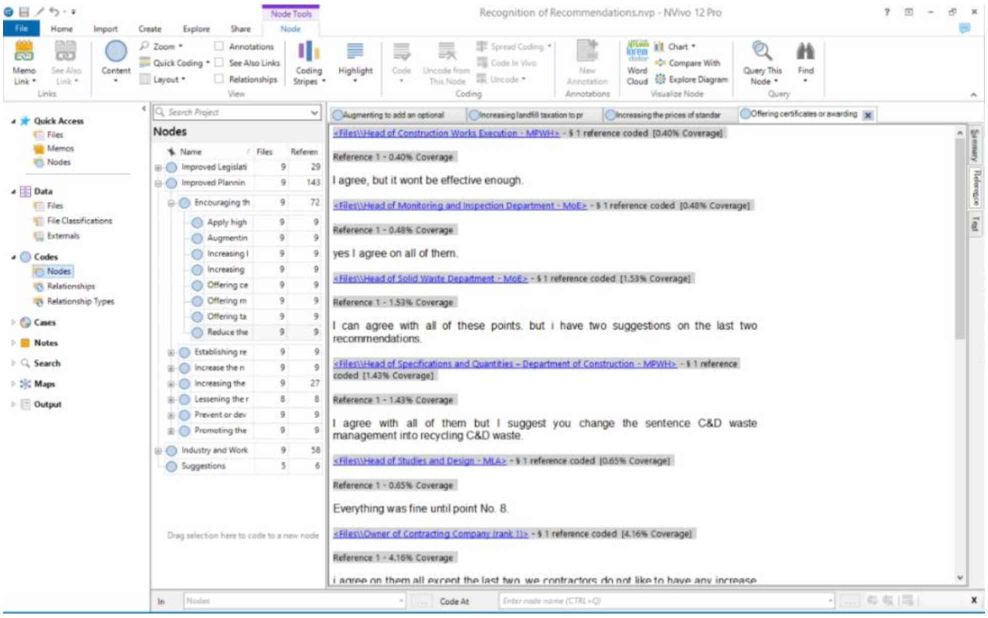


Figure 10-193: Responses of Participants

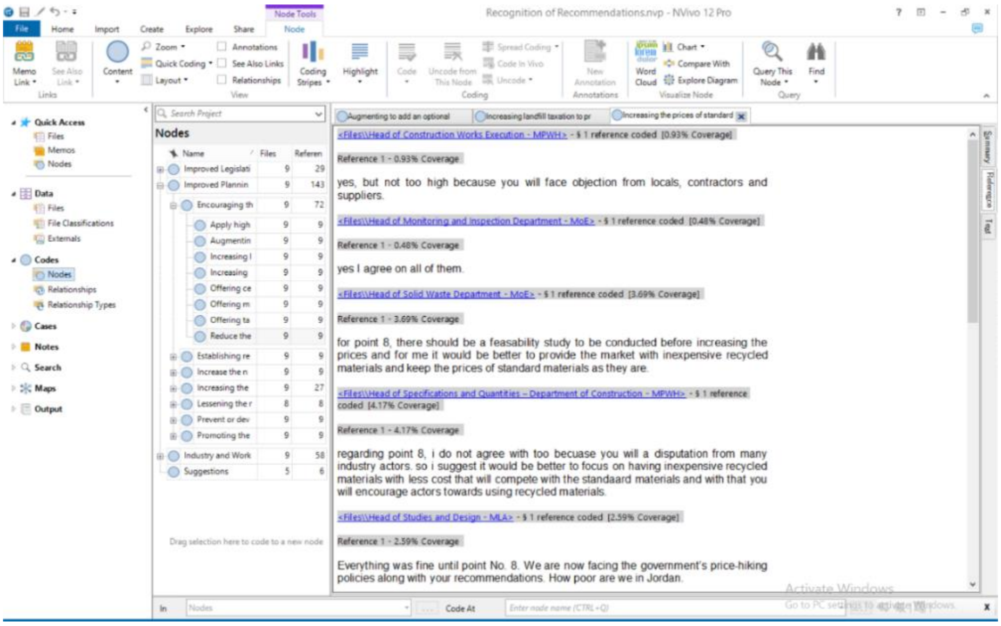
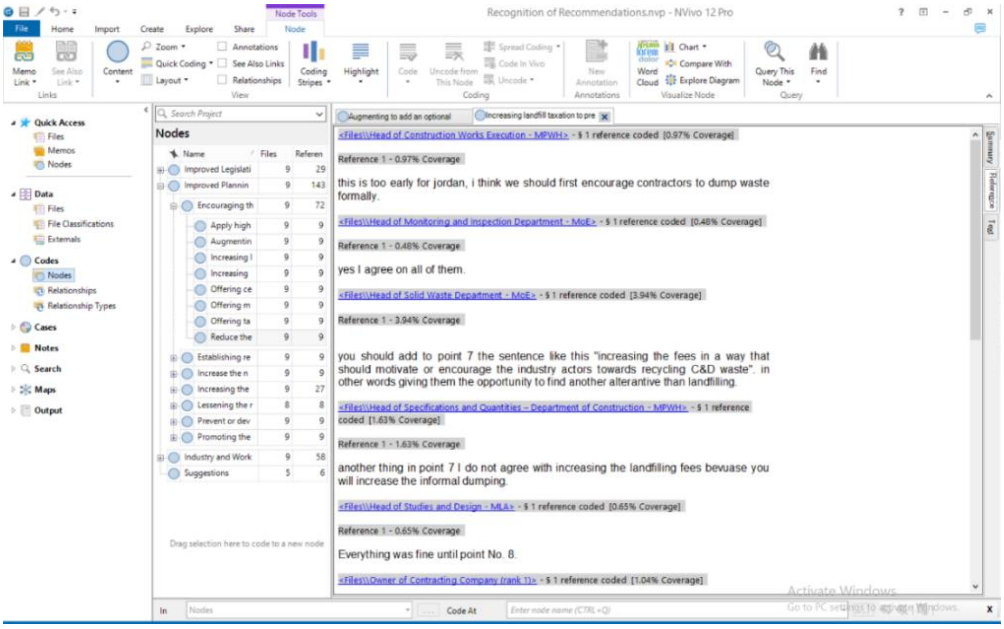


Figure 10-194: Responses of Participants



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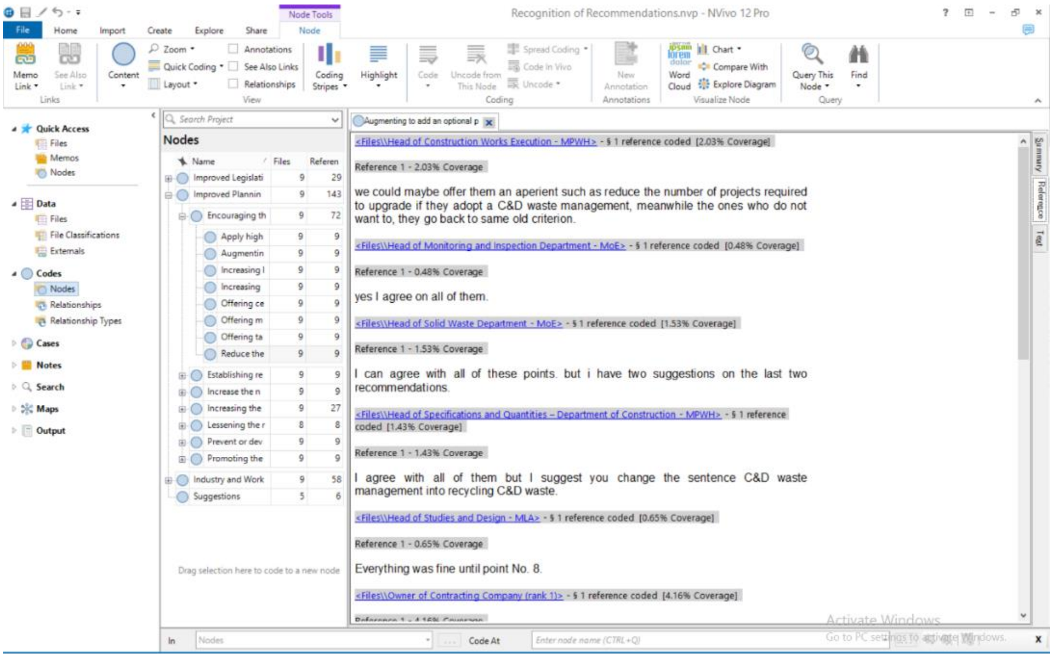


Figure 10-196: Responses of Participants

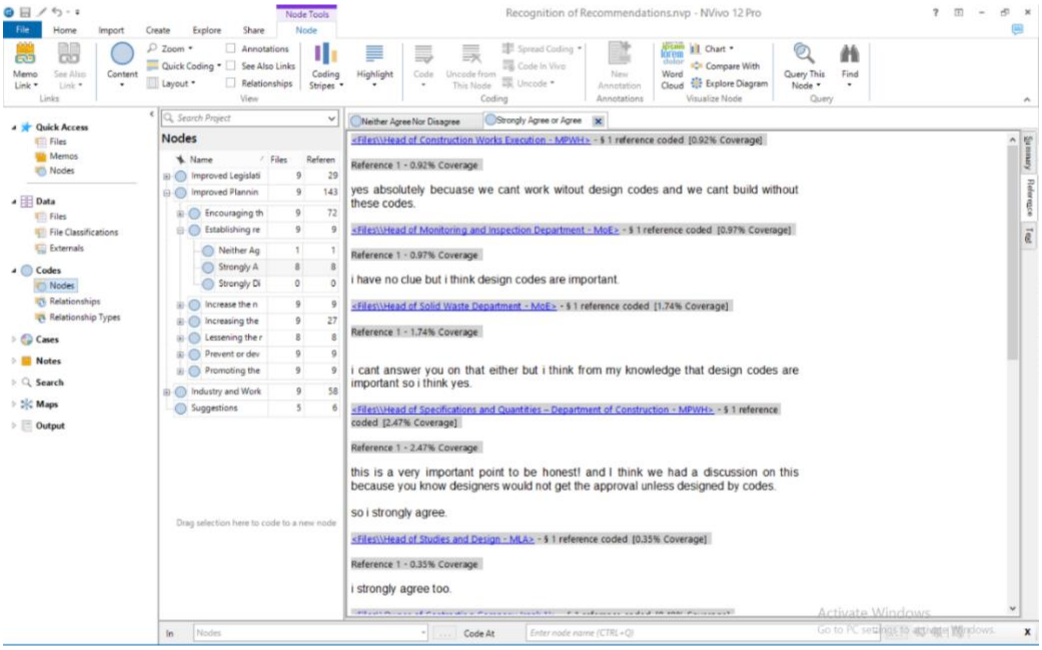
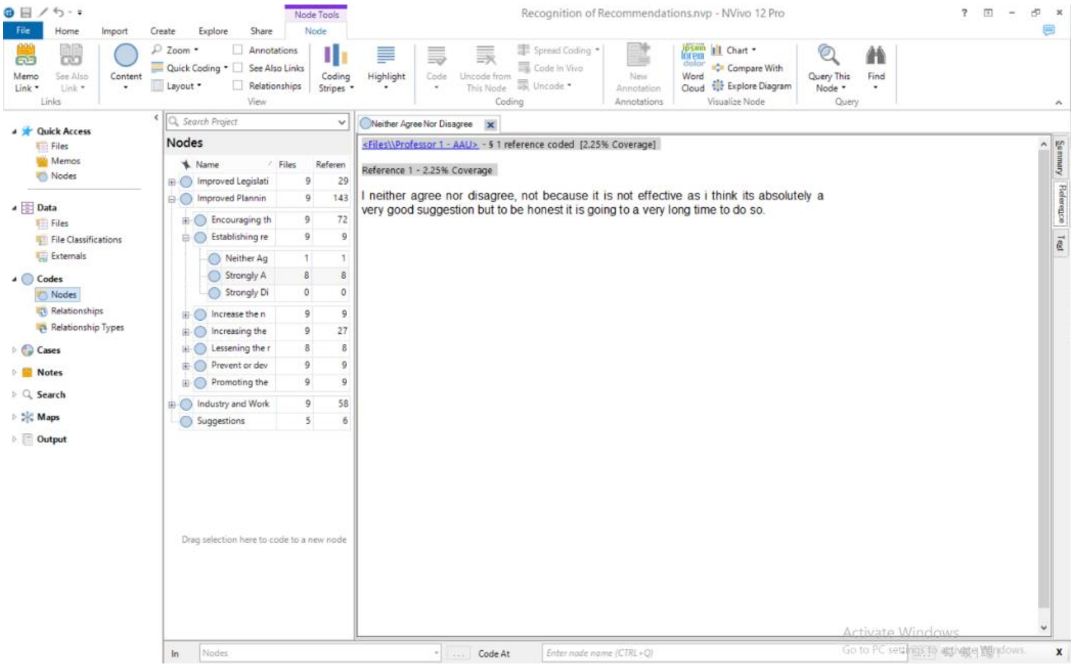


Figure 10-197: Responses of Participants



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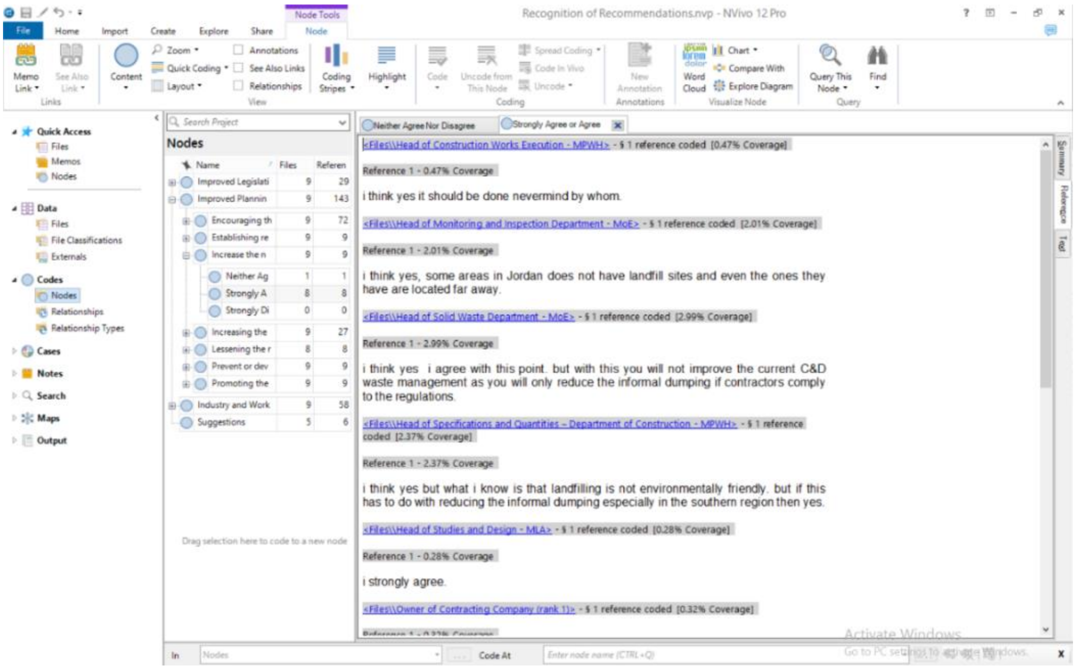

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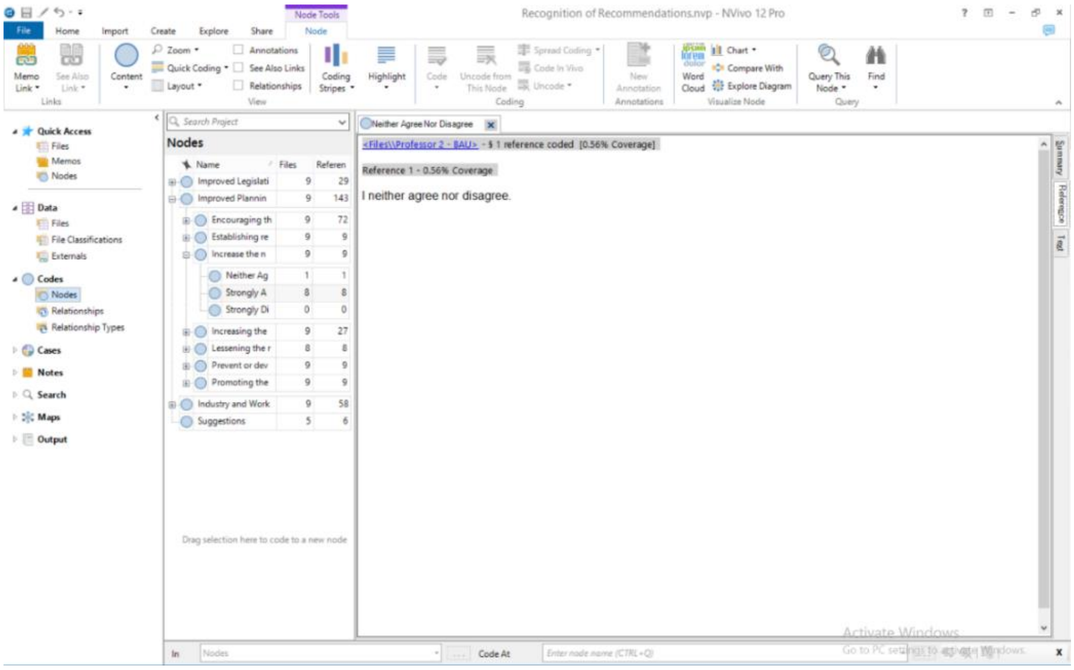

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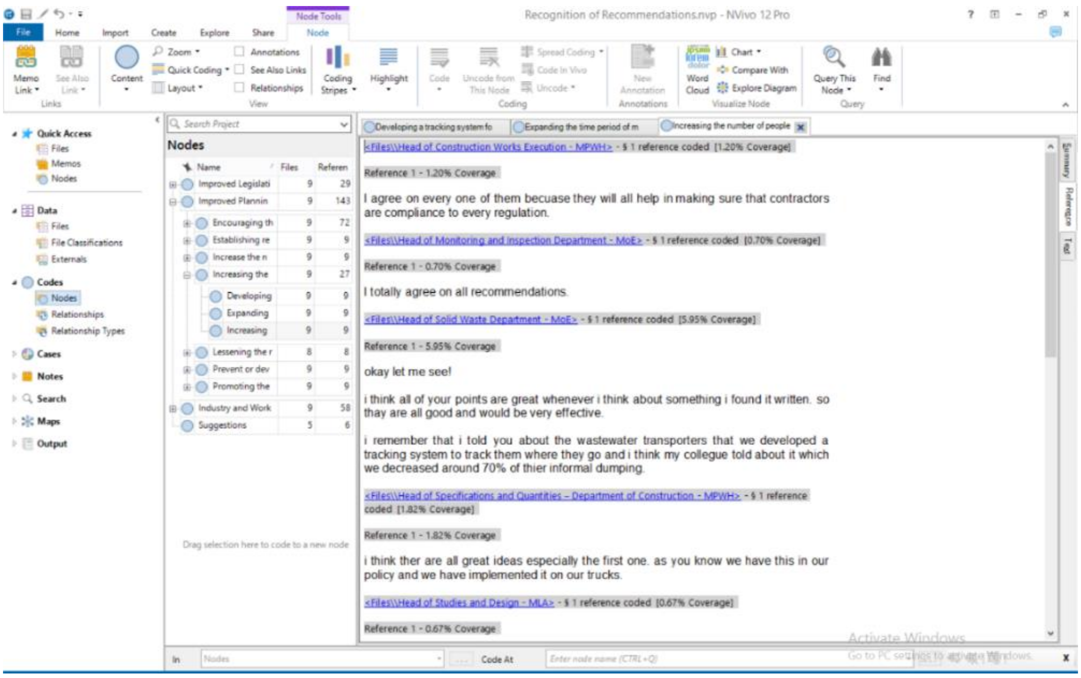

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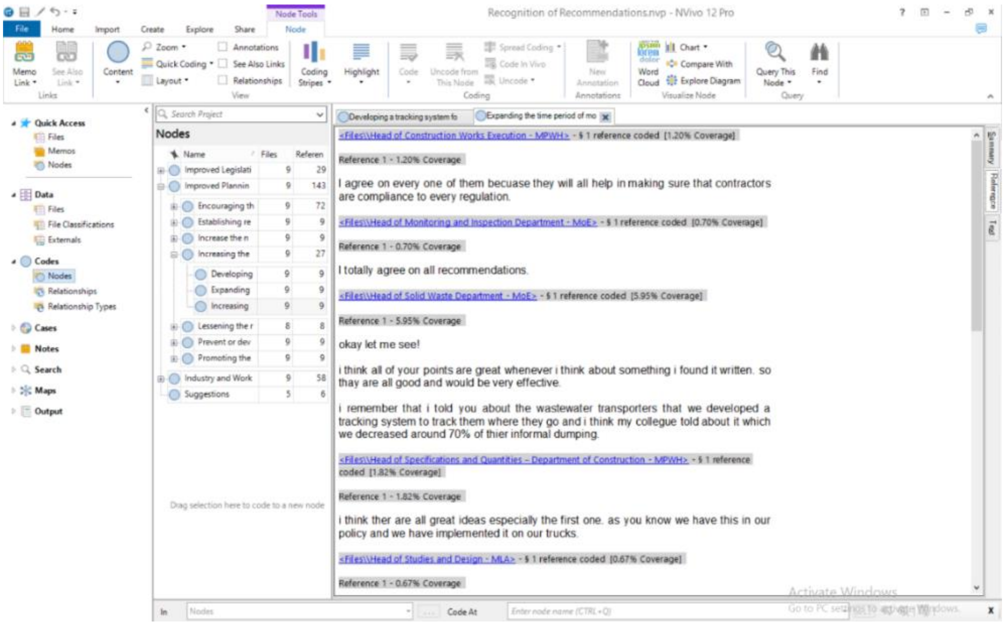

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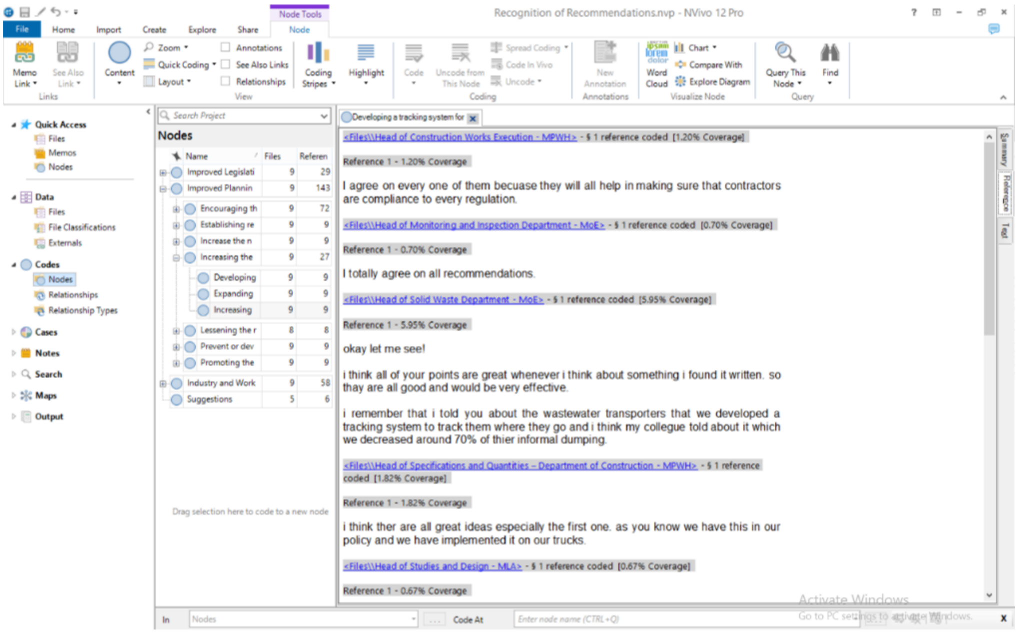

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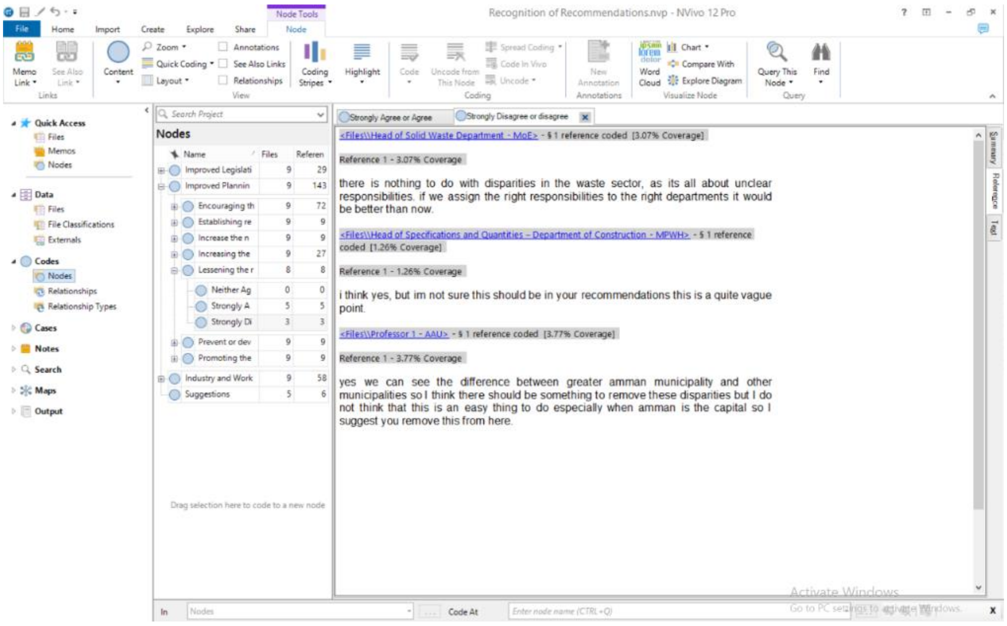

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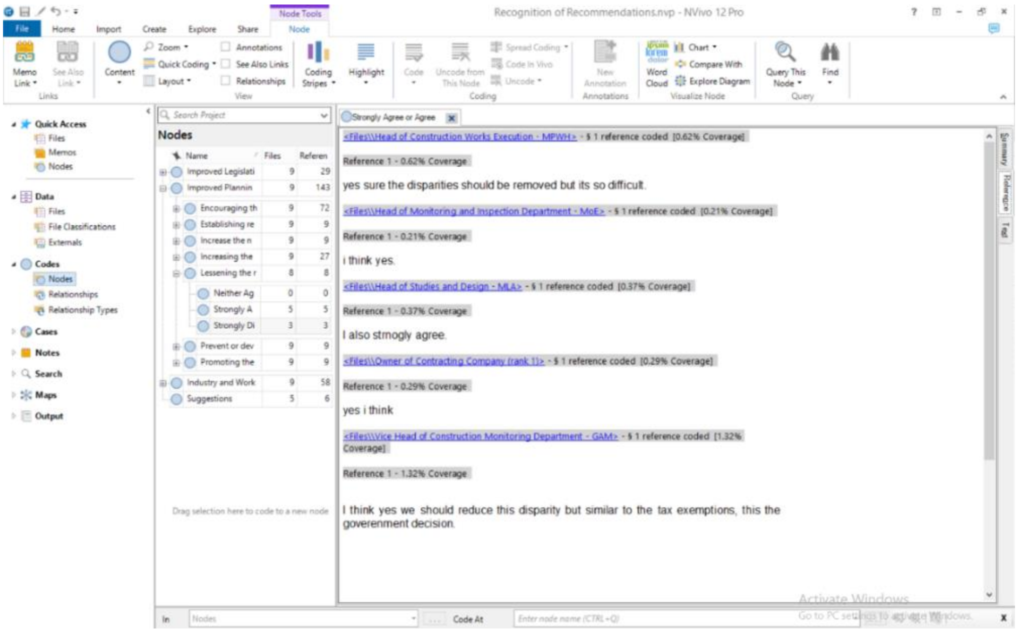

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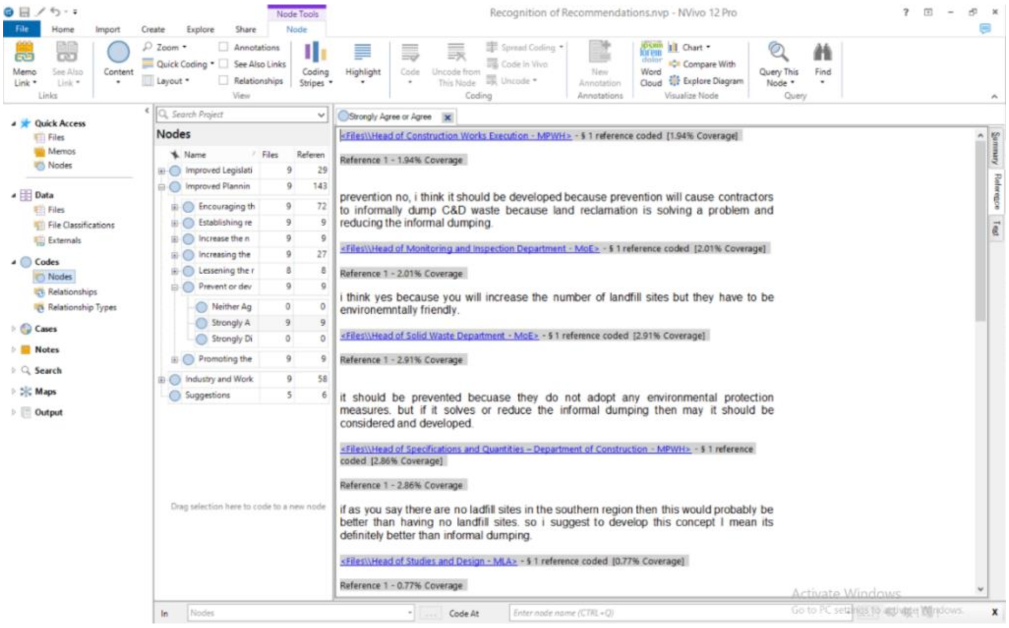

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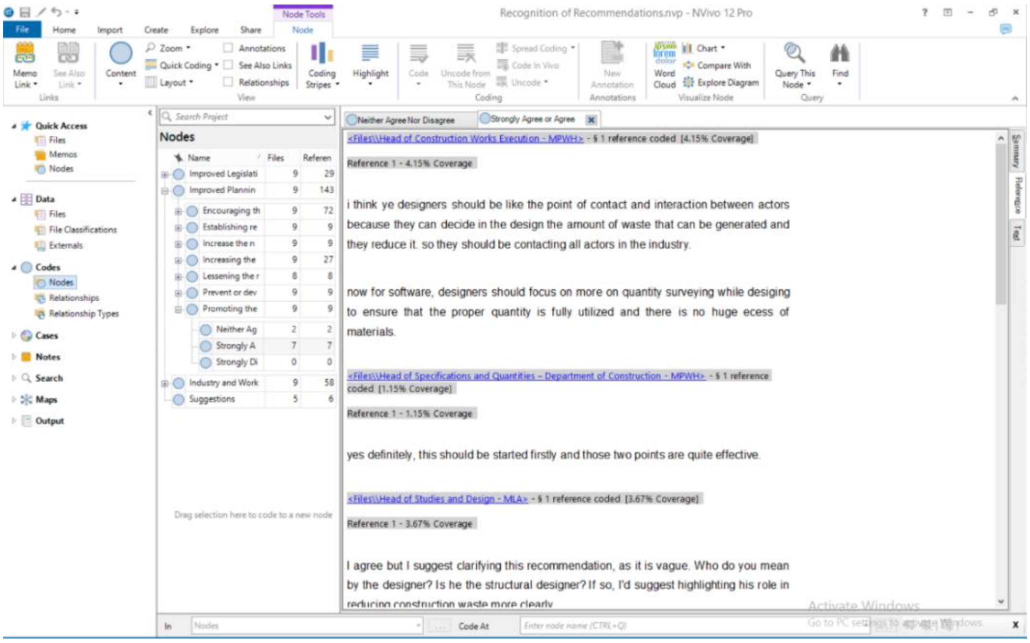

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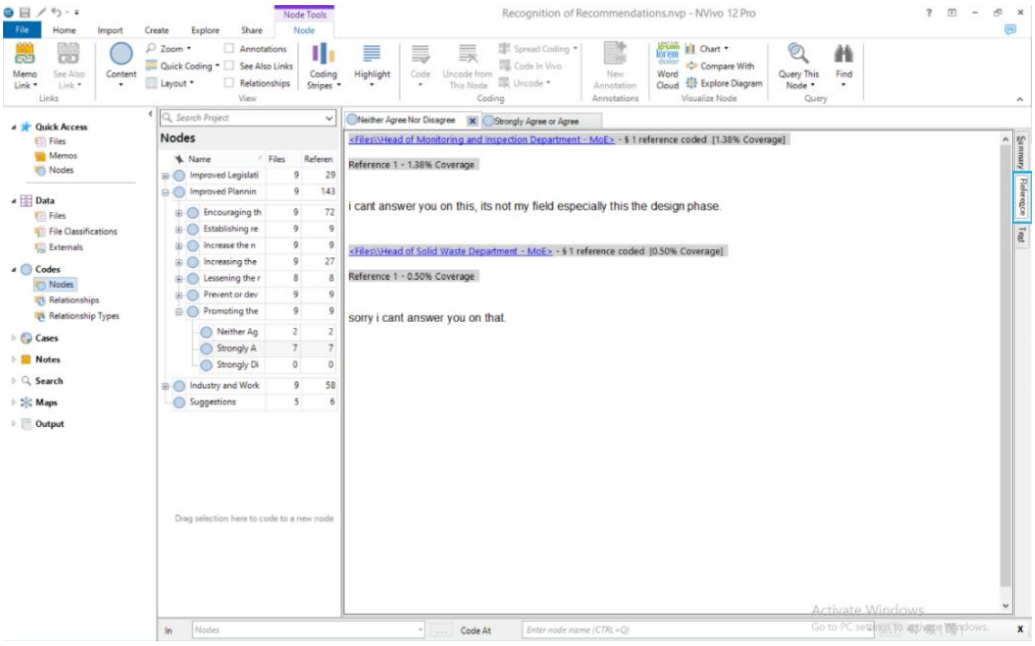

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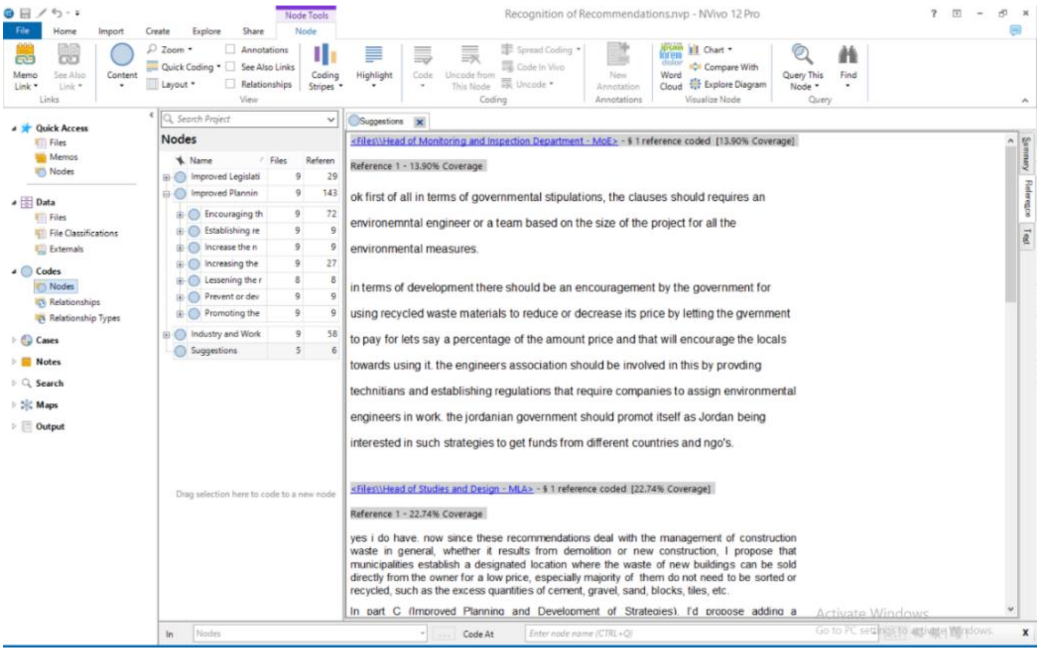
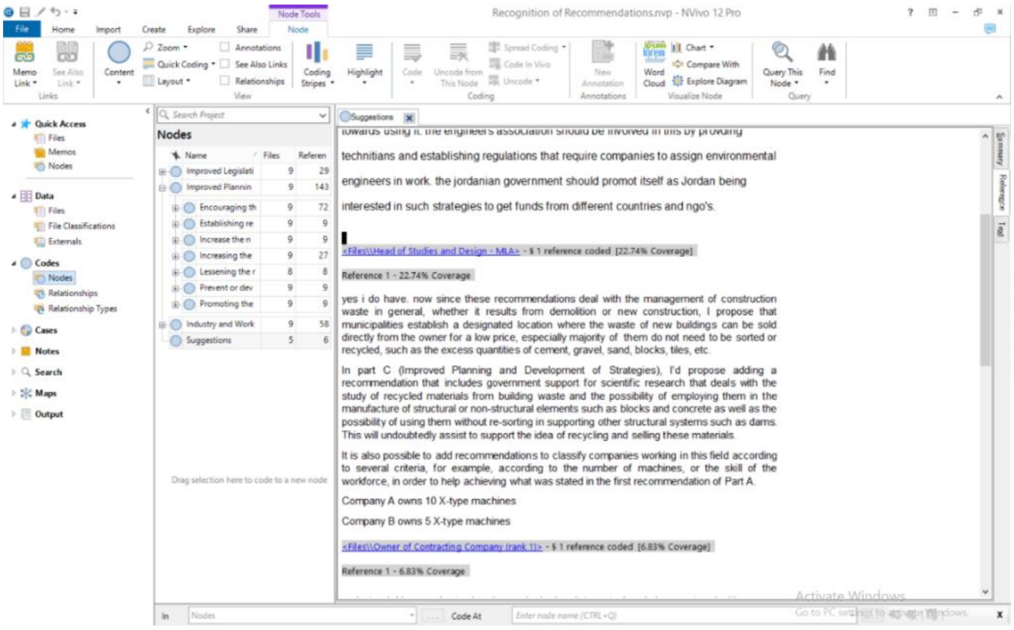


Figure 10-209: Responses of Participants



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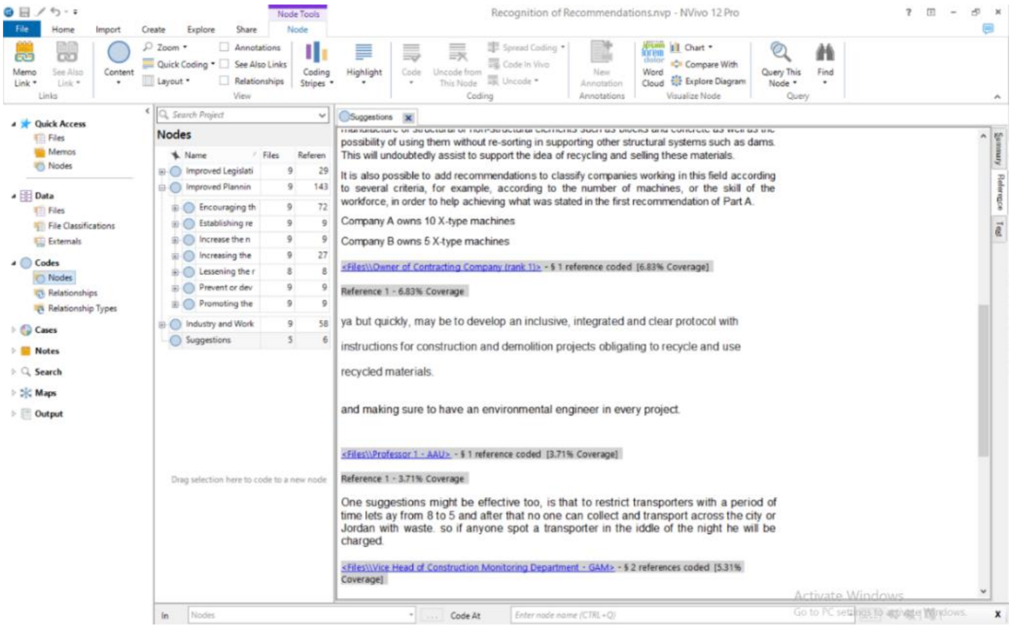

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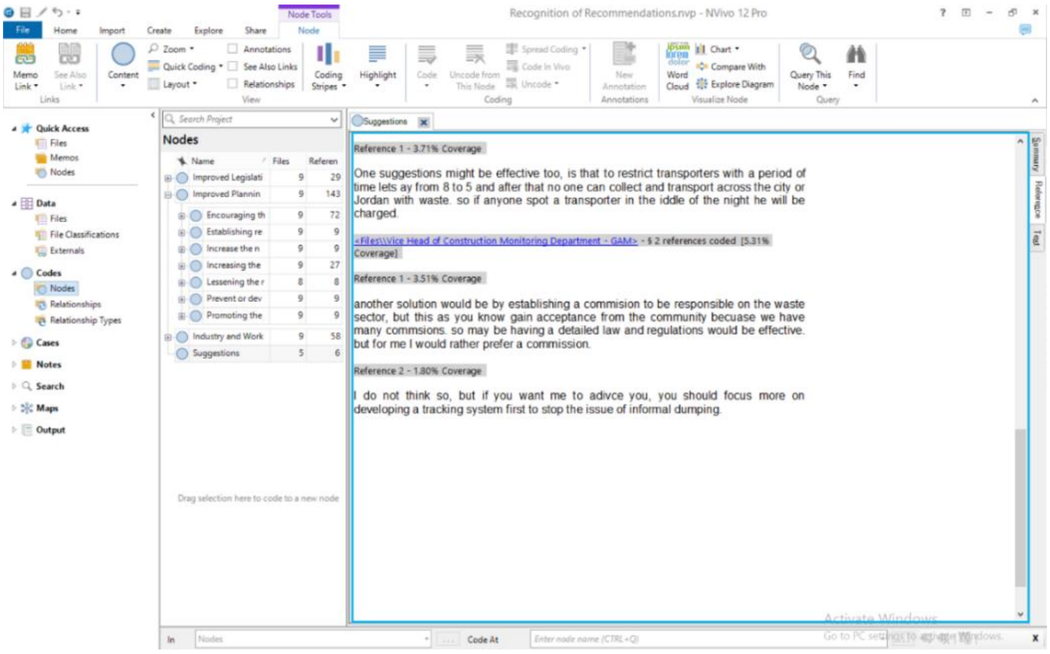

Figure 10-212: Responses of Participants

10.2 Appendix II – Archived Data Collection

10.2.1 Documented Volume of Dumped C&D Waste

This section here demonstrates as pointed out in the main body of the research the documented data of the volume of C&D waste dumped in GAM's landfill.

Figure 10-213: Archived Data of Landfilling

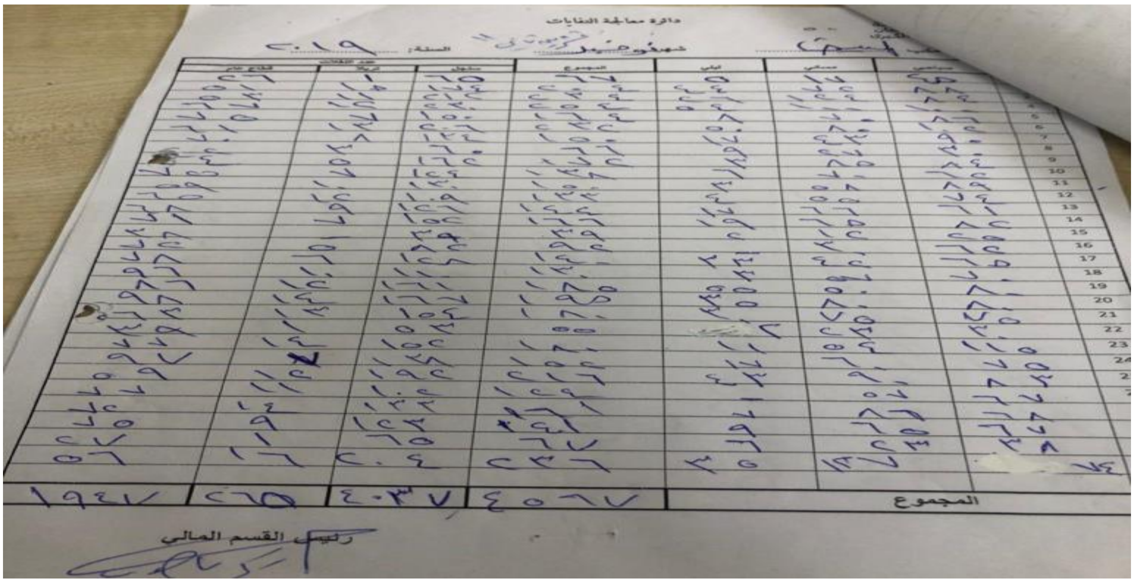

Figure 10-214: Archived Data of Landfilling

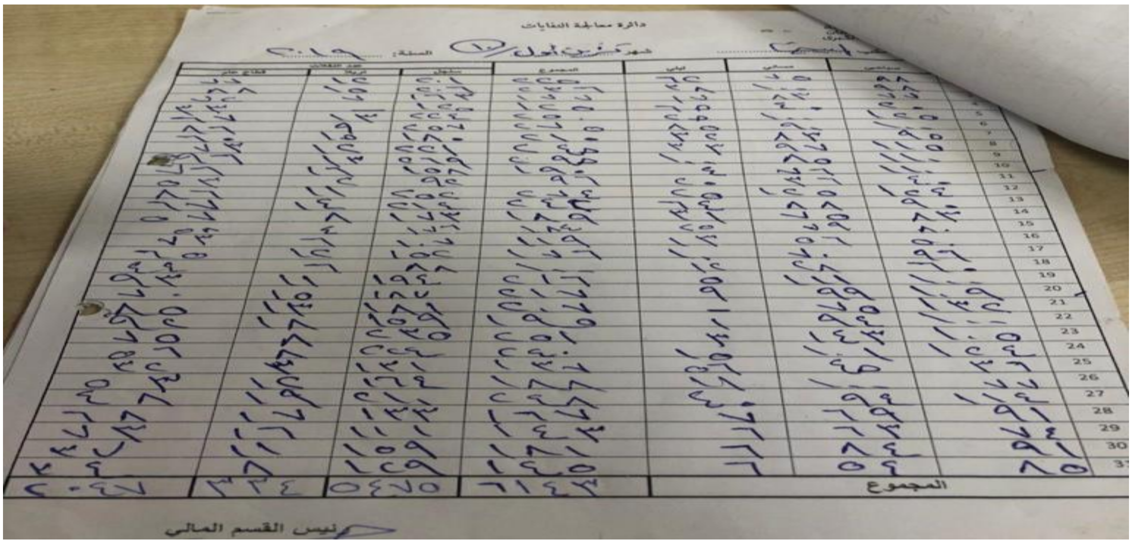

Figure 10-215: Archived Data of Landfilling

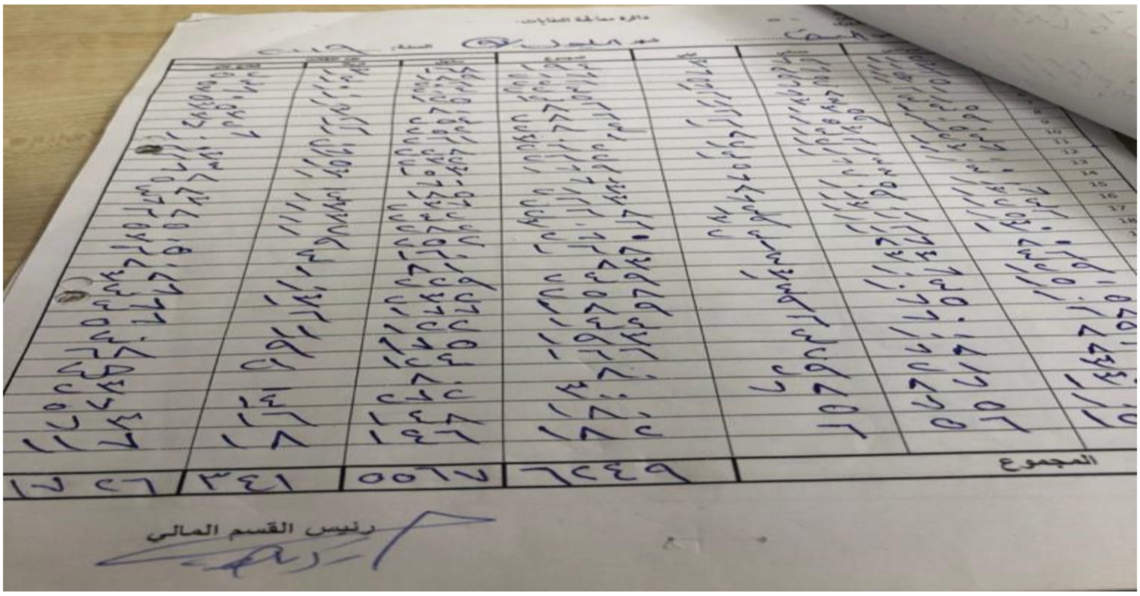

Figure 10-216: Archived Data of Landfilling

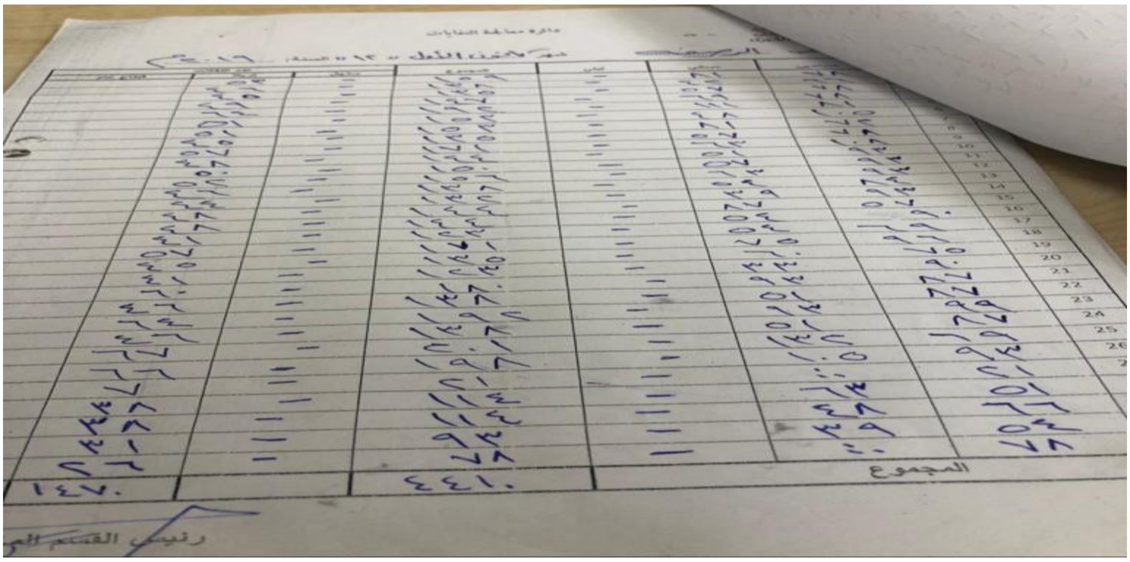

Figure 10-217: Archived Data of Landfilling

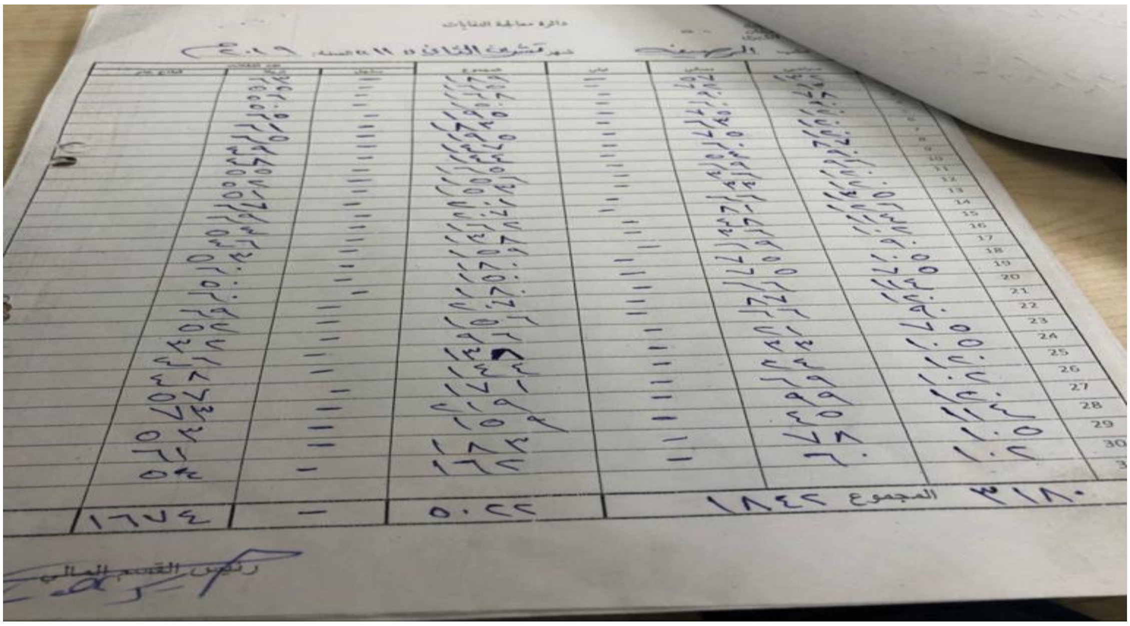

Figure 10-218: Archived Data of Landfilling

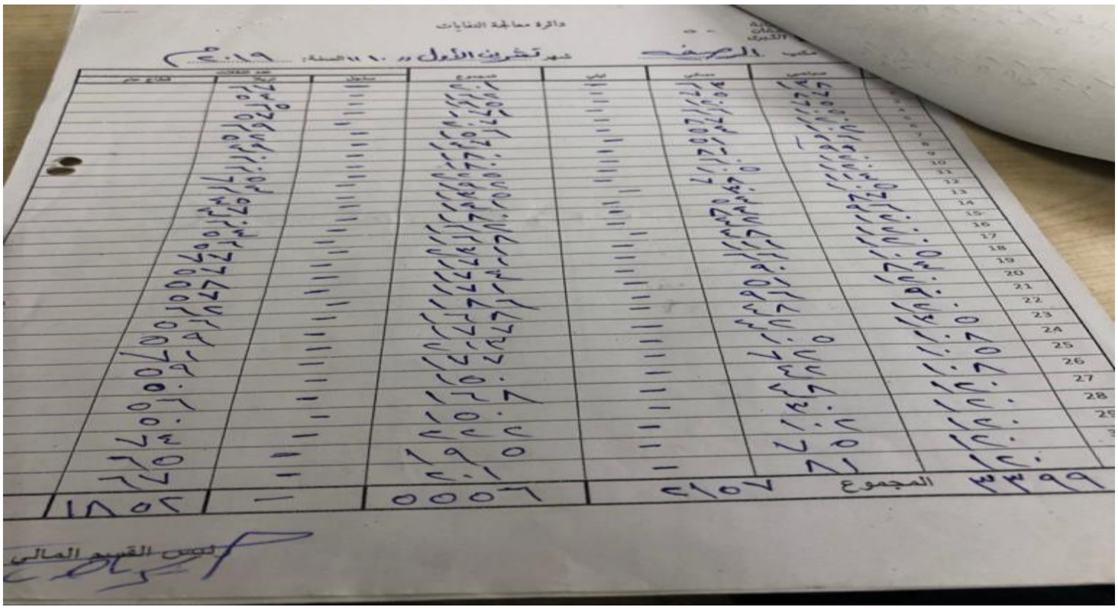

Figure 10-219: Archived Data of Landfilling

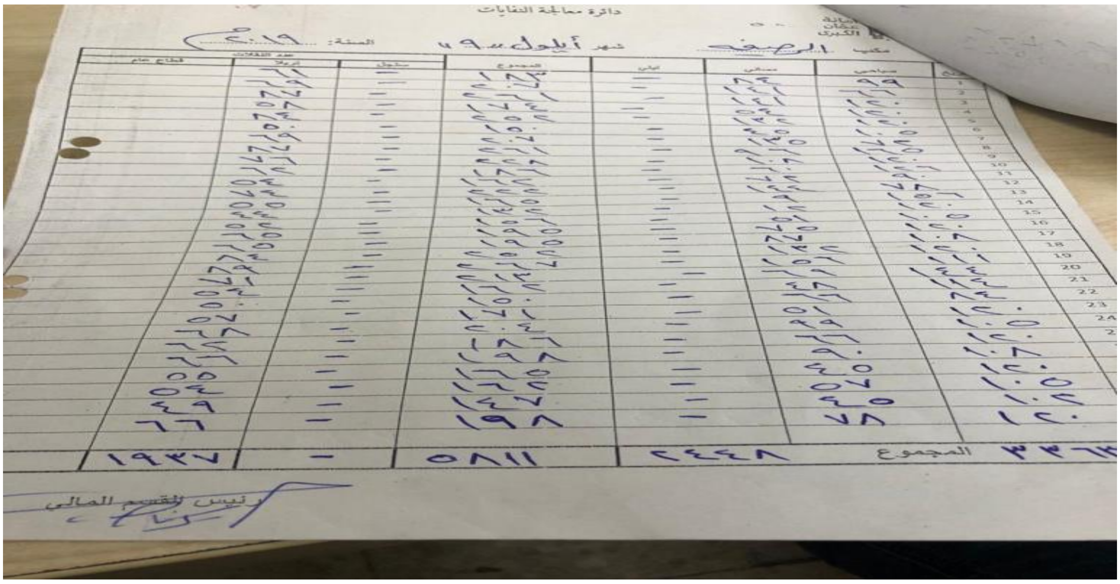

Figure 10-220: Archived Data of Landfilling

10.3 Appendix III – Questionnaires Results

As said in the main body of chapter 5, further information on questionnaire surveys is discussed in **chapter 10-appendix III**. Which are divided into sections and sub-sections. Two main parts have been presented to classify the study of survey data:

1. Analysis of frequently asked questions as reported in the main body of the research. Which analyses the commonalities of frequently asked questions to a variety of actors in the Jordanian construction industry.

2. Analysis of individual surveys that comprise uncommon questions from several surveys given to various participants in the Jordanian construction industry according to their functionality.

10.3.1 Analysis of Common Surveys

As previously stated, this section tackles the additional analysis of questions that were common across multiple surveys. Each section in this appendix is classified according to its classification in the research's main body.

10.3.1.1 Percentage of the Informal Dumping

The surveys conducted in this investigation determined that the large quantifiable percentage of informal dumping could be attributed to the actors' neutrality regarding informal dumping responsibility. As they would not be dishonest in describing the actual situation of informal dumping. Since they observe this issue while touring the country's roads and streets.

Nonetheless, respondents who quantified informal dumping at less than 40%, such as contractors at 22% and GAM at 40%, may bear direct responsibility for such attitudes. Especially when other actors responded with the lowest percentage. To be fair, one significant disadvantage of this approximation is that it was not based on archived data or previous research. But rather on actor experience and observations. However, as described in the literature review, these statements have been significantly validated in recent years by GIZ's investigation.

10.3.1.2 Reasons of the Informal Dumping

The reasons of informal dumping are generally classified into three main taxonomies based on their similarities as follows:

1. Governmental controls:
   This includes lack in legal frame works and regulations, governmental supervision and strictness, lack in management systems and incomplete waste disposal systems.

2. Local actors' involvement:
   This includes awareness of local actors to the benefits and impacts of C&D waste and the involvement of the informal dumping.

3. Costs and expenses:
   This includes high costs of legal dumping and long transportations distances to permitted landfills.

This account should be viewed with caution, as the location of licensed landfills is the duty of GAM. Whereas legal landfilling is the responsibility of the contractors. Thus, each actor chooses his or her reasons depending on their accountability, purpose and advantage. In other words, neither contractors nor GAM will reveal the proximity of landfills to their projects. MLA should have included GAM in this as well, given their identical functions and responsibilities in terms of developing and allocating landfills. Nevertheless, this paradoxical finding could be explained by the fact that other municipalities lack licensed landfills, as previously stated.

10.3.1.3 Approaches for Mitigating the Informal Dumping

According to the hypothesis, there are three distinct approaches to reducing informal dumping of C&D waste, which are as follows:

1. Governmental controls:
   This includes modifying legal frame works and regulations, increasing the governmental supervision and strictness, providing tax exemptions and facilitating recycling plants and markets for recycled waste material.

2. Local actors’ involvement:
   This comprises increasing the awareness to the benefits and impacts of C&D waste.

3. Costs and expenses:
   This constitutes decreasing the charging fees of legal dumping and decreasing the distances to permitted landfills.

There appears to be a clear need for measures to address this issue. Since the survey explained through its questions numerous elements that contribute to such an attitude. As an example, clients have committed, as detailed in **section 5.1.5**, to adopt a reasonable strategy. To resolving this issue through improved C&D waste management practices. A likely explanation is that they view this as a significant issue because it has a negative effect on society. By lowering property values, increasing health concerns, clogging drainage systems. In addition to, in some cases forcing locals to pay for clean-up because local governments may not be able to handle it, thus adding additional expenses.

Finally, one possible consequence of these approaches is that they may be difficult to implement. Particularly in a country that does not support any approach of C&D waste management other than landfilling. This account must be approached with some caution because they are relatively ambitious. This may be because some actors view the issue of C&D waste as a critical one and the country is in desperate need of solutions. To not only minimise informal dumping, but also to enhance recycling of C&D waste. However, this is possible if the accountable parties have been determinant.

10.3.1.4 Responsible Side on the Informal Dumping

This section illustrates the perspectives of academics and clients on their respective responsibilities for the informal dumping of C&D waste. This section divides actors into three categories:

1. Government, which includes ministries and local authorities.
2. Construction practitioners, which includes contractors, transportation contractors, engineering and design firms.
3. Clients.

It should be clear from the start that this question has been limited to academics and clients. Due to their neutrality on the subject and to avoid possible bias on the part of other actors regarding their responsibility. As neither governmental participants nor construction practitioners would blame themselves for informal dumping.

The results of this survey indicate that most construction companies in the industry are highly ranked which contradicts previous literature indicating. That highly ranked construction companies focus on C&D waste management, which is limited to recycling profitable waste or legal dumping. Due to the prevalence of informal dumping. Thus, high-ranking contractors may account for a sizable portion of this problem. However, as clients should be paying for such activities under the regulations. It is possible that clients are paying, but contractors are unlawfully dumping C&D waste to maximize profit without fully informing clients.

10.3.1.5 Procurement Method for Bidding

As said in the main body of the research, this sub-section details the procurement system used by governmental organisations while constructing or demolishing a project. Including best value, low bid, negotiation, qualification-based, direct selection and even no technique of selection.

The study's findings establish the underlying reasons for using such types in projects. Including effectively assigning roles within the project to avoid responsibilities being evaded, ensuring quality in accordance with Jordanian specifications and most importantly, providing price certainty. As the study discovered that economic concerns are a critical factor taken into account by the government. Additionally, most respondents at both ministries agreed that using general contracting entails:

1. Delegating responsibility for development design to the developer and designers.
2. Exercising greater control over the design through the employer's control of the design team.
3. Providing the employer with an independent professional to act as contract administrator monitoring the project.
4. Offering a price certainty if the design has been fully scoped out prior to construction.
5. Avoiding the loss of design that is controlled by the employer.
6. Ensuring quality and saving time as the development design will be finalised before contractors offer tenders.

Although nearly half of respondents at both MPWH and MLA noted that this adoption could also be related to the desire to avoid contractors making design compromises. This does not negate the fact that most respondents indicated that government departments have greater expertise with general contracting than with other types.

Similarly, the design and build contract has been consistent in both ministries' responses regarding the reasons for using it rather than other contracts, including:

1. Transferring most of the risk to the contractor. Thus, removing employer-related responsibilities and offering the lowest risk to the employer.
2. Transferring responsibility for design and construction to the contractor.
3. Transferring responsibility for both design and construction to the contractor.
4. The ability to fast track the project, allowing the ministry to spend its budget for the project within allocated periods.
5. Avoiding splitting responsibility between construction and design. Avoiding whether defects are really design defects (for which the employer is responsible) or defects in material and workmanship.
6. Avoiding price uncertainty.
7. Creating a smoother line of communication.

Although nearly half of respondents felt that this could prevent contractors from starting work on site before the design is complete and expediting construction.

These justifications for using such contracts do not negate the disadvantages of other contract types. Such as risk exposure in design and client performance, price uncertainty, client position requiring decision-making. In addition to, increasing complexity between clients and team members, loss of control, conflict of interests and so on.

The results indicated that less than half of the contractors surveyed do not bid on demolition contracts. This suggests that demolition projects are not as essential as construction projects. Which may contribute to a number of issues such as informal dumping. As the expenses of legal dumping may not be included in the total cost of the project, as they are with construction projects. This also demonstrates the prevalence of ambiguity in the contractual arrangements for demolition projects. As participants' replies varied, despite participants' agreement that demolition activity should be included in the contractual arrangements for building. This may be due to a dearth of legislation and legal frameworks, as well as training courses and workshops. This lack of clarity may contribute to contractors performing poorly on demolition projects. Ignoring legal restrictions, or governmental entities being less strict in regulating these types of projects.

10.3.1.6 Current Approaches for Construction and Demolition Waste Management

The research's primary focus is on the present approaches to C&D waste management used by various actors in the construction sector. Particularly those responsible for generating C&D waste. These approaches include waste collection, sorting, landfilling, recycling and design out waste.

According to GAM and MLA answers, demolition work is typically included in the construction's licensing arrangements. As a result, both construction and demolition projects are incorporated into the same table and chart. Another implication is that waste generated during demolition should be handled similarly to waste generated during construction.

10.3.1.6.1 Reasons Hindering Sorting of Construction and Demolition Waste

The findings indicate that sorting is hampered slightly by time and expense constraints, as well as the composition of solid waste containing hazardous material.

The absence of sorting may be viewed as a constraint on post-collection solid waste management. However, as discussed in **section 5.1.3**, it is prudent to keep in mind that drivers may be incorporated into future strategies. As the MoE appears to be intent on embedding sorting at source through legal frameworks and regulations. One critique could be that the lack of management system should have elicited more replies, given management systems are governed by legislation.

Academics have responded to workers as perceived to be a hindrance to C&D waste. Which might be attributed to their skills and knowledge, but academics have not responded to a lack of skills and knowledge. Academics have cited a lack of awareness among local actors within the industry as a barrier to sorting. Most likely because they are aware that local actors appear to be unaware of the benefits and impacts of C&D waste. Thus, would be unaware of sorting and how this activity would be a step forward in benefiting from C&D waste. Although, if it is true, they, like MLA, should have responded to the lack of skills and knowledge by helping to the prevention of sorting.

This conflicting statement implies that insufficient awareness and a lack of skills and knowledge are not the primary impediments to sorting.

The findings presented here illuminate one factor that may impede the adoption of sorting in sites: a lack of financial rewards. The findings will be significant in demonstrating that governmental actors' answers have been consistent. As none of the governmental participants referred to this rationale as being particularly influential. Although 60% of academics proposed this to prevent sorting from occurring. It is critical to consider the possible bias in these responses. Because financial rewards should be offered by governmental institutes. Which would incur more expenses, which clearly governmental institutes are not interested in. This may have been read cautiously by academics. As 40% of them backed the governmental actors' position on offering financial rewards.

10.3.1.6.2 Reasons Hindering Transportation of Construction and Demolition Waste to Landfill

GAM verified that an insufficient waste disposal system might impede the transportation of C&D waste to a permitted landfill. Implying that there is a deficiency in waste disposal, not just in oversight, as GAM is more active in landfilling. However, others have drawn a distinction stating unequivocally that the transportation of C&D waste and informal dumping of C&D waste are caused by a lack of oversight and supervision.

10.3.1.6.3 Reasons Hindering Designing Waste Out of Projects

This section discusses the factors that contributed to the decision not to design out waste of projects. As virtually all participants indicated that no design firms or departments employ this technique in their work. This includes the absence of design codes for recycled waste material, technical, time and economic constraints. In addition to, lack of awareness and willingness on the part of local actors, ineffective demolition techniques and lax governmental restrictions.

The absence of design codes may be explained by the fact that the Jordanian construction sector is better organised than that of other developing countries, as indicated in the literature study. As a result, construction permits cannot be obtained without the government's approval of the project's design. Thus, designers are unable to design structures using recycled waste material in the absence of such codes. Thus, observations indicate that there may be a strong correlation between the design phase and C&D waste management. Owing to the absence of design codes for recovered waste material.

In terms of local actors, the results indicate that the current adoption of design may also be associated with a lack of awareness and willingness on the part of local actors. As indicated by an average of around 79% of all participants, which could be a major impediment. Because even if design codes and regulations are established, local actors may be unaware of them. These actors may have responded positively to this because of their experience with the attitudes of contemporary local actors. Since actors may be aware of something but unwilling to do it, or conversely, may be unaware of something and so unwilling to do or adopt it. Finally, the results of this analysis have not discounted one issue that may be a barrier to such adoption. Which is related to the willingness and knowledge of local actors, with an average of 48% of academics, MLA and MPWH. Indicating that local actors' concerns could obstruct such adoption. These problems have been divided into three categories: technical, time and money. Nearly a quarter of all participants (20%, 33.3% and 21.1% of academics, MLA and MPWH, respectively) expressed anxiety about technical apprehensions.

As technical issues ranked lower than other concerns. This is because local actors can determine on their own, using design codes or design software, how to eliminate waste from projects. This is especially true when recycled waste material are used in other projects. Meanwhile, nearly double that number has been recognised for time constraints, with an average of 49.9% by 20%, 66.6% and 63.2% of academics, MLA and MPWH, respectively. Additionally, a higher percentage of academics 80%, 55.5% of MLA and 73.7% of MPWH believe that cost issues are a major concern for local actors when adopting a design out waste on projects. These final two concerns demonstrate how construction sector participants prioritise time and cost over all other considerations. Demonstrating that if eliminating design out waste saves time and money, construction industry actors may be inclined to adopt it. However, it is prudent to keep in mind that these actors may be unaware of them.

10.3.1.7 Approaches to Design Out Waste of Projects

According to an average of 79.45% and 87.87% of participants, respectively, giving tax breaks and training. Could boost local actors' desire and awareness for such an adoption. The large percentage of tax exemptions could be attributable to designers' right to tax exemptions, rather than to any industry actor. Because designers, according to multiple prior publications, are the primary source of C&D waste generation and prevention. These findings may also indicate that local actors are not sufficiently aware. Which this approach would be easily adopted if actors' awareness was increased through training courses. As is currently the case in Jordan, or by encouraging actors through tax exemptions, as local actors are highly concerned with time and cost.

10.3.1.8 Hindrance to Design Codes Existence

The absence of design codes may be a result of local actors' lack of awareness or willingness. This does not preclude the influence of other factors, as an average of 5.41% of respondents responded that the low generation of C&D waste is a barrier to such an absence. This was consistent with earlier surveys, as shown previously, which indicated that C&D waste is generated at an alarming pace. Thus, the low generation of C&D waste is not a significant impediment to establishing design codes. Thus, there is no correlation between waste generation and the absence of design codes.

10.3.1.9 Encouragements

These results indicate that none of the participants viewed the legal disposal fees as an incentive or a reason to convert the sector toward recycling. As an average of just 32% of all participants agreed. This might be argued to have a detrimental effect on the current situation. As data indicate that current disposal fees for C&D waste are already inexpensive. Despite the fact that informal dumping occurs at a significant rate. Thus, it shows that a tenuous link between informal dumping and disposal fees may exist. However, this may be due to the high cost of waste transportation. Yet, this may be a factor if alternatives, such as recycling factories, were available to encourage industry actors to switch to recycling.

10.3.1.10 Considerations and Willingness

The sub-section contains the governmental perspectives on the environment, social concerns and the economy. It is worth noting that academics engaged in this survey as a neutral observer. Demonstrating whether these considerations are genuinely taken into account by various governmental entities. As a result, possible bias on the part of government actors is avoided.

10.3.1.10.1 Willingness towards Using Recycled Crushed Concrete Aggregate

It can be concluded that all averages in this sub-section indicate that a minority of clients, contractors and governmental departments would be unwilling to use recycled aggregates in new concrete mixes or to employ governmental projects using recycled aggregates in new concrete mixes. Even if permitted by codes and specifications, owing primarily to quality concerns.

10.3.2 Analysis of Individual Surveys

This section attempts to provide the analysis of data collected from surveys individually. As distributed on different actors within the Jordanian construction industry based on their functionality as mentioned previously.

Several taxonomies for surveys have been developed based on the functionality of each actors constituting as follows:

1. Greater Amman Municipality - Construction Department
2. Greater Amman Municipality - Legal Frameworks and Regulations Department
3. Ministry of Public Works and Housing - Construction Department
4. Ministry of Public Works and Housing – Design and Studies Department
5. Ministry of Local Administration - Construction Department
6. Ministry of Local Administration – Design and Studies Department
7. Ministry of Environment – Solid Waste Department
8. Construction Contractors
9. Concrete Suppliers
10. Clients
11. Academics

10.3.2.1 Greater Amman Municipality Questionnaires

10.3.2.1.1 Department of Construction Questionnaire

The survey carried out here addresses number of aspects related to C&D waste within the authority of GAM.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No and Likert Scale questions. The sample size participated in this survey were 22 in total.

10.3.2.1.1.1 Charts 11 – 12 to 22

Chart 10-12 below accounts the data collected from all responses of participants on the Yes/No questions.

The bars in this chart represent both perspectives of participants based on the questions seen below. Meanwhile, **charts 10-13 to 10-19** below draw a distinction between responses on assessing the contributory reasons to informally dump C&D waste, approaches to mitigate this attitude and types of projects that generate excavation waste. In addition to, determining the reasons preventing the implementation of C&D waste management in landfill, considerations, approaches to promote C&D waste management and evaluation of regulations and compliance as collected from all responses of participants using Likert Scale questions. The bars in this chart represent all the evaluations of participants based on the questions seen below.

Charts 10-20, 10-21 and **10-22** below provides information about the questions of GAM survey that have not been mentioned in the sections above. The bars in these charts represent all responses of participants based on the questions seen below.

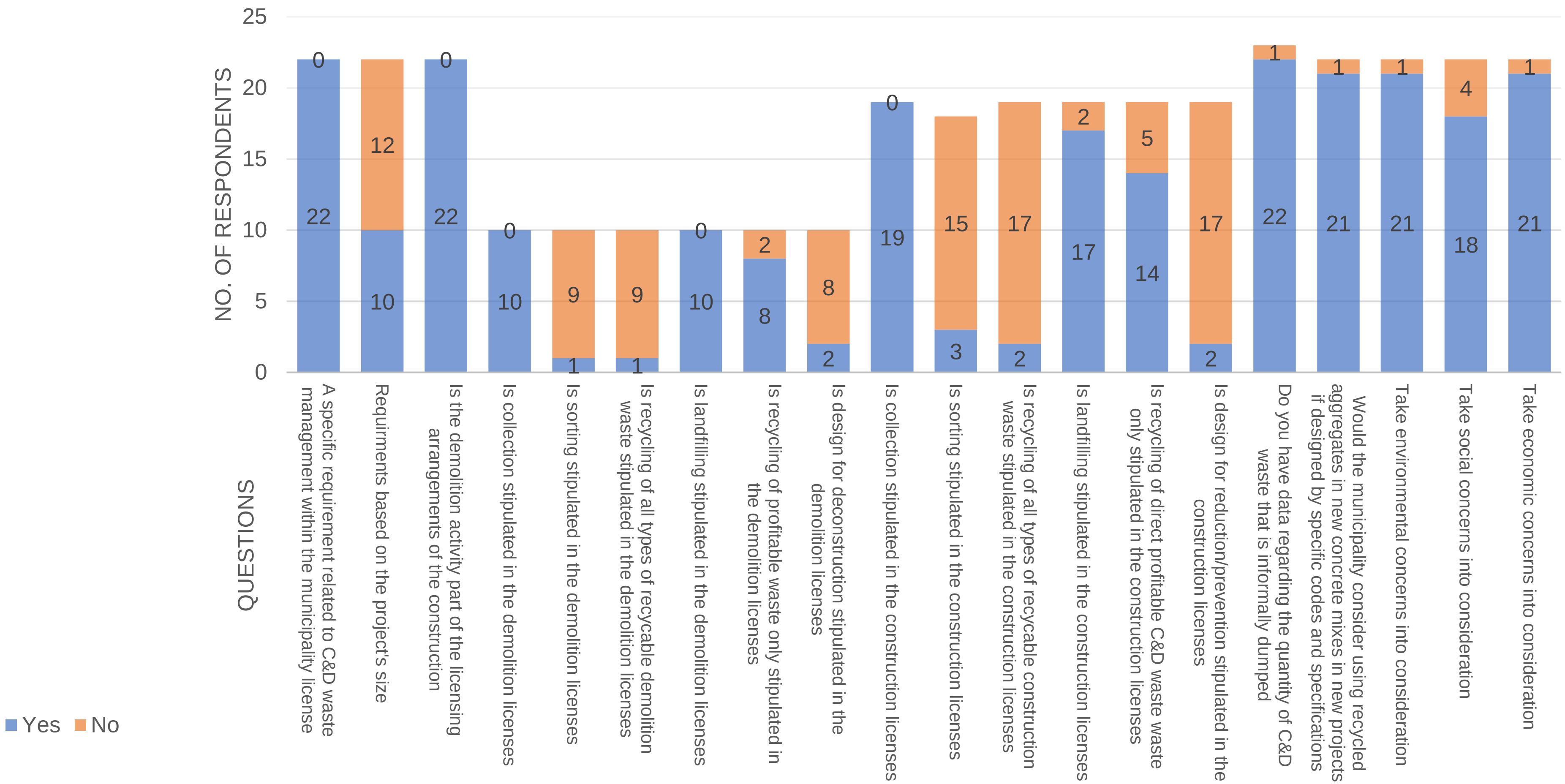

Chart 10-1: Yes/No Questions of Greater Amman Municipality – Construction Department Questionnaire

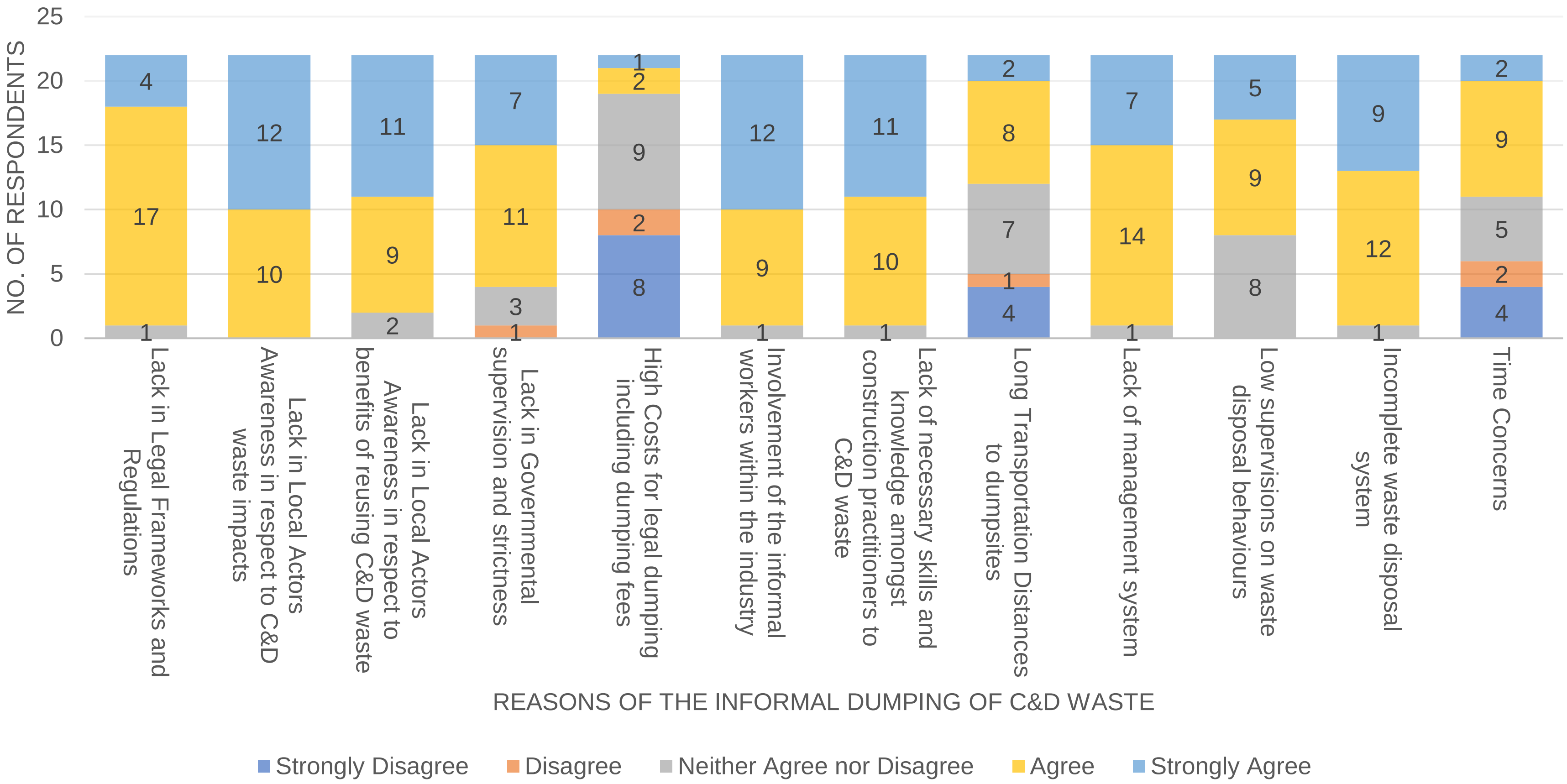

Chart 10-2: Reasons of the Informal Dumping of C&D Waste

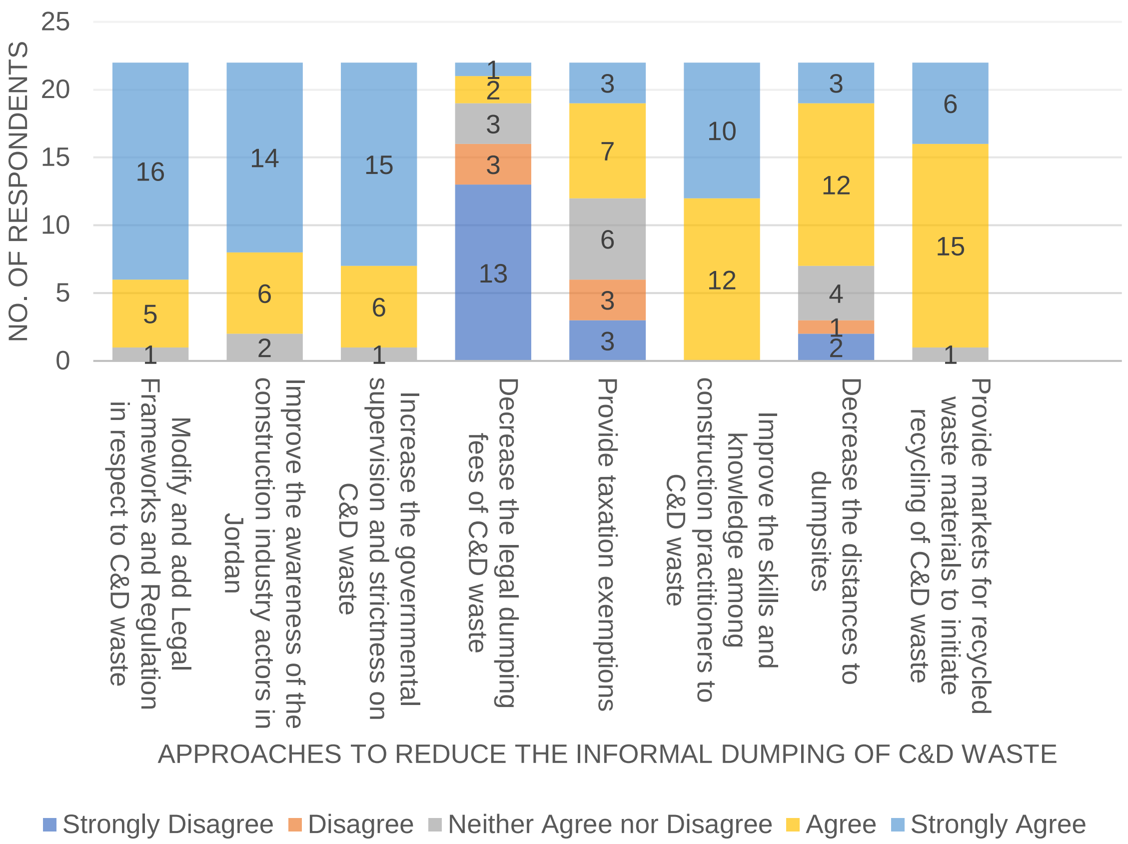

Chart 10-3: Approaches to Reduce the Informal Dumping of C&D Waste

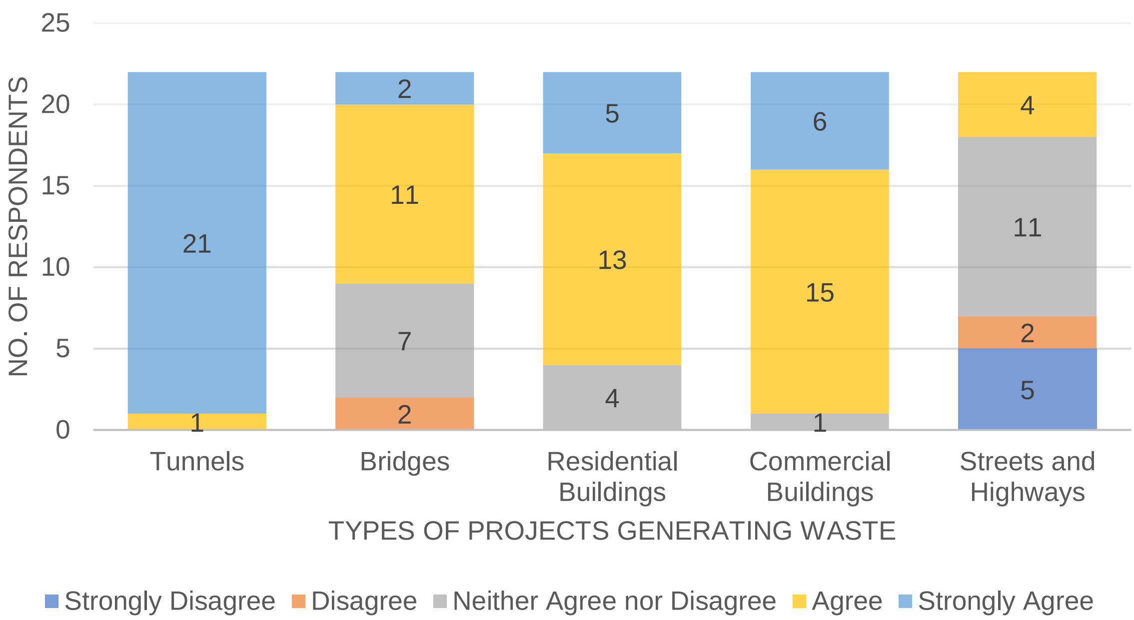

Chart 10-4: Types of Projects Generating Waste

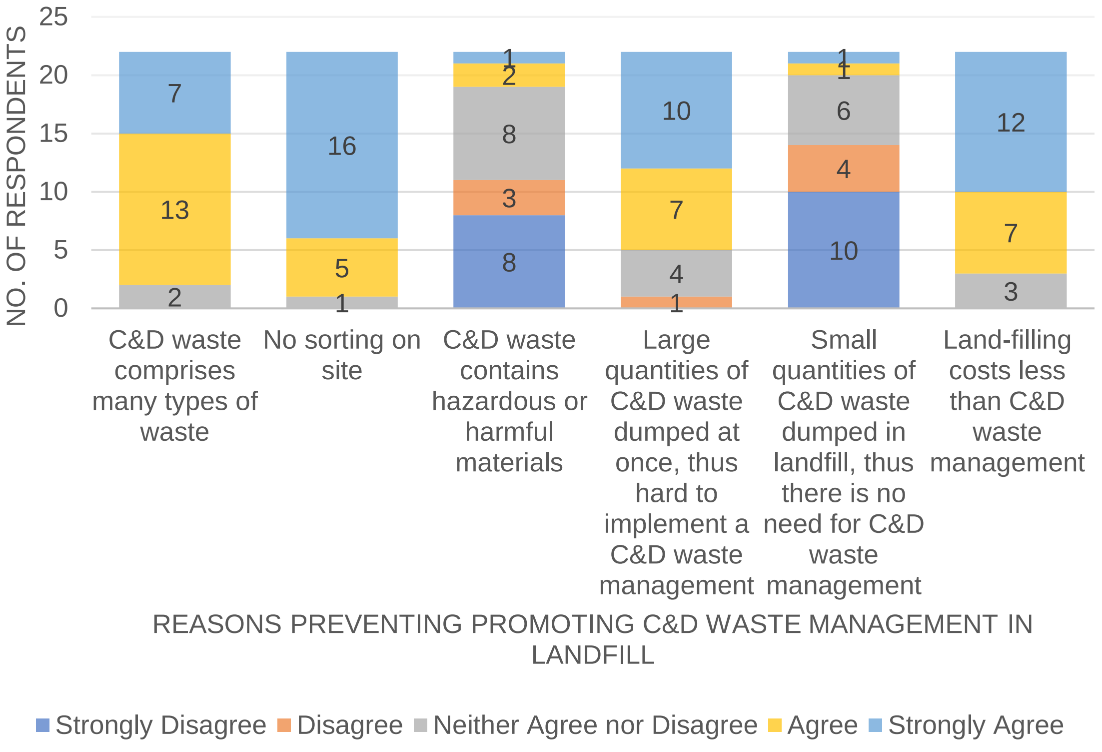

Chart 10-5: Reasons Preventing Promoting C&D Waste Management in Landfill

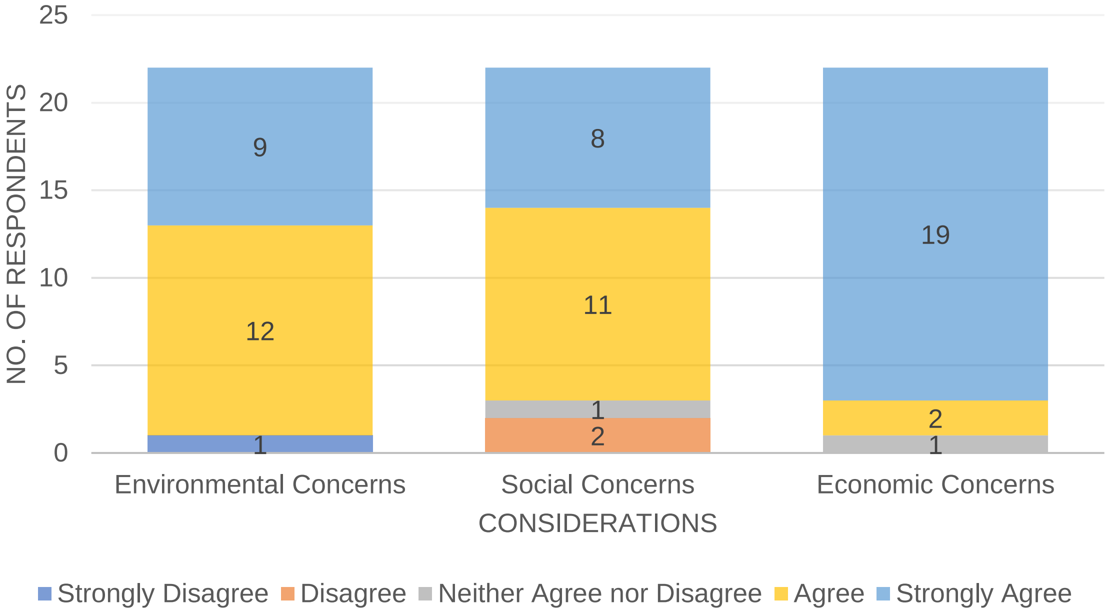

Chart 10-6: Considerations

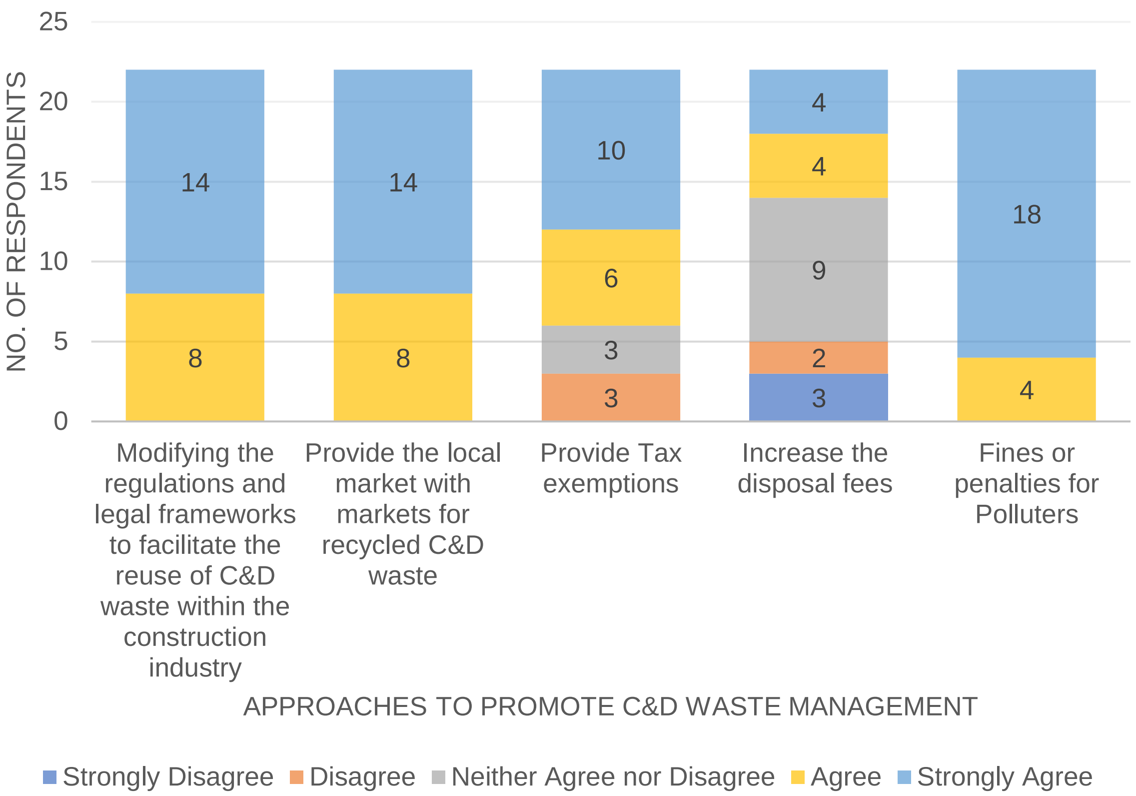

Chart 10-7: Approaches to Promote C&D Waste Management

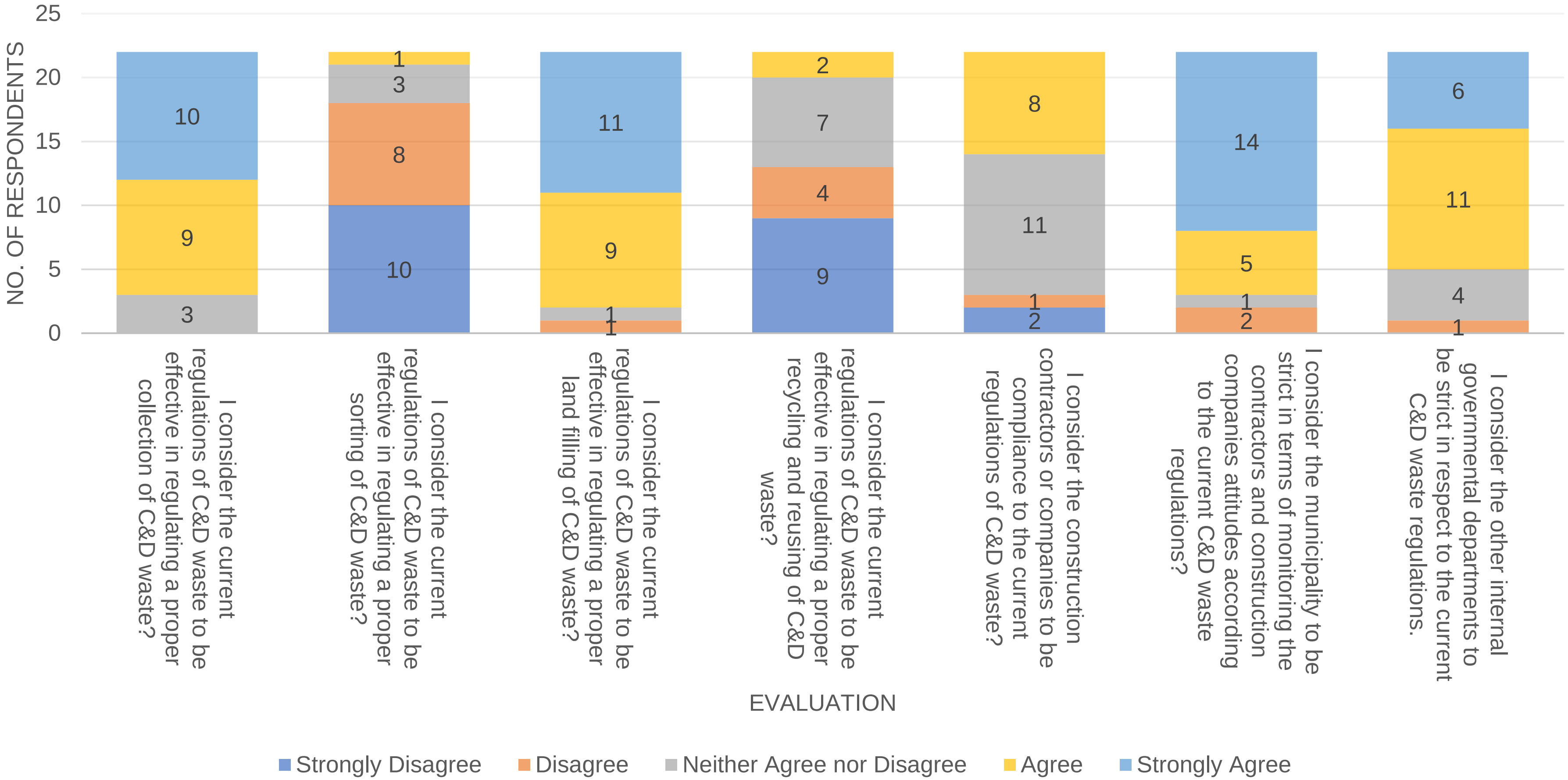

Chart 10-8: Evaluation of Regulations and Compliance

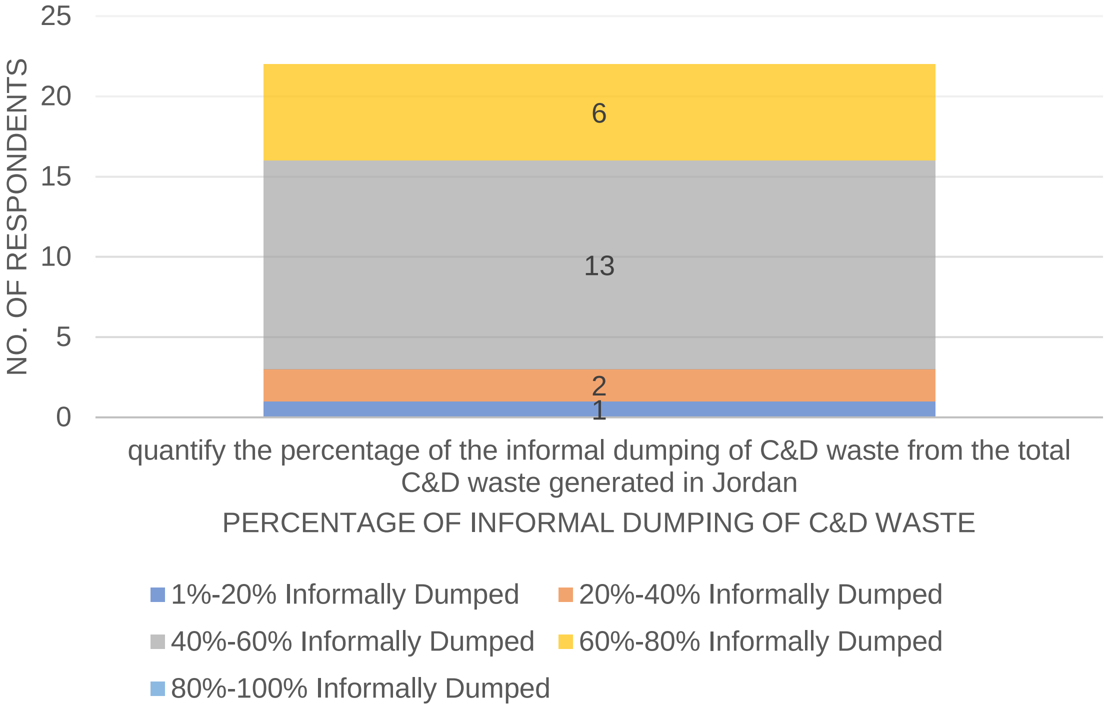

Chart 10-9: Percentage of Informal Dumping of C&D Waste

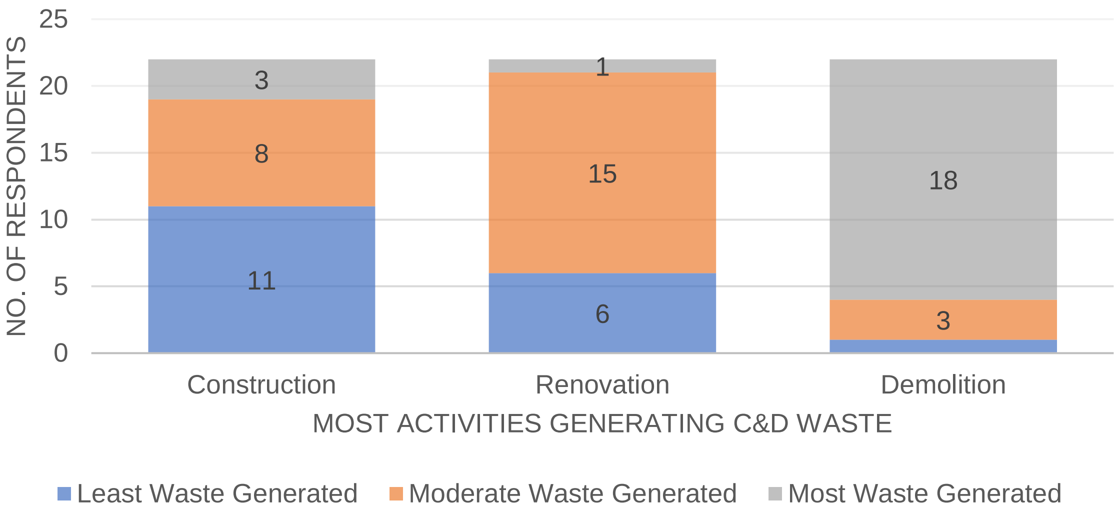

Chart 10-10: Most Activities Generating C&D Waste

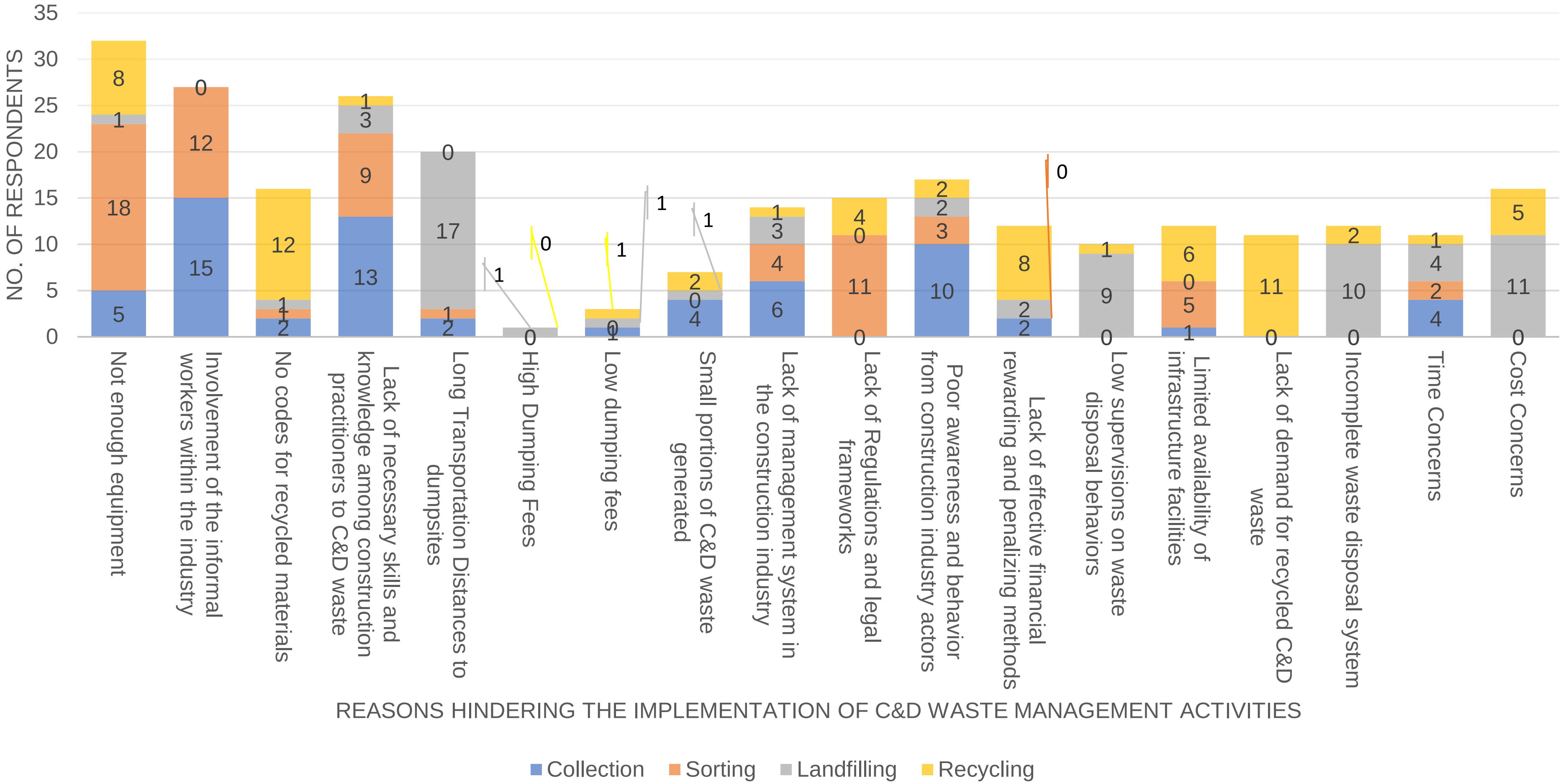

Chart 10-11: Reasons Hindering the Implementation of C&D Waste Management Activities

10.3.2.1.1.2 Charts 11 – 12 to 22 Analysis

The findings of **chart 10-12** suggest that 100% of those who were participated in the survey. Indicated that GAM necessitates specific requirements interrelated to C&D waste management within the licensing documents. However, all participants within the municipality have shown an inconsistency in their responses regarding the size of project that requires C&D waste management. This comes in line with Abu-Afifeh, 2012; Al-Fassa, 2012; Al-Tarawneh, 2012 studies that the JCCA has no written standards or criteria for classifying construction projects in terms of their size.

It has been evidenced that it is typical for the demolition activity to be part of the construction licensing arrangements. One reason why this has been asked is to ascertain if a C&D waste management is stipulated in both licenses. Since all participants have declared that this activity is part of the licensing arrangements and the municipality requires a C&D waste management. As both activities require a C&D waste management to be licensed or regulated. Although, what can be clearly seen in **chart 10-12** that C&D waste management is confined to collection and landfilling with few sorting and recycling activities for some projects. Commonly depending on types of waste material, quantity of waste material generated. In addition to, inexistence of sorting and recycling equipment and the affordable prices of construction raw material.

The data reported here appear support the ignorance of stipulating a design for prevention, reduction, or deconstruction in both activities for all projects. Owing to considering it as a relatively new method in Jordan that should be examined and evaluated before applying it.

In contrast to what the municipality stipulates of C&D waste management activities in its construction license. Almost all participants agreed that the municipality would consider using recycled aggregates in new concrete mixes in new projects. If only designed by specific codes and specifications.

Lastly, the findings from **chart 10-12** suggest that nearly all participants revealed that the municipality takes the environmental, social and economic concerns into consideration within its policies, however, with few variations.

The evidence from this survey suggests that almost all of those who responded agreed that this informal behaviour is associated with lack of regulations, legal framework and legislations and management systems. In addition to, construction actors' awareness in respect to C&D waste impacts and benefits of reusing or recycling C&D waste material, necessary skills and knowledge amongst construction practitioners to C&D waste. Besides, the involvement of the informal workers within the industry and incomplete waste disposal systems.

Just over half of the respondents have referred that the lack in governmental supervision and strictness and low supervisions on waste disposal behaviours are behind this wrong attitude. Although, fewer than half of them have signified that the long transportation distances to dumpsites and time concerns can lead to illegal dumping. Meanwhile, the high costs for legal dumping including dumping fees had the lowest proportion amongst respondents. One of the respondents has raised an attention to the coverage of the municipality landfills in Amman.

Moving on now to consider the approaches that could contribute to mitigating the informal dumping. More than 20 of the respondents share several approaches such as modifying and adding legal frameworks and regulation in respect to C&D waste and improving the awareness of the construction industry actors in Jordan. In addition to, increasing the governmental supervision and strictness on C&D waste and improving the skills and knowledge among construction practitioners to C&D waste. Besides, providing markets for recycled waste material to initiate recycling of C&D waste and facilitating recycling plants to be contributory to such mitigation.

Over half of the participants have declared that the decrease of distances to dumpsites would derive mitigation to this attitude. Less than the half of them stated that decreasing the legal dumping fees of C&D waste or providing taxation exemptions. Result in decreasing the informal dumping of C&D waste. It is worthwhile mentioning that some respondents have stated that applying high fare penalties and increasing the prices of raw material. In addition to, constructing more landfills or recycling plants that are properly distributed to cover more region across the country. Could transform the industry actors towards other alternatives such as recycling.

Having discussed the reasons behind the informal attitude and how to mitigate it. It is now necessary to scale what types of projects generate a huge amount of waste. Specifically, excavation waste, as according to the data collected from the landfill department at GAM. A huge percentage of C&D waste is excavation waste. The most likely projects that causes excavation waste are tunnels and commercial projects. Followed by bridges and residential projects and lastly streets and highways if excavation is needed.

With regard to C&D waste management, this survey has contributed to determining the reasons preventing the C&D waste management in landfill or dumpsites in which 90% of those who were participated have indicated that the composition of C&D waste that comprises many types of waste and the inexistence of sorting on site prevents the management of C&D waste in landfills, however, more than 50% of them stated that the large quantities of C&D waste and the less costs of landfilling are an important determinant of why waste management is not happening in landfills. Noting that fewer than 10% of participants seen that containing hazardous or harmful material in C&D waste and the small quantities of C&D waste as a factor related to prevent C&D waste management in landfills. As far as C&D waste is concerned, this survey has brought to line the encouragements that can transform the construction industry towards adopting a C&D waste management strategy. All applicants have clearly identified that in order to encourage the industry towards such a strategy there should be a modification of regulations and legal frameworks to facilitate the reuse of C&D waste within the construction industry, provide the local market with markets for recycled C&D waste and apply fines or penalties for polluters. Meanwhile, just over 70% of them concurred that providing tax exemptions would derive a transformation. On the other hand, increasing the disposal fees could have a negative effect on this transformation. As indicated previously the environmental, social and economic concerns are taken into consideration although with some variations between them. Nearly 95% of candidates shown that the municipality takes the environmental and economic concerns into consideration, also social concerns is similar to that but with less consideration.

Lastly, **chart 10-19** illustrates a scale of regulations, contractor's compliance and governmental supervision in respect to C&D waste management.

According to participants' responses, the survey shows that the regulations of collection and landfilling are effective in regulating these activities. However, some have clarified that these activities need more effort in terms of management (details and clarifications) than the current situation to be more effectual. The same goes for the municipality strictness and other internal governmental departments in controlling and monitoring contractors and construction companies' attitudes. Nonetheless, municipalities need to utilise more monitoring teams on these actors. Especially municipalities outside Amman as they vary in terms of strictness and monitoring unlike GAM.

Nevertheless, participants have acknowledged that sorting and recycling regulations are quite ineffective. As per the inexistence of sorting regulations, sorting equipment like magnetic conveyors and crushers. For recycling, regulations are also not existed, although one respondent has stated that some informal actors are adopting this activity. As per its revenues and raised that there should be strictness when regulations existed to force formal industries towards recycling.

In respect to construction contractors and companies' compliance to the current regulations of C&D waste. Respondents have scaled their attitudes to be moderate. Thus, not every contractor or company is compliance to the C&D waste regulations. Bringing the low strictness when applying penalties on contractors who violate the regulations. In addition to the low monitoring on contractors who have precedents in violating the regulations of C&D waste as significant contributory factors to their attitudes.

This survey has shown that a large proportion of respondents nearly 60% have ascertained that 40% - 60% of C&D waste generated is dumped informally. Likewise, just over a quarter of the total respondents have ensured that the informal dumping occurs on very high rates 60% - 80%. As predictable, the percentage of participants was less than 5% for less than 40% informally dumped.

On the question of which activity upon construction, renovation and demolition generates C&D waste the most in Jordan. As factors are known to affect the volume and type of C&D waste. Approximately, 80% of respondents ascendingly ordered demolition as the number one reason, followed by renovation with almost with fewer than 70% and then construction with 50%.

In the case of C&D waste management, this survey has distinguished the most 3 reasons behind preventing collection, sorting, landfilling and recycling within the C&D waste management on site. It has been revealed that several factors play a role in hindering the collection process on site. Such as the involvement of the informal workers within the industry, lack of necessary skills and knowledge among construction practitioners to C&D waste and poor awareness and behaviour of construction industry actors.

In terms of sorting, the integration of not enough equipment, involvement of the informal workers within the industry and lack of Regulations and legal frameworks exerts a powerful effect upon sorting on site.

Meanwhile, the long transportation distances to dumpsites, incomplete waste disposal system and cost concerns impact the efficiency and effectiveness of proper landfilling.

Turning to recycling, several factors have revealed to affect it such as the inexistence of codes for recycled material and enough equipment, lack of effective financial rewarding and penalizing methods and lack of demand for recycled C&D waste. Although, the inexistence of recycled material design codes is an important determinant of hindering recycling in Jordan.

10.3.2.1.2 Department of Legal Regulations and Frameworks Questionnaire

This questionnaire has been directed to the legal frameworks department at GAM. This department is responsible on establishing regulations and legislations including solid waste within the authority of GAM.

The number of respondents participated in this survey was only 5. This number tend to be small because the department has few employees compared to other departments and ministries. However, with a small sample size there might be a possible bias in these responses, thus caution must be applied.

10.3.2.1.2.1 Charts 11 – 23 to 33

Chart 10-23 below determines the underlying causes of the absence of sorting as a process in national strategies. Since they are not currently stipulated in the regulatory system of solid waste. These causes are assessed by participants using Likert Scale questions.

The bars in this chart represent all the evaluations of participants based on the questions seen below. Meanwhile, **chart 10-24** offers the consideration and aspiration of the municipality. Towards embedding sorting of solid waste at source in governmental strategies, legal frameworks and regulation. These considerations are provided by participants using Yes/No question. The bar in this chart ascertains the vision of the municipality by participants based on the question seen below.

Additionally, **chart 10-25** assess the effectiveness of several approaches that could help in implementing the sorting of solid waste in the country. These approaches are provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to these approaches based on the question seen below.

Also, **chart 10-26** below distinguishes the actors that should be responsible on sorting solid waste effectively to have sufficient results. These are recognised by participants using Yes/No question. The bars in this chart represents the responsibility of these sides by participants based on the question seen below.

Chart 10-27 below makes an attempt to differentiate between types of waste. By illustrating if C&D waste can be treated like solid waste in regulation and legal frameworks. These are recognised by participants using Yes/No question. The bars in this chart represents the participants' perspective based on the question seen below.

Meanwhile, **chart 10-28** offers an adequate explanation since excluded C&D waste from the current regulations of solid waste. These reasons are provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these reasons based on the question seen below.

In addition, **chart 10-29** below approximates the percentage of C&D waste informal dumping from the total C&D waste generated in Jordan. These percentages are estimated by participants as represented in the bar and based on the question seen below.

The **chart 10-30** below provides information related to the reasons that could be contributory to informally dump C&D waste in Jordan. These reasons are provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these reasons based on the question seen below.

Chart 10-31 below assess the effectiveness of possible approaches that could contribute to mitigating the informal attitude of C&D waste. These approaches are evaluated by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these approaches based on the question seen below.

Meanwhile, **chart 10-32** below assess the effectiveness of possible approaches. That could contribute to transform the construction industry towards adopting a C&D waste management strategy. These approaches are evaluated by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these approaches based on the question seen below.

Chart 10-33 below provides an evaluation of the current regulations of C&D waste. Alongside the compliance of contractors to these regulations. In addition to, the government strictness in monitoring the contractor's attitudes and other internal governmental departments. This evaluation is provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to these regulations and compliances based on the question seen below.

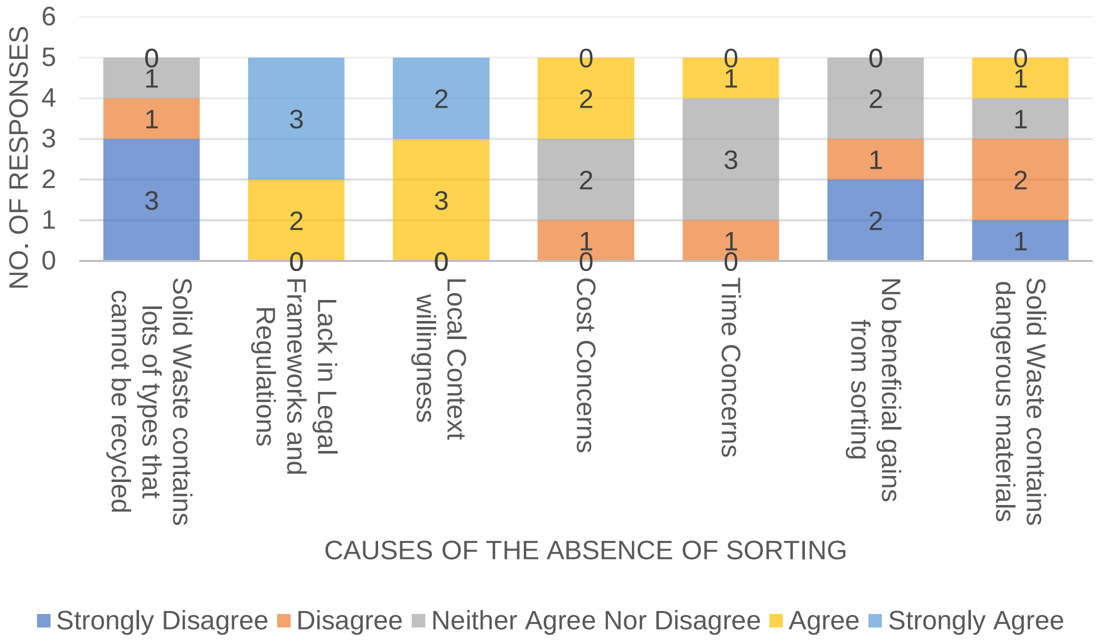

Chart 10-12: Causes of the Absence of Sorting

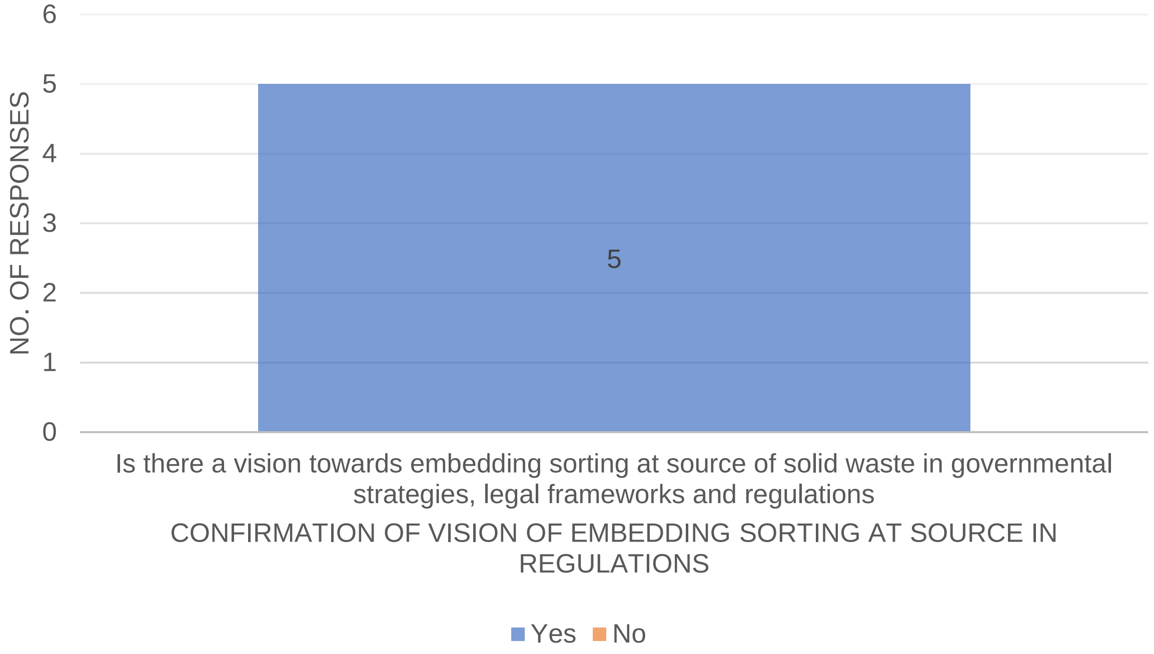

Chart 10-13: Vision of Embedding Sorting at Source in Regulations

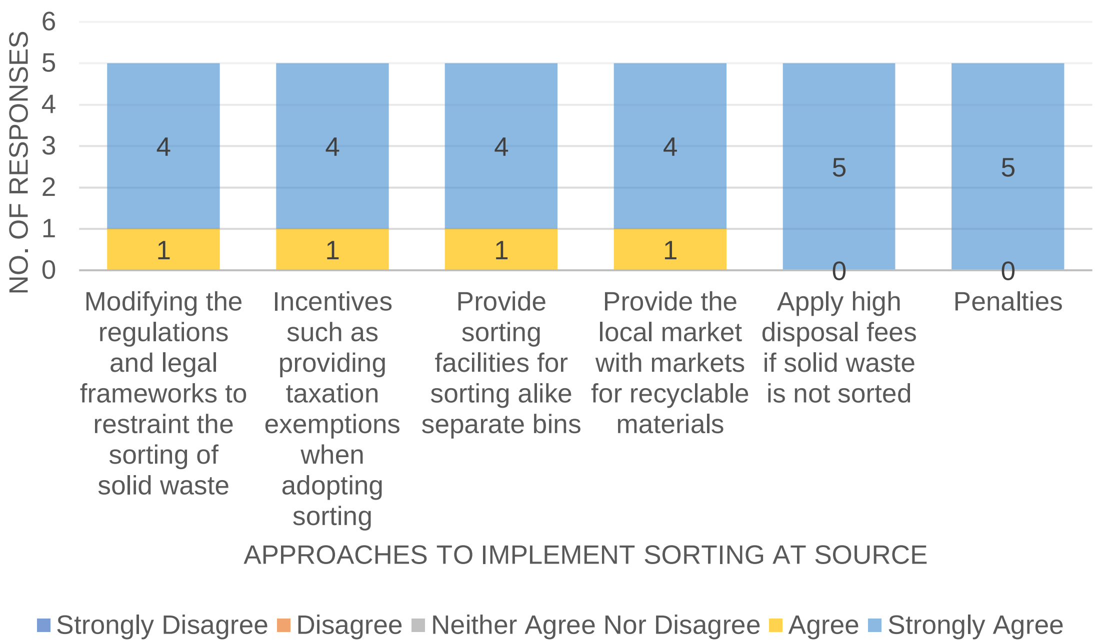

Chart 10-14: Approaches to Implement Sorting at Source

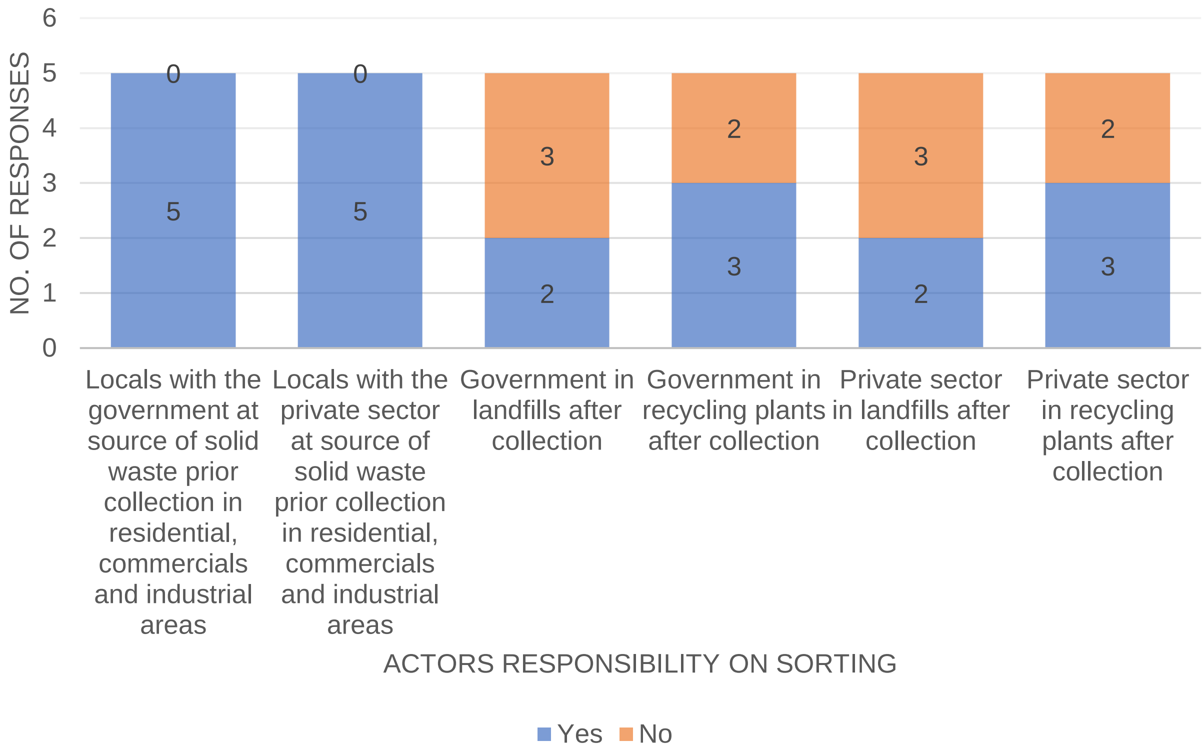

Chart 10-15: Actors Responsibility on Sorting

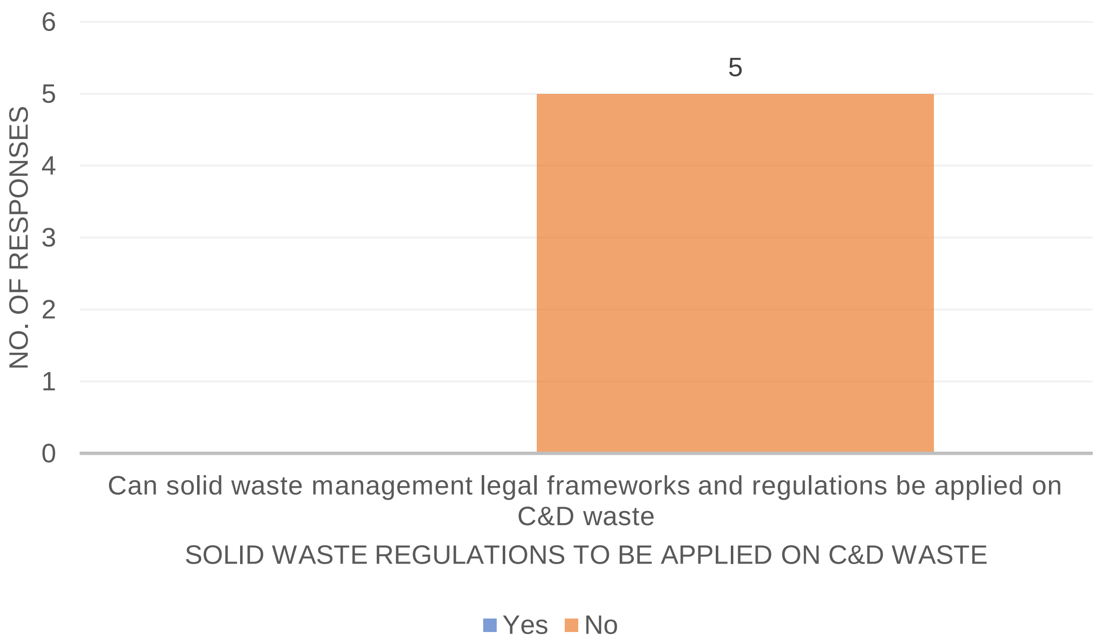

Chart 10-16: Solid waste Regulations to be Applied on C&D Waste

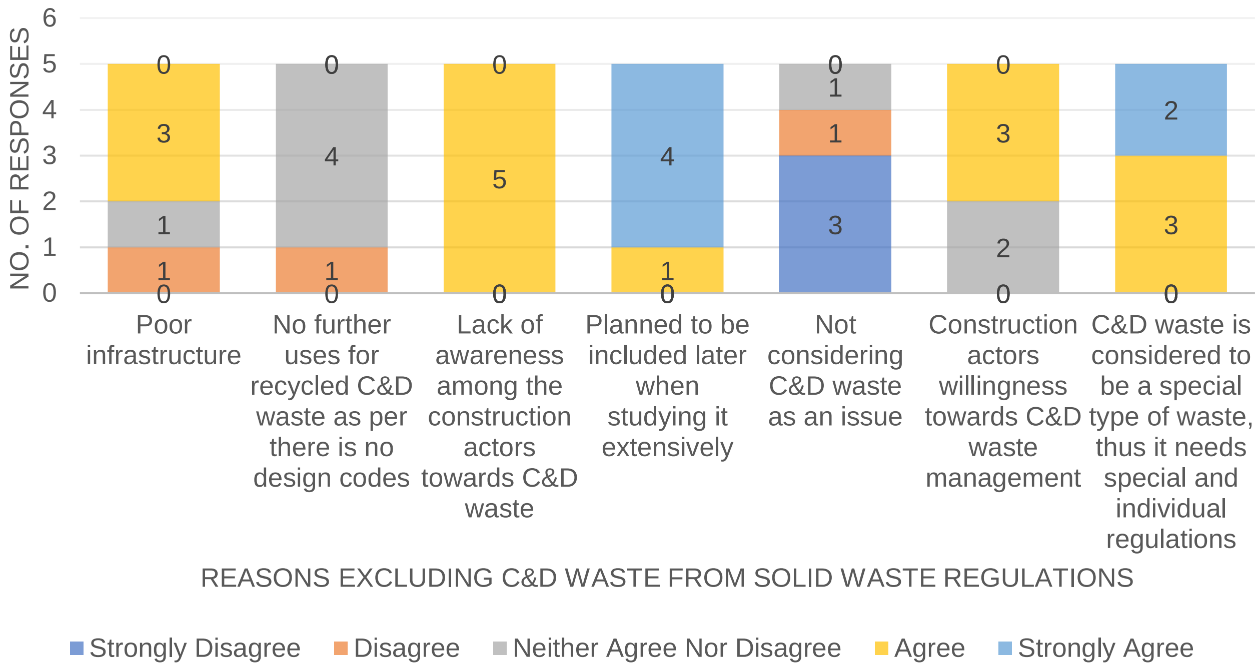

Chart 10-17: Reasons Excluding C&D Waste from Solid Waste Regulations

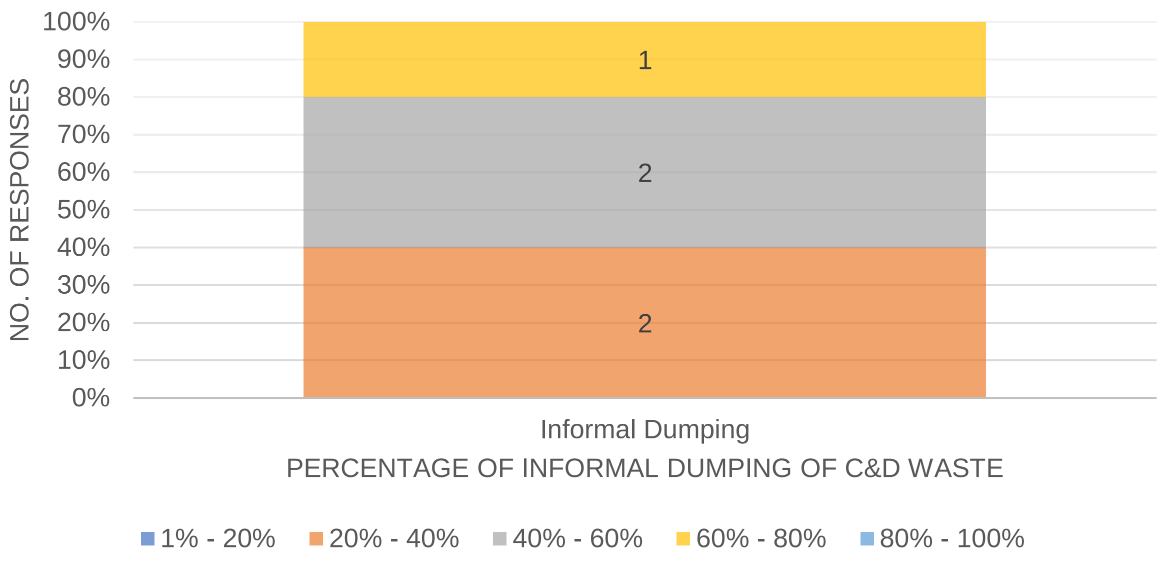

Chart 10-18: Percentage of Informal Dumping of C&D Waste

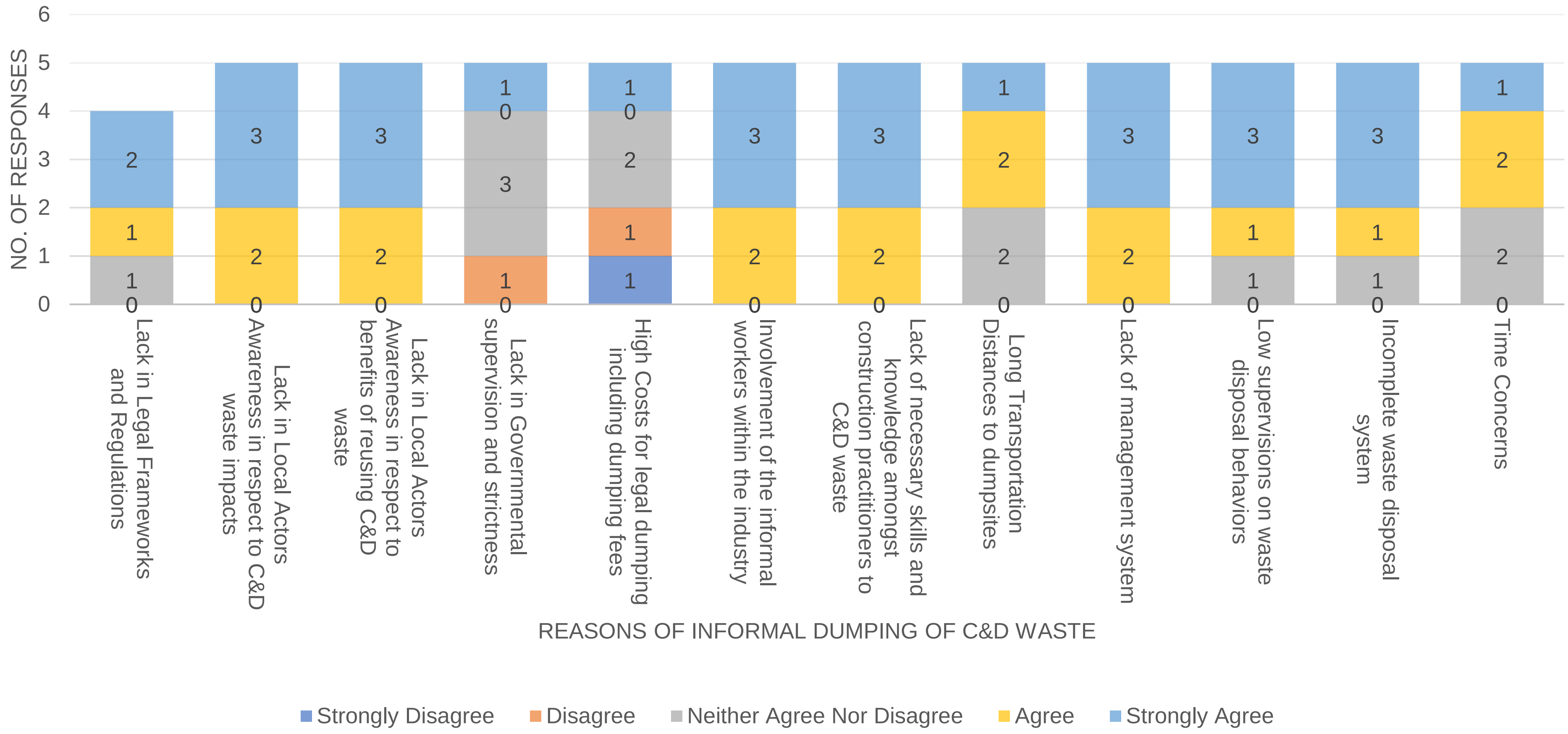

Chart 10-19: Reasons of Informal Dumping of C&D Waste

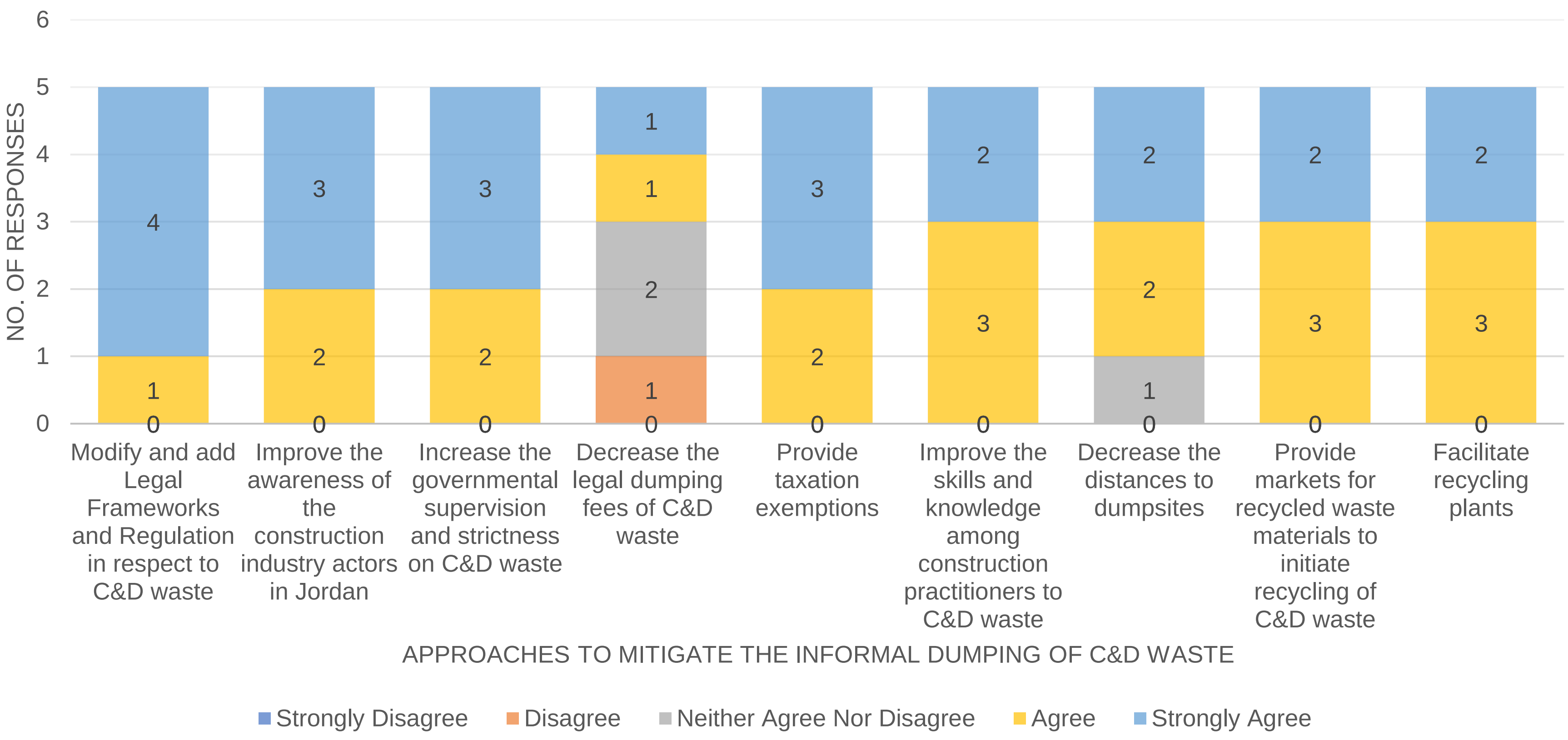

Chart 10-20: Approaches to Mitigate the Informal Dumping of C&D Waste

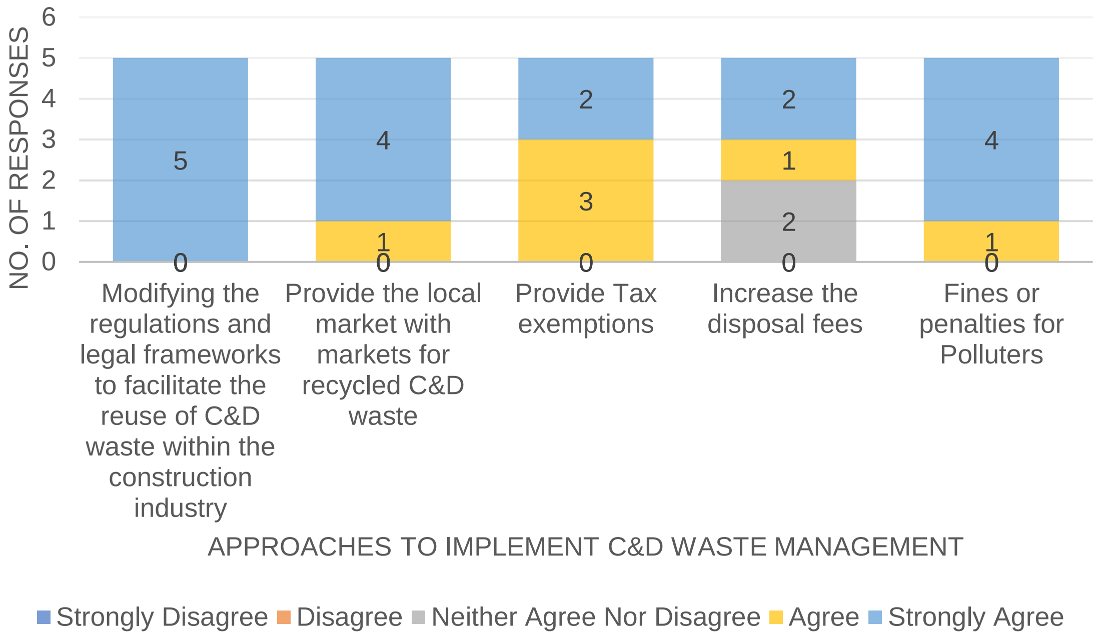

Chart 10-21: Approaches to Implement C&D Waste Management

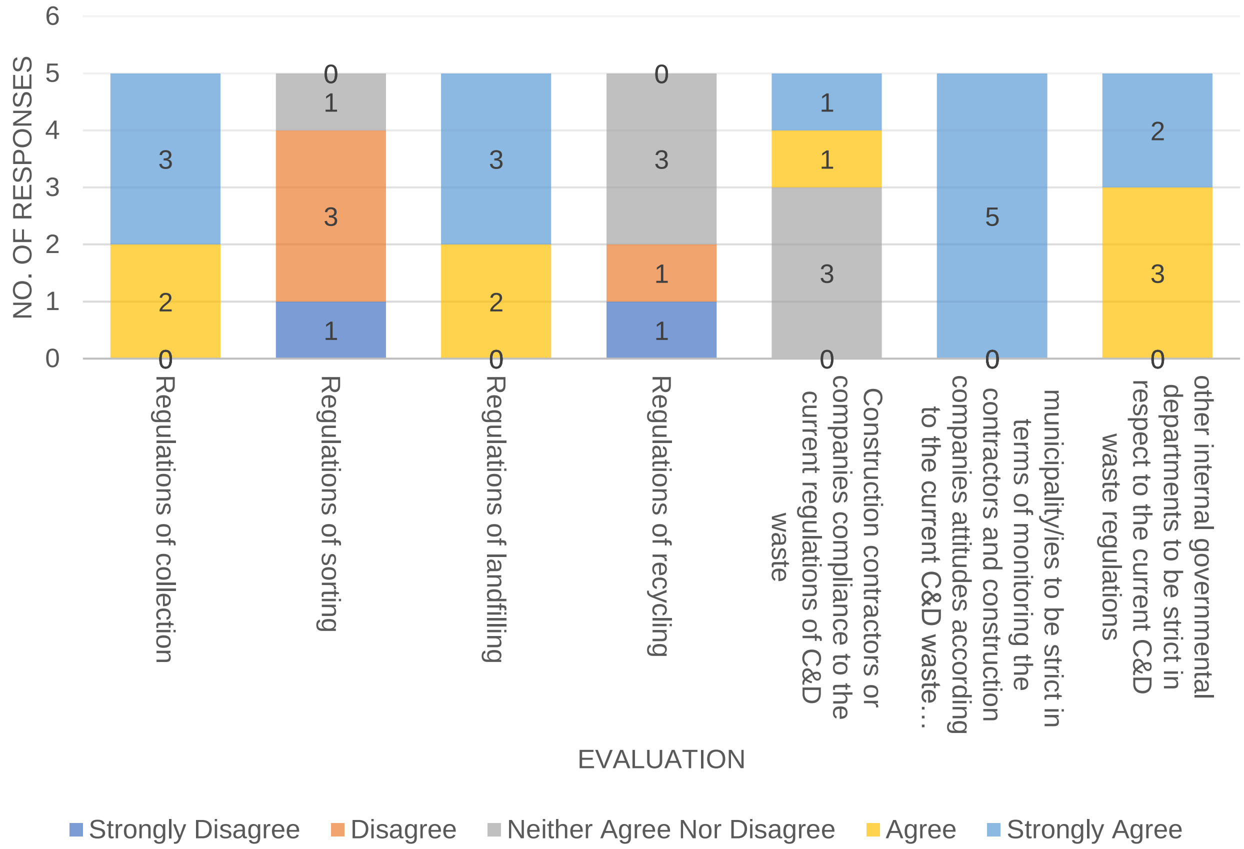

Chart 10-22: Evaluation of Current Regulations, Compliances and Strictness

10.3.2.1.2.2 Charts 11 – 23 to 33 Analysis

The case reported in **chart 10-23** here illustrates by all respondents. That the lack in legal frameworks and the local context willingness are important determinants to the absence of sorting in national strategies. This has been consistent with the MoE survey findings.

Meanwhile, there is some evidence by almost 20% to 40% of participants have seen that cost and time concerns and the composition of solid waste containing dangerous or hazardous material. May affect the existence of sorting in these strategies.

For the time being, 100% of them have excluded the wide variety of waste material types in the composition of solid waste and no beneficial gains from sorting. As reasons not to embed sorting in national strategies. According to all participants in this survey as seen in **chart 10-24**, the municipality is showing an aspiration towards embedding sorting at source. As a vision to be considered in upcoming strategies, frameworks and regulations.

The findings of this survey as illustrated in **chart 10-25**. Suggested that all of those who were participated in the survey seen several factors can perfectly contribute to implementing the sorting of solid waste in the country, such as:

1. Modifying the regulations and legal frameworks.
2. Applying incentives such as tax exemption for actors who adopt sorting as well as penalties.
3. Providing sorting facilities and the local market with markets for recyclable waste material.
4. Increasing the disposal fees.

Chart 10-26 is a good illustration of implementing sorting by the right side to contribute best results of sorting. The survey confirms that 100% of those surveyed agreed that the best implementation of sorting should be by locals. With either the government or the private sector before collection in residential, commercial, or industrial areas as demonstrated in MoE survey. Although, a range of 40% to 60% of the same sample corresponded that sorting will not contribute to better results if implemented after collection by both sectors.

The results in **chart 10-27** show that well over than 95% of respondents suggest that solid waste legal frameworks and regulations cannot be applied on C&D waste. As according to several participants this type of waste is specifically treated as a special waste. Thus, should be having individual regulations to be managed.

The case in **chart 10-28** reveals why C&D waste has been excluded from the regulations of solid waste. Apparently, 100% of those who were participated declared that C&D waste is a special type of waste as previously mentioned. Additionally, it needs special and individual regulations to be applied. Also, the same percentage reasoning that lack of awareness among construction actors' influences excluding C&D waste from the current regulations and strategies. Just 60% of those surveyed referred the excluding of C&D waste to the willingness among construction actors towards C&D waste management and poor infrastructure in the country. Meanwhile, most respondents have agreed that no further use for recycled C&D waste material is not considered to be a reason for such exclusion. Nearly, 80% of respondents have seen that not considering C&D waste as an issue is not responsible for excluding C&D waste from these regulations. However, it is to be true that a percentage of 100% of participants has anticipated that C&D waste is planned to be included in regulations when studied extensively.

The results in **chart 10-29** have revealed that almost 60% of surveyors stated that a range of 40% to 80% of C&D waste is informally dumped. Above two thirds of them estimated that C&D waste is informally dumped with a range of 40% to 60%. Only one third with a range of 60% to 80%. Although only 40% of the total respondents projected that the informal dumping happens on a range of 20% to 40% from the total C&D waste generated.

According to those who participated in this survey as seen in **chart 10-30**. It has been found that many important factors are related to the informal dumping of C&D waste. According to 60% and above of respondents those contributory factors to the informal dumping of C&D waste are as follows:

1. Lack in legal frameworks and regulations.
2. Local actors' awareness in respect to C&D waste impacts and benefits.
3. Poor management systems.
4. Lack of necessary skills and knowledge amongst construction practitioners to C&D waste.
5. Incomplete waste disposal system.
6. Involvement of the informal workers within the industry.
7. Time concerns.
8. Long transportation distances to dumpsites.
9. The low supervisions on waste disposal behaviours.

Whereas less than 20% of respondents has seen the lack in governmental supervision and strictness and the high costs for legal dumping including dumping fees play a vital role in such an issue.

Meanwhile, the analysis demonstrates in **chart 10-31** according to 100% of respondents that there are important driving factors of mitigating the informal dumping of C&D waste, such as:

1. Modifying and adding legal frameworks and regulations in terms of C&D waste.
2. Improving the awareness of the construction industry actors in Jordan.
3. Increasing the governmental supervision and strictness on C&D waste.
4. Provide tax exemption and markets for recycled waste material.
5. Improving the skills and knowledge among construction practitioners to C&D waste.
6. Facilitate recycling plants.

Also, 80% of participants agreed that a strong link may exist between reducing the informal dumping and decrease the distances to landfill. Meanwhile, about 40% of respondents seen that decreasing the legal dumping fees of C&D waste. As a factor related to mitigating the informal dumping of C&D waste.

The analysis of **chart 10-32** confirms that C&D waste management strategy can be adopted by the industry by several approaches. This analysis has reported that 100% of those who responded that there are known factors to affect the industry towards adopting a C&D waste management strategy, such as:

1. Modifying the regulations and legal frameworks.
2. Providing the local market with recycled waste material markets and tax exemptions.
3. Applying fines and penalties for polluters

Likewise, the previous analysis of **chart 10-32** increasing the disposal fees would not encourage the industry towards adopting a C&D waste management strategy according to 60% of respondents.

Lastly, the analysis of **chart 10-33** shows how adequate the current regulations and legislations are in respect to regulating the collection, sorting, recycling, landfilling, contractor's compliances. In addition to, the ministry's strictness on monitoring the contractors and construction companies' attitudes and internal governmental departments.

The results of those who participated in the survey shown that above 95% of respondents evaluated that the current regulations of collection and landfilling are effective enough in terms of regulating C&D waste. Also, the same percentage revealing that other internal governmental departments to be strict in respect to the current C&D waste regulations and for the municipality strictness in monitoring the contractor's attitudes. However, only 40% of those participants illustrated that contractors are compliance to these regulations. Meanwhile, the rest 60% were neutral in scaling their compliance. In contrast to the collection and landfilling regulations, all participants measured the sorting and recycling regulations to be not adequate for regulation C&D waste.

10.3.2.2 Ministry of Public Works and Housing

10.3.2.2.1 MPWH – Department of Construction

This section includes the analysis and the discussion of MPWH – department of construction questionnaire.

The total number of participants in this questionnaire was 24 as Civil Engineers. This questionnaire has covered several aspects comprising:

1. Identifying the types of contracts used by the ministry including the contractual arrangements and the procurement methods.
2. Recognising the C&D waste management strategies, activities and barriers.
3. Spotting the informal dumping of C&D waste including its causes, mitigations and encouragements.
4. Measuring the ministry environmental, social, economic considerations and their willingness towards using recycled crushed concrete aggregates in new concrete mixes.
5. Measuring the adequacy of current regulations in regulating a proper C&D waste management embracing collection, sorting, landfilling and recycling. In addition to, ministry monitoring and supervision and contractors' compliance to these regulations.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No, Likert Scale and multiple-choice questions.

10.3.2.2.1.1 Chart 10 - 34, 35 and 36

The charts below distinguished the types of contracts used by the ministry when constructing governmental projects, the C&D waste management activities within the construction and demolition methods. In addition to, the ministry willingness and consideration.

These aspects have been provided by participants using Yes/No question. The bars in these charts represents the aspects as corresponded by participants based on the question seen below.

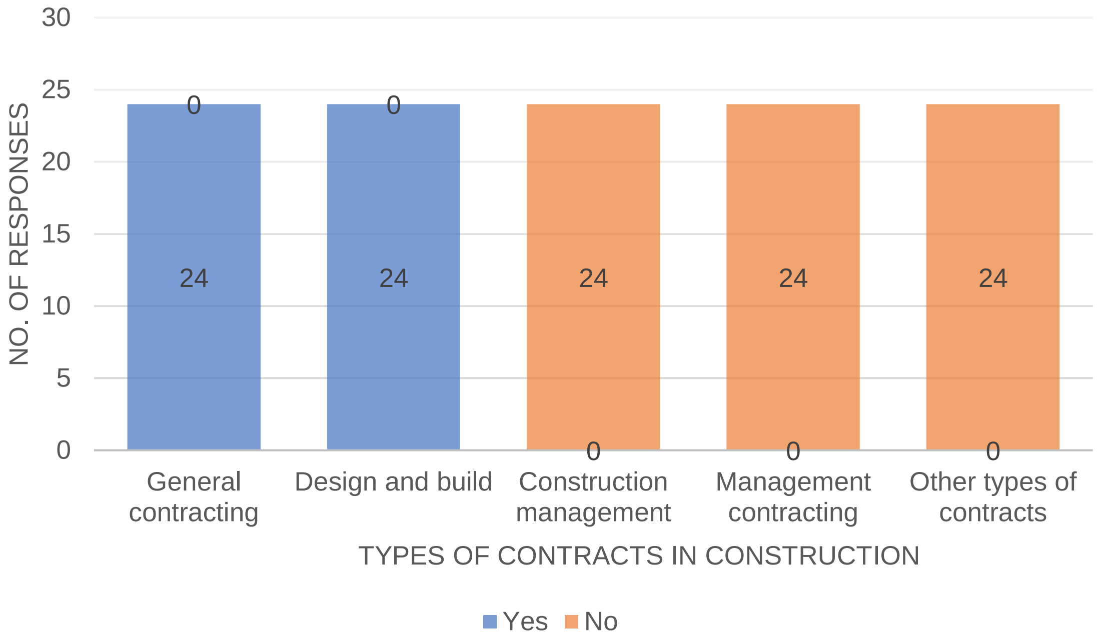

Chart 10-23: Types of Contracts in Construction

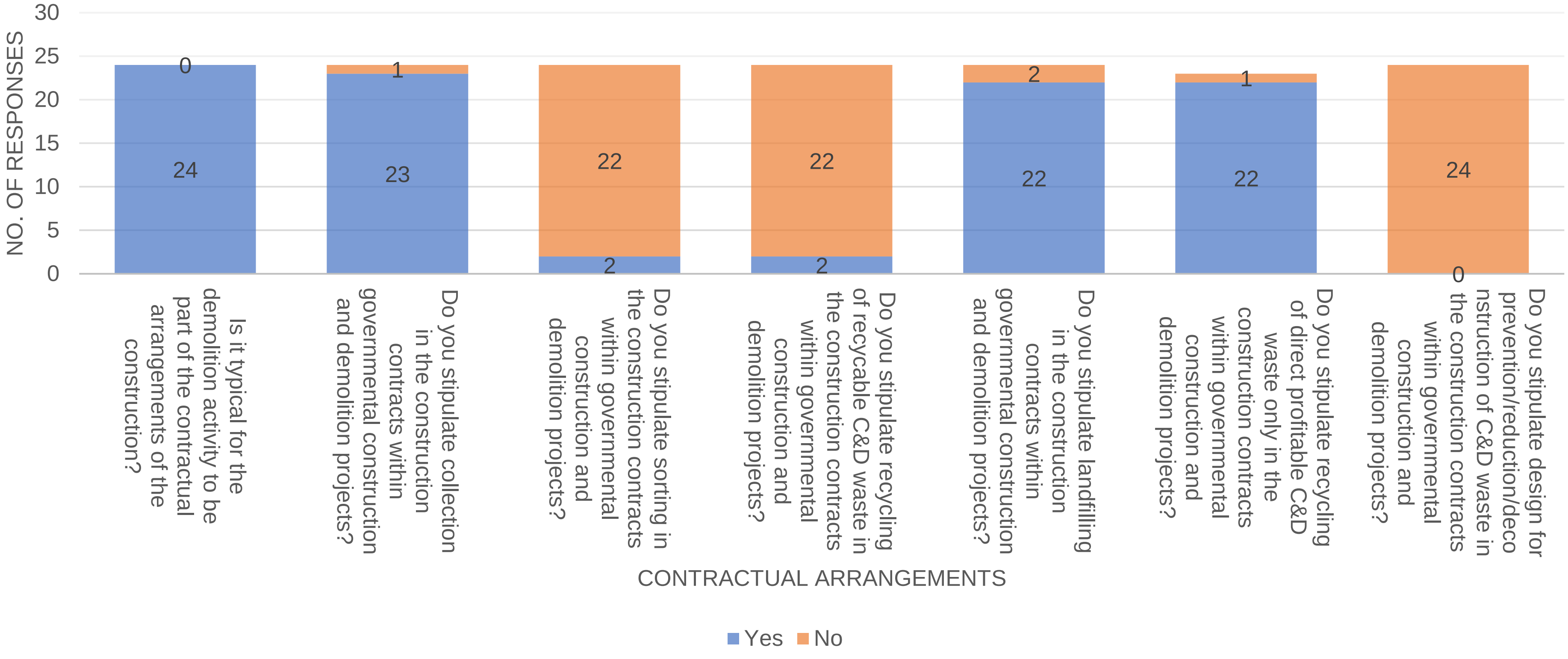

Chart 10-24: Contractual Arrangements

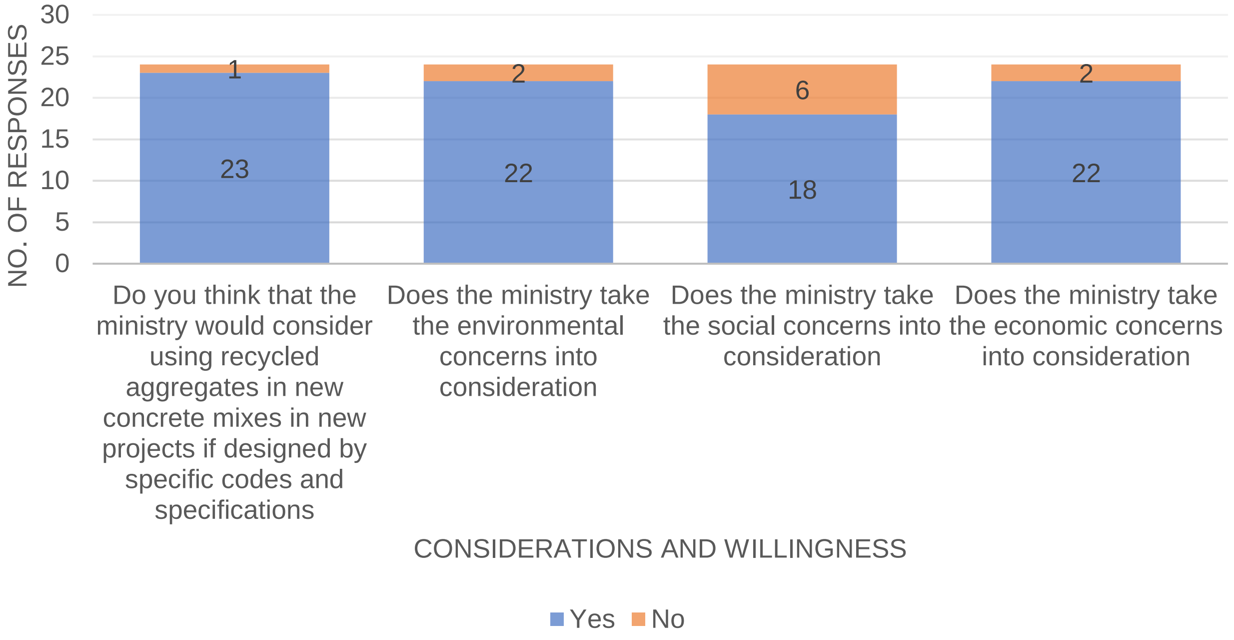

Chart 10-25: Considerations and Willingness

10.3.2.2.1.2 Charts 11 – 34, 35 and 36 Analysis

As observed above all responses have ascertained that there are two types of contracts used when constructing governmental projects by the ministry. The general contracting and the Design and build contracts. The usage and the causes of using these two types have been subjected in the next section.

Having identified what types of contracts are used. It is now necessary to explain what activities of C&D waste management stipulated in the contracts within governmental construction and demolition projects. As all of respondents have indicated that the demolition activity is typically part of the contractual arrangements of the construction. Well over than 95% of responses have shown that the collection, recycling of profitable C&D waste (steel and timber for recycling and C&D debris for backfilling) and landfilling are stipulated within these contracts. However, in contrast many more than 95% have shown that designing out waste, sorting and recycling of all types of C&D waste are not stipulated within the same contracts. This is generally seen as a factor strongly related to:

1. Absence of regulations and equipment.
2. No further use for recycled waste material.
3. The unawareness of the construction sector in respect to recycling benefits. As per the presence of unskilled workers and the preference of actors to landfilling at once. In addition to managing cost in design most likely because C&D waste is not as important as other aspects such as cost.

This interpretation differs from that of the ministry's awareness. As almost all responses have shown that the ministry would use recycled aggregates in new concrete mixes. As they agreed that using it would reduce the cost of projects. As generally recycled C&D waste material are cheaper than the standard ones, thus, cost savings. Although, they argued that recycled waste material should be correspondent to the Jordanian codes and specifications. Besides, preferring the ministry to reuse or recycle rather landfilling or informal dumping. As they are expecting the capacity of landfills is reaching its maximum. Hence, there should be another solution to C&D waste sooner or later rather than landfilling. In addition to keep up with the development pace within the construction industry. This awareness comes together with the ministry considerations. As just over 90% of responses coincided that the ministry takes the environmental and economic concerns into consideration. This is compliance to what was mentioned in the literature. Whereas almost 75% of them come to an agreement that the social concerns is the least consideration taken by the ministry.

10.3.2.2.1.3 Chart 10 - 37

The charts below offer an assessment of how frequent each type of contract is used by the ministry. This assessment is provided by participants using Likert Scale question.

The bars in this chart represents the participants' anticipation of using these types of contracts based on the question seen below.

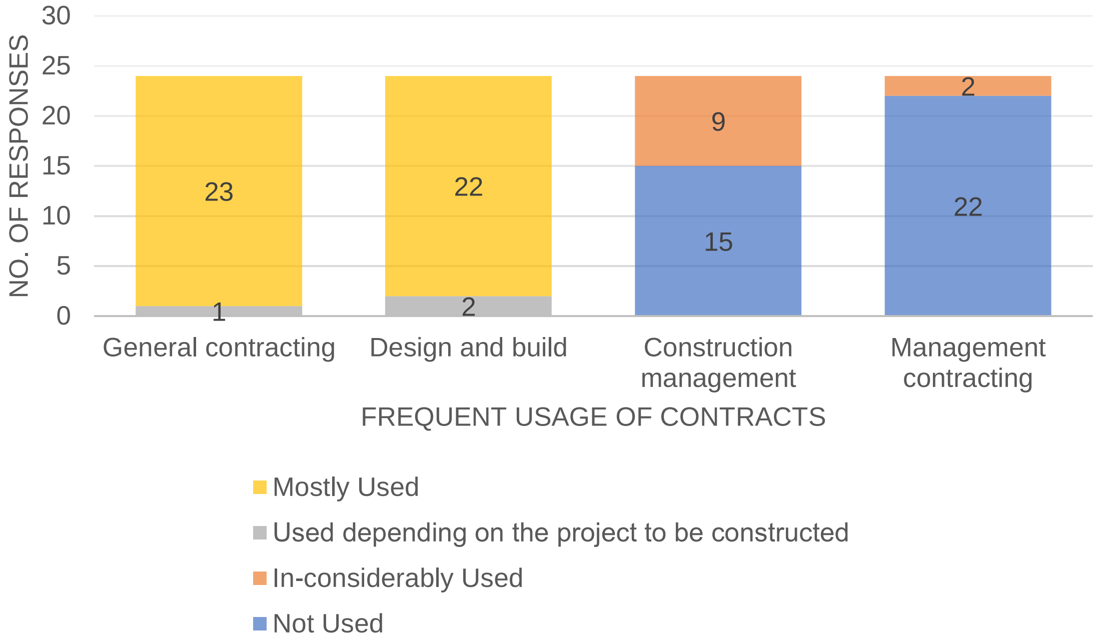

Chart 10-26: Frequent Usage of Contracts

10.3.2.2.1.4 Chart 10 - 37 Analysis

As demonstrated in the chart above, the General Contracting and Design and build had appeared to be the mostly used types of contracts as agreed by 23 and 22 of participants, respectively. Meanwhile, 100% of those who were participated indicated that the construction management and management contracting are not used or inconsiderably used in governmental projects.

10.3.2.2.1.5 Chart 10 – 38, 39, 40, 41, 42, 43, 44 and 45

The charts below offer an adequate explanation for several Likert Scale questions in the survey. Comprising the strongly related factors to use specific types of contracts, the causes of informal dumping, approaches to mitigate the informal dumping of C&D waste and the hindrances to C&D waste management in landfill. In addition to the approaches to promote the adoption of C&D waste management in Jordan, evaluation of current regulations and compliances and the considerations of the ministry.

The bars in these charts represent the participants' responses on evaluating these aspects as based on the questions seen below. It is to be noted that some of these chart's analysis is not provided in this section. As it has been already pointed out in the main body of the research.

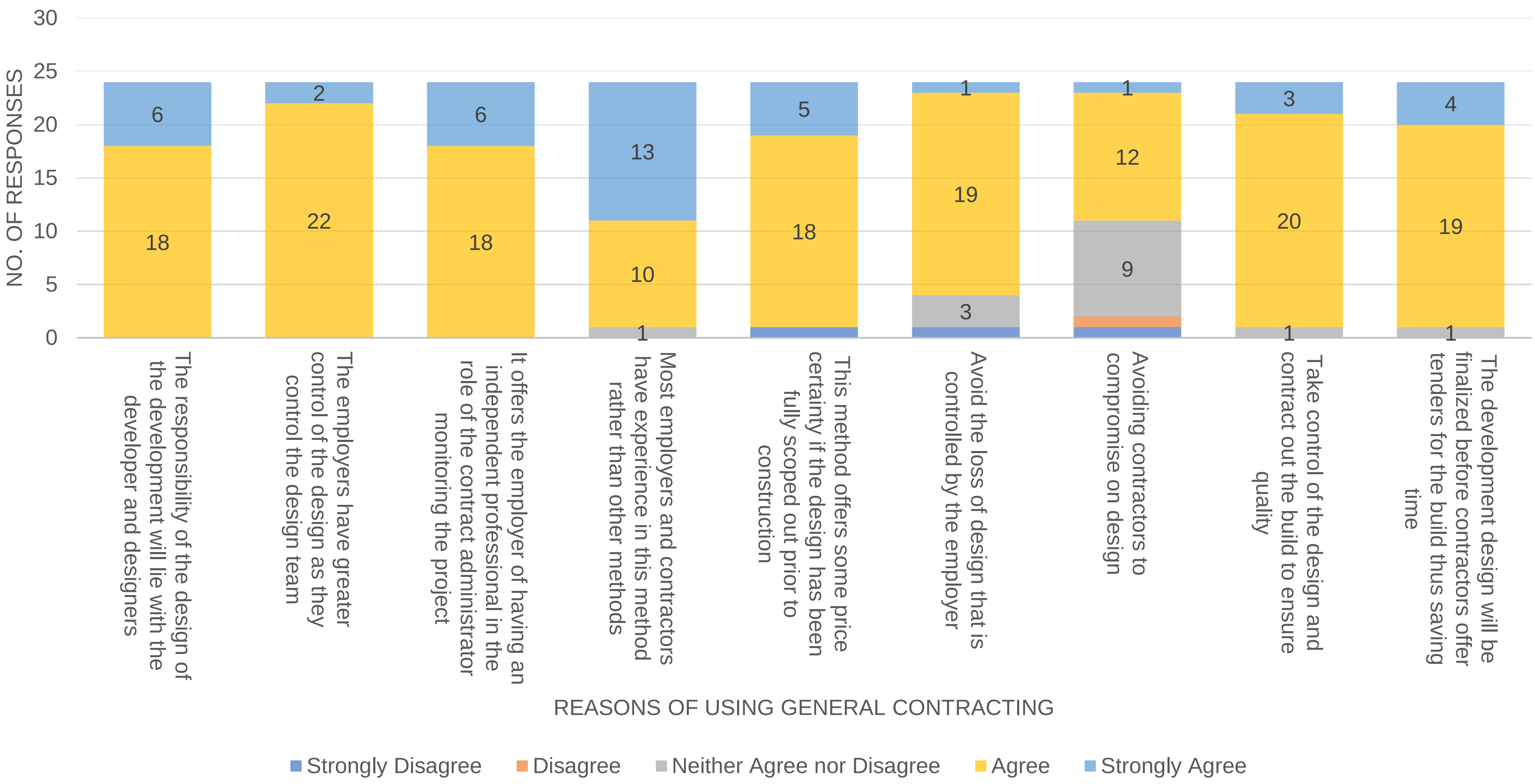

Chart 10-27: Reasons of Using General Contracting

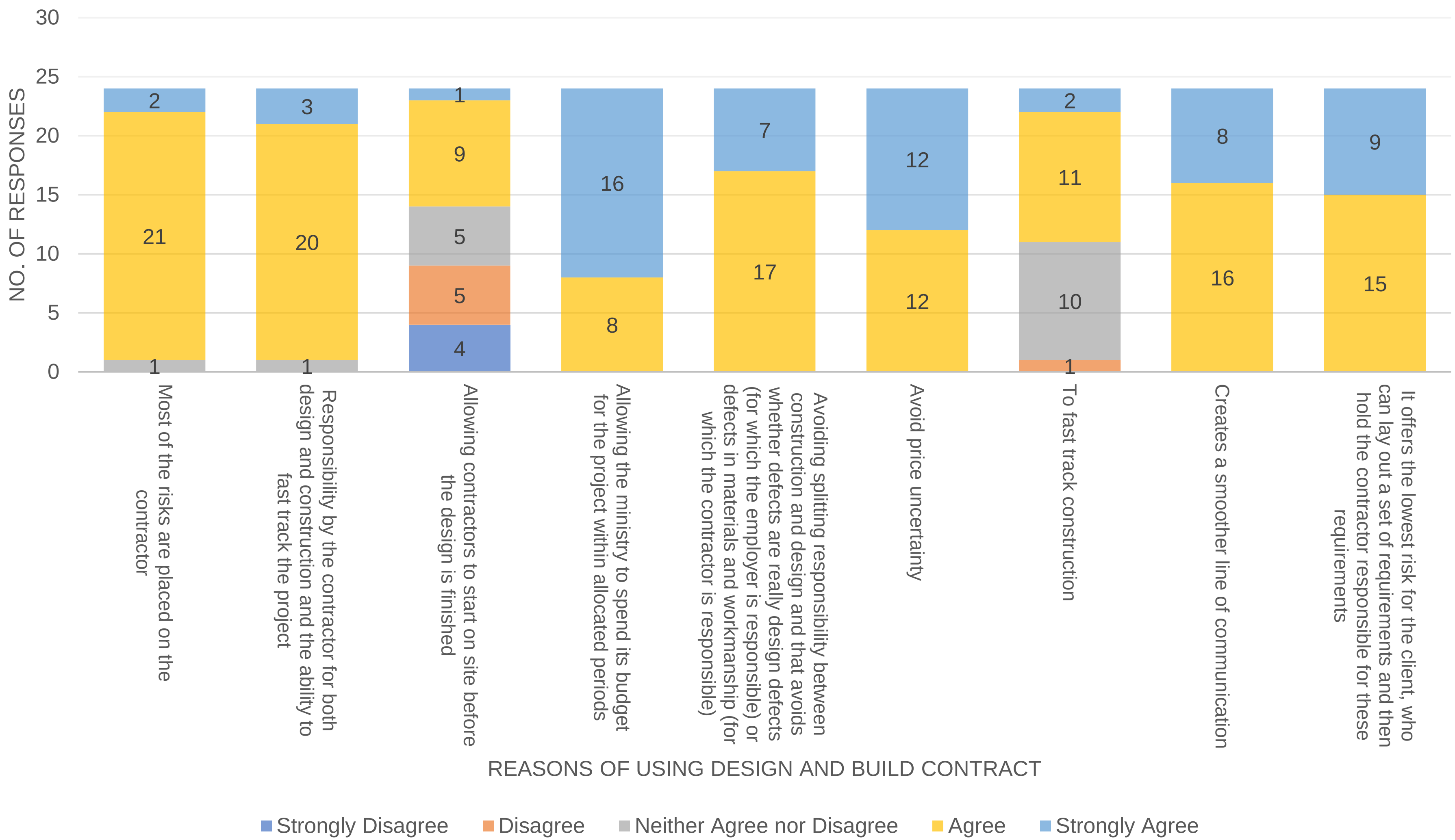

Chart 10-28: Reasons of Using Design and Build Contract

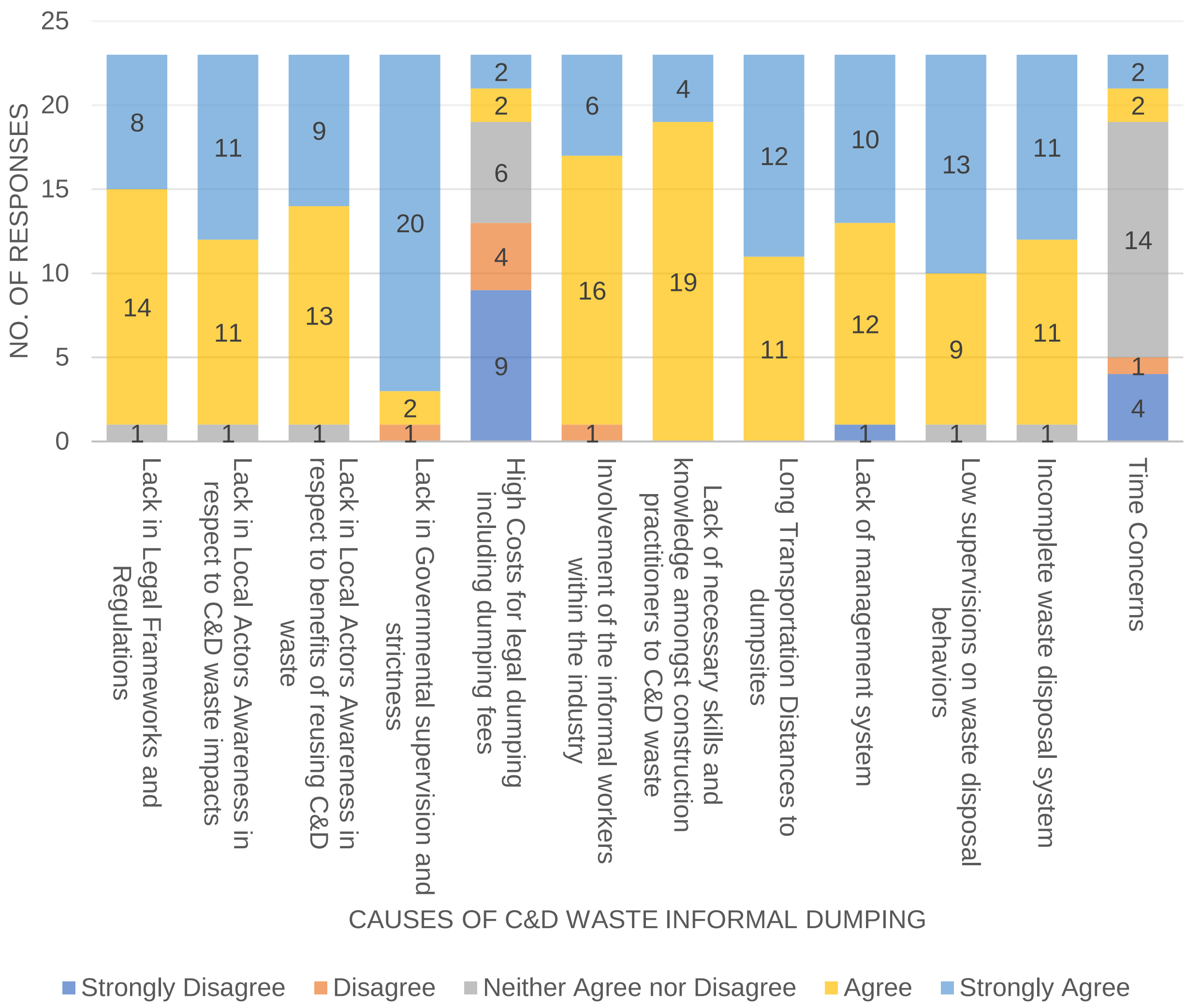

Chart 10-29: Causes of C&D Waste Informal Dumping

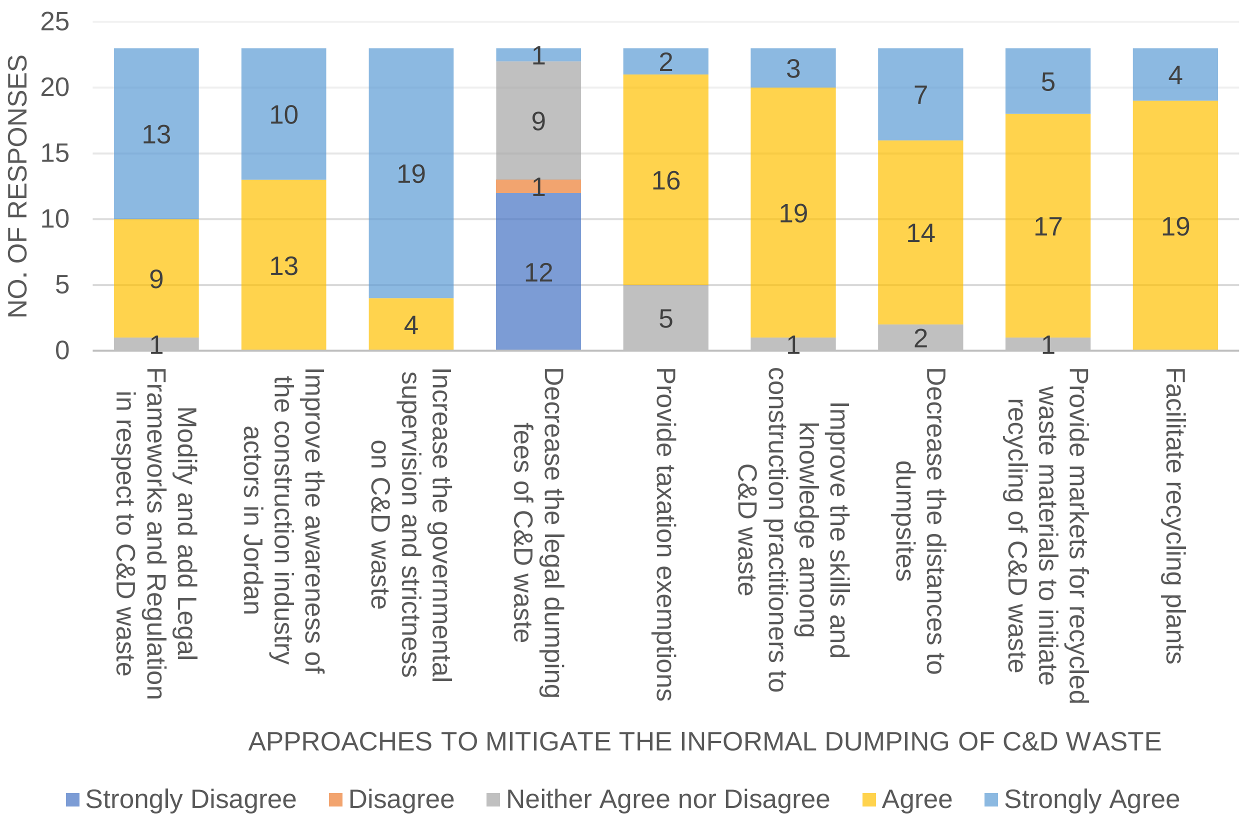

Chart 10-30: Approaches to Mitigate the Informal Dumping of C&D Waste

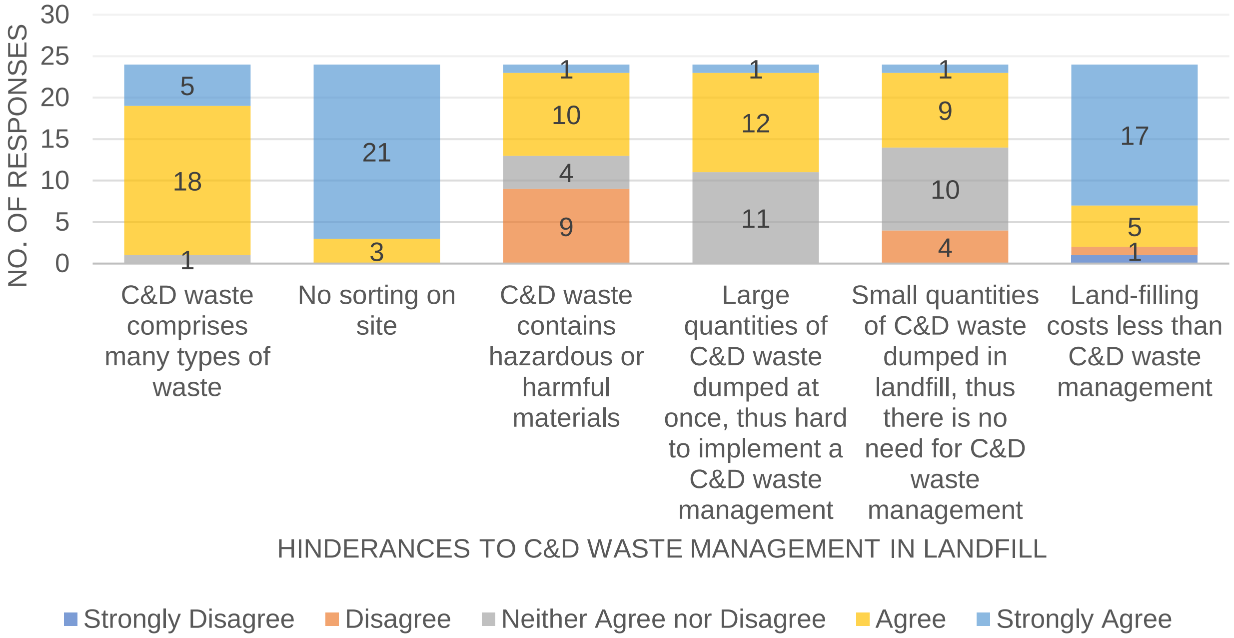

Chart 10-31: Hindrances to C&D Waste Management in Landfill

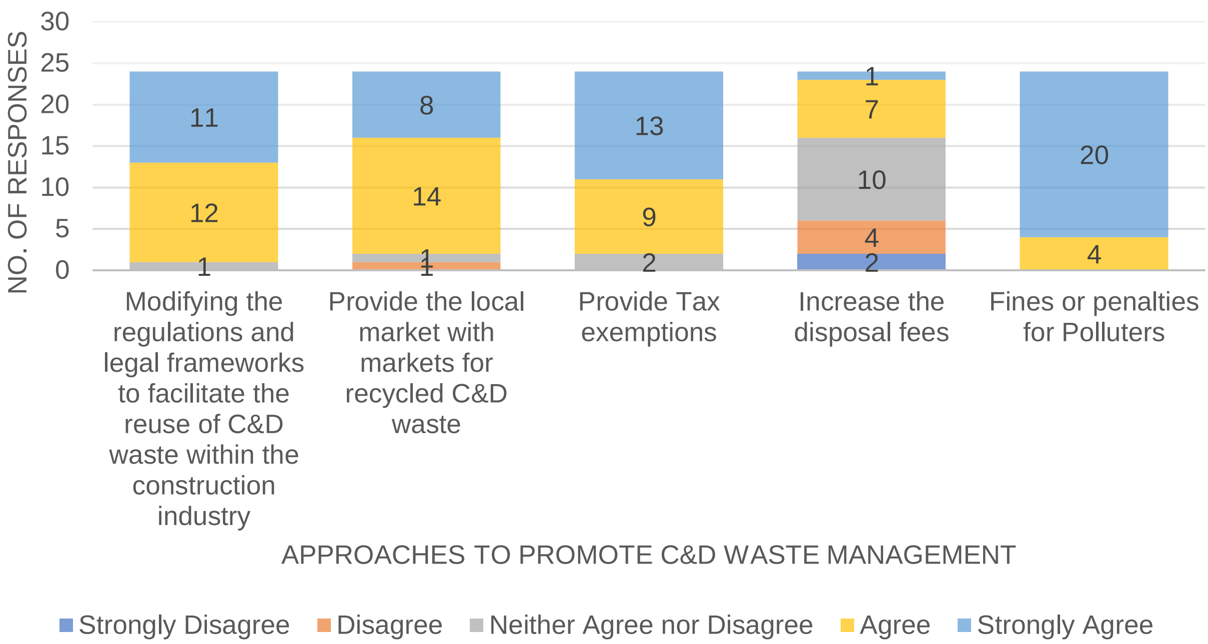

Chart 10-32: Approaches to Promote C&D Waste Management

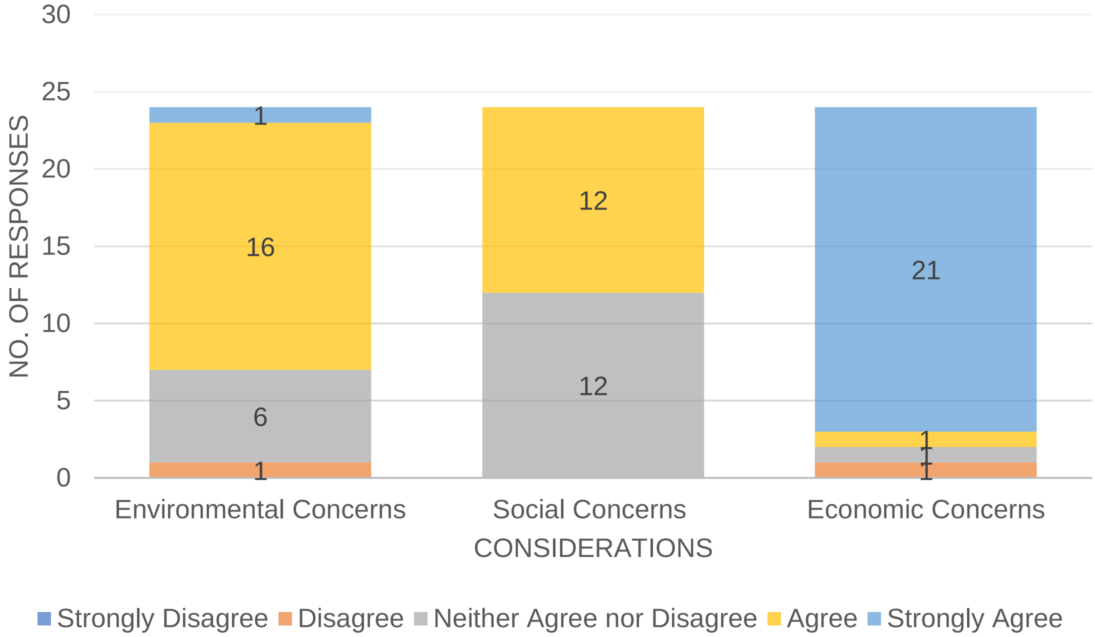

Chart 10-33: Considerations

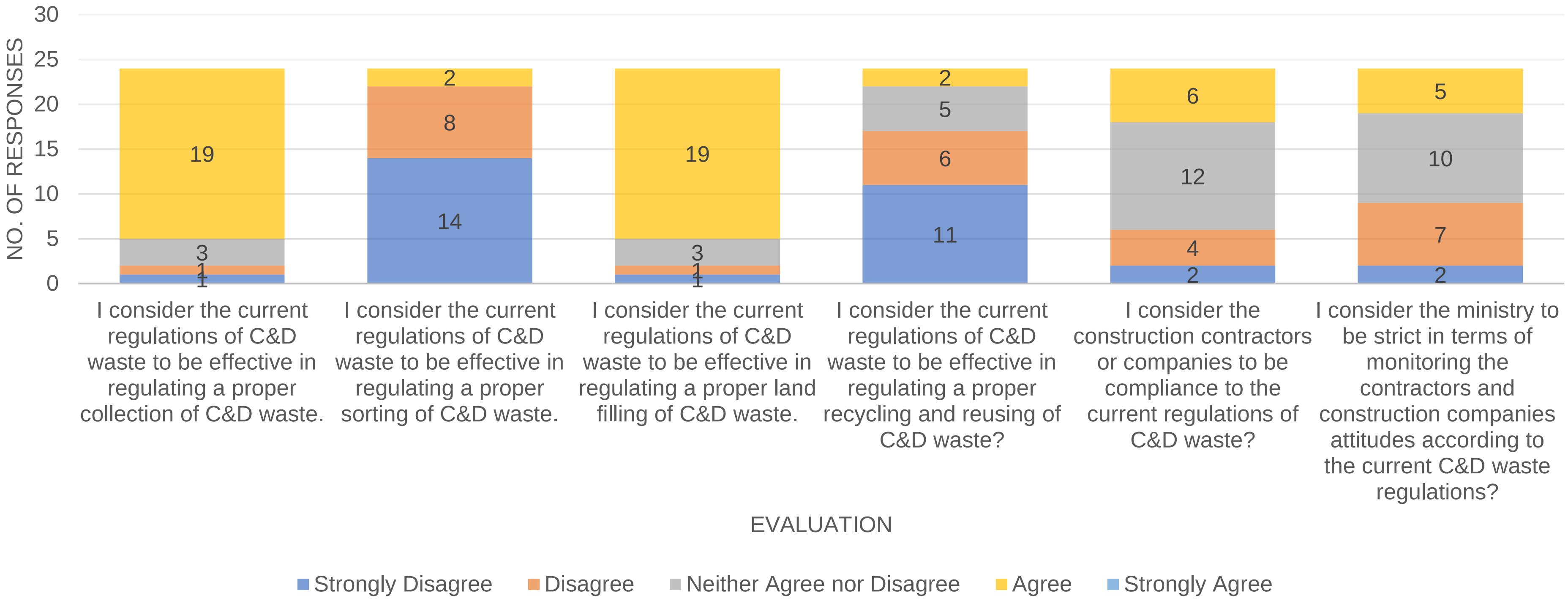

Chart 10-34: Evaluation of Regulations and Compliances

10.3.2.2.1.6 Charts 11 - 38, 39, 40, 41, 42, 43, 44 and 45 Analysis

Returning to what the ministry uses of contracts in its projects and as indicated previously. It uses the general contracting and the design and build contracts. According to 90% of respondents, several factors are known to be associated with using general contracting such as:

1. The responsibility of the design of the development that will lie with the developer and designers.
2. The employers' great control of the design as they control the design team.
3. Offering the employer of having an independent professional in the role of the contract administrator monitoring the project.
4. Offering some price certainty if the design has been fully scoped out prior to construction.
5. Avoiding the loss of design that is controlled by the employer.
6. Taking control of the design and contract out the build to ensure quality.
7. Finalising the development design before contractors offer tenders for the build. Thus, saving time.
8. Most employers and contractors in the country have experience in this method rather than other methods.

Meanwhile, the survey with above 90% of responses has revealed several factors that are responsible for using the design and build contract in the ministry's projects such as:

1. Most of the risks are placed on the contractor.
2. Responsibility by the contractor for both design and construction.
3. The ability to fast track the project.
4. Allowing the ministry to spend its budget for the project within allocated periods.
5. Avoiding splitting responsibility between construction and design. That avoids whether defects are really design defects (for which the employer is responsible) or defects in material and workmanship (for which the contractor is responsible).
6. Avoiding price uncertainty.
7. Creating a smoother line of communication.
8. Offering the lowest risk for the client, who can lay out a set of requirements and then hold the contractor responsible for these requirements.

Perhaps the most serious criticism of these factors is that they do not prioritise C&D waste in any aspect. Thus, further observation should be done on the types of contracts used by the ministry to prioritise this type of waste.

On the question of C&D waste, the survey has investigated what reasons could be associated with preventing the management of such a waste after generation if legally dumped in landfills. Apparently, C&D waste comprises many types of waste, the absence of sorting on site and the low costs of landfilling only had the highest proportion of responses. In addition to that, some respondents have clarified that the concept of land reclamation (valley reclamation) is one of the hindrances to C&D waste management. As contractors and locals consider it as a C&D waste management solution especially when these landfills are located within an acceptable distance range. Meanwhile, the hazardous contaminations in C&D waste alongside C&D waste dumped quantities had less few than 50% of responses. However, it is worth mentioning that some respondents have referred the large quantity of dumped C&D waste in landfills is a contributory factor to C&D waste management prevention. This could majorly indicate that the absence of sorting on site with proper landfilling results in hindering C&D waste management in landfills. As C&D waste composition varies in its types, thus, difficulties in recycling C&D waste. Therefore, few respondents have stated that buying C&D waste from contractors could encourage them to sort waste on site.

According to the survey, some evidence that the informal dumping is affected majorly by:

1. Lack in legal frameworks and regulations.
2. Lack in local actors' awareness in respect to C&D waste impacts.
3. Lack in local actors' awareness in respect to benefits of reusing C&D waste.
4. Lack in governmental supervision and strictness.
5. Involvement of the informal workers within the industry.
6. Lack of necessary skills and knowledge amongst construction practitioners to C&D waste.
7. Long transportation distances to dumpsites.
8. Lack of management system.
9. Low supervisions on waste disposal behaviours.
10. Incomplete waste disposal system as over 20 responses of the 24 total responses agreed on that.

Though, the high costs for legal dumping including dumping fees and time concerns are fewer contributory factors to the informal dumping. Yet, the survey has found dramatic related elements for mitigation including:

1. Modifying and adding legal frameworks and regulation in respect to C&D waste.
2. Improving the awareness of the construction industry actors in Jordan.
3. Increasing the governmental supervision and strictness on C&D waste.
4. Improving the skills and knowledge among construction practitioners to C&D waste.
5. Decreasing the distances to dumpsites.
6. Providing markets for recycled waste material to initiate recycling of C&D waste and facilitating recycling plants.

While, decreasing the legal dumping fees of C&D waste and providing taxation exemptions would make no attempt to give sufficient effect on reducing the informal attitude.

Another significant aspect that could encourage the industry. To transform towards adopting a national C&D waste management strategy as indicated by many more than 20 of respondents. To modify regulations and legal frameworks to facilitate the reuse of C&D waste within the industry, provide the local market with recycled C&D waste material markets, provide tax exemptions and apply fines or penalties for waste polluters. Although, well over 60% of those respondents have agreed that increasing the disposal fees would not be beneficial for such a national strategy. This seems to be true as per the low feeing system of C&D waste and yet C&D waste is informally dumped. On the other hand, few participants have mentioned that establishing design codes for recycled waste material and apply more monitoring observations on renovation projects. In addition to, controlling C&D waste management through issuing demolition licenses and post construction usage permissions of buildings under terms and conditions such as sorting waste on site. Would all encourage the adoption of a national C&D waste management strategy.

Having defined what could encourage the industry towards adopting a C&D waste management strategy. It is now necessary to measure how adequate the current regulations and legislations are in respect to regulating the collection, sorting, recycling and landfilling. In addition to, contractor’s compliances and the ministry’s strictness on monitoring the contractors and construction companies’ attitudes. The results have shown that around 80% of responses agreed that the collection and landfilling regulations are effective in terms of adequacy. Although, 20% of those respondents stated that these regulations do not obligate these activities from occurring effectively. As they depend on contractor’s effort, landfills-based location and absence of enough numbers of landfills. This could be seen as evidence associated to the low rate of their compliance. For the time being, 80% to 90% of them have agreed that regulations are not adequately effective to sort nor recycle C&D waste. As a result of the absence of sorting places, equipment and regulations that obligate contractors to do so not to orient them for such activities.

The data reported here appear to suggest that there may be a link between contractor's attitudes and regulations by forcing them to do such activities. This to be fair is not only associated with regulations, but also the contractors and construction companies' attitudes complying with these regulations. That is why the survey has measured their compliance and according to the results nearly 75% of those who were participated stated that contractors do not comply with the current regulations. It may be the more informal dumping is a result of contractor's disobeying to the current regulations. Although, it is worthwhile mentioning that these attitudes confined on low levelled firms. As they benefit some cost savings by avoiding proper landfilling. Besides, the dependent factor of landfilling which is the distance between sites and landfills. As far as regulations are concerned, it is valuable also to observe the strictness of the ministry in terms of monitoring the contractor's attitudes. Nearly the same as the contractor's attitude response percentage, 79% of respondents have measured the strictness of the ministry to a poor limit. This may be linked to the site location, time of construction or demolition as some activities take place at night and disregarding C&D waste from some municipality supervision programs. The level of strictness tends to perform better in Amman than in other cities across Jordan.

10.3.2.2.1.7 Chart 10 - 46 and 47

The charts below draw a distinction between the procurement methods of bidding and estimates the percentage of informal dumping.

This distinction and estimation are provided by participants using Likert Scale question. The bars in this chart represents the participants anticipation of using these procurement methods and anticipating the percentages based on the question seen below.

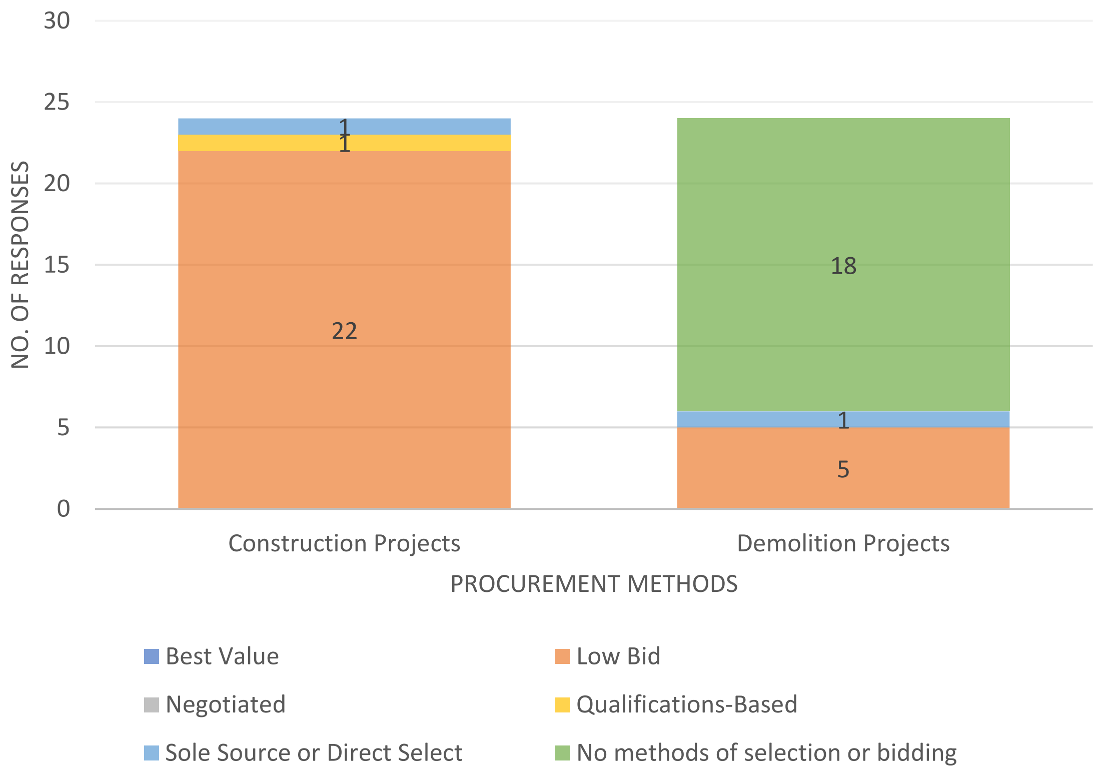

Chart 10-35: Procurement Methods

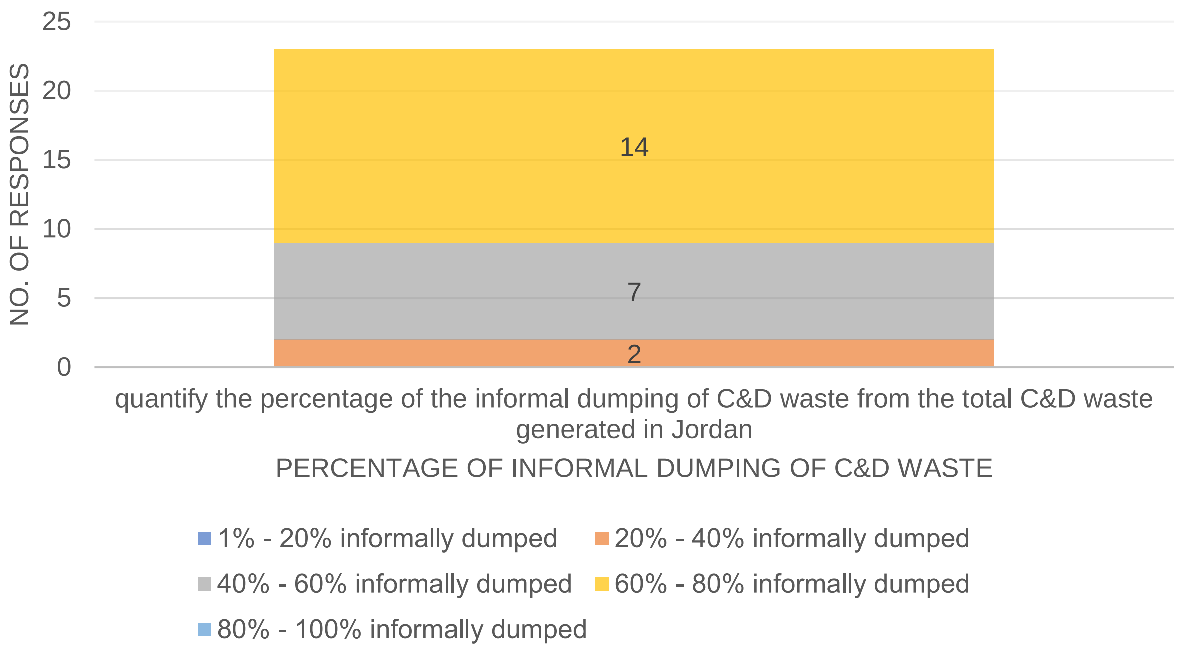

Chart 10-36: Percentage of Informal Dumping of C&D Waste

10.3.2.2.1.8 Charts 11 – 46 and 47 Analysis

Regarding the major problem of C&D waste in the country as previously indicated in the literature, what can be clearly seen in **chart 10-47** is the high percentage of the informal dumping of C&D waste.

Approximately 60% of those who were participated indicated that 60% to 80% of the total C&D waste generated is informally dumped. 30% of them shown that 40% to 60% is informally dumped and below 10% of respondents revealed that only 20% - 40%. These percentages could indicate that on average almost 60% of C&D waste is informally dumped. The analysis of procurement methods has been outlined in the main body of the research.

10.3.2.2.1.9 Chart 10 - 48

The charts below distinguish the causes that could be attributed to hinder C&D waste management activities from taking place. This recognition is provided by participants using multiple choice question.

The bars in this chart represents the participants' anticipation on the possible hindrances to activities comprising collection, sorting, landfilling and recycling.

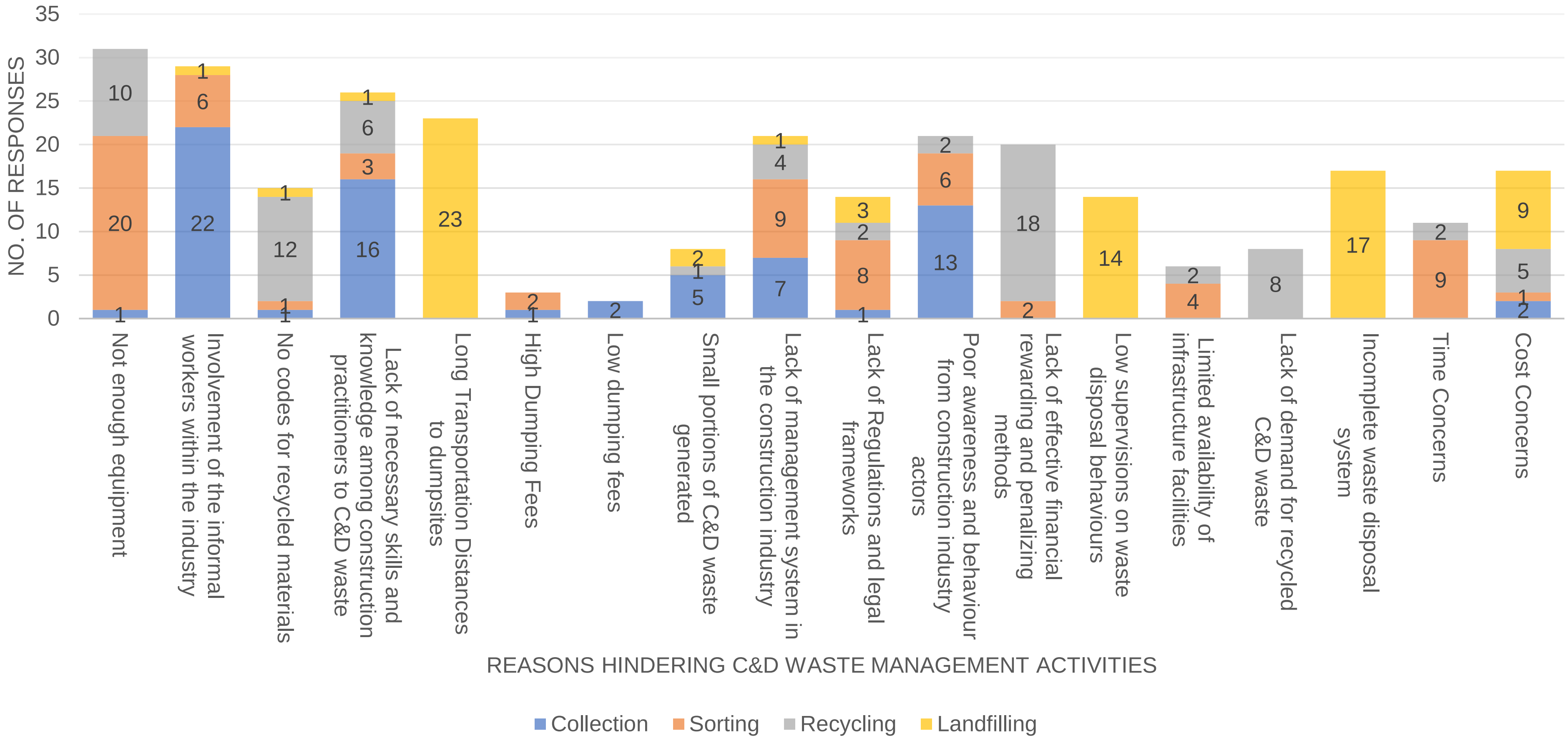

Chart 10-37: Reasons Hindering C&D Waste Management Activities

10.3.2.2.1.10 Chart 10 - 48 Analysis

Moving on now to consider the most 3 possible reasons that could prevent each activity including collection, sorting, recycling and landfilling from taking place within a C&D waste management.

The survey has successfully identified underlying factors preventing the collection process from happening. As more than 90% of respondents have referred the involvement of the informal workers within the industry is the number one reason. 66% of them have agreed that the lack of necessary skills and knowledge among construction practitioners to C&D waste is the second reason. Meanwhile, just over half of them have revealed that the poor awareness and behaviour of construction industry actors plays an important role in preventing a proper collection of C&D waste. Also, only few respondents have seen that small portions of C&D waste generated, lack of management system in the construction industry, lack of regulations and legal frameworks and high costs are fewer confounding factors to prevent collection.

With respect to C&D waste sorting, several factors play a role in determining the effects on sorting. As nearly 83% of those who participated signified that the absence of sorting equipment is the most determinant cause. Just over 37% stated that for the lack of management system in the construction industry and time concerns when sorting waste. Just under 34% for the lack of regulations and legal frameworks. Although, less than 25% of responses suggested weak links may exist between sorting and its prevention such as:

1. The involvement of the informal workers within the industry.
2. Absence of codes for recycled material.
3. Lack of necessary skills and knowledge among construction practitioners to C&D waste.
4. Poor awareness and behaviour from construction industry actors.
5. No further use for C&D waste if sorted.
6. Lack of effective financial rewarding and penalizing methods.

Before proceeding to identify the reasons preventing landfilling. It is important to determine the factors that impacts the recycling of C&D waste from taking place. Much of the prevention stems from the lack of effective financial rewarding and penalizing methods. As nearly 75% of respondents agreed on that. In addition to, the absence of codes for recycled C&D waste material and equipment such as crushers. Meanwhile, the minority of respondents revealed that there are several factors seen as insignificantly contributory to prevent recycling from taking place, such as:

1. The lack of necessary skills and knowledge among construction practitioners to C&D waste.
2. Lack of management system in the construction industry.
3. Lack of regulations and legal frameworks.
4. Poor awareness and behaviour from construction industry actors.
5. Time and cost concerns.

Lastly, as previously mentioned, the long transportation distances to dumpsites as seen by most of the respondents may be associated with preventing proper landfilling. Well over than 70% of them agreed that the incomplete waste disposal system is a common factor hindering landfilling of C&D waste. Approximately 55% of them referred that to the low supervisions on waste disposal behaviours and nearly 37% of respondents owned that for cost concerns. As was pointed out in other activities, only few respondents have agreed that landfilling is prevented because of the informal workers involvement within the industry, absence of recycled C&D waste material codes and lack of necessary skills and knowledge among construction practitioners to C&D waste. In addition to, small portions of C&D waste generated, lack of management system in the construction industry and lack of regulations and legal frameworks.

10.3.2.2.2 Department of Design and Studies

This section includes the analysis and the discussion of MPWH – department of design and studies questionnaire.

The total number of participants in this questionnaire was 19. This questionnaire has covered several aspects comprising identifying the types of contracts used by the ministry including the contractual arrangements and the procurement methods. In addition to, recognising the adoption of design out waste approaches, willingness, considerations and evaluation of regulations and compliances.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No and Likert Scale questions.

10.3.2.2.2.1 Charts 11 – 49, 50, 51, 52 and 53

The charts below provide information related to the phases of design of projects at MPWH and the internal tasks that take place through these phases. This has been provided by participants using Yes/No question.

The bars in these charts represents the aspects as corresponded by participants based on the question seen below.

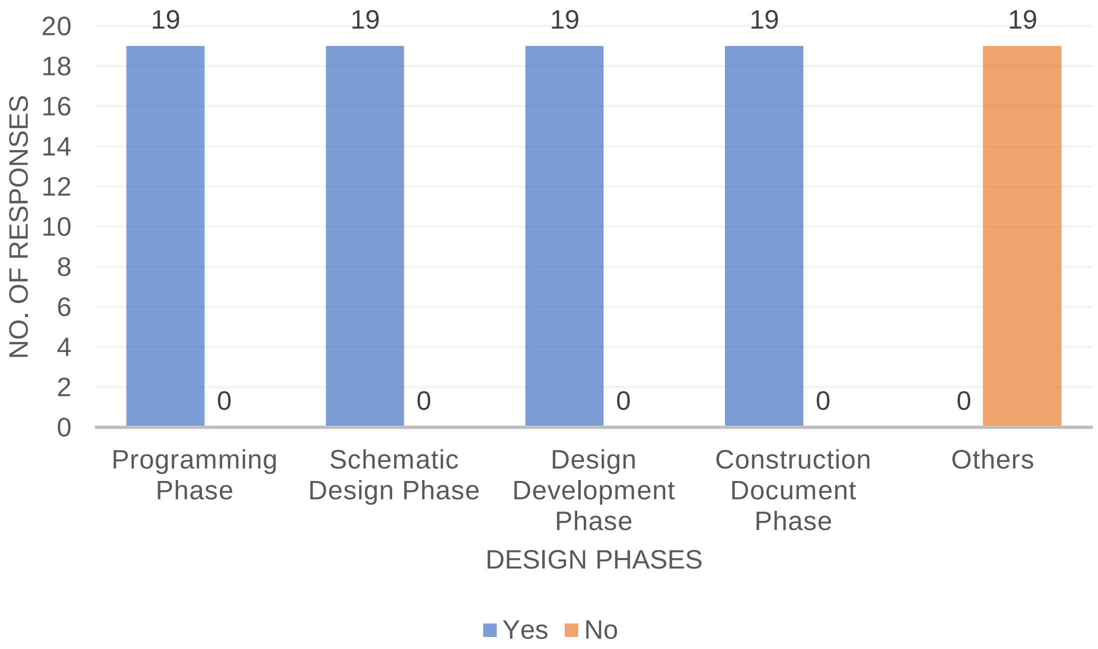

Chart 10-38: Design Phases

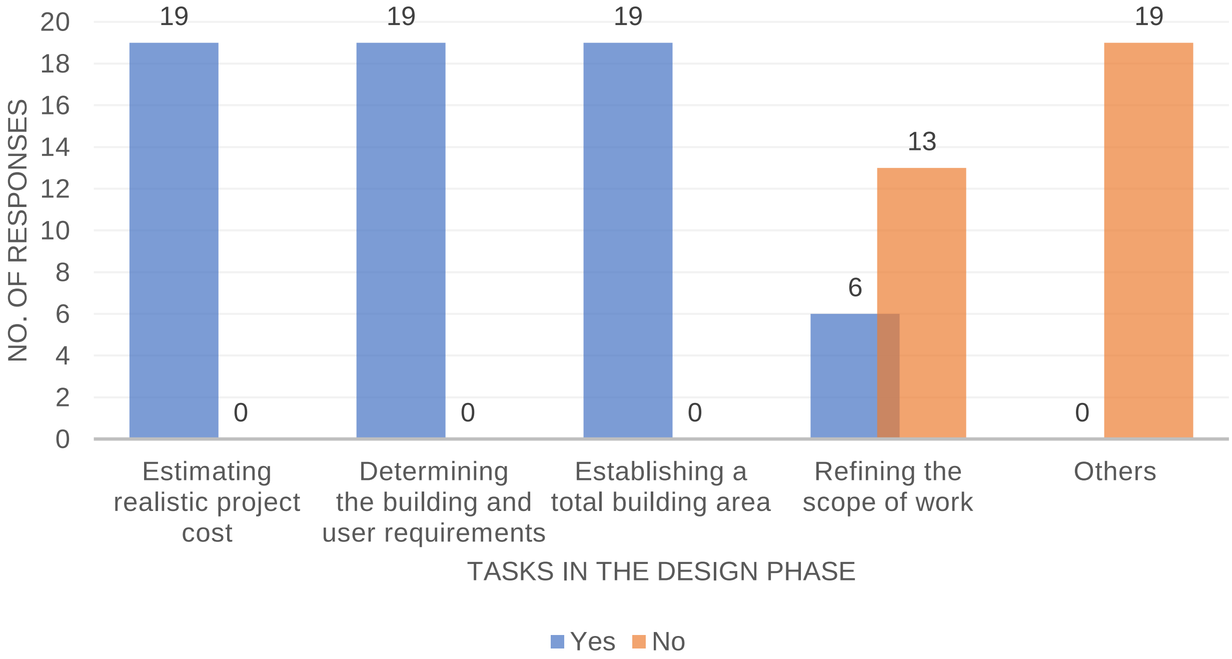

Chart 10-39: Tasks in the Design Phase

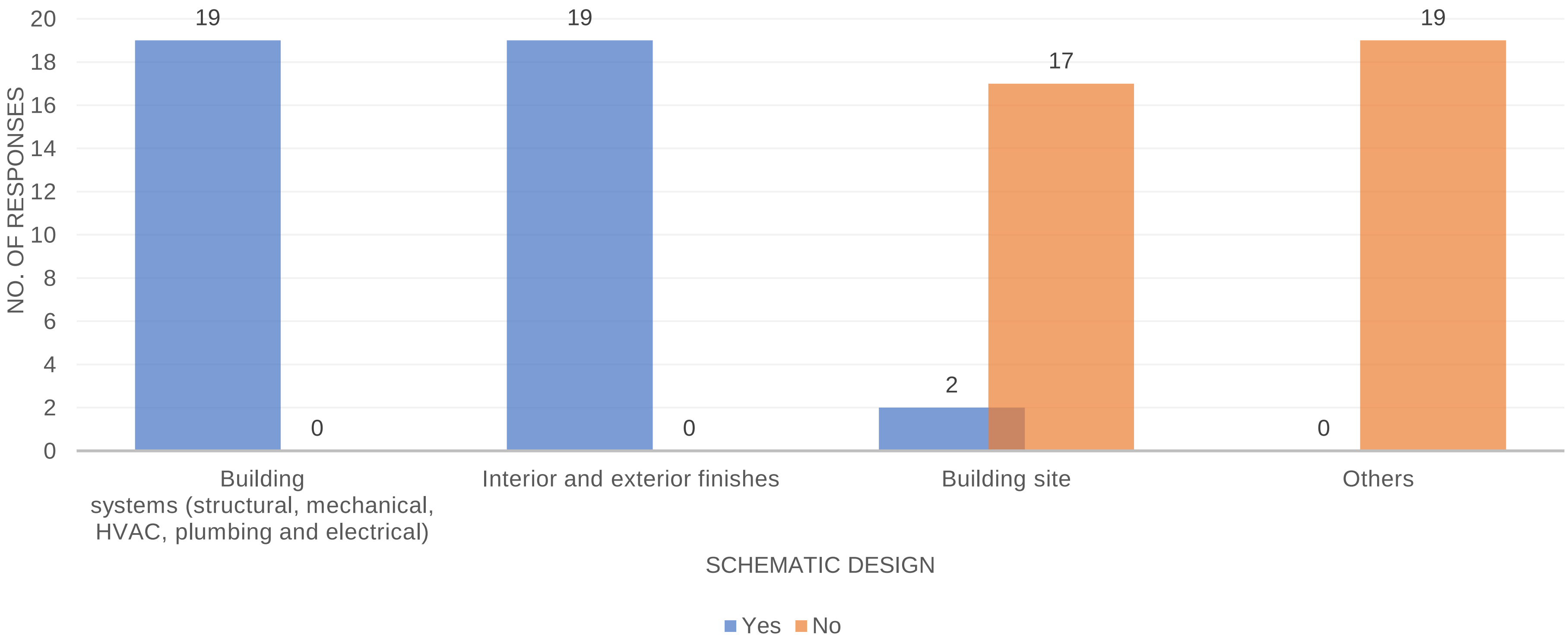

Chart 10-40: Schematic Design

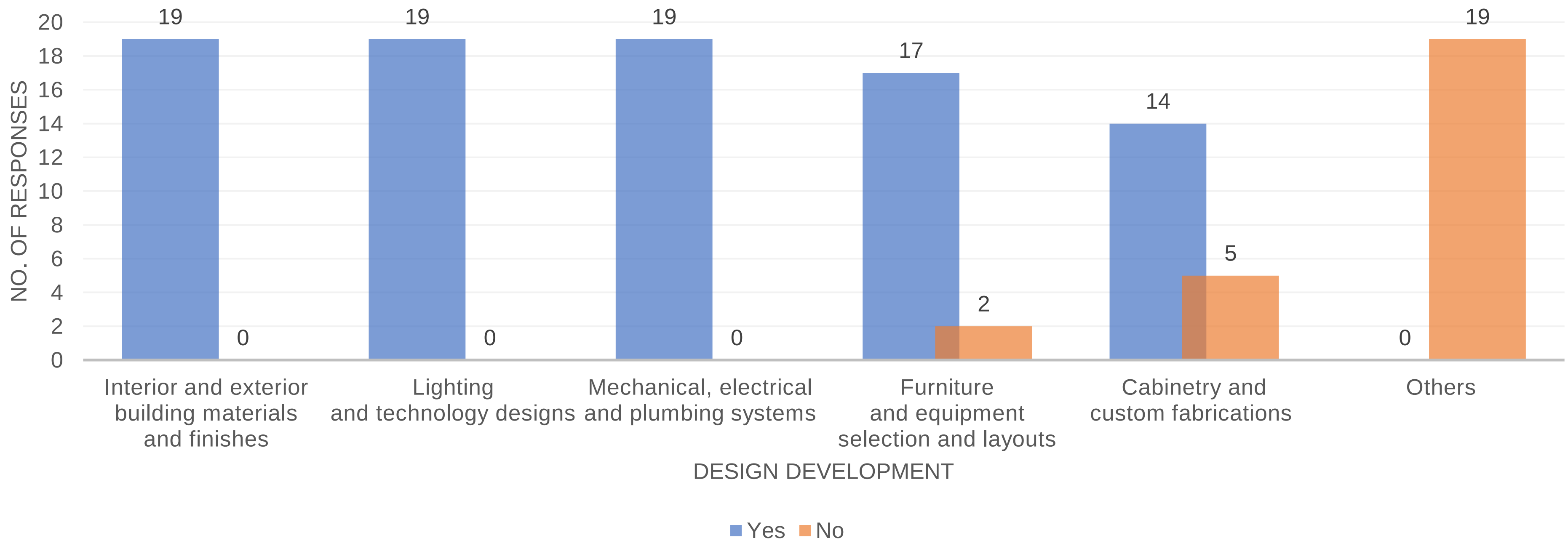

Chart 10-41: Design Development

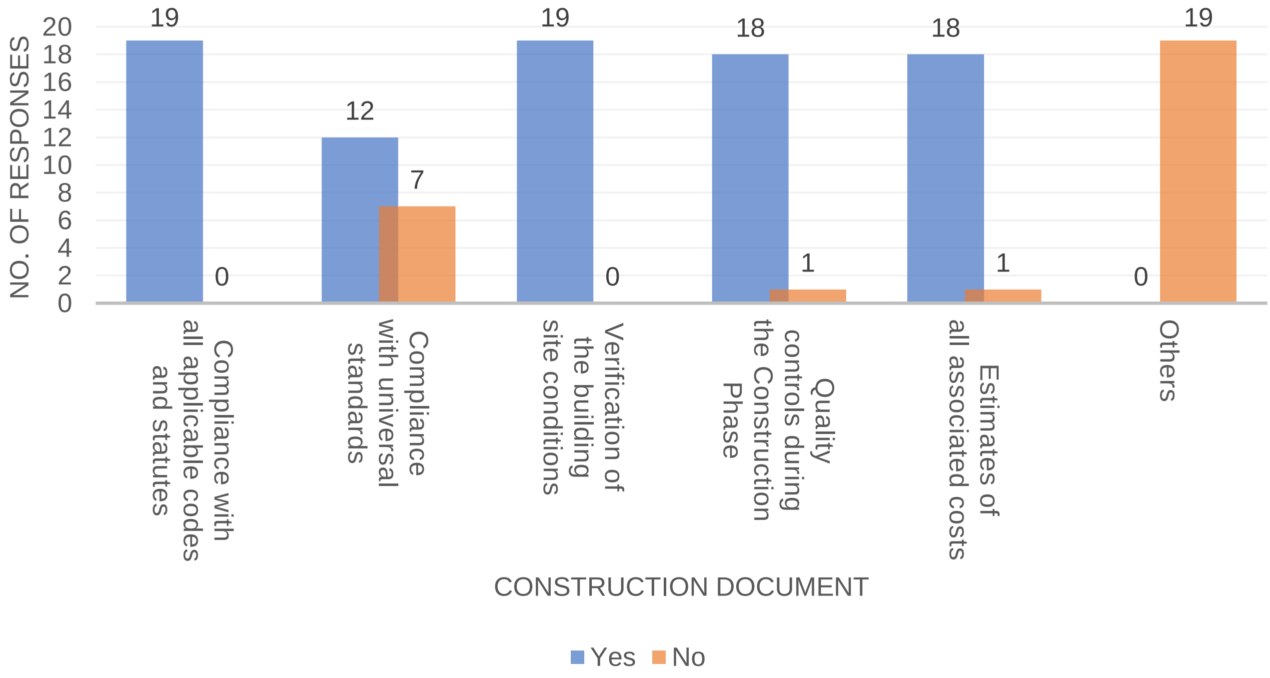

Chart 10-42: Construction Document

10.3.2.2.2.2 Charts 11 – 49, 50, 52, 52 and 53 Analysis

The analysis describes that there are four types of phases that take place within any design stage of projects. Comprising programming, schematic design, deign development and construction document according to 100% of respondents. Respondents illustrate clearly what tasks are inclusive within these phases.

As for the programming phase, 100% of respondents indicated that estimating realistic project cost, determining the building and user requirements and establishing a total building area occur during this phase. Whereas only 31% of them indicated that for refining the scope of work.

As regards the schematic design phase, the design for building systems (structural, mechanical, plumbing and electrical) and the design for interior and exterior finishes take place based on all respondents. Logically, building site does not take place at all as this shows the honesty of respondents in the survey.

With respect to design development phase, estimates of respondents range from 14 to 19. Indicated that this phase includes the interior and exterior design finishes, lighting and technology designs and designing electrical, mechanical and plumbing systems. In addition to, furniture and equipment selection and layouts and cabinetry and custom fabrications.

With regard to construction document phase, 94% to 100% of those who had responded to the survey shown that this phase is for checking the compliance of design to codes, verifying building site conditions, checking quality controls during the construction phase and estimating all associated costs. Meanwhile, only 63% of them illustrates that this phase includes checking the compliance of universal standards.

10.3.2.2.2.3 Chart 10 - 54

The chart below outlines the policy of the MPWH towards demolition projects if be treated as construction projects in the design phase. In addition to measuring the ministry current adoption of design for reduction, prevention, or deconstruction.

This has been provided by participants using Yes/No question. The bars in this chart represents the aspects as corresponded by participants based on the question seen below.

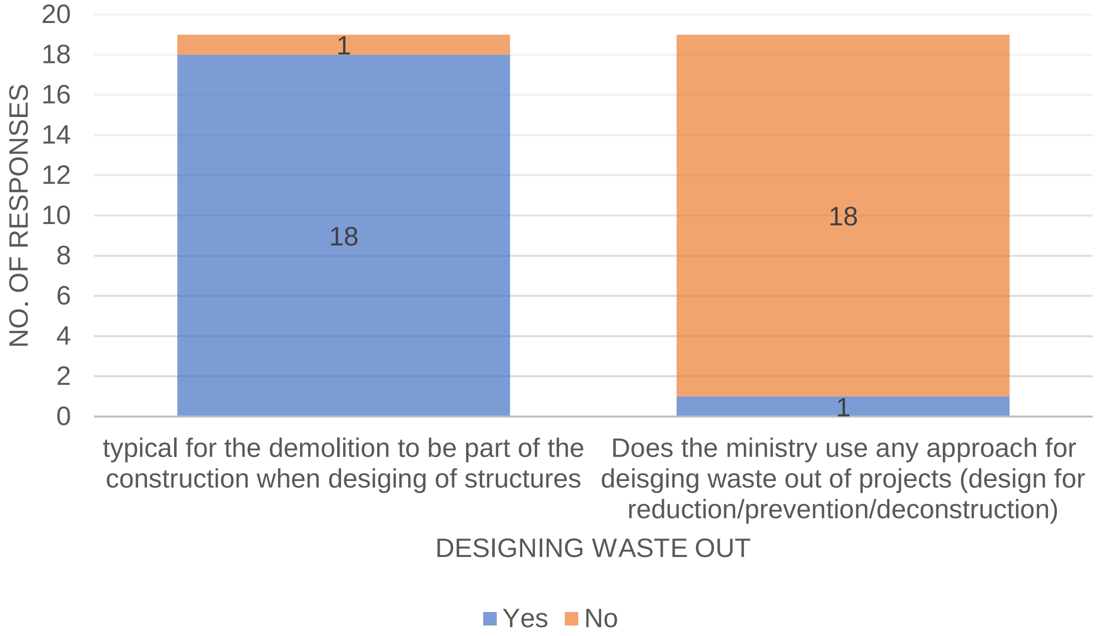

Chart 10-43: Designing Waste Out

10.3.2.2.2.4 Chart 10 - 54 Analysis

It appeared that as shown previously by the department of construction within MPWH. Above 90% of participants shown that it is typical for demolition to be part of the construction when designing of projects. Although, the same percentage have agreed that the MPWH does not use any approach for designing waste out of projects including all its types of reduction, prevention nor deconstruction.

10.3.2.2.2.5 Chart 10 – 55, 56, 57, 58 and 59

The charts below determine the underlying causes hindering the adoption of design out waste of projects and the absence of recycled waste material design codes. It also considers the possible approaches that could contribute the adoption of such an approach. In addition to assess the willingness to establish design codes and towards adopting such approaches in governmental projects.

These aspects have been provided by participants using both Likert Scale and Yes/No questions. The bars in these charts represent these aspects as corresponded by participants based on the question seen below.

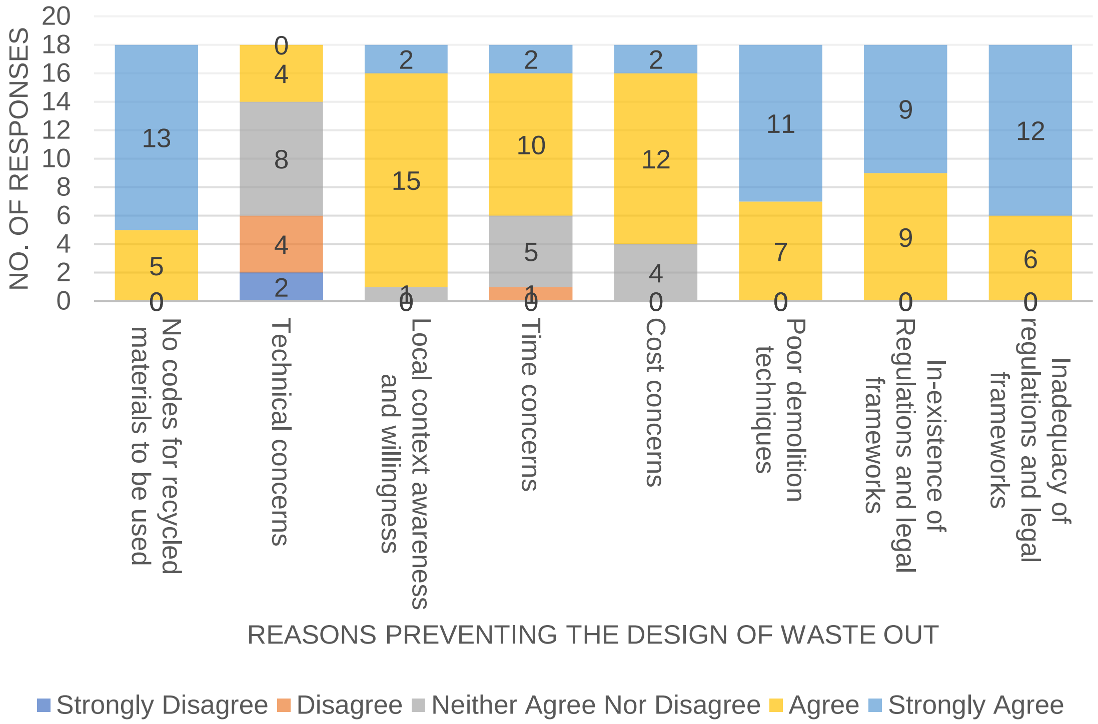

Chart 10-44: Reasons Preventing the Design of Waste Out

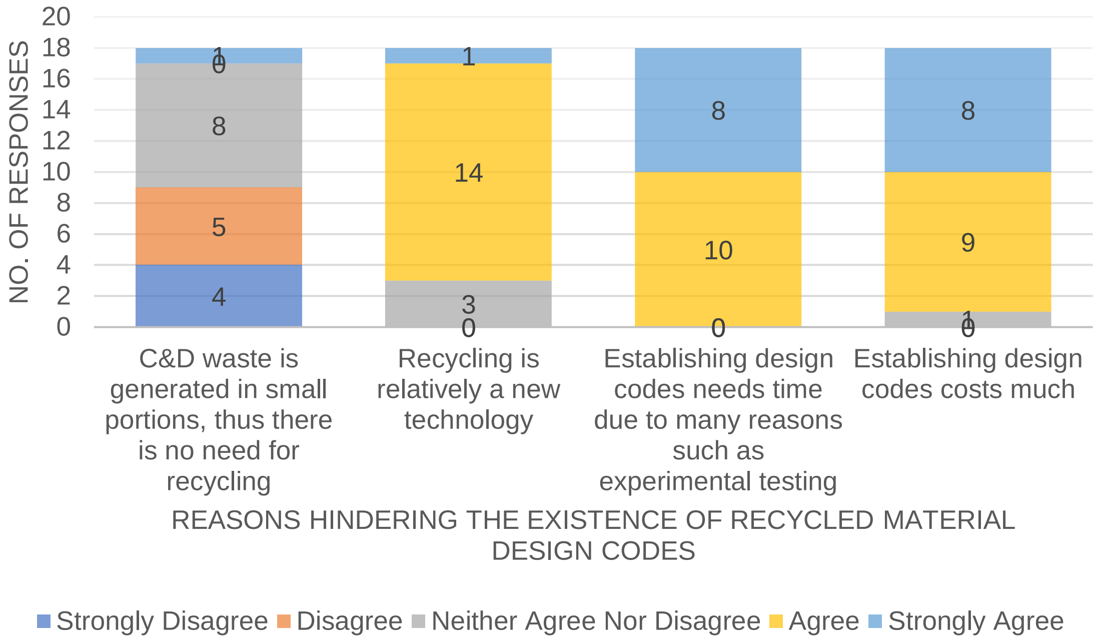

Chart 10-45: Reasons Hindering the Existence of Recycled Material Design Codes

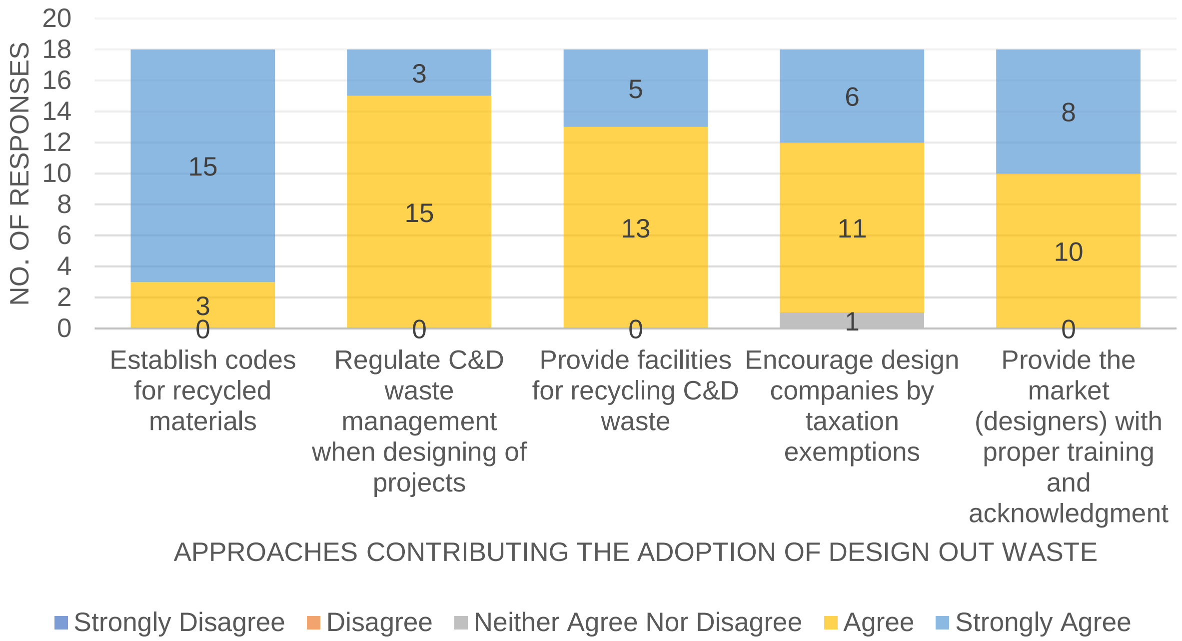

Chart 10-46: Approaches Contributing the Adoption of Design Out Waste

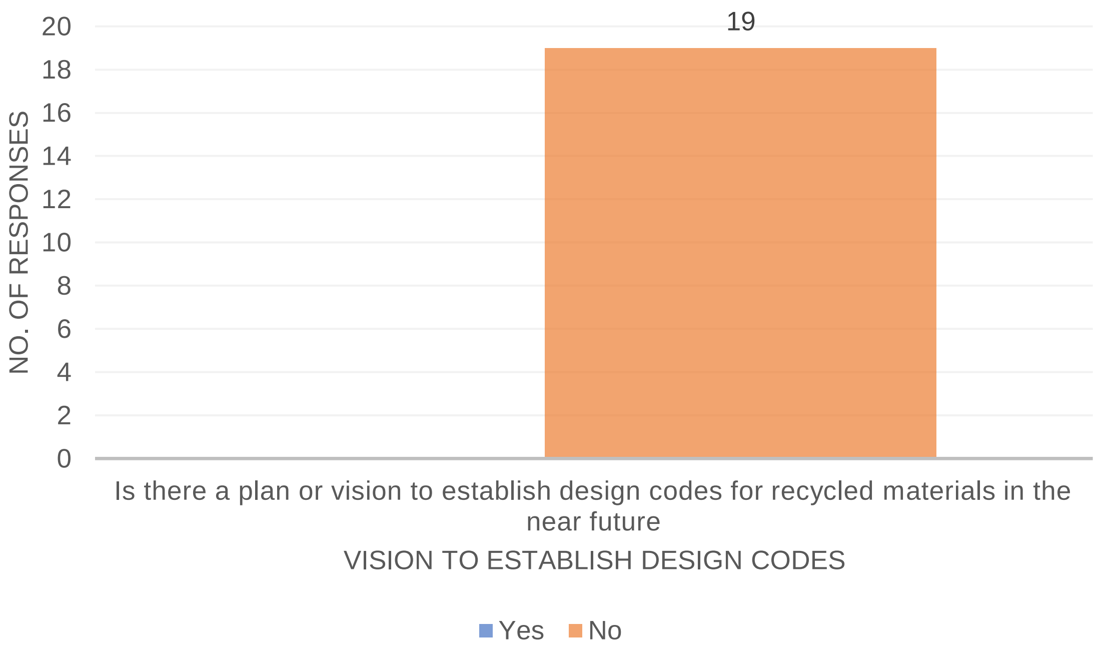

Chart 10-47: Vision to Establish Design Codes

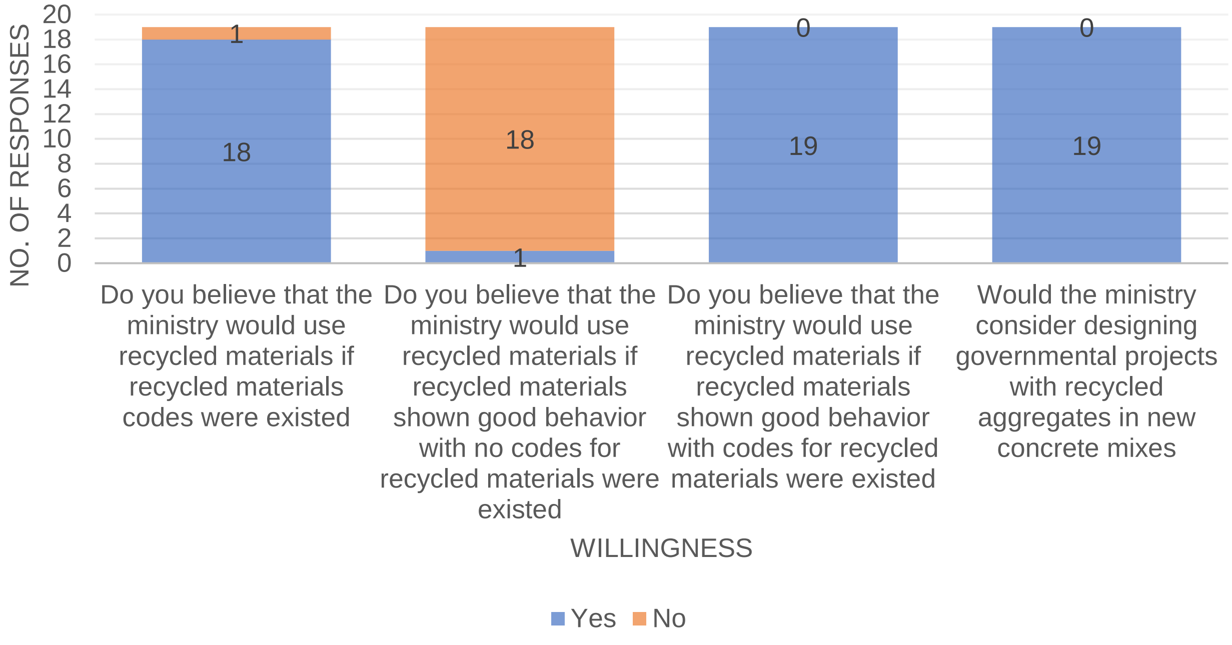

Chart 10-48: Willingness

10.3.2.2.2.6 Charts 11 – 55, 56, 57, 58 and 59 Analysis

The case reported previously illustrated that MPWH does not use any approach for designing waste out of projects. This has been seen majorly by nearly 100% of respondents due to the absence of recycled waste material codes. As over than 80% of those who were surveyed suggested that the absence of recycled waste material design codes stems from considering:

1. Recycling as a relatively new technology.
2. The establishment of such codes needs time and cost as it requires experimental testing.

On the other hand, many more than 90% agreed that the C&D waste is generated in small portions is a weakly related factor to such absence. Unfortunately, thus far the MPWH does not seem to show any interest whatsoever towards having a plan or vision to establish design codes for recycled waste material.

Although above 90% of surveyors agreed on believing that the MPWH would consider designing governmental projects with recycled waste material. As they agreed on using recycled waste material if waste material shown good behaviour and under specifications and design codes. In addition to, poor awareness of locals and their willingness, poor demolition techniques, absence of regulations and legal frameworks and inadequacy if existed.

Estimates of responses range 66% to 77% referred the un-usage of such approaches to time and cost concerns. Although nearly 80% of them agreed that the technical concern is not a limitation towards designing waste out of projects. These limitations could be mitigated according to more than 90% of respondents by:

1. Establishing design codes of recycled waste material.
2. Regulating C&D waste management when designing projects.
3. Providing recycling facilities.
4. Applying tax exemptions and proper training to design companies to encourage them to use such an approach.

10.3.2.2.2.7 Chart 10 - 60

The chart below assesses the effectiveness of several encouragements that could be attributed to adopt a C&D waste management strategy by MPWH.

These encouragements have been evaluated by participants using Likert Scale question. The bars in these charts represent this evaluation as corresponded by participants based on the question seen below.

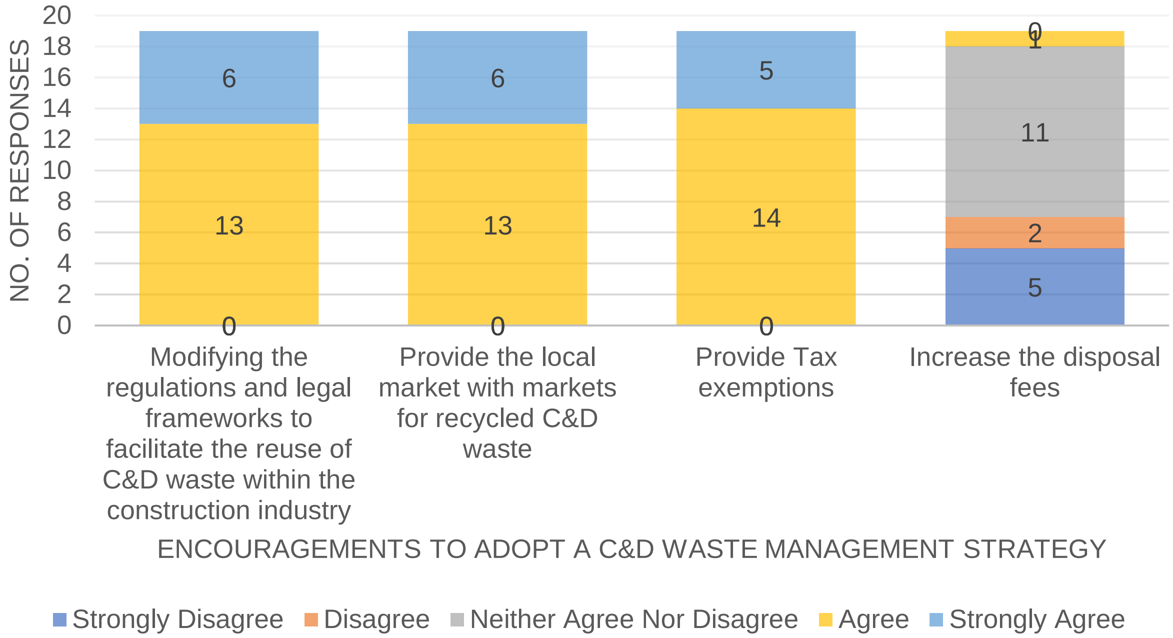

Chart 10-49: Encouragements to Adopt a C&D Waste Management Strategy

10.3.2.2.2.8 Chart 10 - 60 Analysis

The analysis of **chart 10-60** confirms that C&D waste management strategy can be adopted by the industry by several approaches. This analysis has reported that 100% of those who responded that several factors are known to affect the industry towards adopting a C&D waste management strategy:

1. Modifying the regulations and legal frameworks.
2. Providing the local market with recycled waste material markets.
3. Providing tax exemptions.

Likewise, any previous analysis of questionnaires revealed that increasing the disposal fees would increase the risk of keeping the current situation as it is with no C&D waste management strategy according to more than 90% of respondents.

10.3.2.2.2.9 Charts 11 -61 and 62

The charts below distinguish between the environmental, social and economic concerns taken into consideration by the ministry.

These aspects have been provided by participants using both Likert Scale and Yes/No questions. The bars in these charts represent these aspects as corresponded by participants based on the question seen below.

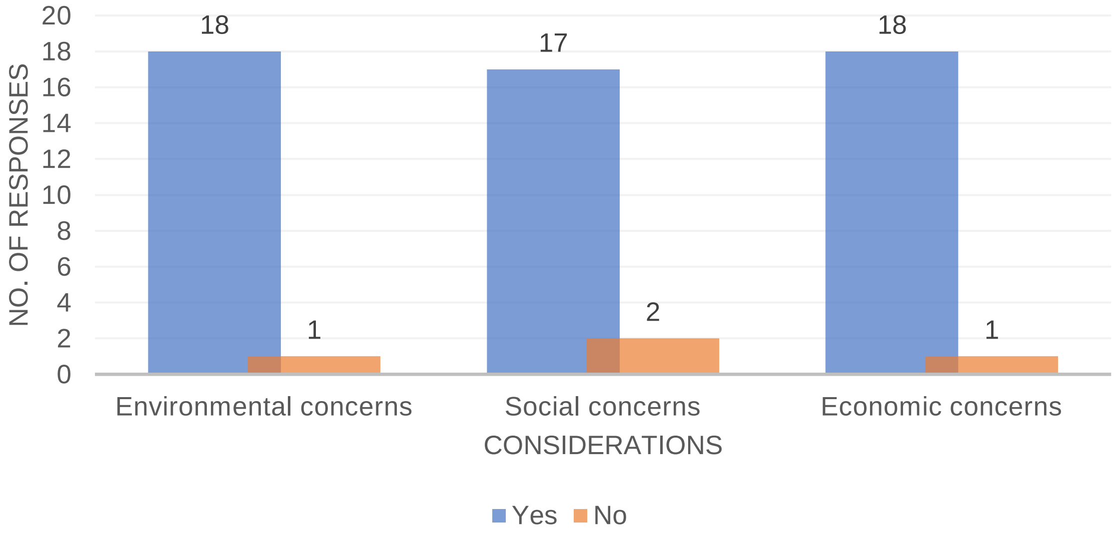

Chart 10-50: Considerations

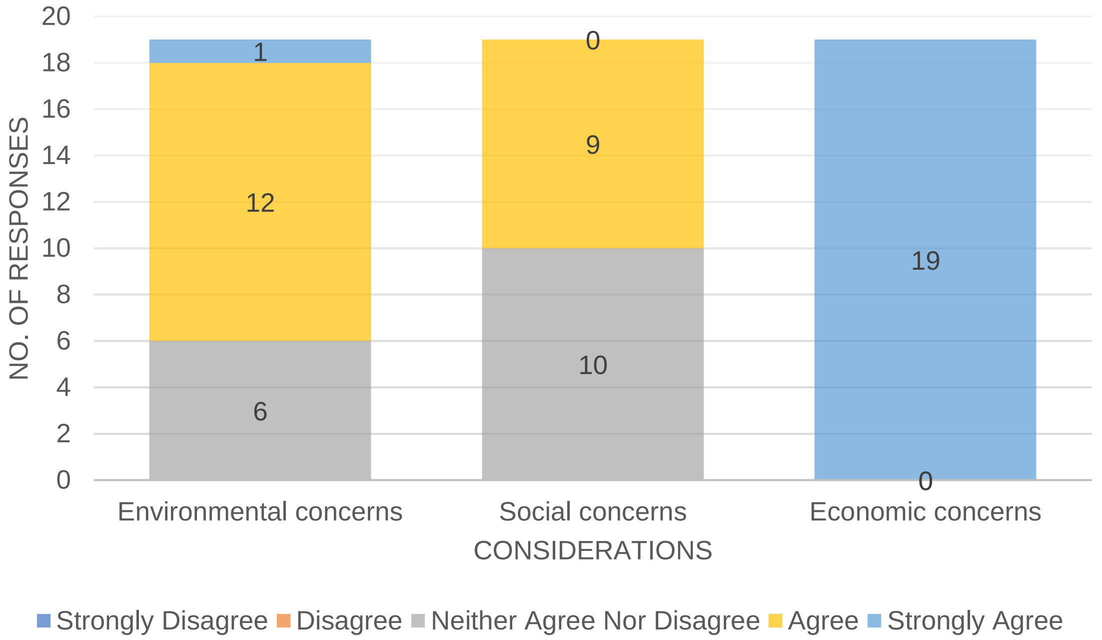

Chart 10-51: Considerations

10.3.2.2.2.10 Charts 11 - 61 and 62 Analysis

This analysis demonstrates how the MPWH considers the major 3 aspects of environment, social and economy. Above 85% of respondents clearly identified that MPWH considers majorly all the three aspects within its policies. Although, the most important aspect is the economic one. As 100% of respondents agreed on that, meanwhile, 63% and 47% agreed on the environmental and social aspects, respectively.

10.3.2.2.2.11 Chart 10 - 63

This chart is similar to several charts pointed out in different questionnaires which makes an attempt to evaluate the regulations in respect to C&D waste including collection, sorting, landfilling and recycling. In addition to, the compliance of contractors to these regulations and the strictness of the MPWH to monitor the contractors’ attitudes.

These aspects have been provided by participants using Likert Scale question. The bars in these charts represent these aspects as corresponded by participants based on the question seen below.

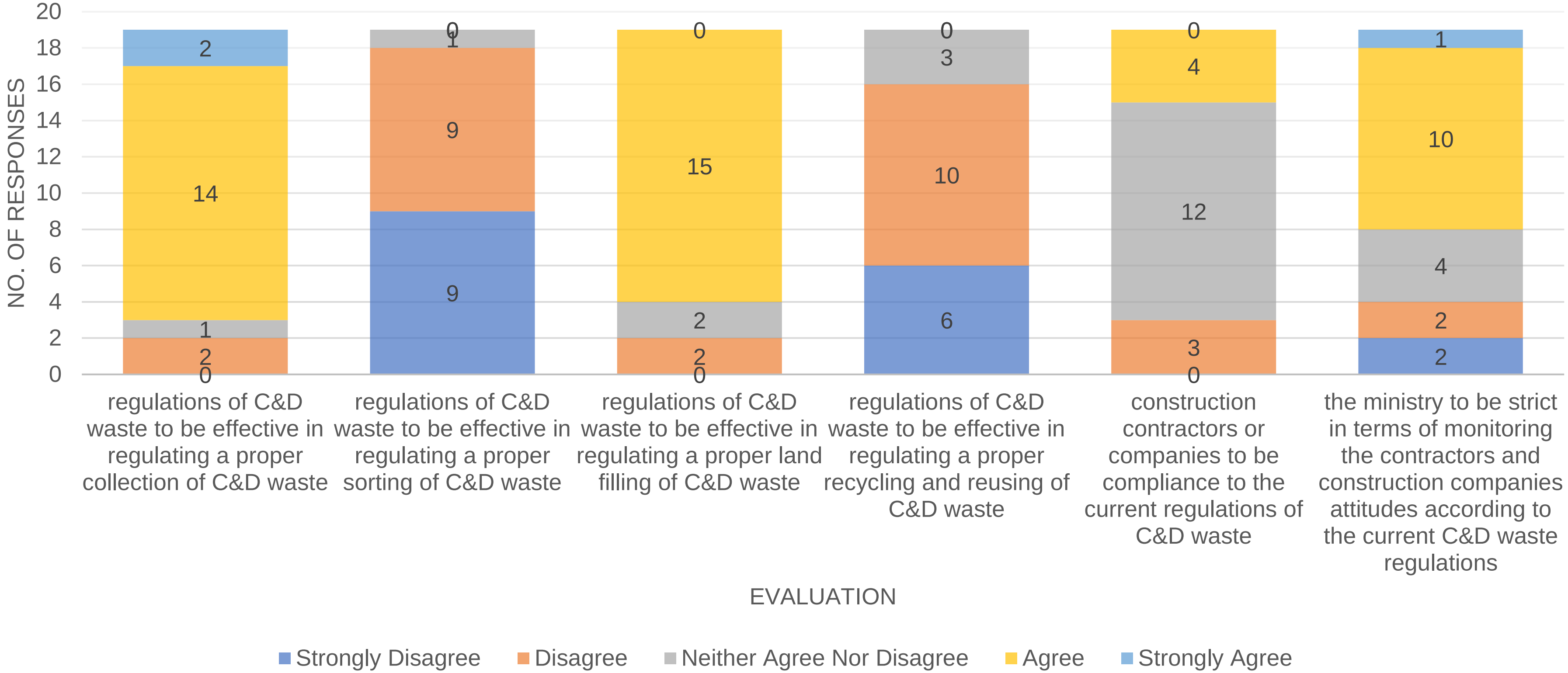

Chart 10-52: Evaluation

10.3.2.2.2.12 Chart 10 - 63 Analysis

The case reported here illustrates that a range of 78% to 85% of respondents indicated that the current regulations of collection and landfilling are adequate in regulating these activities. Although, above 85% of them indicated the contrast in respect to sorting and recycling regulations as not adequate in regulating such activities. Apart from these regulations, only 21% of those who responded agreed that contractors comply to the current regulations of C&D waste. Meanwhile, just over 55% of them stated that the ministry is applying its strictness in monitoring the contractor’s attitudes according to the current regulations.

10.3.2.3 Ministry of Local Administration

10.3.2.3.1 Department of Construction

This section constitutes the analysis and the discussion of MLA – department of construction questionnaire.

The total number of participants in this questionnaire was 11 as Civil Engineers. The approach and questions used in this investigation are similar to those of department of construction - MPWH survey. One reason why these questions are common between these departments is that both are found to be similar in their functionality. Although an area where significant difference has been found includes the geographical location of functionality. As MLA is responsible on municipalities across the country excluding GAM. Meanwhile MPWH is responsible on areas that are included within the authority of MLA and GAM.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No, Likert Scale and multiple-choice questions.

10.3.2.3.1.1 Chart 10 - 64

The charts below provide several ascertains related to different aspects such as types of contracts used by the ministry when constructing governmental projects. In addition to, the C&D waste management activities within the construction and demolition methods and the ministry willingness and consideration.

These aspects have been provided by participants using Yes/No question. The bars in these charts represents the aspects as corresponded by participants based on the question seen below.

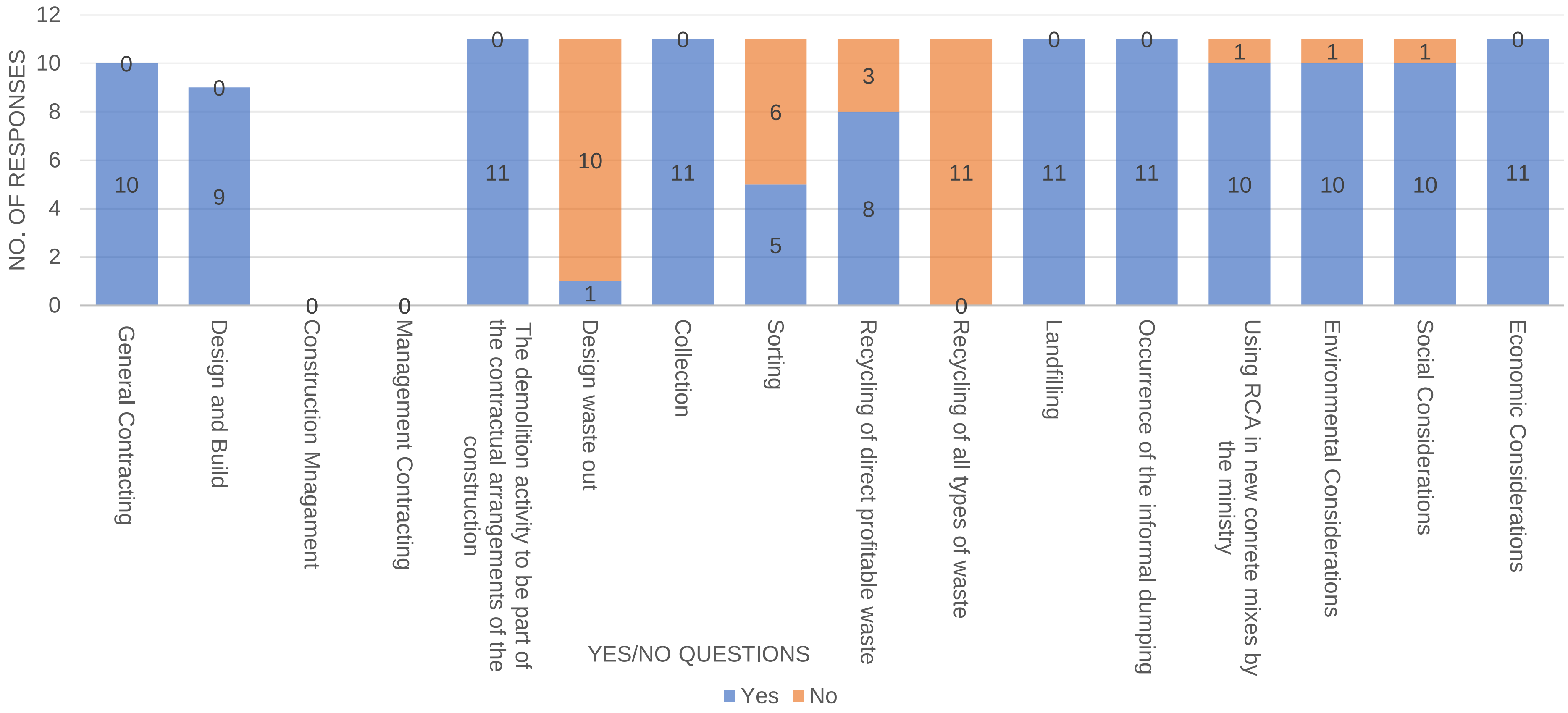

Chart 10-53: Yes/No Questions

10.3.2.3.1.2 Chart 10 - 64 Analysis

As demonstrated in **chart 10-64**, the General Contracting and Design and Build had the highest proportion of the mostly used types of contracts with 10 and 9 out of 11, respectively. Meanwhile, 100% of those who were involved in the survey indicated that the construction management and management contracting are not used. Or nearly inconsiderably used just as previously discussed in the MPWH analysis. This consistency between respondents of GAM, MPWH and MLA gives a thorough observation on how organised the industry is, unlike many development countries.

As seen in the chart above, the MLA survey has also identified the C&D waste management activities that are stipulated in the ministry's contracts. Noting that 100% of respondents revealed that the demolition activity is typically part of the contractual arrangements of the construction.

With regards to C&D waste management activities, the MLA survey results are similar to those analysed in MPWH survey expect for sorting. As all responses have indicated that the collection and landfilling are stipulated within these contracts. Almost 72% of them for recycling of profitable C&D waste (Steel and Timber for recycling and C&D debris for backfilling). Likewise, the MPWH survey above 90% of respondents revealed that designing out waste and recycling of all types of C&D waste are unfortunately not stipulated within these contracts. Because design out waste of projects is costly as it requires workshops and training courses to allow designers and engineers to do so. In addition to the absence of equipment like crushers as two respondents stated. On the other hand, in MLA survey the sorting activity had more responses than in MPWH, nearly 45% of total responses. This inconsistency argues that the MLA respondents might have considered the sorting of steel, timber and other recoverable waste material such as doors and windows. Critics question this percentage because if sorting is happening. The informal dumping could be prevented or decreased and that is not the case in Jordan. As estimates of informal dumping occurrence shown that all MLA respondents evidenced it with quantified percentage explained in the chart below.

In terms of C&D waste, the number of respondents reached almost a peak with 91%. Stating the ministry is willing to use recycled aggregates in new concrete mixes. Although correspondent to the Jordanian codes and specifications. A consequence of that is the savings in prices as the prices of recycled waste material is cheaper than standard ones and delivering environmental solutions. This predicts what the ministry takes into consideration within its policies as seen in the chart above. Where more than 85% of respondents clarified that the ministry takes the environmental, social and economic concerns into consideration in its policies.

10.3.2.3.1.3 Chart 10 – 65 and 66

The charts below offer an assessment of how frequent each type of contract is used by the ministry and the considerations of the ministry.

This assessment is provided by participants using Likert Scale question. The bars in this chart represents the participants' anticipation of using these types of contracts based on the question seen below.

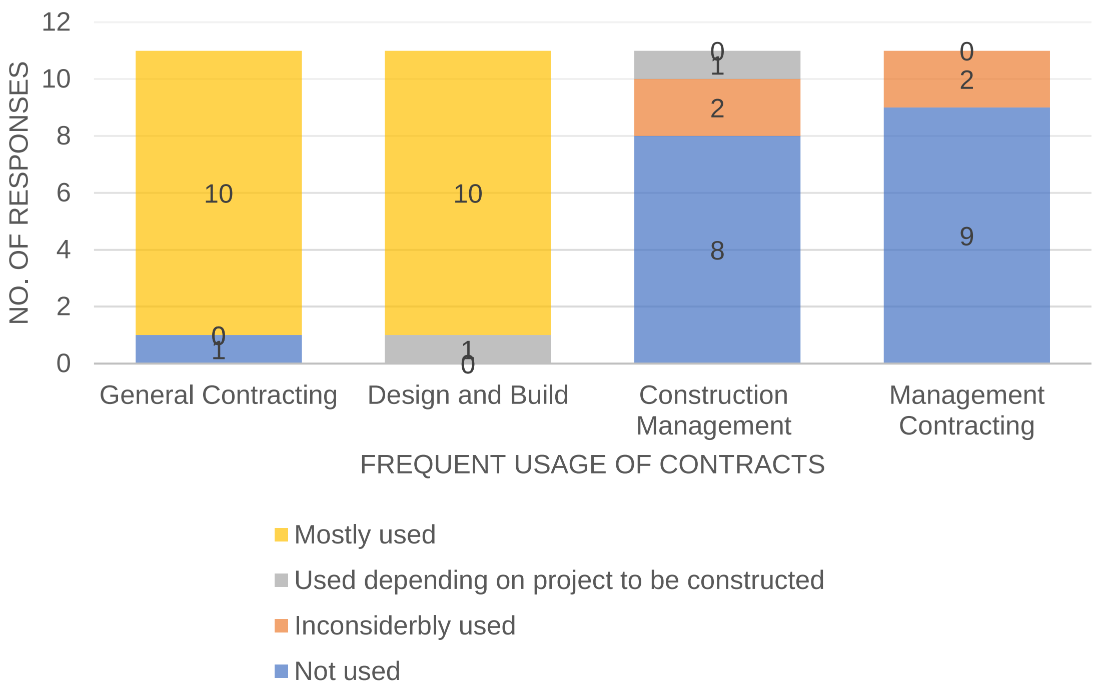

Chart 10-54: Frequent Usage of Contracts

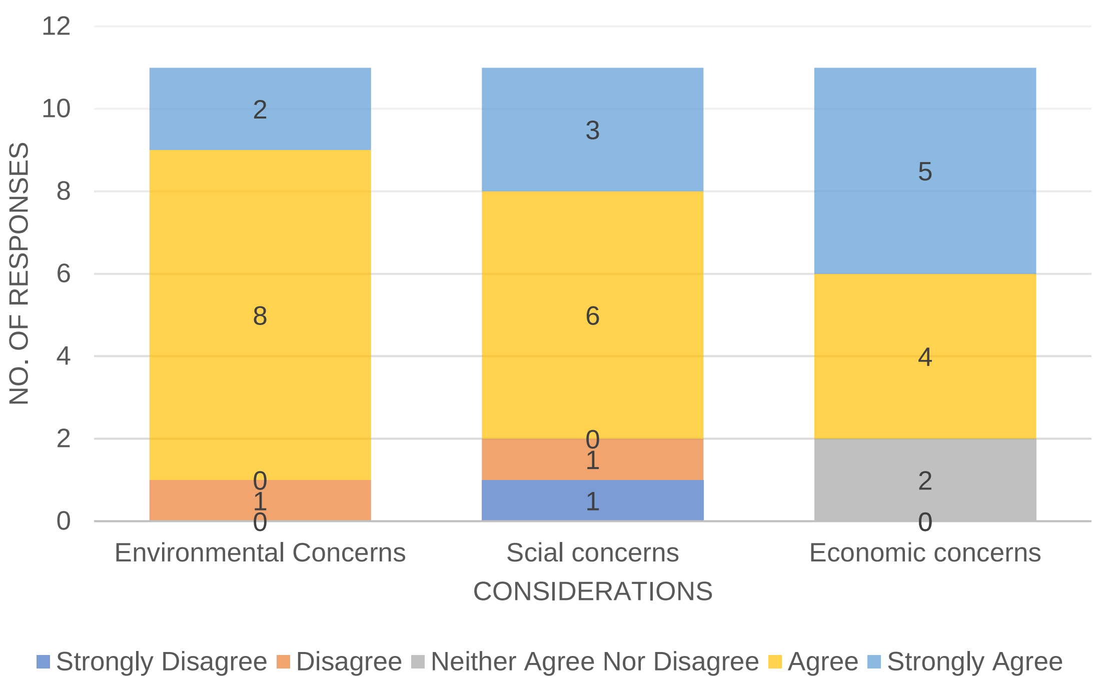

Chart 10-55: Considerations

10.3.2.3.1.4 Chart 10 - 67

The charts below offer an adequate explanation for several Likert Scale questions in the survey. Comprising the strongly related factors contributing to use specific types of contracts upon other types.

The bars in these charts represent the participants’ responses on distinguishing these reasons as based on the questions seen below. It is to be noted that some of these chart’s analysis is not provided in this section, as it has been already pointed out in the main body of the research.

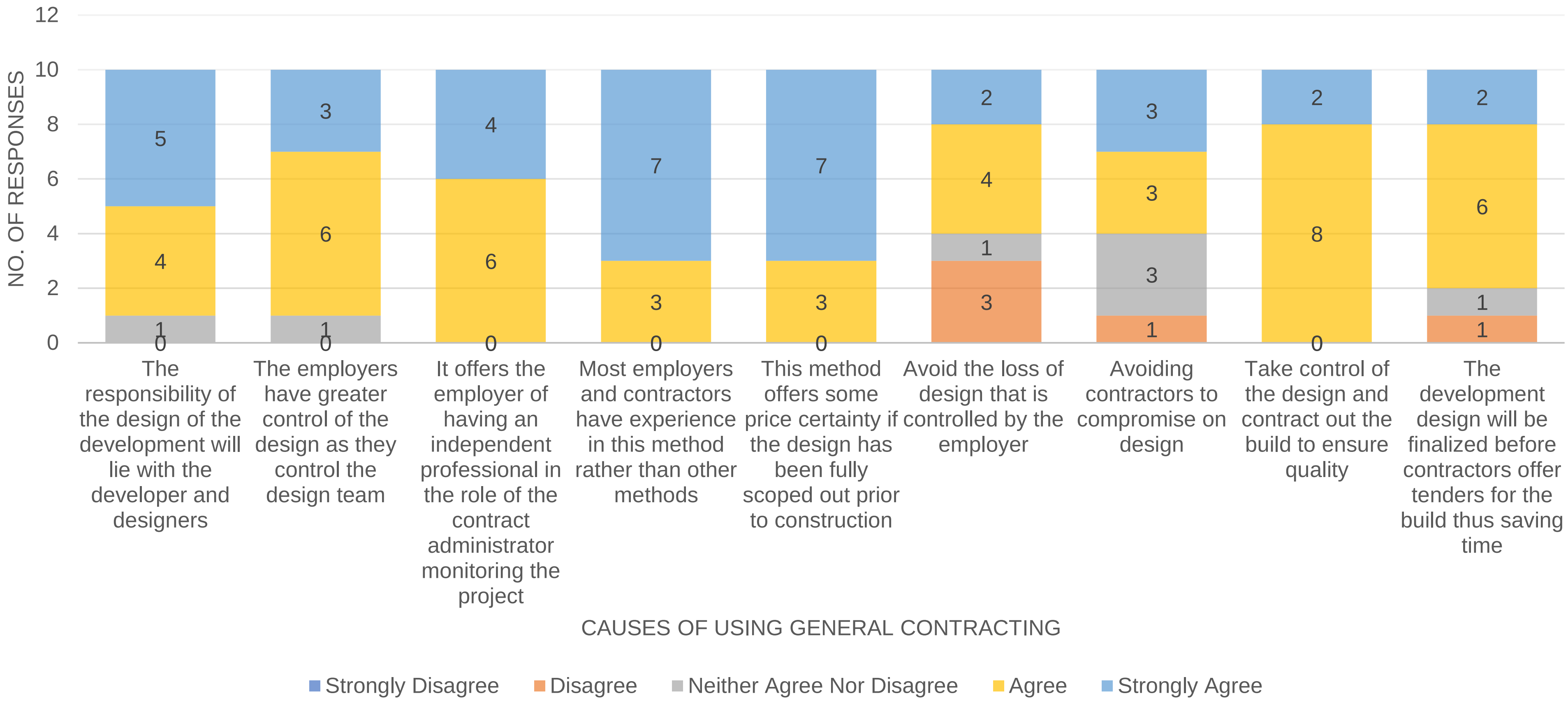

Chart 10-56: Causes of Using General Contracting

10.3.2.3.1.5 Chart 10 – 67 Analysis

As indicated previously, one of the contracts used by the ministry is the general contracting. It has been identified by approximately 80% to 90% of respondents that this type of contract is known to be used due several reasons such as:

1. Assigning clear roles and responsibilities between designers, developers and contractor.
2. The employer’s great control of the design as they control the design team.
3. Offering the employer of having an independent professional in the role of the contract administrator monitoring the project.
4. Offering some price certainty if the design has been fully scoped out prior to construction.
5. Avoiding the loss of design that is controlled by the employer.
6. Taking control of the design and contract out the build to ensure quality.
7. Finalising the development design before contractors offer tenders for the build. Thus, saving time.

It is to be noted that apart from the above-mentioned reasons. Participants have explained that most employers and contractors in the country have experience in this method rather than other methods.

10.3.2.3.1.6 Chart 10 - 68

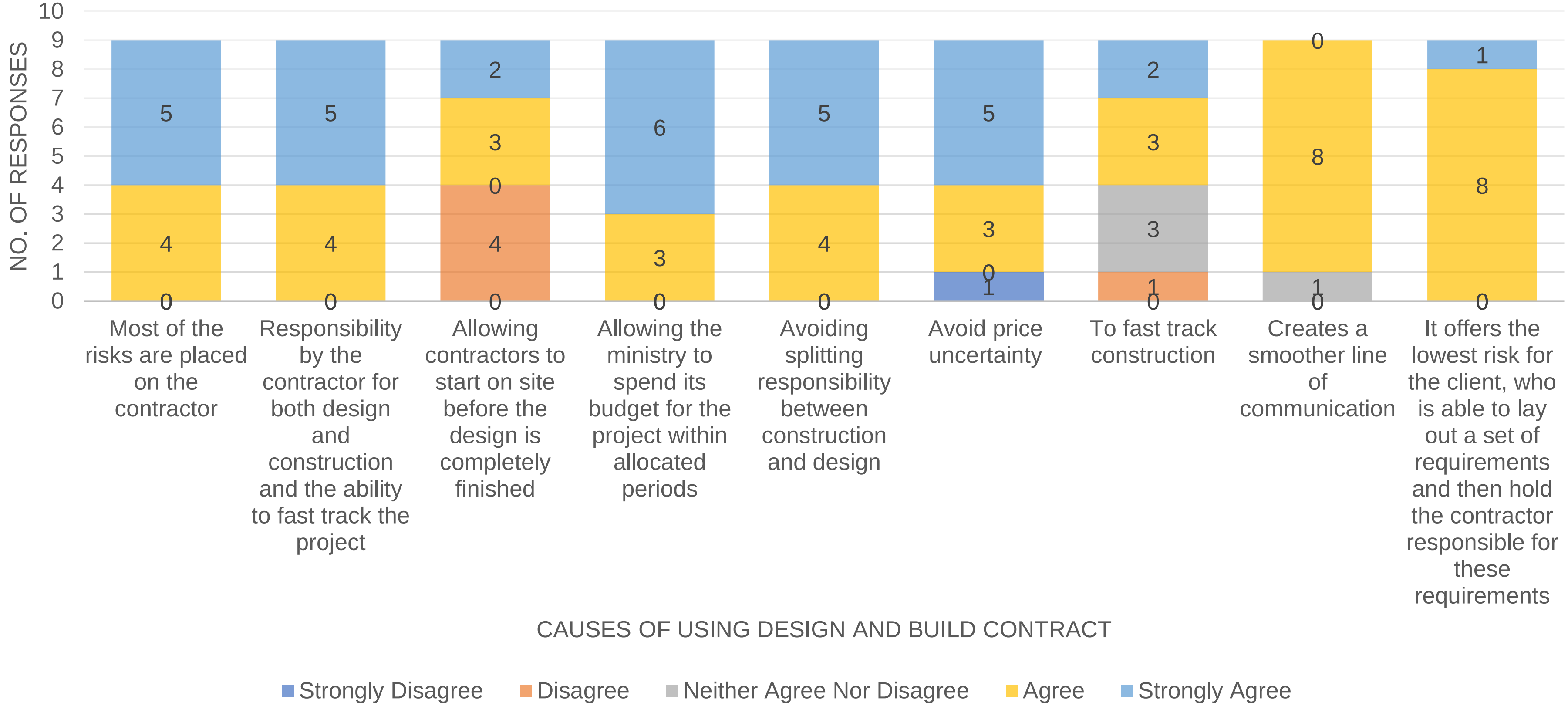

Chart 10-57: Causes of Using Design and Build Contract

10.3.2.3.1.7 Chart 10 - 68 Analysis

This chart as seen above shows that 70% to 90% of respondents demonstrated that the use of design and build contract is linked to several reasons such:

1. Most of the risks are placed on the contractor.
2. Responsibility by the contractor for both design and construction.
3. The ability to fast track the project.
4. Allowing the ministry to spend its budget for the project within allocated periods.
5. Avoiding splitting responsibility between construction and design. As this avoids whether defects are really design defects (for which the employer is responsible) or defects in material and workmanship (for which the contractor is responsible).
6. Avoiding price uncertainty.
7. Creating a smoother line of communication.
8. Offering the lowest risk for the client, who can lay out a set of requirements and then hold the contractor responsible for these requirements.

Perhaps the most serious criticism of these factors is that they do not prioritise C&D waste in any aspect. Thus, further improvements should be done on the types of contracts used by the ministry to prioritise this type of waste.

10.3.2.3.1.8 Chart 10 – 69, 70, 71, 72 and 73

The charts below offer an adequate explanation for several Likert Scale questions in the survey. Comprising the causes of informal dumping and approaches to mitigate the informal dumping of C&D waste. In addition to, the hindrances to C&D waste management activities in-site and in landfill and the approaches that could promote the adoption of C&D waste management in Jordan.

The bars in these charts represent the participants’ responses on evaluating these aspects as based on the questions seen below.

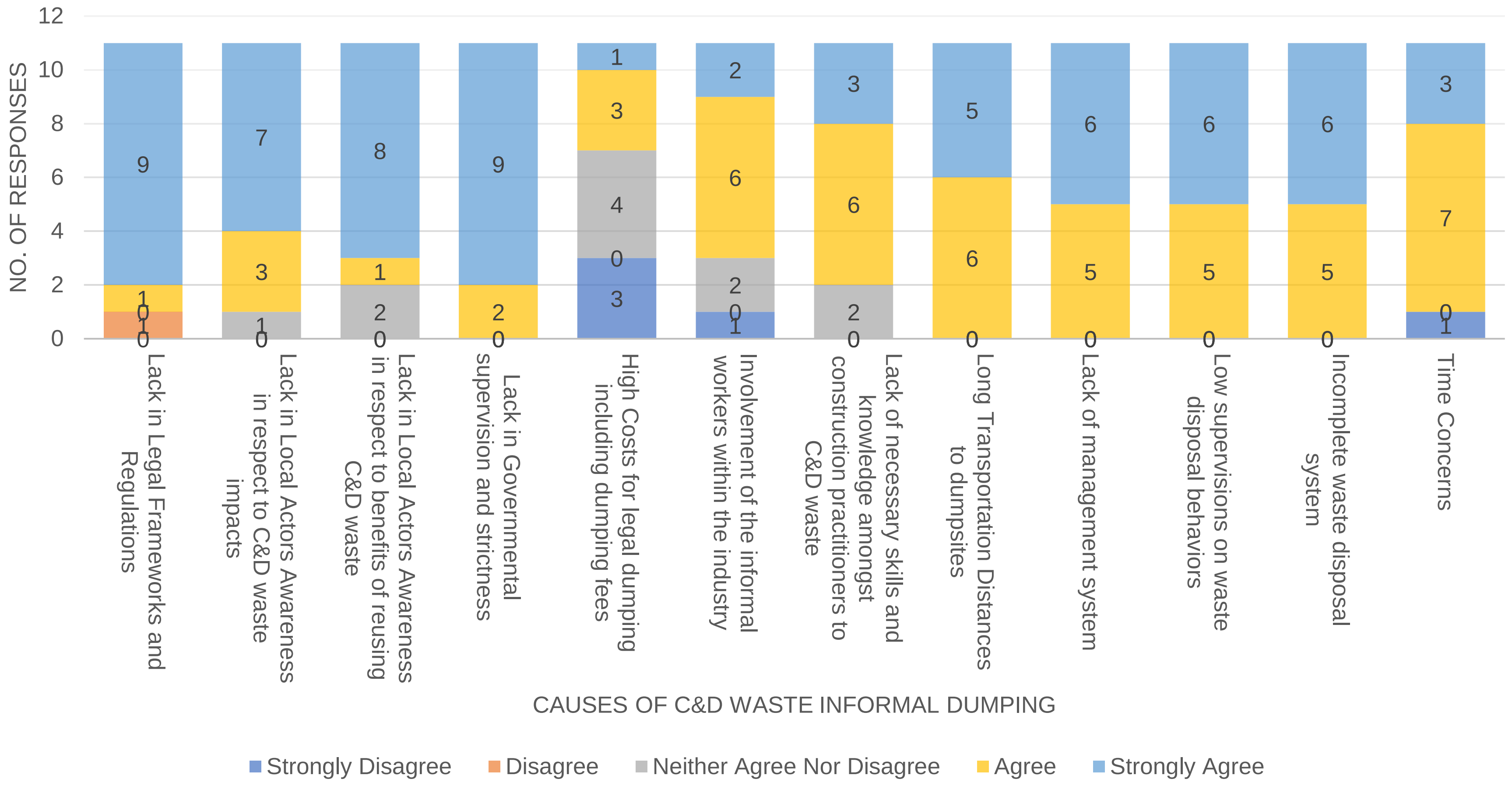

Chart 10-58: Causes of C&D Waste Informal Dumping

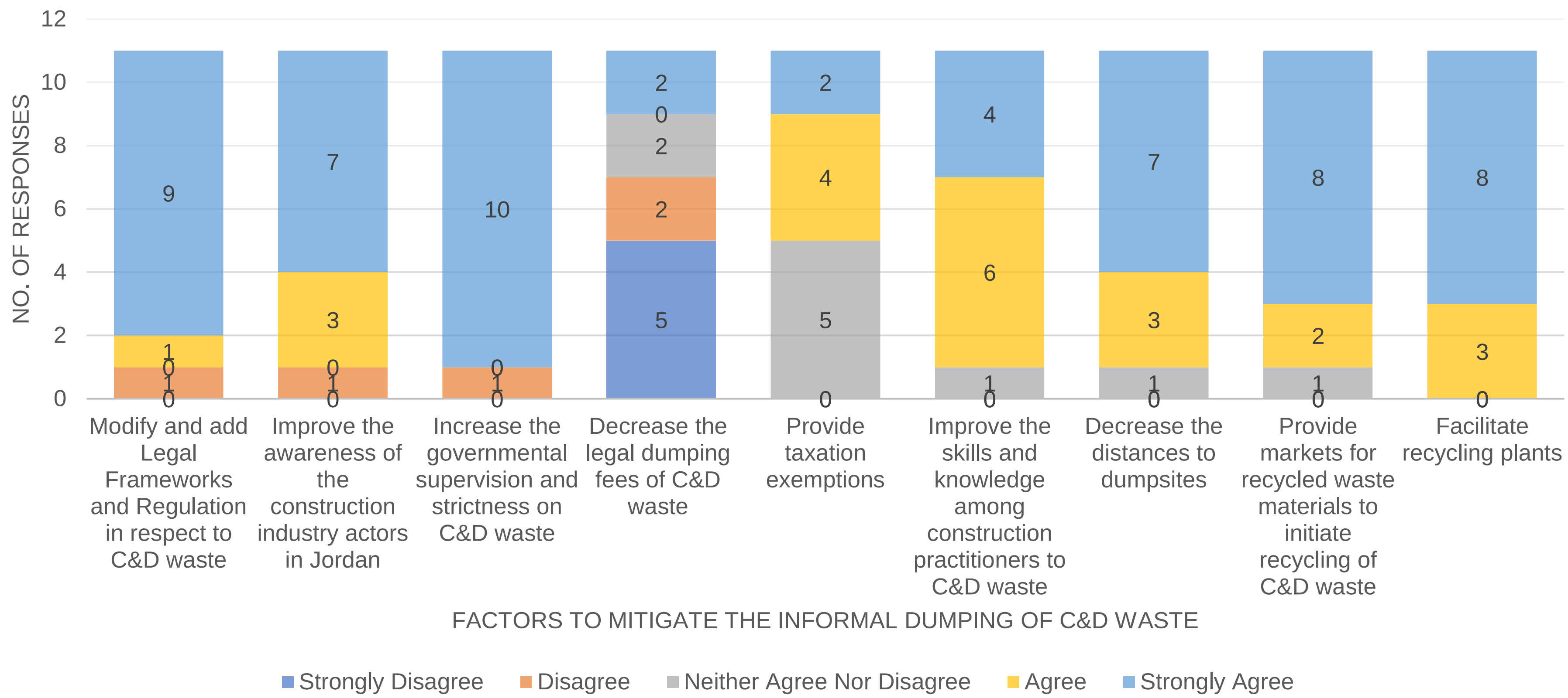

Chart 10-59: Factors to Mitigate the Informal Dumping of C&D Waste

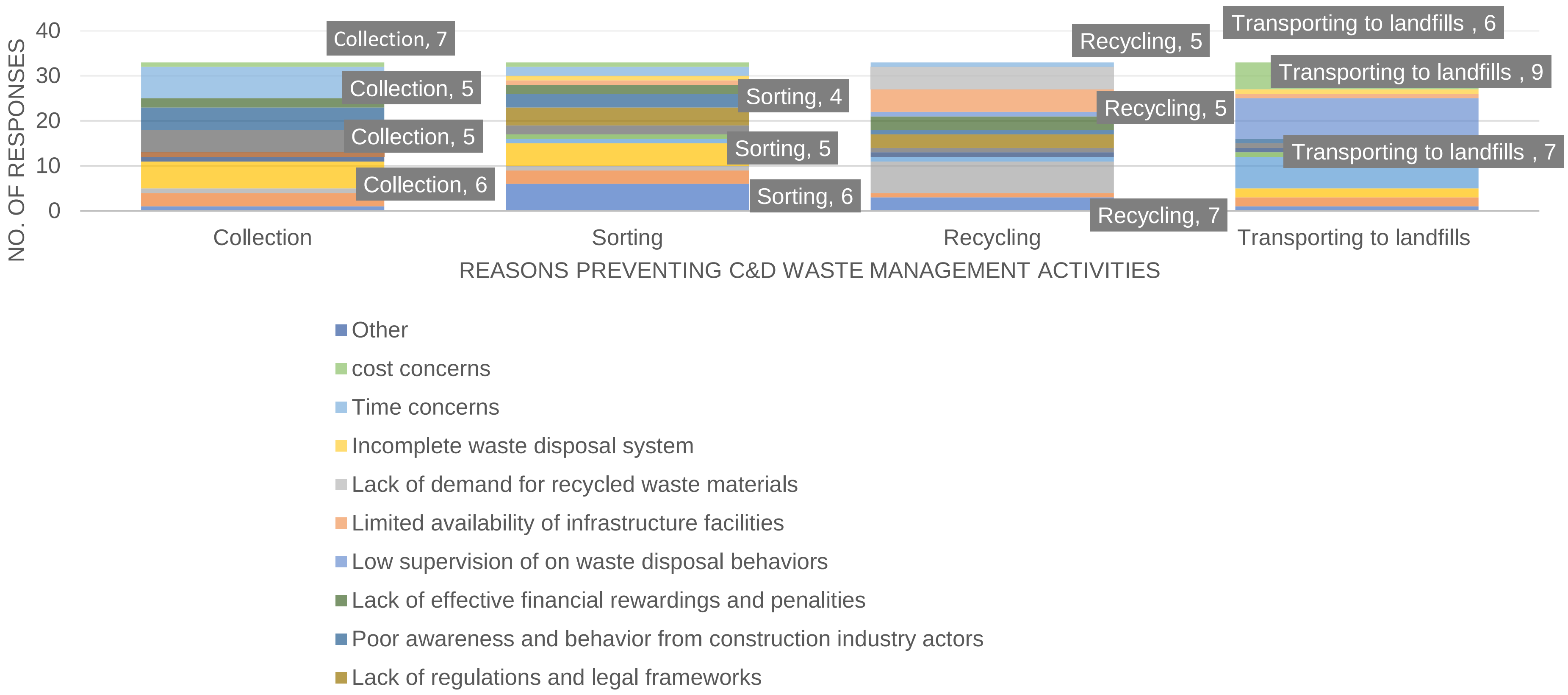

Chart 10-60: Reasons Preventing C&D Waste Management Activities

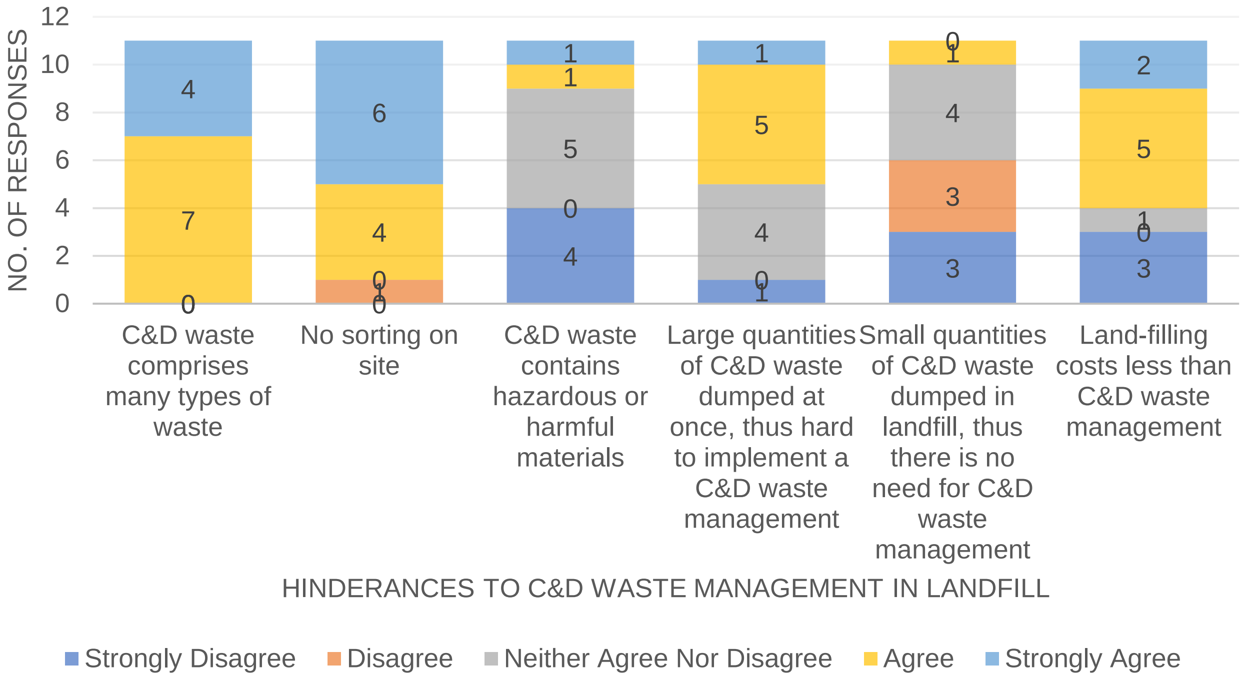

Chart 10-61: Hinderances to C&D Waste Management in Landfill

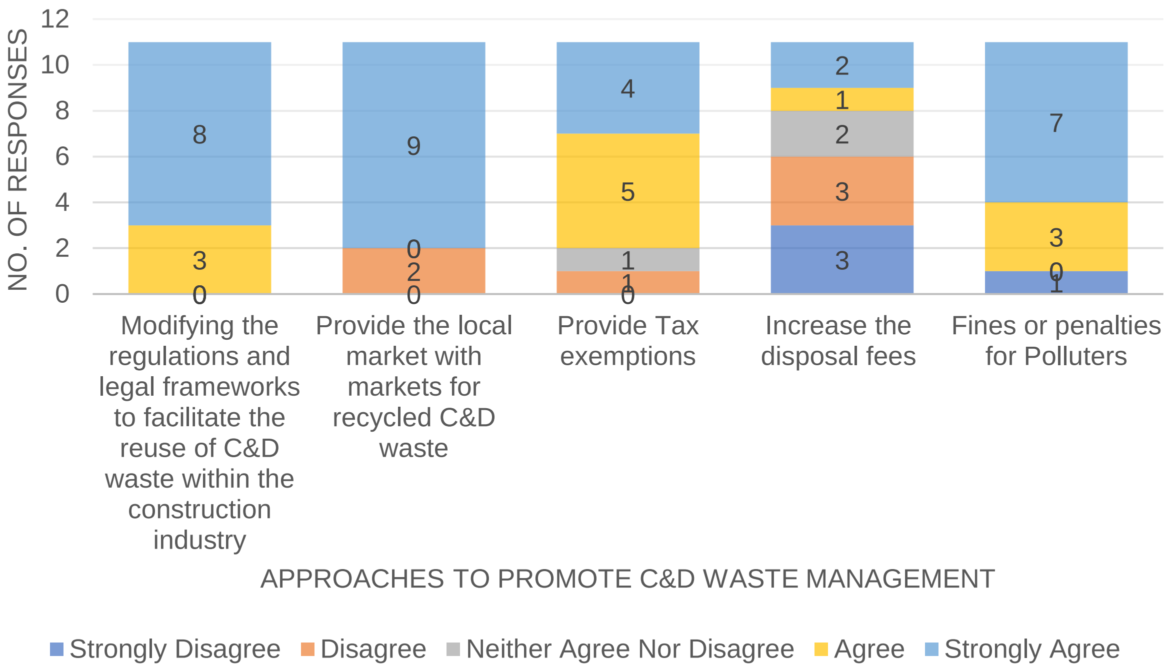

Chart 10-62: Approaches to Promote C&D Waste Management

10.3.2.3.1.9 Charts 11 – 69, 70, 71, 72 and 73 Analysis

According to those who participated in this survey, the percentage of the informal dumping is predicted to be as high as the percentage revealed in MPWH survey. The survey found many important factors to this having more than 90% of respondents including:

1. Lack in legal frameworks and regulations.
2. Lack in local actors' awareness in respect to C&D waste impacts.
3. Lack in governmental supervision and strictness.
4. Long transportation distances to dumpsites.
5. Lack of management system.
6. Low supervisions on waste disposal behaviours.
7. Incomplete waste disposal system and time concerns.

Whereas 70% to 80% of them referred this issue to other reasons, such as:

1. The lack in local actors' awareness in respect to benefits of reusing C&D waste.
2. Involvement of the informal workers within the industry.
3. Lack of necessary skills and knowledge amongst construction practitioners to C&D waste.

One of respondents suggests a link may exist between the informal dumping and absence of landfills covering all regions across the country as for instance the southern region. Similarly, as in the MPWH survey analysis the high costs for legal dumping including dumping fees are a fewer contributory factor to the informal dumping.

As previously investigated in MPWH questionnaire, the survey has studied the factors that could mitigate or reduce the high percentage of the informal dumping by MLA. It is now understood that modifying and adding legal frameworks and regulation in respect to C&D waste, improving the awareness of the construction industry actors in Jordan and increasing the governmental supervision and strictness on C&D waste. In addition to, improving the skills and knowledge among construction practitioners to C&D waste, decreasing the distances to dumpsites, providing markets for recycled waste material to initiate recycling of C&D waste and facilitating recycling plants play an important role in mitigating such an attitude, as identified by just over than 90% of respondents. Only, half of them have linked the mitigation to provide more tax exemptions for the industry's actors. Meanwhile, less than 10% have stated that increasing the coverage of landfills by allocating them across the country through studies. For the time being, as indicated in the MPWH analysis, 80% of MLA respondents suggest a weak link may exist between decreasing the legal dumping fees of C&D waste and informal dumping reduction.

As shown in **chart 10-73** above, the survey has identified several aspects that might be important factors in encouraging the industry into a transformation. By adopting a national C&D waste management strategy. The results of this survey revealed that many more than 90% of respondents agreed that this transformation may have been caused by:

1. Modifying regulations and legal frameworks.
2. Provide the local market with recycled C&D waste material markets.
3. Provide tax exemptions.
4. Apply fines or penalties for waste polluters.

On the other hand, as analysed in the MPWH section 90% of respondents indicated that increasing the disposal fees would not be beneficial for such a national strategy. Although, just under 10% stated that increasing the disposal could be effective only if the alternative is available as investigated in the interviews. This seems to be true as per the low feeing system of C&D waste and yet C&D waste is informally dumped. On the other hand, few participants have mentioned other encouragements that would inspire the adoption of a national C&D waste management strategy, such as:

1. Establishing design codes for recycled waste material.
2. Controlling C&D waste management through:
    a. Issuing demolition licenses and post construction usage permissions of buildings under terms and conditions such as sorting waste on site.
3. Apply more monitoring on renovation projects.

The survey revealed that under 65% of MLA respondents clarified that time concerns plays a major role in hindering the collection process within the C&D waste management on site. Meanwhile, 54% of participants revealed that the lack of necessary skills and knowledge among construction practitioners to C&D waste. In addition to, 45% for poor awareness and behaviour of the construction industry actors and lack of management system in the construction industry. Meanwhile, the rest of factors have been factors weakly related to collection prevention as responded by below 30% of respondents including:

1. Absence of equipment.
2. Involvement of the informal workers within the industry.
3. Absence of recycled waste material codes.
4. Small portions of C&D waste generated.
5. Lack of effective financial rewarding and penalizing methods.
6. Cost concerns.

With respect to sorting, estimates of the most likely causes hindering such an activity on site range from 35% to 55% of respondents which are:

1. The absence of enough equipment.
2. Lack of necessary skills and knowledge among construction practitioners to C&D waste.
3. Lack of regulations and legal frameworks.

Although, a maximum of 30% of respondents have linked this hindrance to:

1. Involvement of the informal workers within the industry.
2. Lack of management system in the construction industry including regulations and legal frameworks.
3. Poor awareness and behaviour from construction industry actors.
4. Lack of effective financial rewarding and penalizing methods.

Several factors have been revealed to affect recycling such as the inexistence of codes for recycled material, limited availability of infrastructure facilities and lack of demand on recycled waste material. Where a range of over 1 third to 2 thirds of those surveyed agreed on that. As previously indicated the absence of recycled material codes is an important determinant towards recycling hindrance. In addition to these factors, less than a third of those who responded (27%) indicated that the absence of equipment, lack of effective financial rewarding and penalizing methods and lack of regulations and legal frameworks.

Turning now to landfilling as the least preferable solution for C&D waste. From those 11 participants who completed the questionnaire, 60% to 80% of them indicated several factors appeared to have a detrimental effect on proper landfilling, such as:

1. Long transportation distances to dumpsites.
2. Low supervision on waste disposal behaviours.
3. Cost concerns.

Although, few factors are different from the previous ones in respect to their effect. As below 20% of respondents indicated that several factors could have profound less consequences on landfilling prevention, such as:

1. The involvement of the informal workers within the industry.
2. Lack of necessary skills and knowledge among construction practitioners to C&D waste.
3. Low supervisions on waste disposal behaviours.
4. Incomplete waste disposal system.
5. Cost concerns.

Having defined what reasons could prevent landfilling, it is now necessary to show what could hinder C&D waste management post legal landfilling. **Chart 10-72** allows the observer to identify important driving factors to this hindrance. Including the composition of C&D waste that varied a lot of types. This factor has been strongly associated in several questionnaires with the absence of sorting on site as over 95% of respondents agreed on that. Just over 60% of them referred that to the costs of landfilling that tend to be less cheap than C&D waste management. Meanwhile, only 54% to the huge amount of C&D waste that is dumped at once in landfills. In contrast, above 90% of those who responded agreed that the contaminations in C&D waste. In addition to, the small quantities of C&D waste do not make the C&D waste management worse in landfills.

10.3.2.3.1.10 Chart 10 – 74 and 75

The charts below draw a distinction between the procurement methods of bidding adopted when constructing or demolishing governmental projects and estimates the percentage of informal dumping.

This distinction and estimation are provided by participants using Likert Scale question. The bars in this chart represents the participants anticipation of using these procurement methods and anticipating the percentages based on the question seen below.

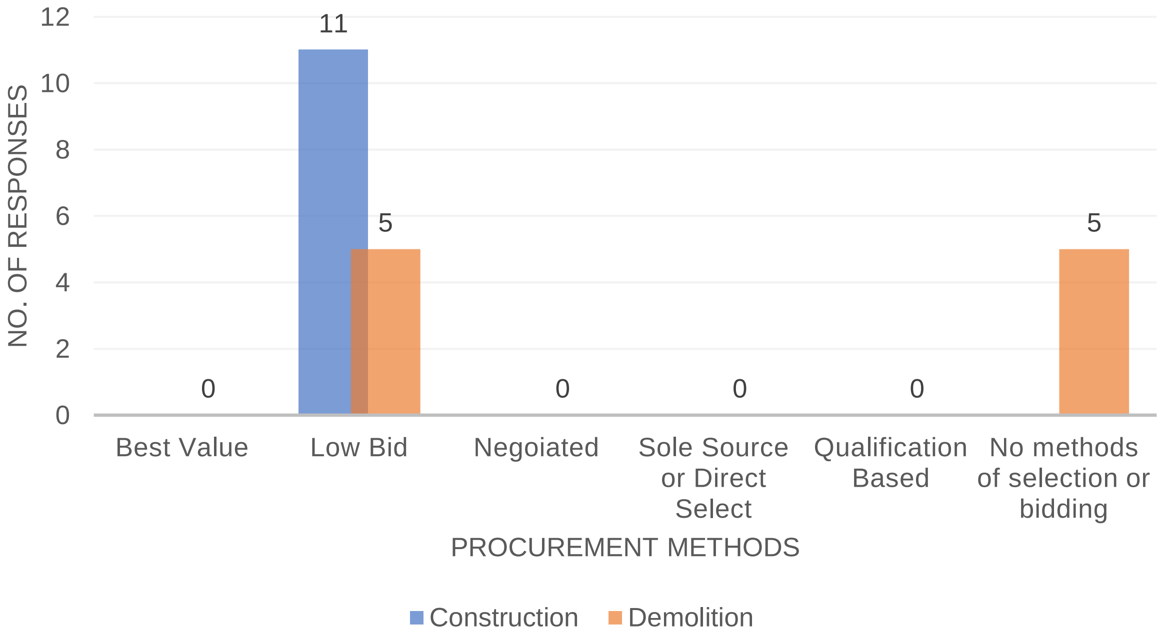

Chart 10-63: Procurement Methods

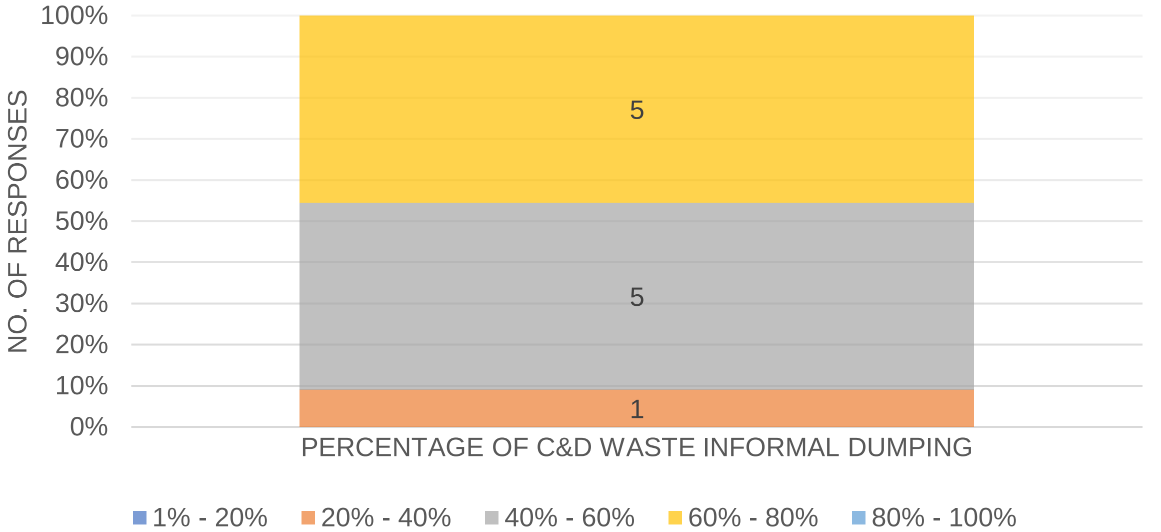

Chart 10-64: Percentage of C&D Waste Informal Dumping

10.3.2.3.1.11 Charts 11 – 74 and 75 Analysis

Both MLA and MPWH adopt the same procurement methods of projects as seen in **chart 10-74** which is low bidding for all construction projects. As some respondents suggested that reducing the cost of projects and gain savings have contributed to increase its use. Although, unlike MPWH, half of respondents in MLA survey have revealed that demolition projects are also procured via low bidding. Although some stated that demolition projects could be gone for the least price with no bidding. Or with bidding if the size of the project is huge and contains adequate quantity of recyclable waste material such as steel. Whereas the other half demonstrated the contrast and stated that demolition projects are procured with no selection method. This opens a field to be investigated in the interviews.

The analysis of **chart 10-75** shows that almost 2 halves of respondents anticipated that 40% to 60% and 60% to 80% of C&D waste generated is informally dumped. Meanwhile, just under 10% of them indicated that the informal dumping covers 20% to 40% of generated C&D waste.

10.3.2.3.1.12 Chart 10 - 76

The chart below assesses the effectiveness of the current regulations and compliances of different actors within the industry.

The responses of participants are provided by using Likert Scale questions. The bars in these charts represent the participants' responses on evaluating these aspects as based on the questions seen below.

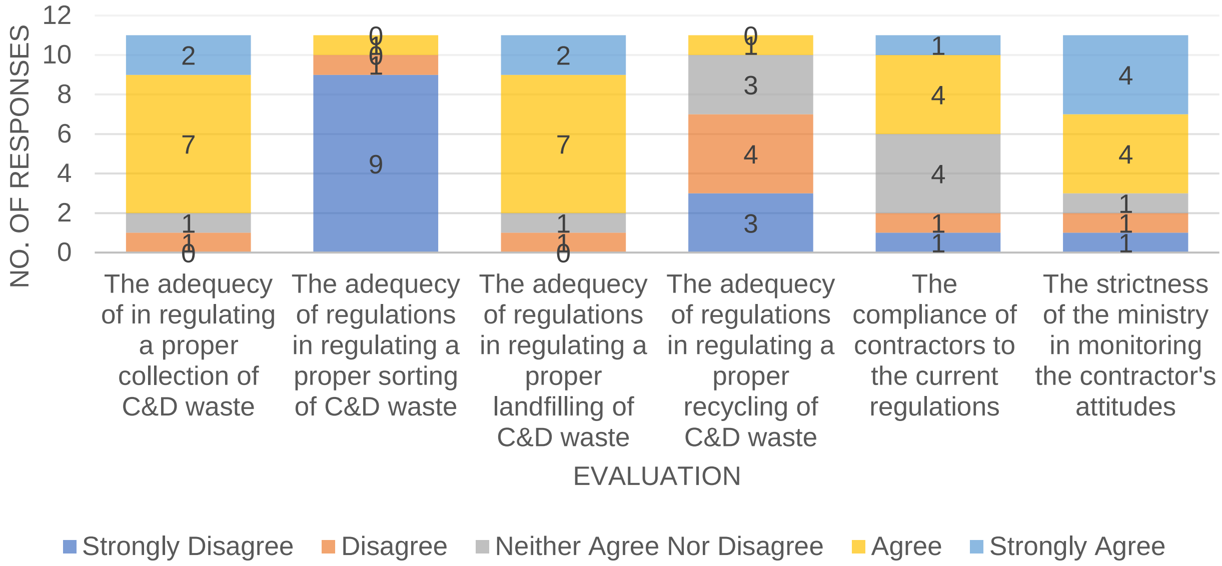

Chart 10-65: Evaluation

10.3.2.3.1.13 Chart 10 - 76 Analysis

As regards C&D waste management strategy, it is necessary to scale how adequate the current regulations and legislations in regulating collection, sorting, recycling, landfilling. In addition to, contractor's compliances and the ministry's strictness on monitoring the contractors and construction companies' attitudes.

This chart shows the results of those who participated in the MLA survey. These results are similar to that in MPWH survey. As they indicated that more than 70% of respondents evaluated that the current regulations of collection and landfilling are effective to regulate them. Together with the ministry that tends to perform strict in monitoring the contractor's attitudes. Although, fewer than 10% stated that the collection regulations are not existed. Meanwhile, 50% of respondents revealed that contractors are not compliance with the current regulations of C&D waste. As the class of the companies and absence of landfills in the southern region may be linked to behaviour problems. The rest of regulations related to sorting and recycling, around 90% of respondents evaluated these regulations less likely to perform well than the collection and landfilling regulations. As many as a third of respondents stated that these regulations are not existed.

10.3.2.3.2 Department of Design and Studies

This survey includes the analysis and the discussion of MLA – department of design and studies questionnaire.

The total number of participants in this questionnaire was 18. This topic can best be treated similarly to the survey outlined above. Which is in the same way similar to those of department of design and studies - MPWH survey covering the same topics. As it can have profound to be common as previously pointed out.

This survey covers several aspects comprising identifying the types of contracts used by the ministry including the contractual arrangements and the procurement methods, recognising the adoption of design out waste approaches. In addition to the willingness, considerations and evaluation of regulations and compliances.

It outlines analysis of data collected from different types of questions as seen below comprising Yes/No and Likert Scale questions.

10.3.2.3.2.1 Charts 11 – 77, 78, 79, 80 and 81

The following charts provides information related to the phases of design of projects at MLA and the internal tasks that take place through these phases.

This has been provided by participants using Yes/No question. The bars in these charts represents the aspects as corresponded by participants based on the question seen below.

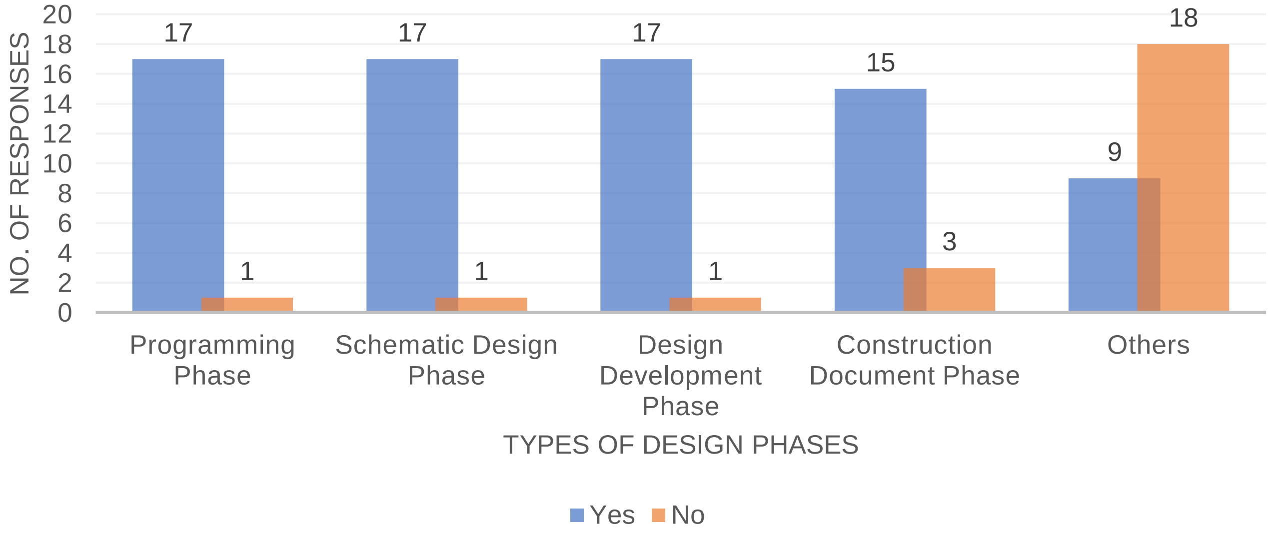

Chart 10-66: Types of Design Phases

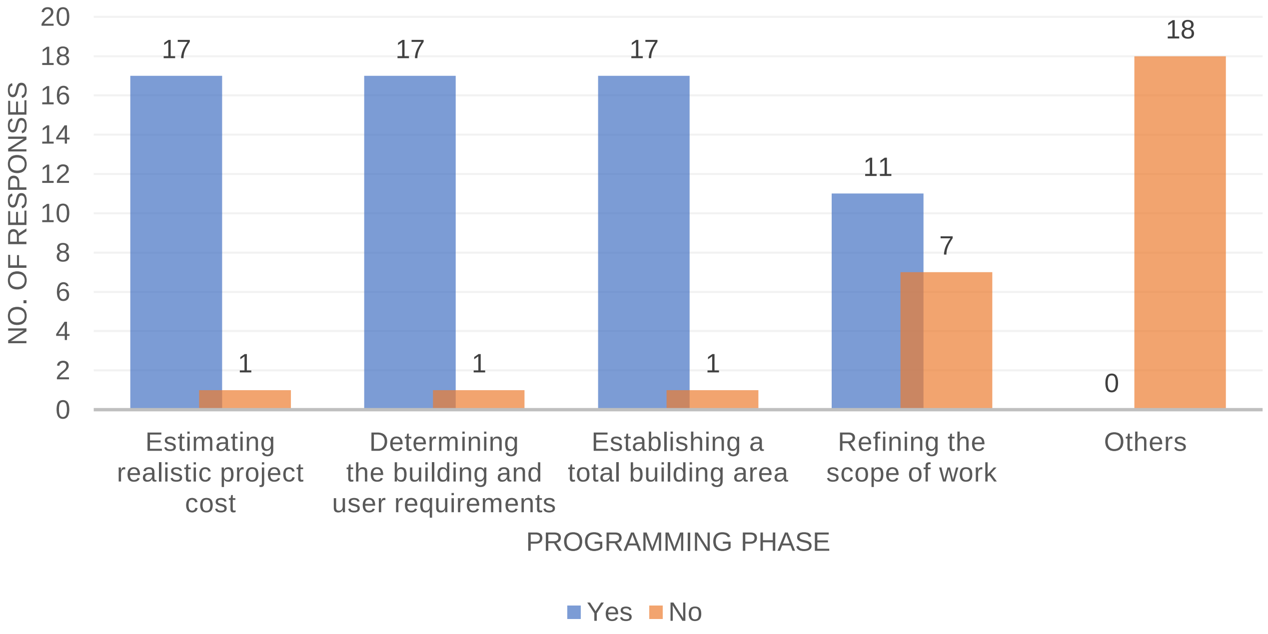

Chart 10-67: Programming Phase

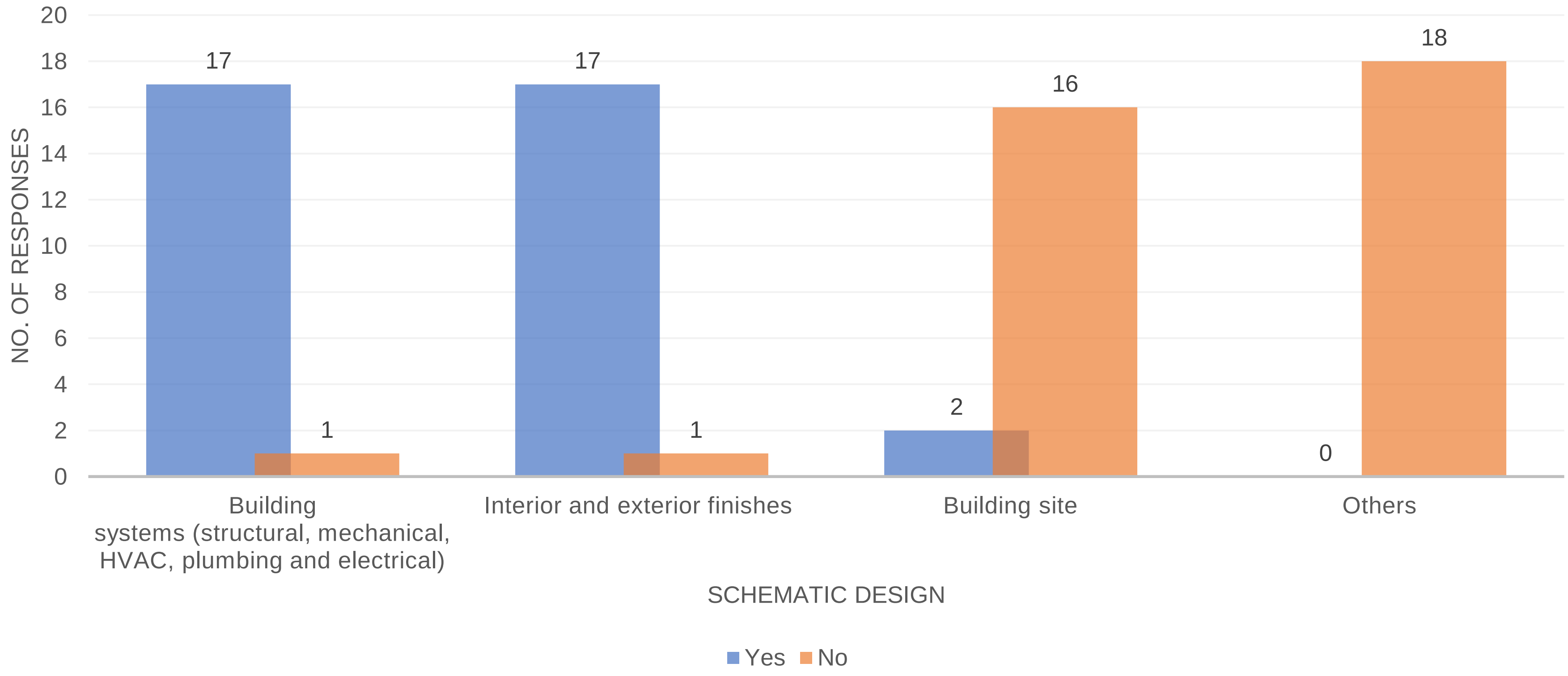

Chart 10-68: Schematic Design

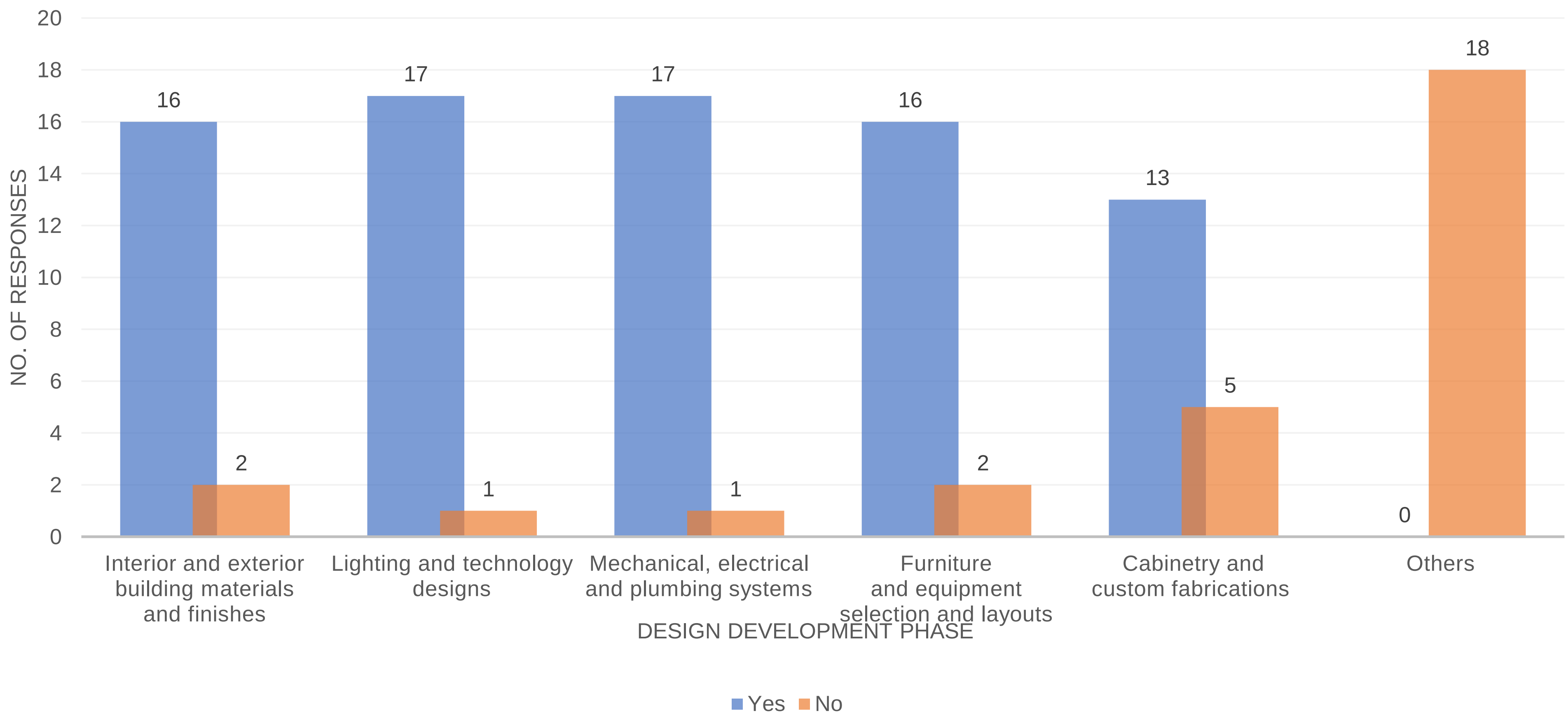

Chart 10-69: Design Development Phase

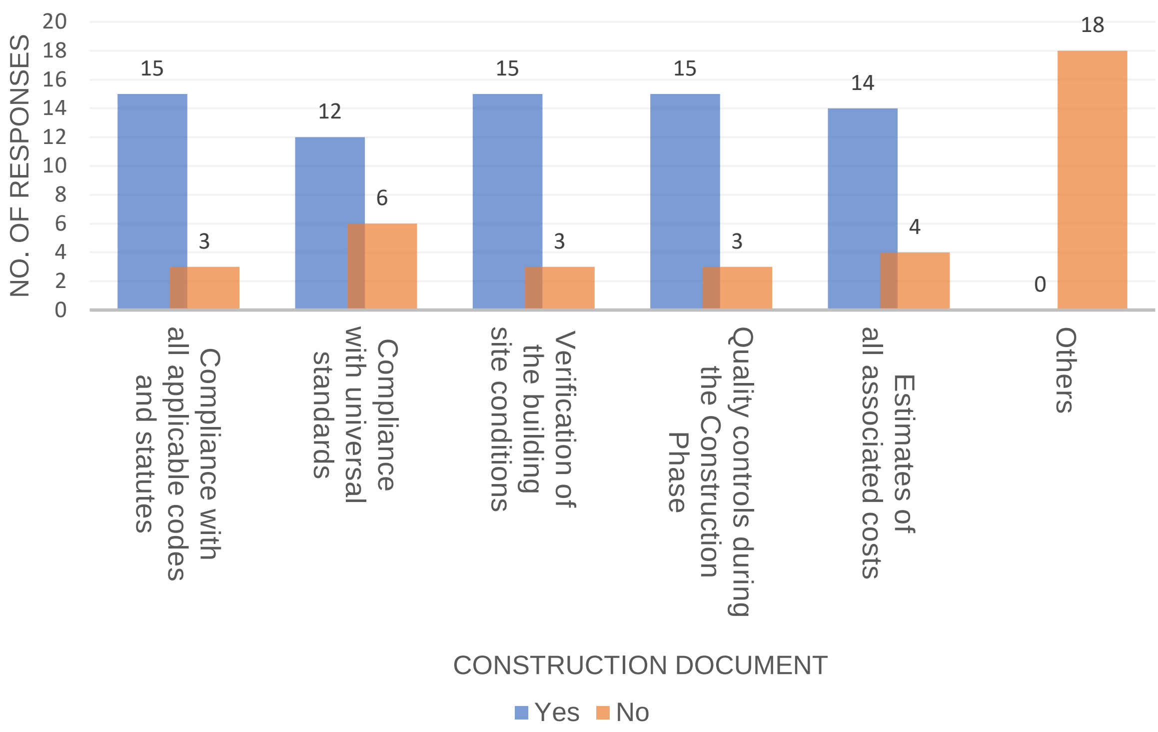

Chart 10-70: Construction Document

10.3.2.3.2.2 Charts 11 – 77, 78, 79, 80 and 81 Analysis

The analysis describes that there are four types of phases that take place within any design stage of projects. Comprising programming, schematic design, deign development and construction document according to 100% of respondents. Respondents illustrate clearly what tasks are inclusive within these phases.

As for the programming phase, above 90% of respondents indicated these tasks:

1. Estimating realistic project cost.
2. Determining the building and user requirements.
3. Establishing a total building area.
4. Whereas only 61% of them indicated that for refining the scope of work.

As for the schematic design phase, these tasks include:

1. Design for building systems (structural, mechanical, plumbing and electrical).
2. Design for interior and exterior finishes take place based on nearly all respondents.

Logically, building site does not take place at all as this shows the honesty of respondents in the survey except for 11% of them as they indicated the contrast.

With respect to design development phase, estimates of respondents range from 13 to 17 indicated that this phase includes:

1. The interior and exterior design finishes.
2. Lighting and technology designs.
3. Designing electrical, mechanical and plumbing systems.
4. Furniture and equipment selection and layouts.
5. Cabinetry and custom fabrications.

Regarding construction document phase, 77% to 84% of those who had responded to the survey shown that this phase is for:

1. Checking the compliance of design to codes.
2. Verifying building site conditions.
3. Checking quality controls during the construction phase.
4. Estimating all associated costs.
5. Meanwhile, only 66% of them illustrates that this phase includes checking the compliance of universal standards.

10.3.2.3.2.3 Chart 10 - 82

The charts below outline the policy of the MLA towards demolition projects. If be treated as construction projects in the design phase and measure the ministry current adoption of design for reduction, prevention, or deconstruction.

This has been provided by participants using Yes/No question. The bars in these charts represents the aspects as corresponded by participants based on the question seen below.

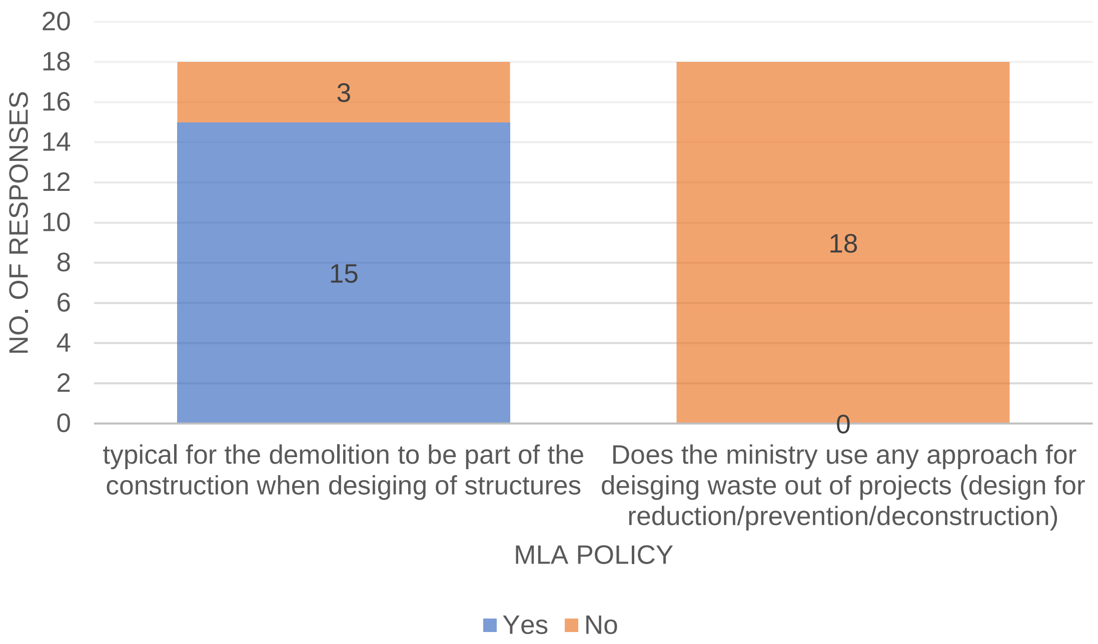

Chart 10-71: MLA Policy

10.3.2.3.2.4 Chart 10 - 82 Analysis

It appeared that as shown previously by the department of construction within MPWH. Above 80% of participants shown that it is typical for demolition to be part of the construction when designing of projects. Although, the same percentage have agreed that the MPWH does not use any approach for designing out waste on projects including all its types of reduction, prevention nor deconstruction.

10.3.2.3.2.5 Chart 10 – 83, 84, 85, 86 and 87

The charts below determine the underlying causes hindering the adoption of design out waste of projects and the absence of recycled waste material design codes. It also considers the possible approaches that could contribute the adoption of such an approach. In addition to assess the willingness to establish design codes and towards adopting such approaches in governmental projects.

These aspects have been provided by participants using both Likert Scale and Yes/No questions. The bars in these charts represent these aspects as corresponded by participants based on the question seen below.

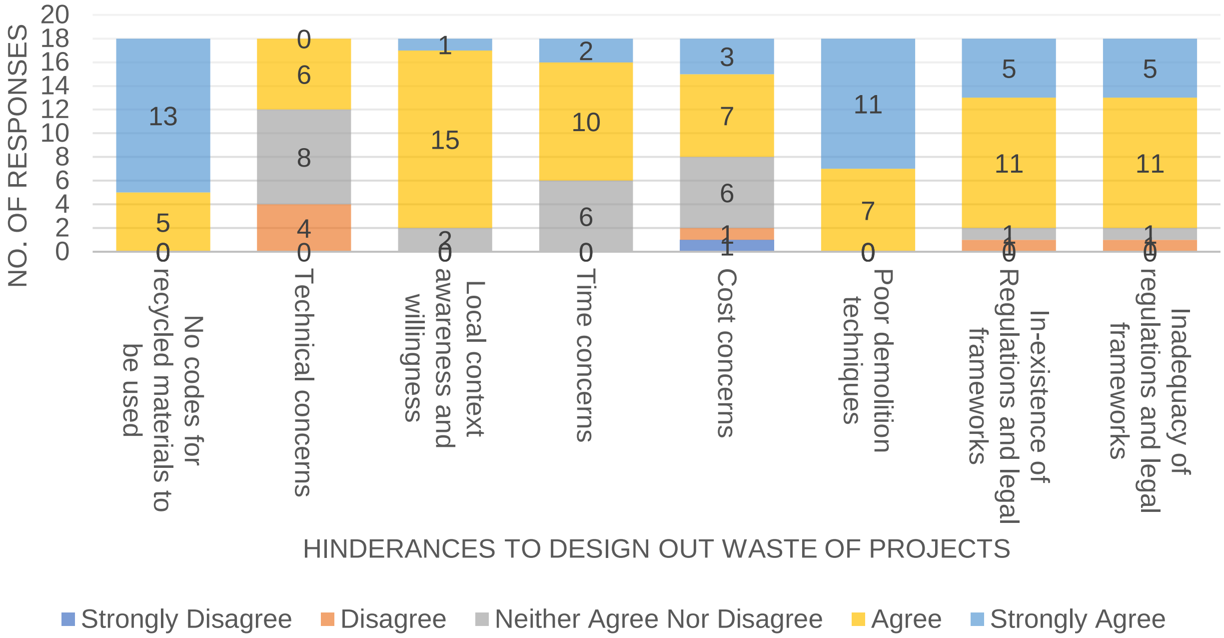

Chart 10-72: Hindrances to Design Out Waste on Projects

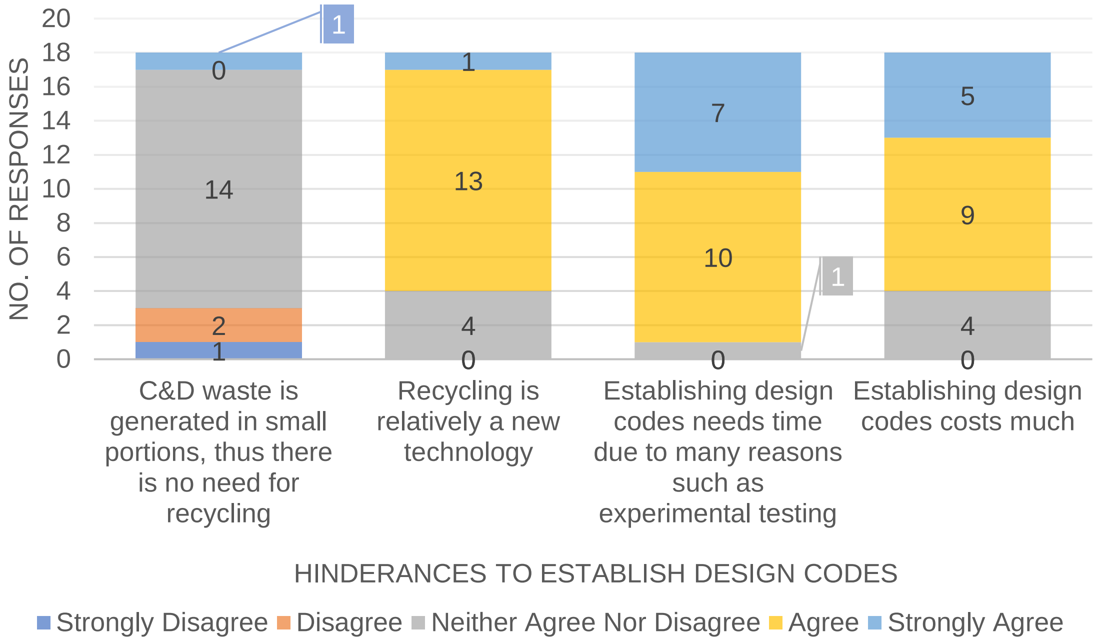

Chart 10-73: Hindrances to Establish Design Codes

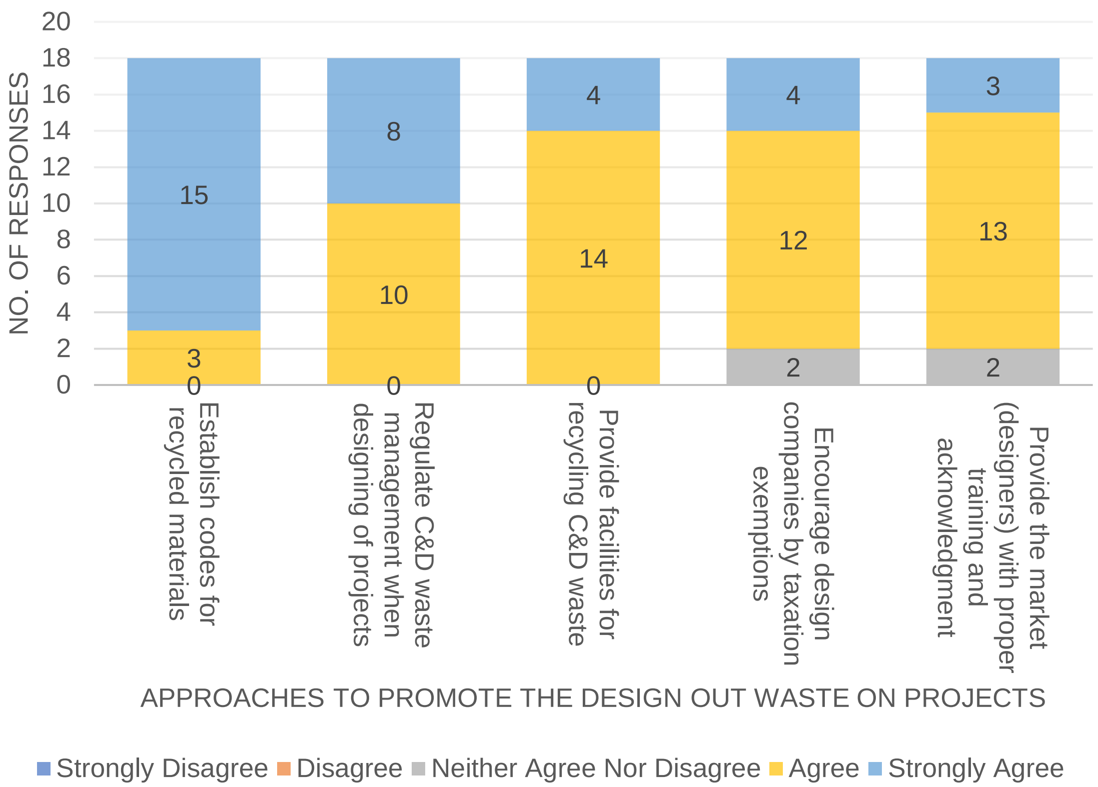

Chart 10-74: Approaches to Promote the Design Out Waste on Projects

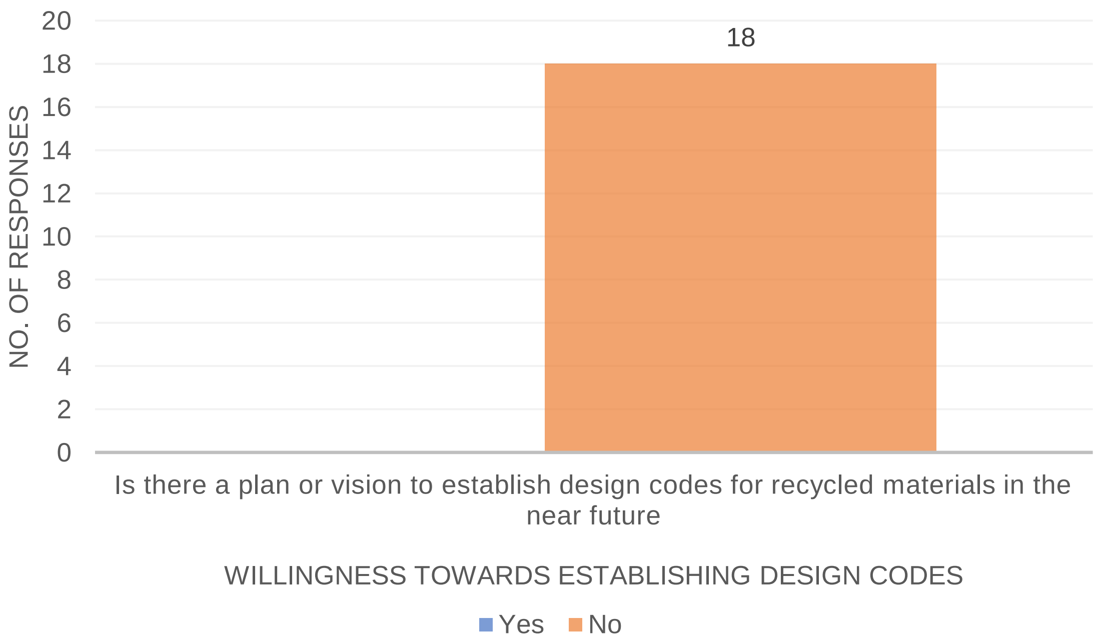

Chart 10-75: Willingness Towards Establishing Design Codes

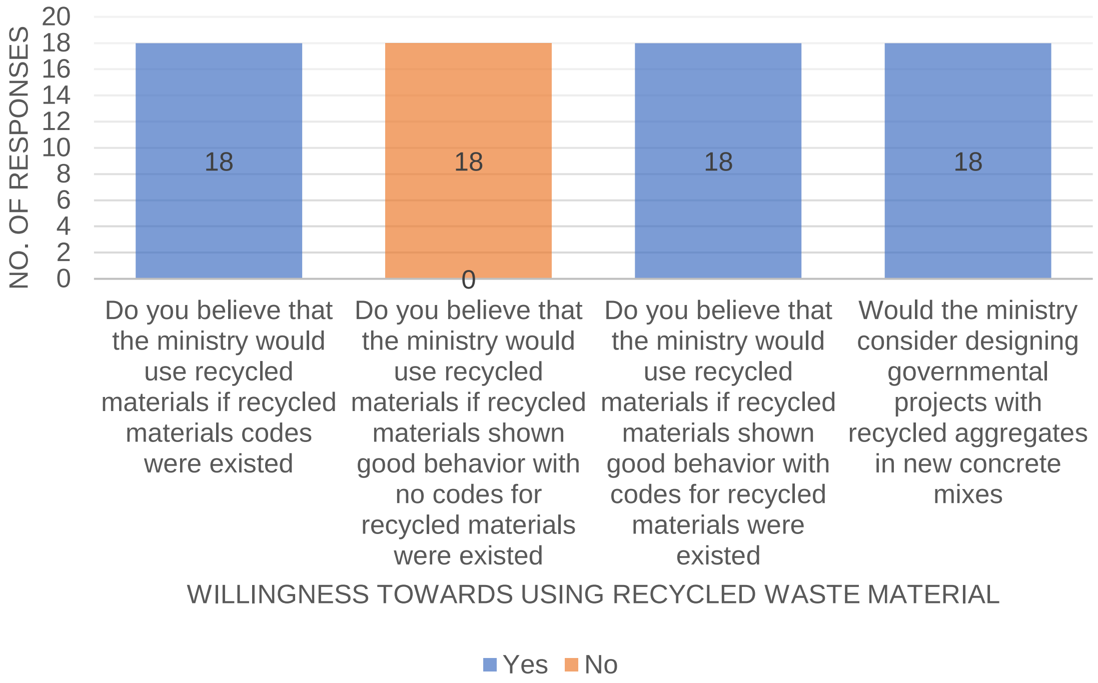

Chart 10-76: Willingness Towards Using Recycled Waste Material

10.3.2.3.2.6 Charts 11 – 83, 84, 85, 86 and 87 Analysis

The case reported previously illustrated that MPWH does not use any approach for designing out waste on projects. This has been seen majorly by nearly 100% of respondents due to the absence of recycled waste material codes and poor demolition techniques. As over than 75% of those who were surveyed suggested that the absence of recycled waste material design codes stems from considering:

1. Recycling as a relatively new technology.
2. The time concerns.
3. The costs associated with the establishment of such codes. As it requires experimental testing.

On the other hand, many more than 90% agreed that the C&D waste is generated in small portions. Thus, it is a weakly related factor to the absence of design codes.

Unfortunately, thus far the MPWH does not seem to show any interest whatsoever towards having a plan or vision to establish design codes for recycled waste material. Although, 100% of surveyors agreed on believing that the MPWH would consider designing governmental projects with recycled waste material. As they agreed on using recycled waste material if waste material shown good behaviour and under specifications and design codes. In contrast and as expected the same percentage has indicated that the ministry would not use recycled waste material with no design codes even if recycled waste material shown good behaviour. In addition to, poor awareness of locals and their willingness, absence of regulations and legal frameworks and inadequacy if existed based on over than 85% of respondents. Estimates of responses range 55% to 66% referred the un-usage of such approaches to time and cost concerns. Although nearly 65% of them agreed that the technical concern is not a limitation towards designing out waste on projects. These limitations could be mitigated according to more than 88% of respondents by establishing design codes of recycled waste material and regulating C&D waste management when designing projects. In addition to providing recycling facilities and applying tax exemptions and proper training to design companies to encourage them to use such an approach.

10.3.2.3.2.7 Chart 10 – 88

The chart below assesses the effectiveness of several encouragements that could be attributed to adopt a C&D waste management strategy by MLA.

These encouragements have been evaluated by participants using Likert Scale question. The bars in these charts represent this evaluation as corresponded by participants based on the question seen below.

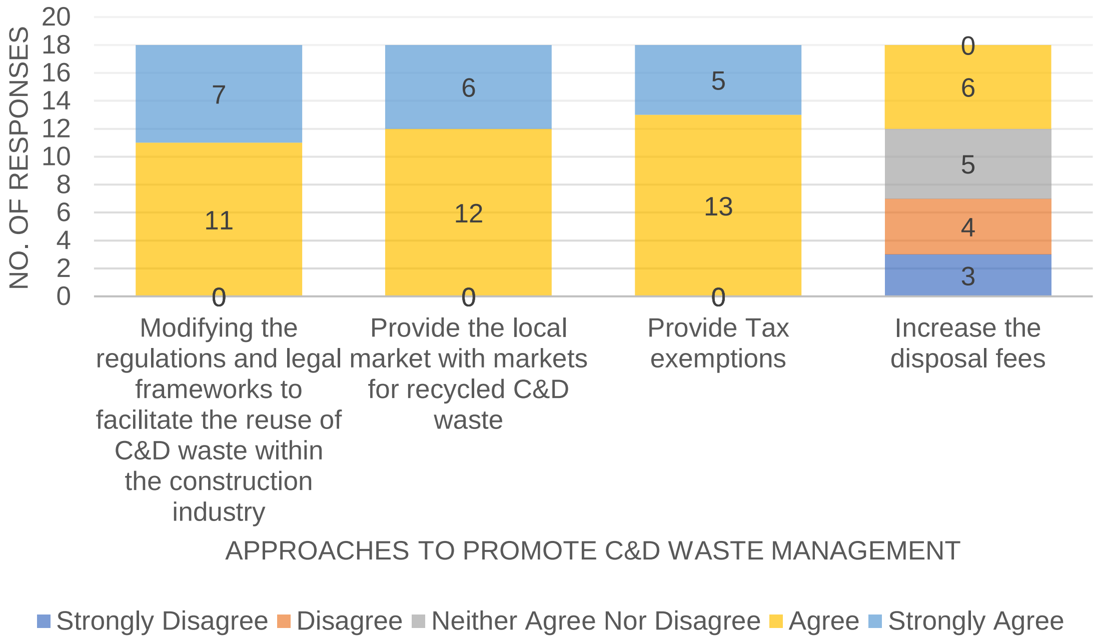

Chart 10-77: Approaches to Promote C&D Waste Management

10.3.2.3.2.8 Chart 10 – 88 Analysis

The analysis of **chart 10-88** confirms that C&D waste management strategy can be adopted by the industry by several approaches. This analysis has reported that 100% of those who responded that several factors are known to affect the industry towards adopting a C&D waste management strategy, such as:

1. Modifying the regulations and legal frameworks.
2. Providing the local market with recycled waste material markets.
3. Providing tax exemptions.

Likewise, any previous analysis of questionnaires revealed that increasing the disposal fees would increase the risk of keeping the current situation. As it is with no C&D waste management strategy according to two thirds of respondents.

10.3.2.3.2.9 Charts 11 – 89 and 90

The charts below distinguish between the environmental, social and economic concerns taken into consideration by the ministry.

These aspects have been provided by participants using both Likert Scale and Yes/No questions. The bars in these charts represent these aspects as corresponded by participants based on the question seen below.

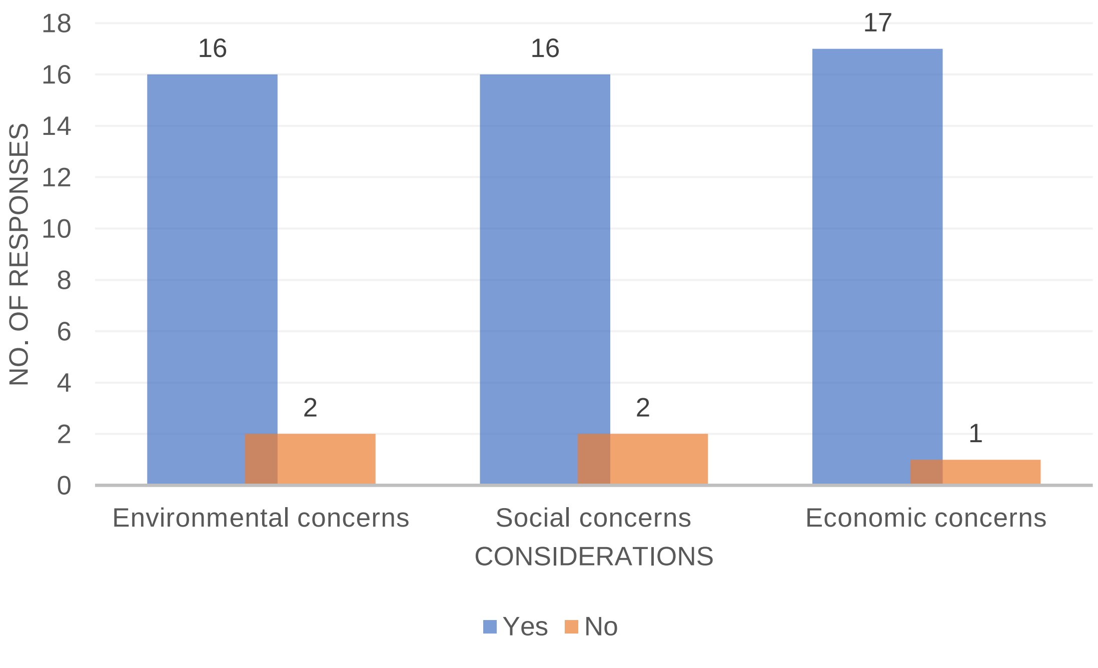

Chart 10-78: Considerations

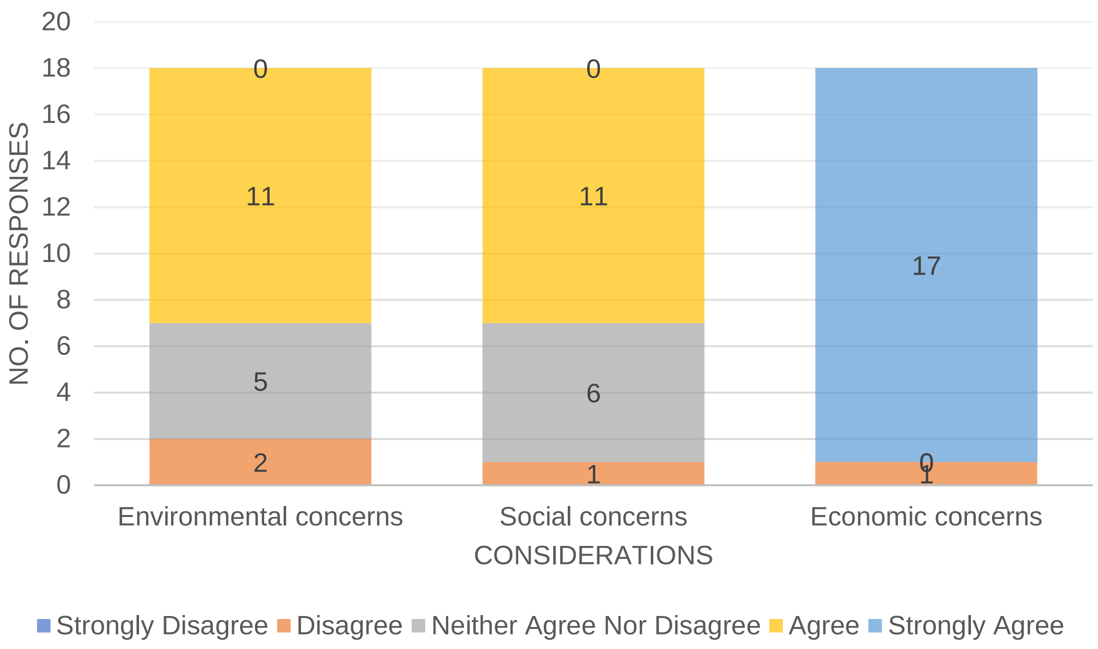

Chart 10-79: Considerations

10.3.2.3.2.10 Charts 11 – 89 and 90 Analysis

This analysis demonstrates how the MPWH considers the major 3 aspects of environment, social and economy. Above 85% of respondents clearly revealed that MPWH considers majorly all the three aspects within its policies. Although, the most important aspect is the economic one. As more than 94% of respondents agreed on that, meanwhile, 61% agreed on the environmental and social aspects, respectively.

10.3.2.3.2.11 Chart 10 – 91

This chart is similar to several charts pointed out in different questionnaires. Which makes an attempt to evaluate the regulations in respect to C&D waste including collection, sorting, landfilling and recycling. In addition to the compliance of contractors to these regulations and the strictness of the MPWH to monitor the contractors' attitudes according also to these regulations.

These aspects have been provided by participants using Likert Scale question. The bars in these charts represent these aspects as corresponded by participants based on the question seen below.

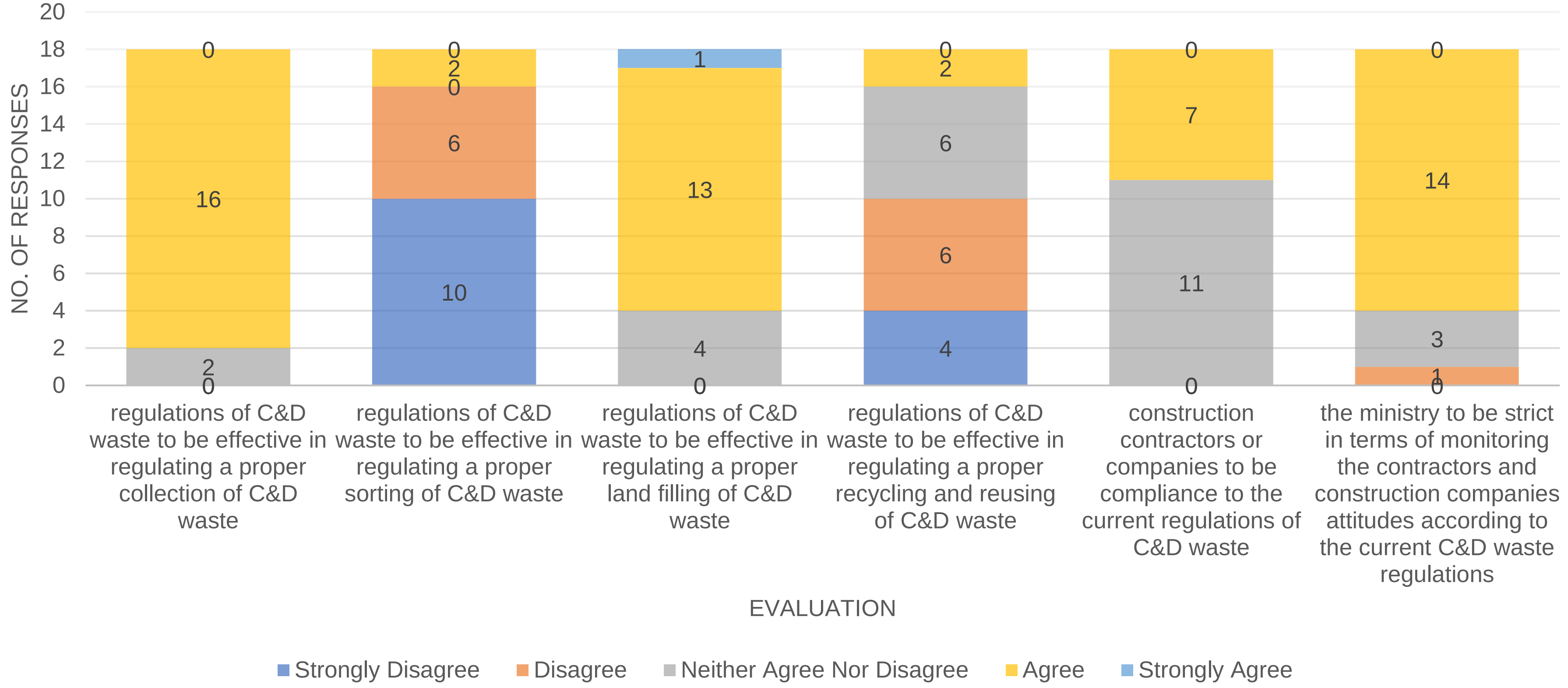

Chart 10-80: Evaluation of Regulations and Compliances

10.3.2.3.2.12 Chart 10 – 91 Analysis

The case reported here illustrates that a range of 77% to 88% of respondents indicated that the current regulations of collection and landfilling are adequate in regulating these activities. Although above 85% of them indicated that sorting and recycling regulations as not adequate in regulating such activities. Apart from these regulations, 100% of those who responded agreed that contractors do not comply with the current regulations of C&D waste. Meanwhile, just over 77% of them stated that the ministry is applying its strictness in monitoring the contractors' attitudes according to the current regulations.

10.3.2.4 Ministry of Environment

10.3.2.4.1 Department of Legal Frame works

This questionnaire has been directed to the legal frameworks department at Ministry of Environment. This department is responsible on establishing regulations and legislations including solid waste within the authority of MoE.

The number of respondents participated in this survey was only 7. This number tend to be small because the department has few employees compared to other departments and ministries. However, with a small sample size there might be a possible bias in these responses, thus caution must be applied.

10.3.2.4.1.1 Chart 10 – 92

The chart below determines the underlying causes of the absence of sorting as a process in national strategies. Since they are not currently stipulated in the regulatory system of solid waste.

These causes are assessed by participants using Likert Scale questions. The bars in this chart represent all the evaluations of participants based on the questions seen below.

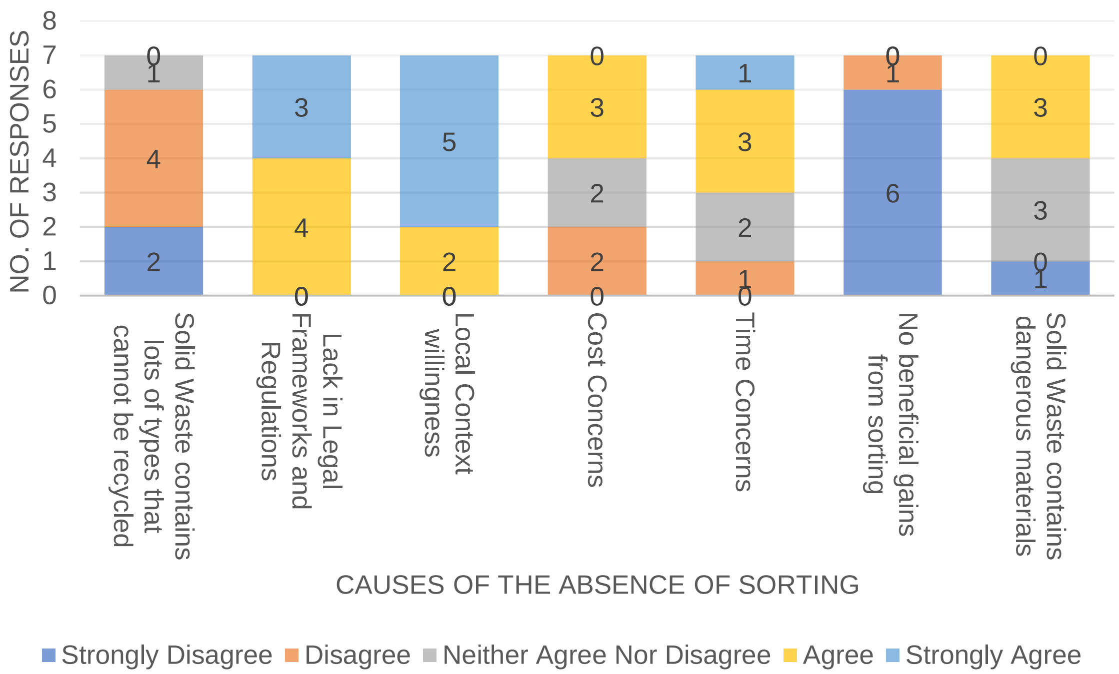

Chart 10-81: Causes of the Absence of Sorting

10.3.2.4.1.2 Chart 10 – 92 Analysis

The case reported here illustrates by all respondents that the lack in legal frameworks and the local context willingness are important determinants to absence of sorting in national strategies.

Meanwhile, there is some evidence by almost 42% of participants have seen that cost and time concerns and the composition of solid waste containing dangerous or hazardous material. May affect the existence of sorting in these strategies. For the time being, nearly 100% of them have excluded the wide variety of waste material types in the composition of solid waste. In addition to, the no beneficial gains from sorting as reasons not to embed sorting in national strategies.

10.3.2.4.1.3 Chart 10 – 93

The chart below assesses the effectiveness of several approaches that could help in implementing the sorting of solid waste in the country.

These approaches are provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to these approaches based on the question seen below.

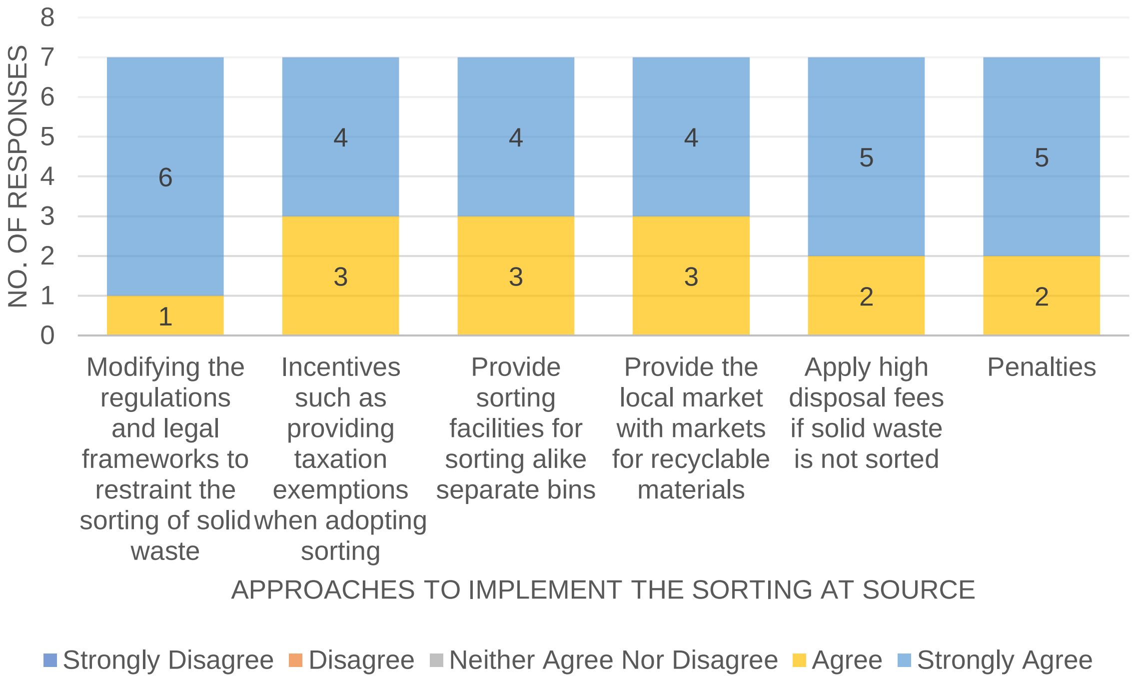

Chart 10-82: Approaches to Implement the Sorting at Source

10.3.2.4.1.4 Chart 10 – 93 Analysis

The findings of this survey suggested that all of those who were participated in the survey seen several factors can contribute to best implementing the sorting of solid waste in the country, such as:

1. Modifying the regulations and legal frameworks.
2. Applying incentives such as tax exemption for actors who adopt sorting as well as penalties.
3. Providing sorting facilities and the local market with markets for recyclable waste material.
4. Increasing the disposal fees.

10.3.2.4.1.5 Chart 10 – 94

The chart below offers the consideration and aspiration of the municipality. Towards embedding sorting of solid waste at source in governmental strategies, legal frameworks and regulation.

These considerations are provided by participants using Yes/No question. The bar in this chart ascertains the vision of the municipality by participants based on the question seen below.

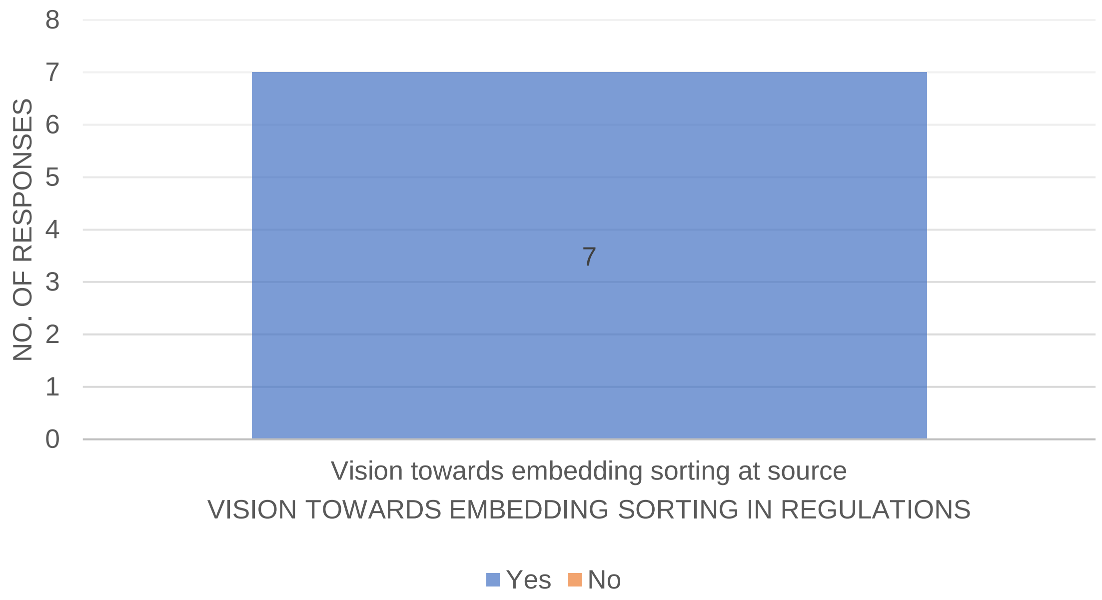

Chart 10-83: Considerations Towards Embedding Sorting in Regulations

10.3.2.4.1.6 Chart 10 – 94 Analysis

According to all participants in this survey, they have shown that the ministry’s aspiration towards embedding sorting at source is a vision to be considered in upcoming strategies, frameworks and regulations.

10.3.2.4.1.7 Chart 10 – 95

The chart below distinguishes the actors that should be responsible on sorting solid waste effectively to have sufficient results.

These are recognised by participants using Yes/No question. The bars in this chart represents the responsibility of these sides by participants based on the question seen below.

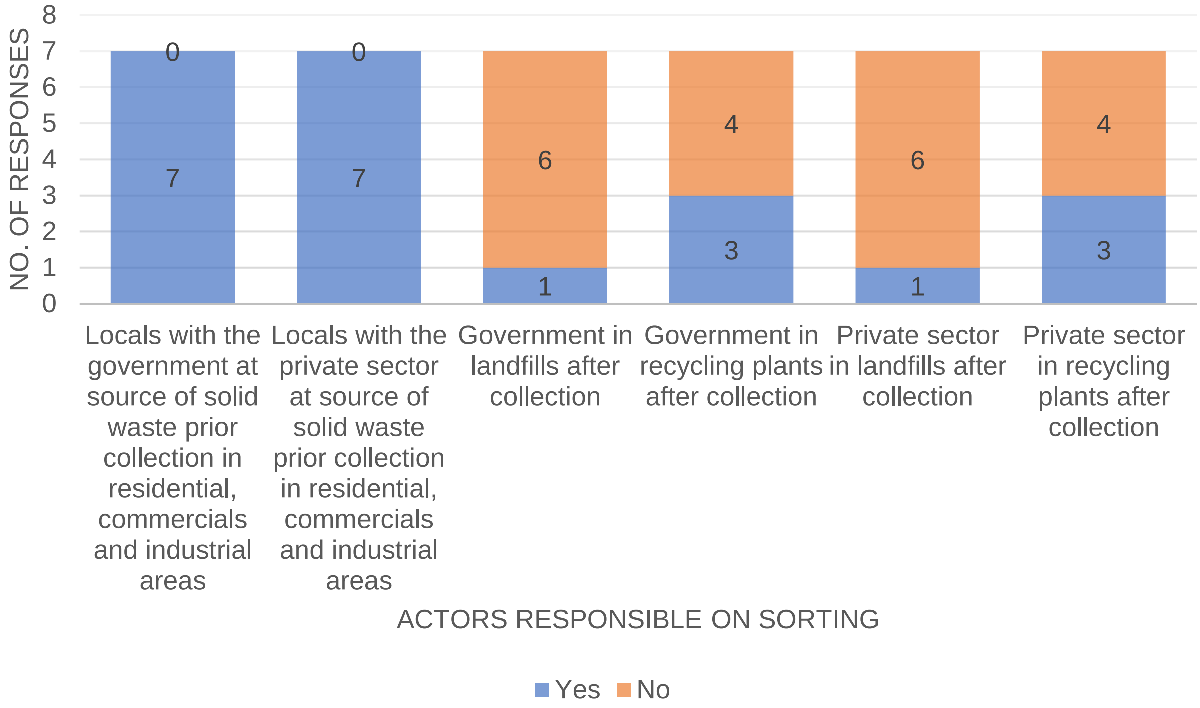

Chart 10-84: Actors Responsible on Sorting

10.3.2.4.1.8 Chart 10 – 95 Analysis

This chart is a good illustration of implementing sorting by the right side contributing the best results.

The survey confirms that well over than 95% of those surveyed agreed that the best implementation of sorting should be by locals. With either the government or the private sector before collection in residential, commercial, or industrial areas. Although, a range of 57% to 85% of the same sample corresponded that sorting will not contribute to better results if implemented after collection by both sectors.

10.3.2.4.1.9 Chart 10 – 96

The chart below makes an attempt to differentiate between types of waste. By illustrating if C&D waste can be treated like solid waste in regulation and legal frameworks.

These are recognised by participants using Yes/No question. The bars in this chart represents the participants perspective based on the question seen below.

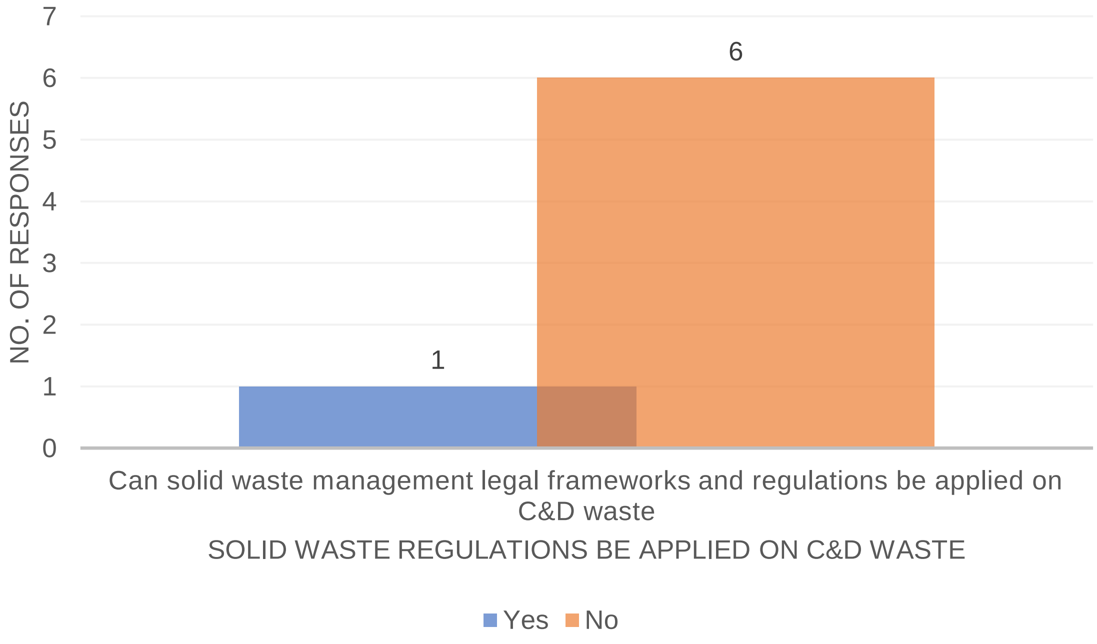

Chart 10-85: Confirmation of Applying Solid Waste Regulations on C&D Waste

10.3.2.4.1.10 Chart 10 – 96 Analysis

The results of above 85% of respondents suggest that solid waste legal frameworks and regulations cannot be applied on C&D waste. As according to several participants this type of waste is specifically treated as a special waste and should be having individual regulations to be managed.

10.3.2.4.1.11 Chart 10 – 97

The chart below offers an adequate explanation of why C&D waste is excluded from the current regulations of solid waste.

These reasons are provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these reasons based on the question seen below.

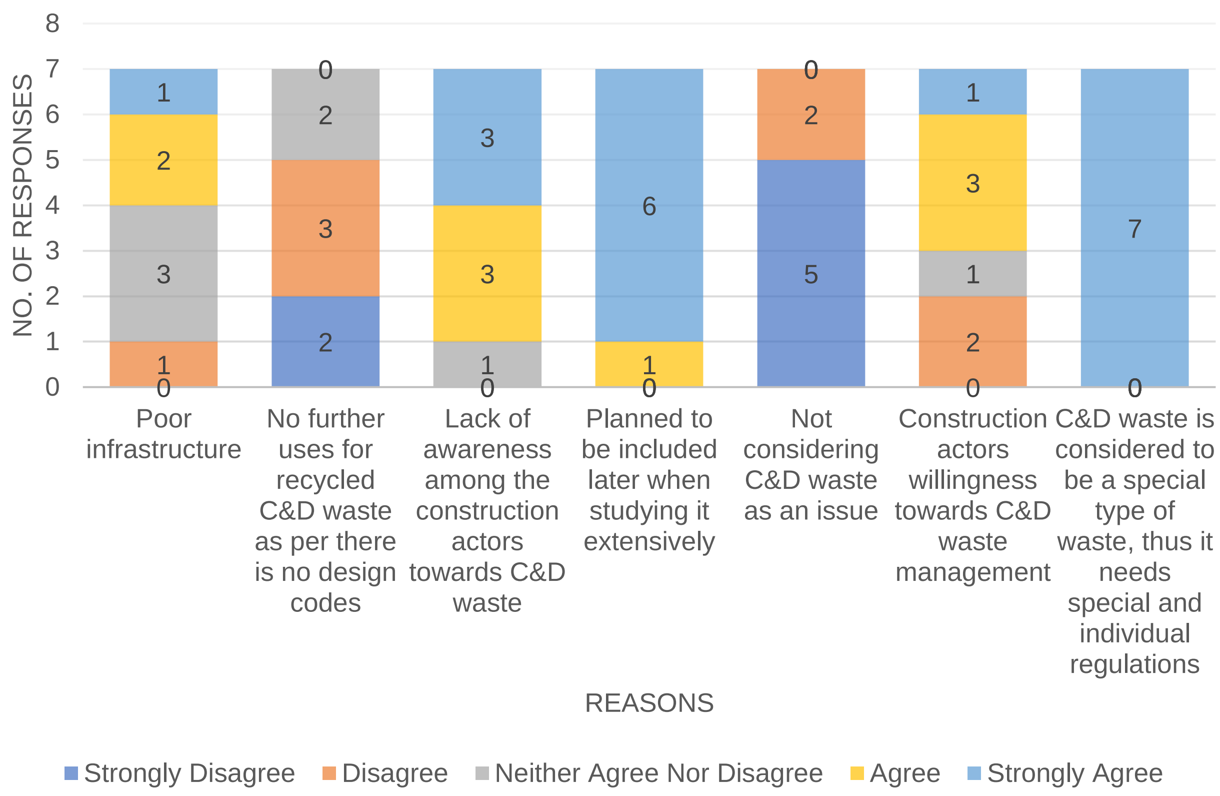

Chart 10-86: Reasons Excluding C&D Waste from Solid Waste Regulations

10.3.2.4.1.12 Chart 10 – 97 Analysis

The case here reveals why C&D waste has been excluded from the regulations of solid waste. Apparently, 100% of those who were participated declared that C&D waste is a special type of waste as previously mentioned. Thus, it needs special and individual regulations to be regulated.

Also, a range of 42% to 86% of those surveyed agreed that the lack of awareness and willingness among construction actors' influences excluding it from regulations. Only, 42.8% of them referred the excluding to the poor infrastructure in the country. Meanwhile, all respondents have agreed that no further use for recycled C&D waste material and not considering C&D waste as an issue are not responsible for excluding C&D waste from these regulations. However, it is to be true that a percentage of 100% of participants has anticipated that C&D waste is planned to be included in regulations when studied extensively.

10.3.2.4.1.13 Chart 10 – 98

The chart below approximates the percentage of C&D waste informal dumping from the total C&D waste generated in Jordan.

These percentages are estimated by participants as represented in the bar and based on the question seen below.

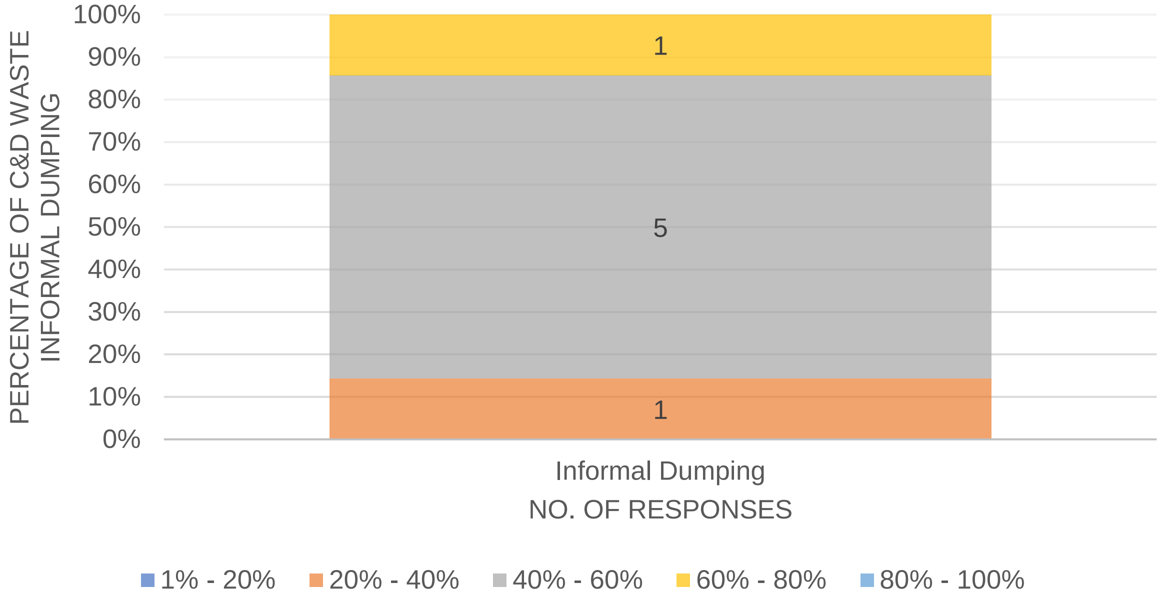

Chart 10-87: Percentage of C&D Waste Informal Dumping

10.3.2.4.1.14 Chart 10 – 98 Analysis

The results have revealed that almost 86% of surveyors stated that a range of 40% to 80% of C&D waste is informally dumped. Nearly 83% of them estimated that C&D waste is informally dumped with a range of 40% to 60%. In addition to, 16% with a range of 60% to 80%. Although only 14% of the total respondents projected that the informal dumping happens with a range of 20% to 40%.

10.3.2.4.1.15 Chart 10 – 99

The chart below provides information related to the reasons that could be contributory to informally dump C&D waste in Jordan.

These reasons are provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these reasons based on the question seen below.

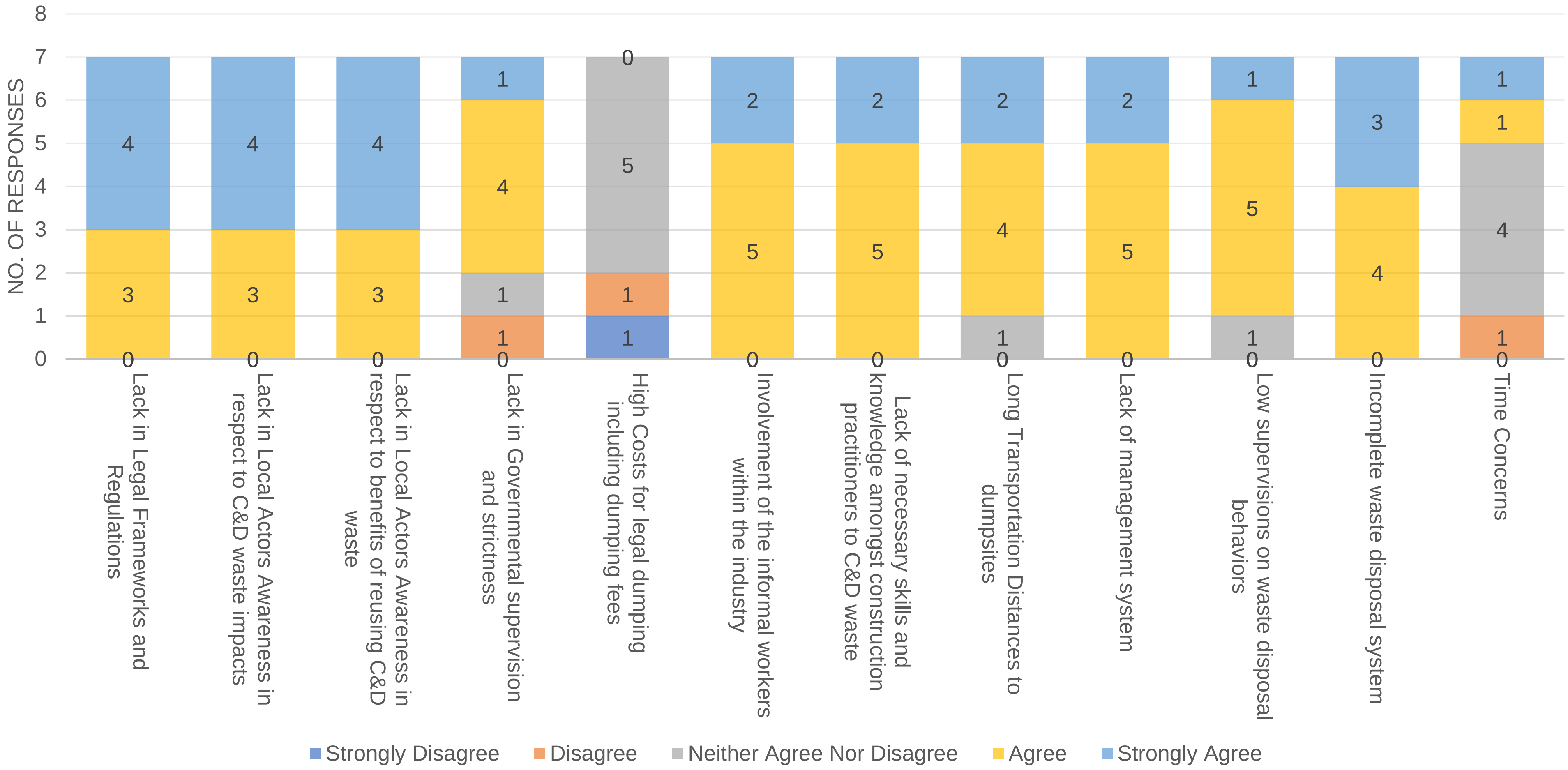

Chart 10-88: Causes of Informal Dumping of C&D Waste

10.3.2.4.1.16 Chart 10 – 99 Analysis

According to those who participated in this survey, it has been found that many important factors are related to the informal dumping of C&D waste. According to more than 95% of respondents, these contributory factors to the informal dumping of C&D waste are as follows:

1. The lack in legal frameworks and regulations.
2. Local actors' awareness in respect to C&D waste impacts and benefits.
3. Poor management systems.
4. Lack of necessary skills and knowledge amongst construction practitioners to C&D waste.
5. Incomplete waste disposal system.
6. Involvement of the informal workers within the industry.

Whereas 71% to 86% of those participants referred this issue to the lack in governmental supervision and strictness, long transportation distances to dumpsites and the low supervisions on waste disposal behaviours. Meanwhile, less than 30% of respondents has seen the time concerns play a vital role in such an issue. In addition, as expected the whole sample has agreed that a very weak link may exist between the informal dumping and the high costs for legal dumping including dumping fees.

10.3.2.4.1.17 Chart 10 – 100

The chart below assesses the effectiveness of possible approaches that could contribute to mitigating the informal attitude of C&D waste.

These approaches are evaluated by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these approaches based on the question seen below.

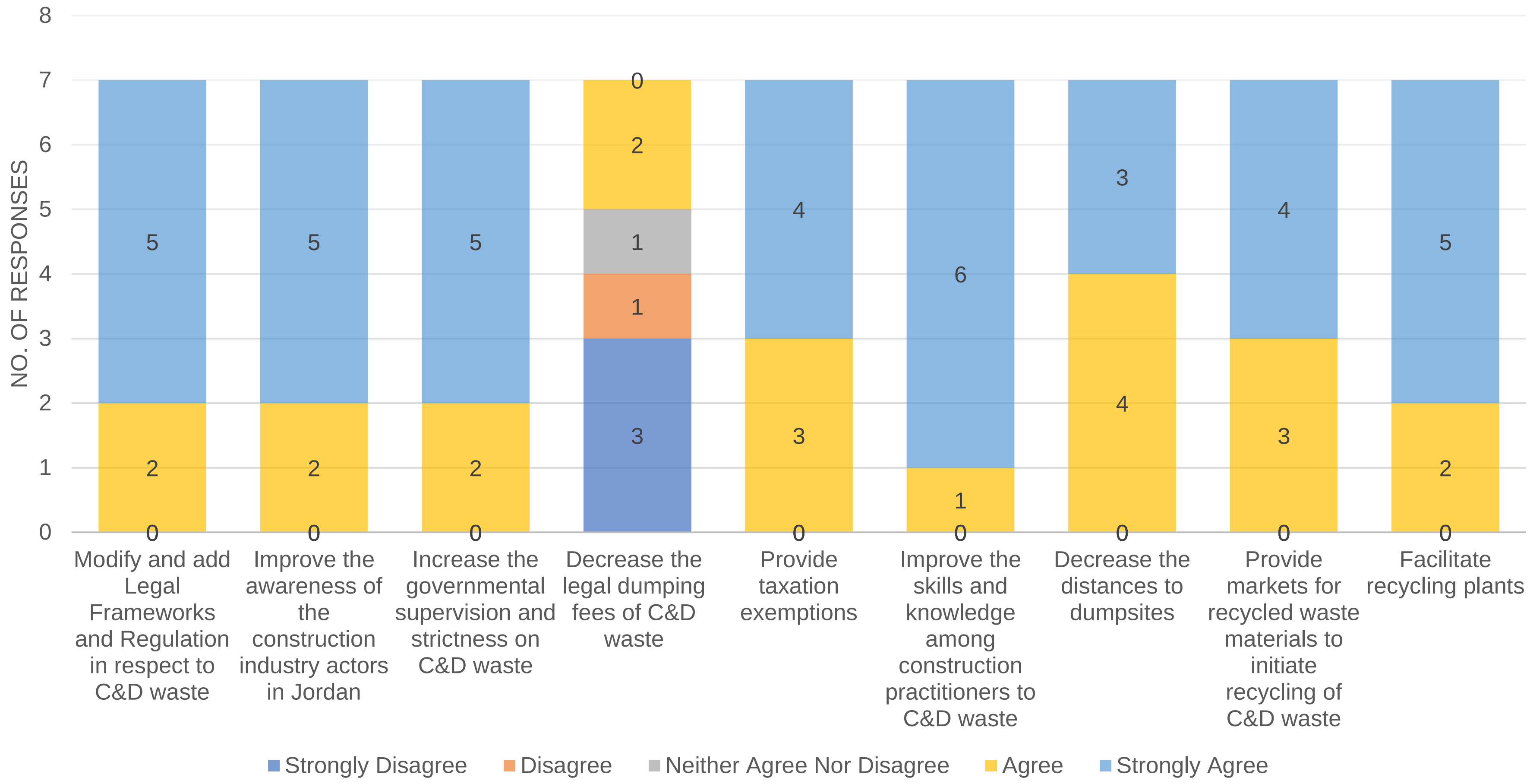

Chart 10-89: Approaches to Mitigate the Informal Dumping

10.3.2.4.1.18 Chart 10 – 100 Analysis

The analysis demonstrates according to 100% of respondents that there are important driving factors of mitigating the informal dumping of C&D waste, such as:

1. Modifying and adding legal frameworks and regulations in terms of C&D waste.
2. Improving the awareness of the construction industry actors in Jordan.
3. Increasing the governmental supervision and strictness on C&D waste.
4. Provide tax exemption and markets for recycled waste material.
5. Improving the skills and knowledge among construction practitioners to C&D waste.
6. Decrease the distances to landfill.
7. Facilitate recycling plants.

Meanwhile, less than 30% of respondents seen that decreasing the legal dumping fees of C&D waste as a factor related to mitigating the informal dumping of C&D waste.

10.3.2.4.1.19 Chart 10 – 101

The chart below assesses the effectiveness of possible approaches that could contribute to transform the industry towards adopting a C&D waste management strategy.

These approaches are evaluated by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to the contribution of these approaches based on the question seen below.

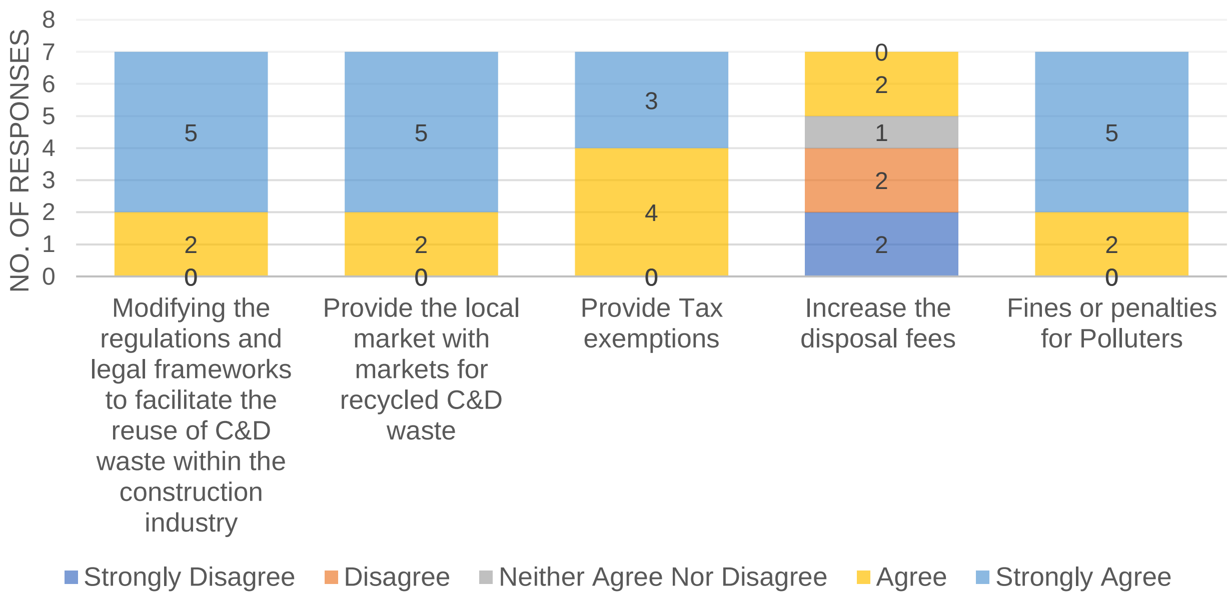

Chart 10-90: Approaches to Encourage the Implementation of C&D Waste Management

10.3.2.4.1.20 Chart 10 – 101 Analysis

The analysis of **chart 10-101** confirms that C&D waste management strategy can be adopted by the industry by several approaches. This analysis has reported that 100% of those who responded refer to several known factors to affect the industry towards adopting a C&D waste management strategy. These include:

1. Modifying the regulations and legal frameworks.
2. Providing the local market with recycled waste material markets.
3. Providing tax exemptions.
4. Applying fines and penalties for polluters.

Likewise, the previous analysis of **chart 10-101** increasing the disposal fees would not encourage the industry towards adopting a C&D waste management strategy according to more than 70% of respondents.

10.3.2.4.1.21 Chart 10 – 102

The chart below provides an evaluation of the current regulations of C&D waste. Alongside the compliance of contractors to these regulations and the government strictness in monitoring contractors and other governmental departments.

This evaluation is provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to these regulations and compliances based on the question seen below.

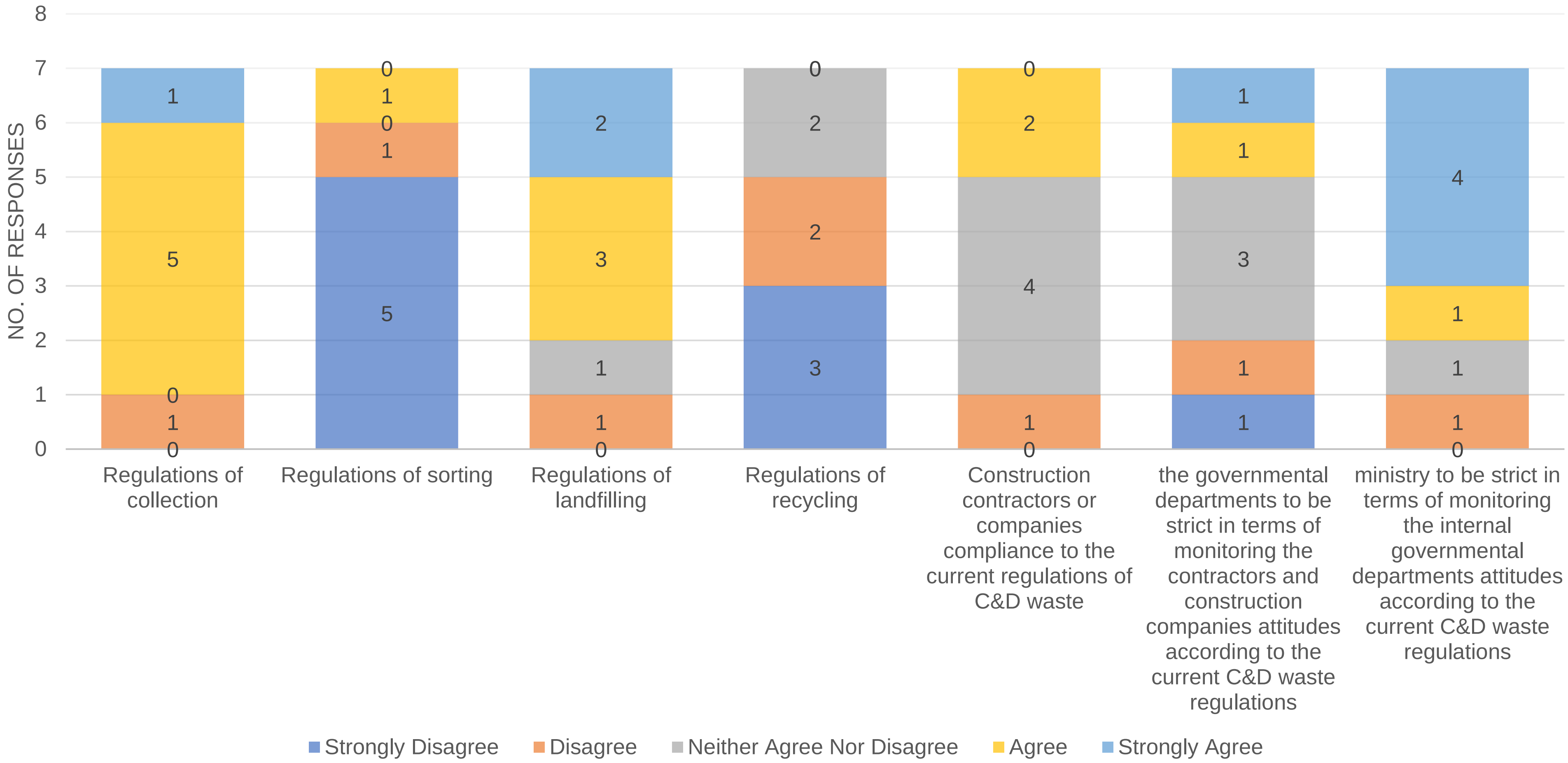

Chart 10-91: Evaluation

10.3.2.4.1.22 Chart 10 – 102 Analysis

The analysis of this chart shows how adequate the current regulations and legislations are in respect to regulating the collection, sorting, recycling, landfilling. In addition to, contractor's compliances and the ministry's strictness on monitoring the contractors and construction companies' attitudes and internal governmental departments.

The results of those who participated in the survey shown that above 70% of respondents evaluated that the current regulations of collection and landfilling are effective enough in terms of regulating C&D waste. Also, the same percentage for the ministry's strictness in monitoring the internal governmental departments. However, above 85% of those participants illustrated that the sorting and recycling regulations are evaluated to be not adequate for regulation C&D waste. Together with the low strictness of the ministry to perform monitoring on contractor's attitudes. Resulting in measuring the contractor's compliance to these regulations to a very low rate as only 30% confirmed their attitudes to be compliance to the current regulations.

10.3.2.5 Contractors Questionnaire

So far, this chapter has analysed several construction departments in different governmental associations including GAM, MPWH and MLA. The following section discusses the analysis of construction contractors and companies.

The total number of participants in this questionnaire was 27 from different ranks. This questionnaire has covered several aspects comprising:

1. The classifications of contractors participated.
2. Types of projects they construct.
3. C&D waste management adoption including its activities.
4. Spotting the informal dumping of C&D waste including its causes, mitigations and encouragements.
5. Willingness towards using recycled crushed concrete aggregates in new concrete mixes.
6. Measuring the adequacy of current regulations in collection, sorting, landfilling and recycling, governmental monitoring and supervision and contractors' compliance to these regulations.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No and Likert Scale.

10.3.2.5.1 Chart 10 – 103 and 104

The charts below draw a distinction between the classifications of contractors participated in the survey together with the types of projects they construct based on their responses.

This distinction is provided by participants using both Yes/No and Likert Scale questions. The bars in this chart represents the participants' responses on their classification and the types constructed by them based on the question seen below.

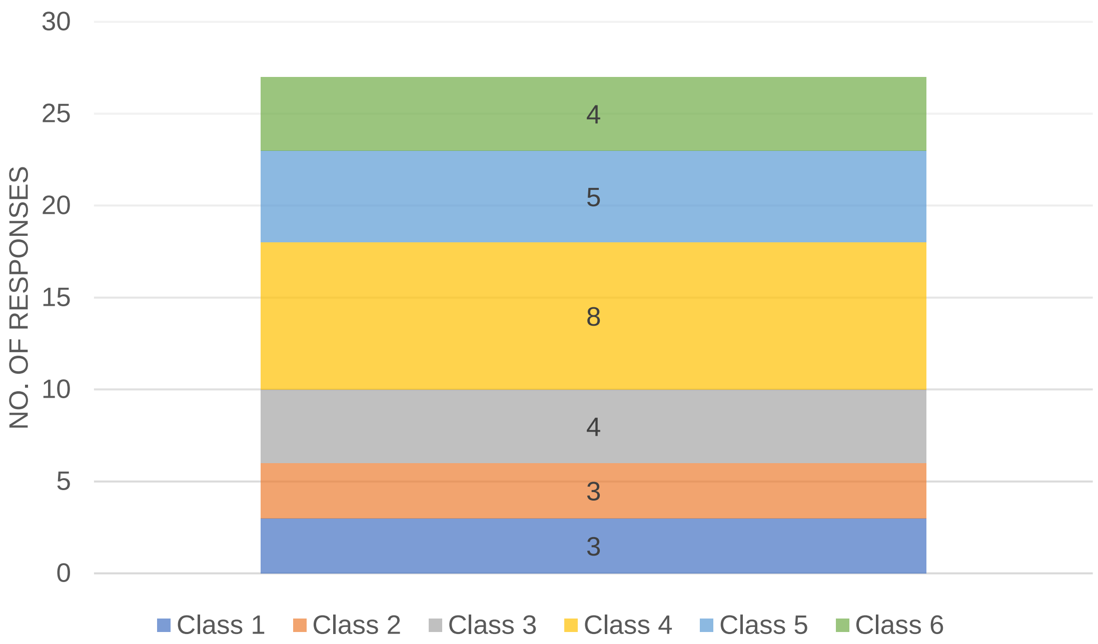

Chart 10-92: Classification of Contractors

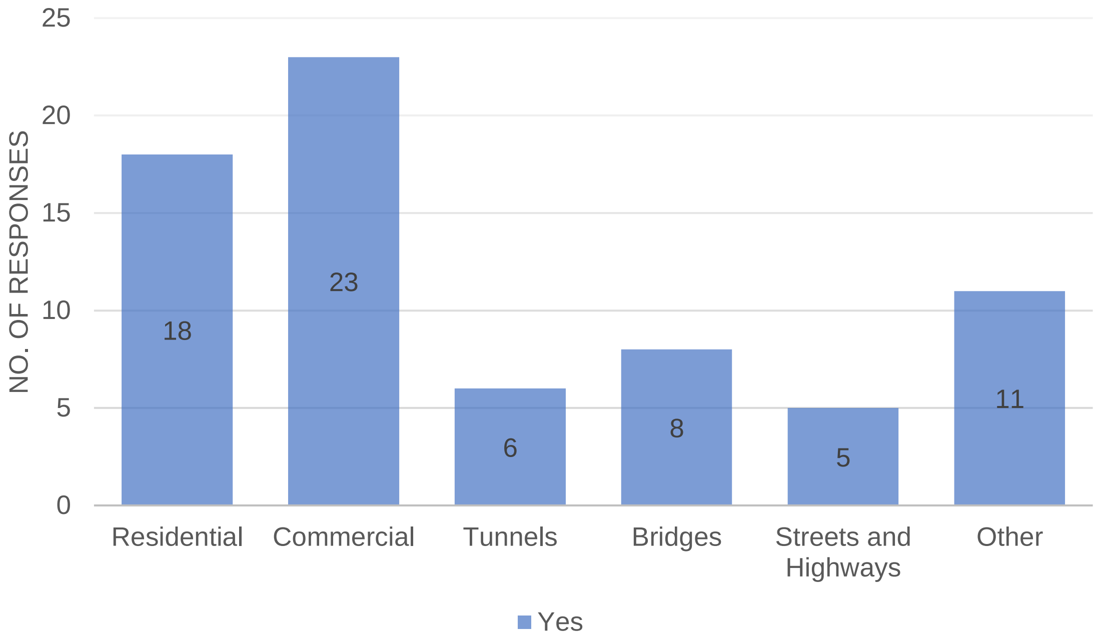

Chart 10-93: Types of Projects Constructed

10.3.2.5.2 Chart 10 – 103 and 104 Analysis

It can be seen from **chart 10-103** that a wide variety of companies have participated in this survey. Where just over two thirds of those surveyed classified their companies as top ranked companies. Comprising 16% of them class 1 and 2, 22% classed as 3 and 44% as a moderated class 4. Whereas the other one third is ranked as class 4 and 5 which are the least ranked companies.

The second chart shows the most 3 types of projects constructed by these companies. Where the commercial projects had the highest proportion of responses with 28%. Followed by 23% for the rest types of projects including tunnels, streets and highways, residential projects with around 22%. In addition to 13.5% for other types of projects including sewage system projects and renovation and maintenance projects.

10.3.2.5.3 Chart 10 – 105, 106 and 107

The charts below ascertain the adoption of C&D waste management and distinguishes the activities of C&D waste management that takes place in their projects.

This is provided by participants using Yes/No questions. The bars in this chart represents the participants' recognition on adopting C&D waste management and its activities based on the question seen below.

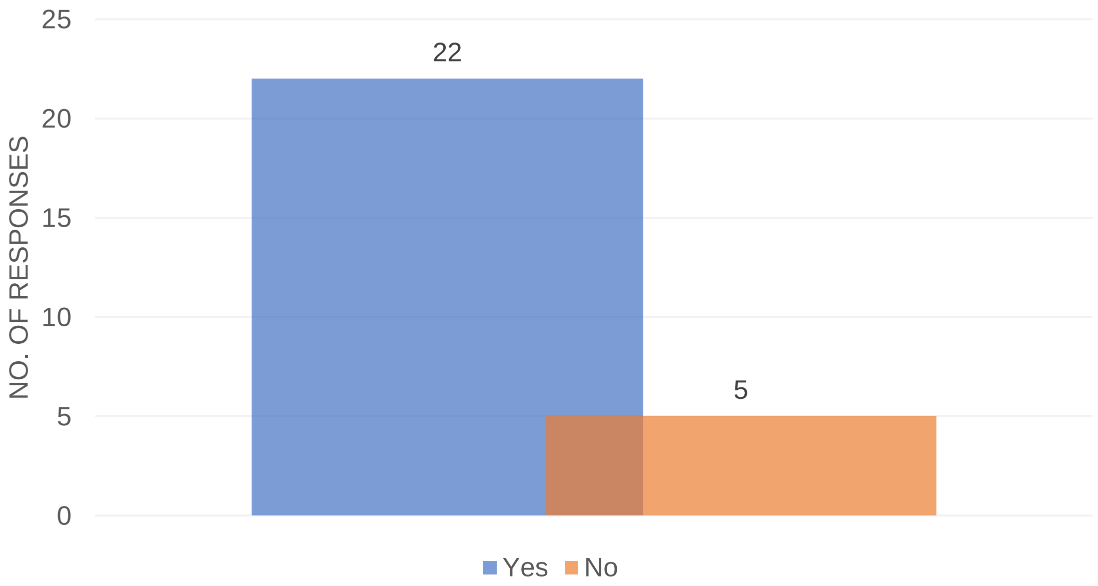

Chart 10-94: Adoption of C&D Waste Management

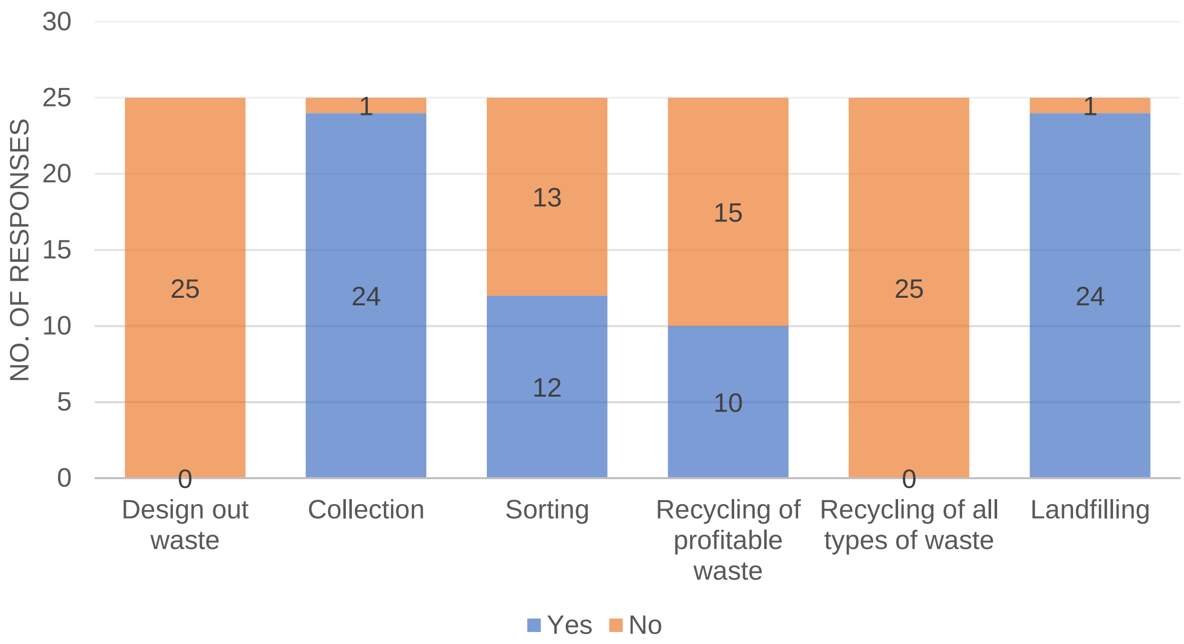

Chart 10-95: C&D Waste Management Activities in Construction Projects

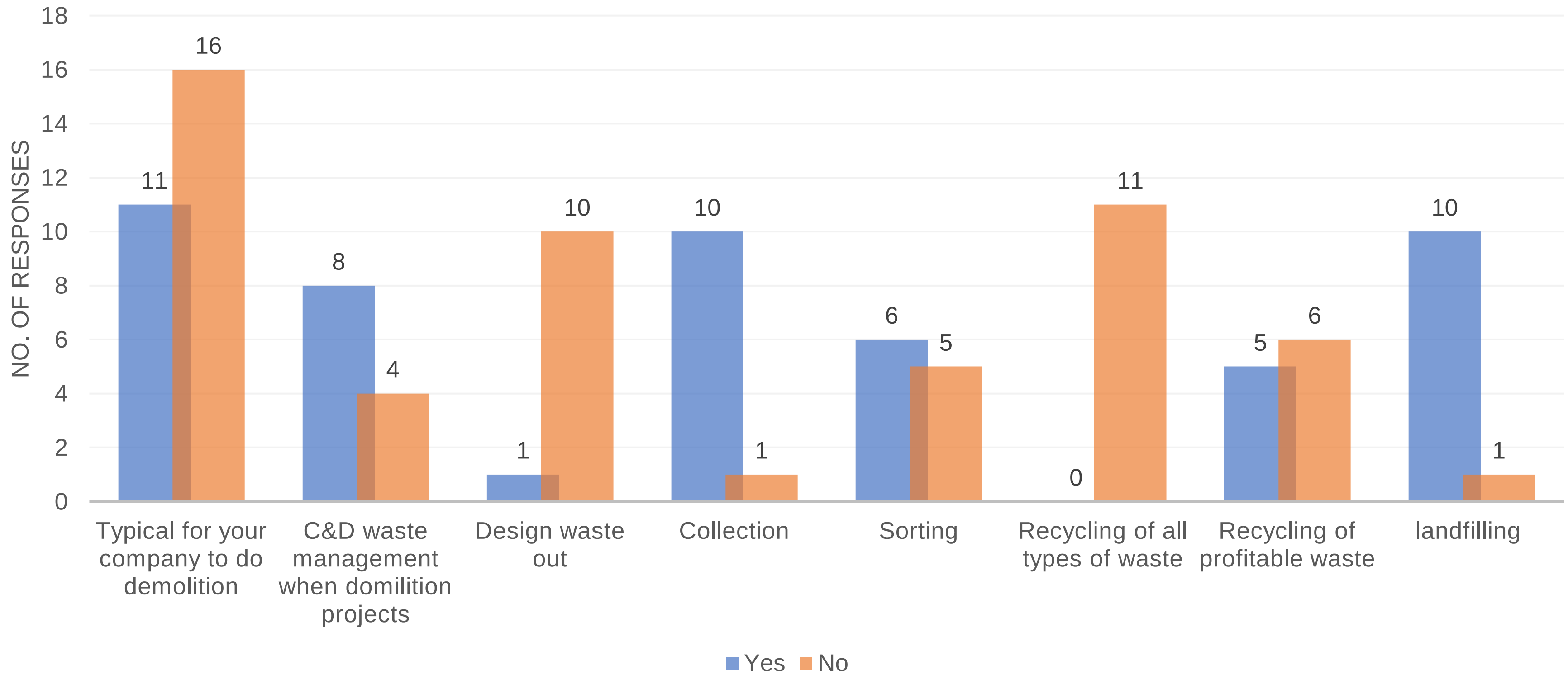

Chart 10-96: C&D Waste Management Activities in Demolition Projects

10.3.2.5.4 Chart 10 – 105, 106 and 107 Analysis

The case reported here illustrates that around 80% of contractors adopt C&D waste management while constructing any type of project. However, C&D waste management is generally understood by companies to be confined on proper landfilling.

As **chart 10-106** shows that well over 95% of companies consider collection and proper landfilling. With only few movements of sorting and recycling majorly depending on the type of waste material generated. Unfortunately, with no design out waste on projects and not recycling of all types of waste. Almost 48% and 40% of respondents agreed that sorting and recycling of profitable waste take place.

Regarding demolition projects, only 40% of those participated in the survey revealed that it is typical for their companies to do demolition. Nearly 72% of them indicated that they adopt C&D waste management while demolishing projects. Deepening into the management activities, these results are similar to those reported in **chart 10-106**. Considering collection, landfilling and few sorting and recycling movements of profitable waste together with no designing waste out nor recycling of all types of projects.

10.3.2.5.5 Chart 10 – 108, 109, 110 and 111

The charts below recognises if participants have data related to the informal dumping of C&D waste. Thus approximate the percentage of this informal dumping from the total generation of C&D waste. Together with offering an explanation regarding the possible contributory causes and the approaches to mitigate such an attitude.

This is provided by participants using both Yes/No and Likert Scale questions. The bars in this chart represents the participants responses based on the question seen below.

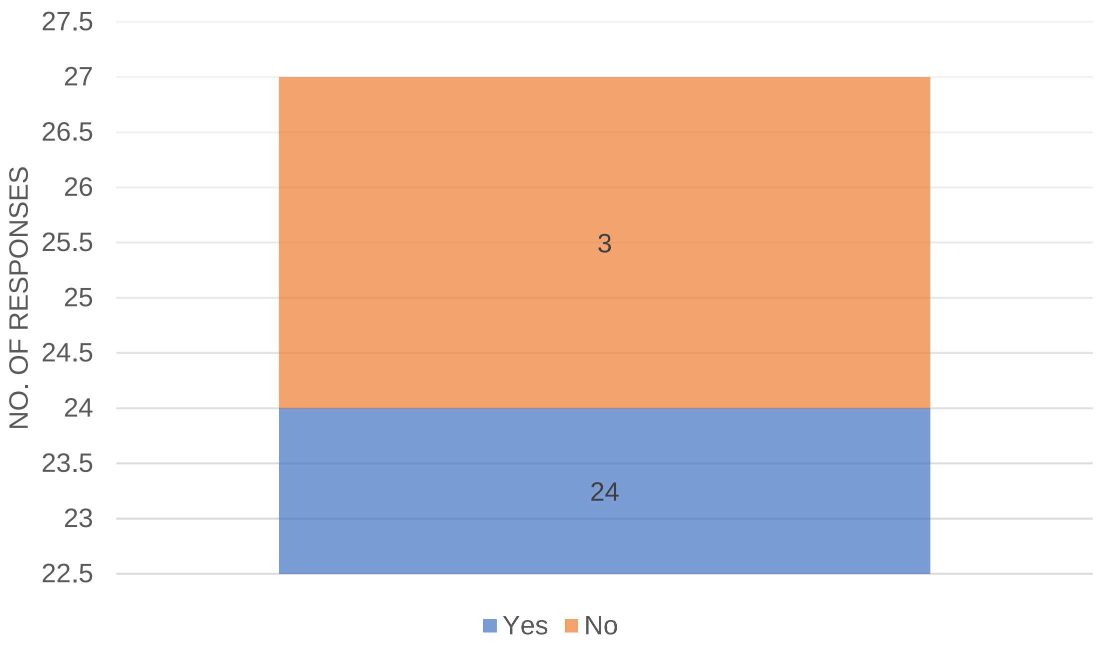

Chart 10-97: Acquiring Information Related to the Informal Dumping

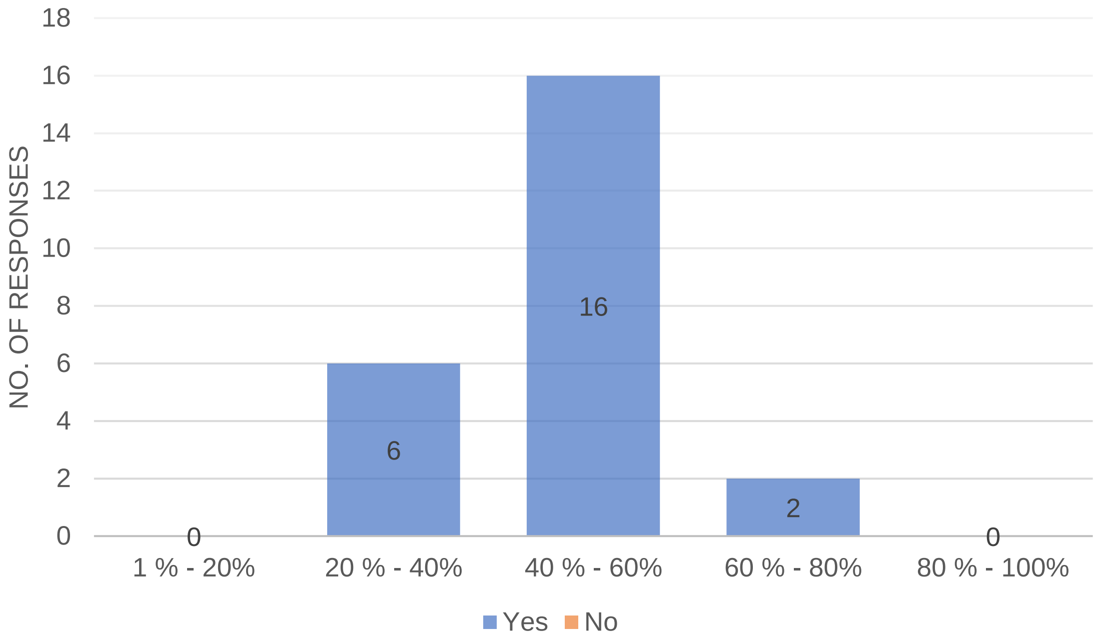

Chart 10-98: Informal Dumping of C&D Waste Percentages

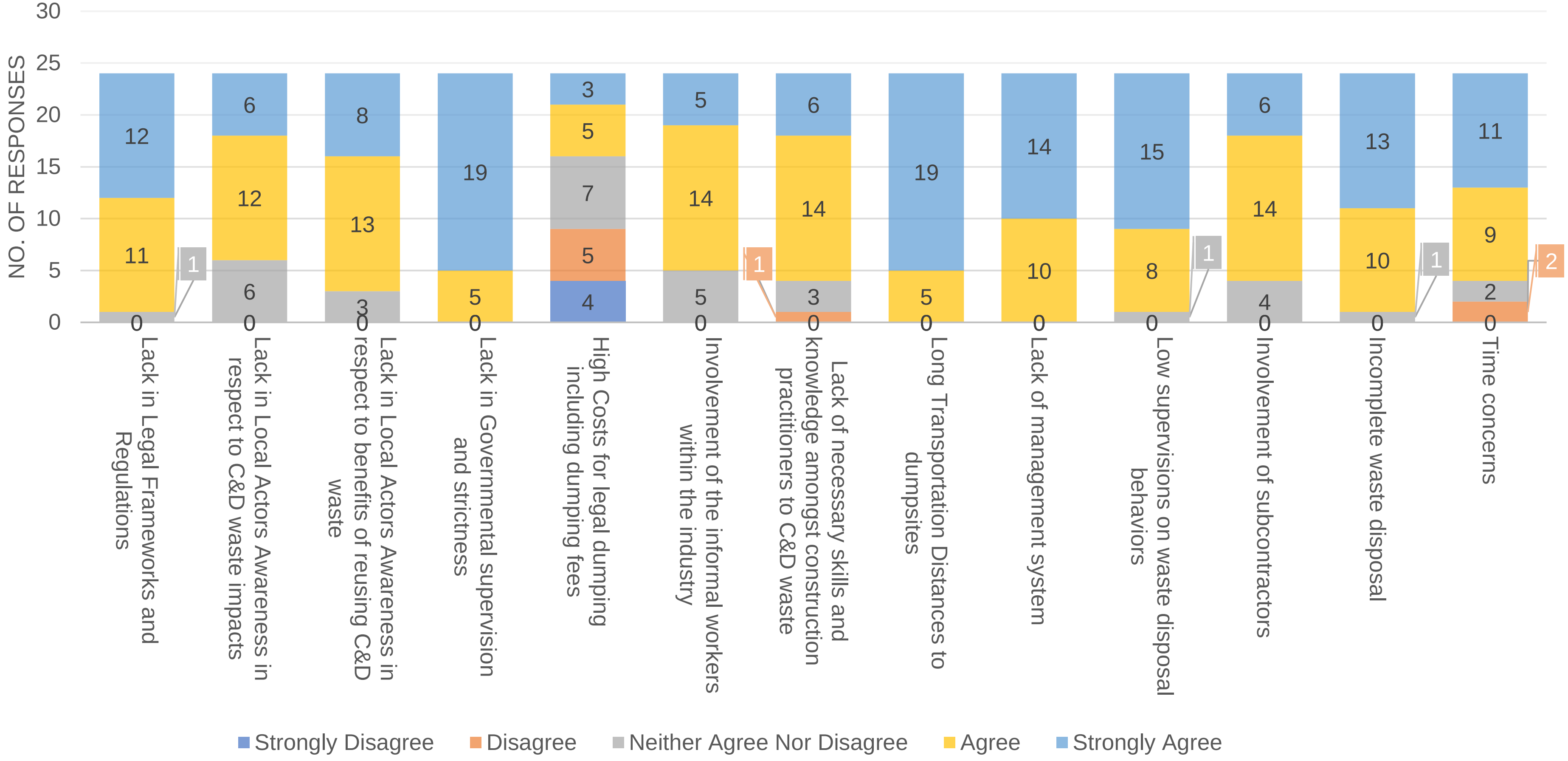

Chart 10-99: Causes of Informal Dumping

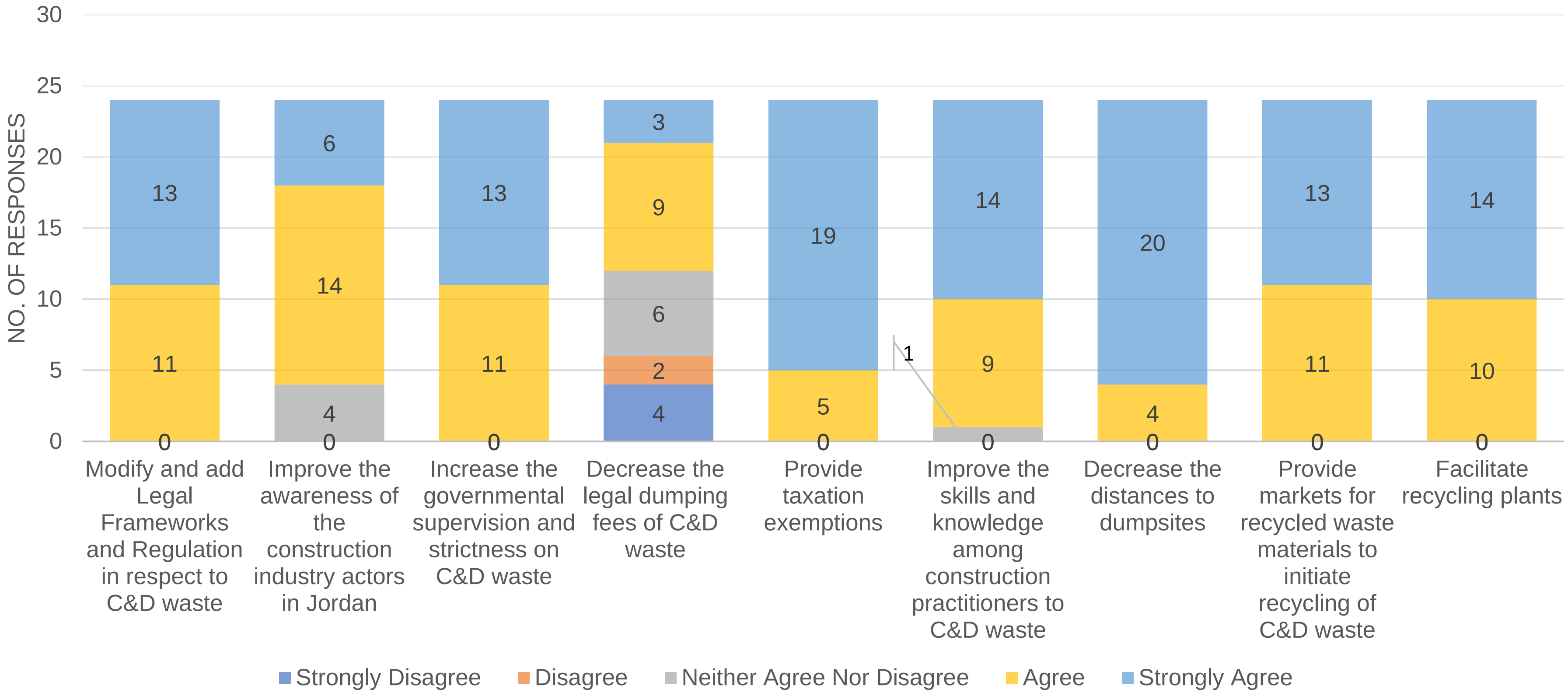

Chart 10-100: Approaches to Mitigate the Informal Dumping of C&D Waste

10.3.2.5.6 Charts 11 – 108, 109, 110 and 111 Analysis

The charts above present the issue of the informal dumping of C&D waste from contractors' point of view. Including percentages, causes and contributory factors for mitigating such an issue.

What can be clearly seen from **chart 10-108** that over than 85% of contractors have data regarding the issue of the informal dumping. As results have shown that two thirds of respondents indicated that 40% to 60% of total C&D waste generated is informally dumped. Around 25% of them pointed out that 20% to 40% is informally dumped and just under 10% for a percentage of 60% to 80%. The most important aspect of these percentages is the factors that are known to affect the rate of this attitude as according to above 80% of those who responded:

1. Lack of management system including legal frameworks and regulations.
2. Lack in governmental supervision and strictness.
3. Low supervisions on waste disposal behaviours.
4. Incomplete waste disposal system.
5. Time concerns.
6. Involvement of sub-contractors.
7. Lack of necessary skills and knowledge amongst construction practitioners to C&D waste.
8. Lack in local actors' awareness in respect to benefits of reusing C&D waste.
9. Long transportation distances to landfills. Resulting in consuming more fuel especially as prices of fuel is relatively high in the country, therefore overall increase the informal dumping of C&D waste.

Also, a percentage of less than 80% indicated that the lack in local actors' awareness in respect to C&D waste impacts and the involvement of the informal workers within the industry are factors related to the informal dumping. Furthermore, some respondents have stated that the prices of standard raw material are quite cheap. Making recycling or recycled waste material costly. However, two thirds of those respondents suggest a weak link between the high costs of dumping fees and the informal dumping.

Despite this, the survey has investigated what could be done in the industry in order to mitigate such an attitude. Analysis of results have clearly shown that informal dumping may have been mitigated according to more than 80% of respondents by:

1. Modifying and adding legal frameworks and regulation in respect to C&D waste.
2. Improving the awareness of the construction industry actors in Jordan.
3. Increasing the governmental supervision and strictness on C&D waste.
4. Providing taxation exemptions.
5. Improving the skills and knowledge among construction practitioners to C&D waste.
6. Decreasing the distances to dumpsites by constructing for instance 4 landfills at 4 locations around the capital (North, South, East and West).
7. Providing markets for recycled waste material to initiate recycling of C&D waste.
8. Facilitating recycling plants.

Surprisingly, as unexpected from contractors 50% of them have agreed that decreasing the legal dumping fees would not help in mitigating this attitude. Meanwhile, some respondents have stated that increasing the prices of raw material would indirectly not just reduce the informal dumping, but also to promote recycling of C&D waste.

10.3.2.5.7 Chart 10 – 112 and 113

The charts below assess the willingness towards using recycled aggregates in new concrete mixes and determines the underlying causes hindering their willingness towards using them.

These aspects have been provided by participants using both Likert Scale and Yes/No questions. The bars in these charts represent these aspects as corresponded by participants based on the question seen below.

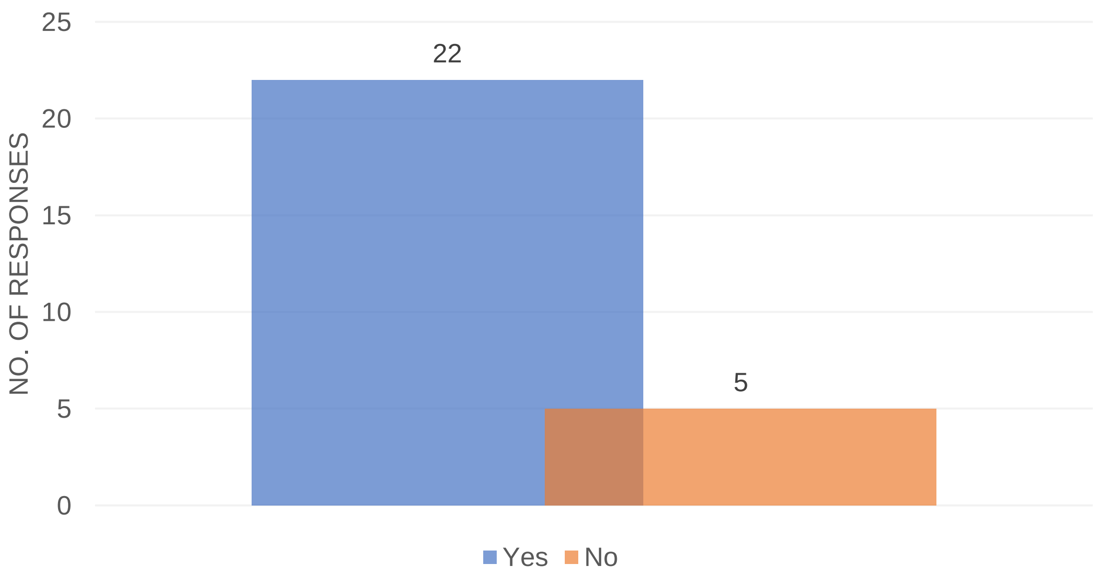

Chart 10-101: Willingness Towards Using Recycled Aggregates in New Concrete Mixes

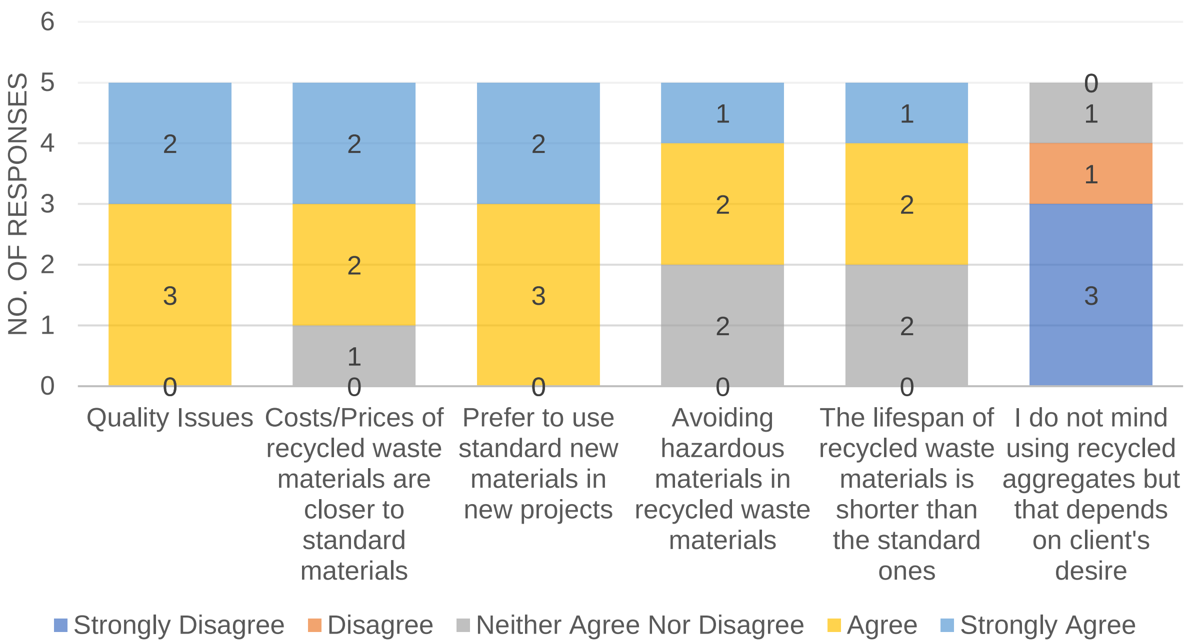

Chart 10-102: Causes Hindering the Use of Recycled Aggregates

10.3.2.5.8 Charts 11 – 112 and 113 Analysis

Chart 10-112 have revealed the willingness of construction contractors towards using recycled aggregates in new concrete mixes.

It appeared that 81% of those who were surveyed shown their interests and willingness to use such waste material in new concrete mixes. Meanwhile, the rest 19% have agreed on not using recycled aggregates in such mixes.

These results have also shown that all responses have not hesitated even if clients agreed on using recycled aggregates in new mixes. As just over than 80% of those 19% stated that quality issues and costs/prices of recycled waste material are closer to standard material. Because standard material is very cheap and the preference to use standard new material in new projects instead of recycled ones play an important role in not using recycled aggregates in new mixes. In addition, it is worthwhile mentioning that 60% of them have also indicated that avoiding hazardous material in recycled waste material. In addition to, the lifespan of recycled waste material that is shorter than the standard ones are partially responsible for not using them.

10.3.2.5.9 Chart 10 – 114

The chart below provides an evaluation of the current regulations of C&D waste management. Alongside the compliance of contractors to these regulations and the government strictness in monitoring contractors and other governmental departments.

This evaluation is provided by participants using Likert Scale question. The bars in this chart represents the evaluation of participants to these regulations and compliances based on the question seen below.

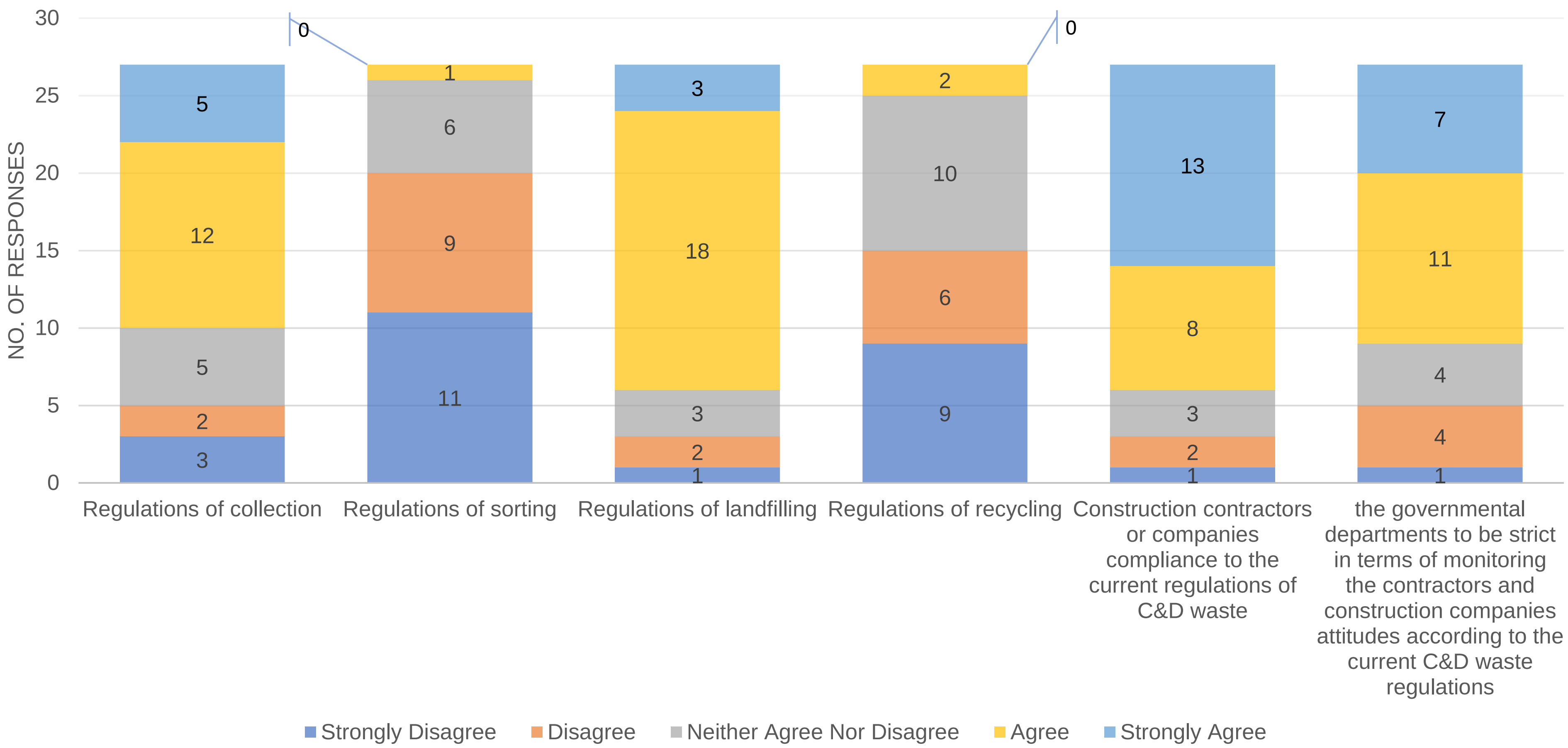

Chart 10-103: Evaluation of Regulations and Compliances

10.3.2.5.10 Charts 11 – 114 Analysis

The survey has evaluated sets of regulations in respect to collection, sorting, recycling, landfilling, contractors' compliances and the government strictness in supervision and monitoring.

Estimates of collection and landfilling regulations, contractor's compliances and government strictness evaluation range from 60% to just under 80% effective and adequate in respect to C&D waste. Basically, this is what contractors do according to one respondent in which they collect C&D waste to be landfilled averting fines and penalties. However, all of that depends majorly on the place of construction or demolition in respect to provide more strictness and location of landfills.

On the other hand, more than 90% of those who responded revealed that C&D waste regulations are not adequate and effective enough to regulate sorting and recycling. Almost two thirds of those surveyed indicated that these regulations are not existed at all. As most of these movements are happening on personal diligence, unfortunately not regulated.

10.3.2.6 Concrete Suppliers questionnaires

This section presents a discussion of analysis of concrete suppliers' survey. The total number of participants in this questionnaire was 22. This questionnaire has covered several aspects comprising:

1. The types of construction material produced.
2. The most types of projects demand concrete.
3. Several aspects related to C&D waste including the generation of C&D waste, types, adopted approaches to discard such waste and the reasons associated to their attitude.
4. Assessment of the constructions actors' willingness to use recycled material.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No and Likert Scale.

10.3.2.6.1 Chart 10 – 115

The chart below draws a distinction between the types of construction material produced by factories.

This distinction is provided by participants using Yes/No question. The bars in this chart represents the types of construction material as distinguished by participants based on the question seen below.

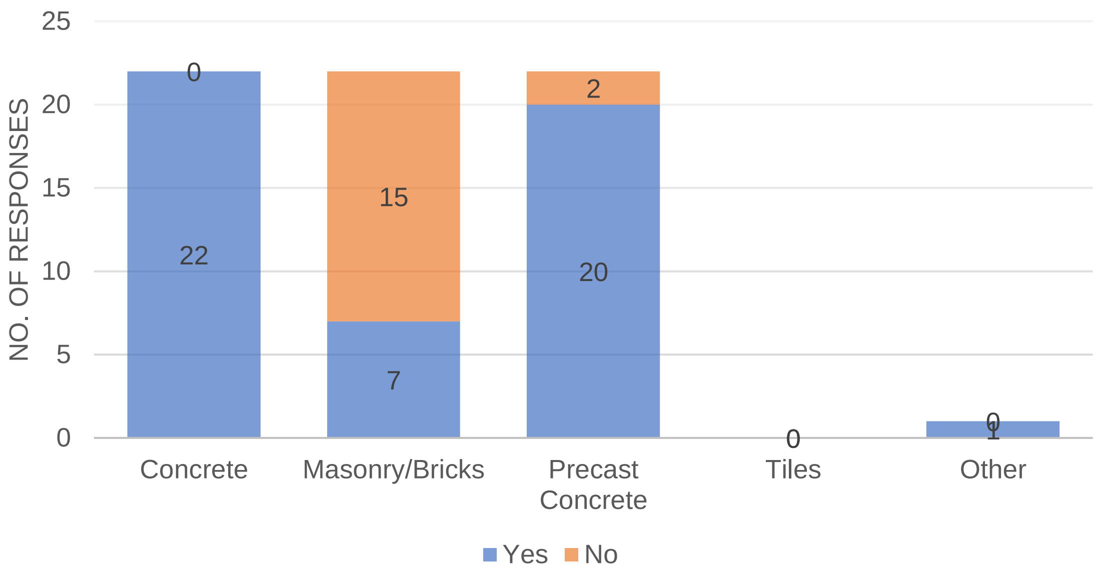

Chart 10-104: Types of Construction Material

10.3.2.6.2 Chart 10 – 115 Analysis

It has been revealed that all the participated factories in this survey produce concrete and almost 91% of them produce precast concrete. Just under one third of these participants manufacture masonry or bricks within their factories.

10.3.2.6.3 Chart 10 – 116

The chart below outlines the most 3 types of projects that factories deliver concrete for construction.

This is provided by participants using Yes/No question. The bars in this chart represents these responses of participants based on the question seen below.

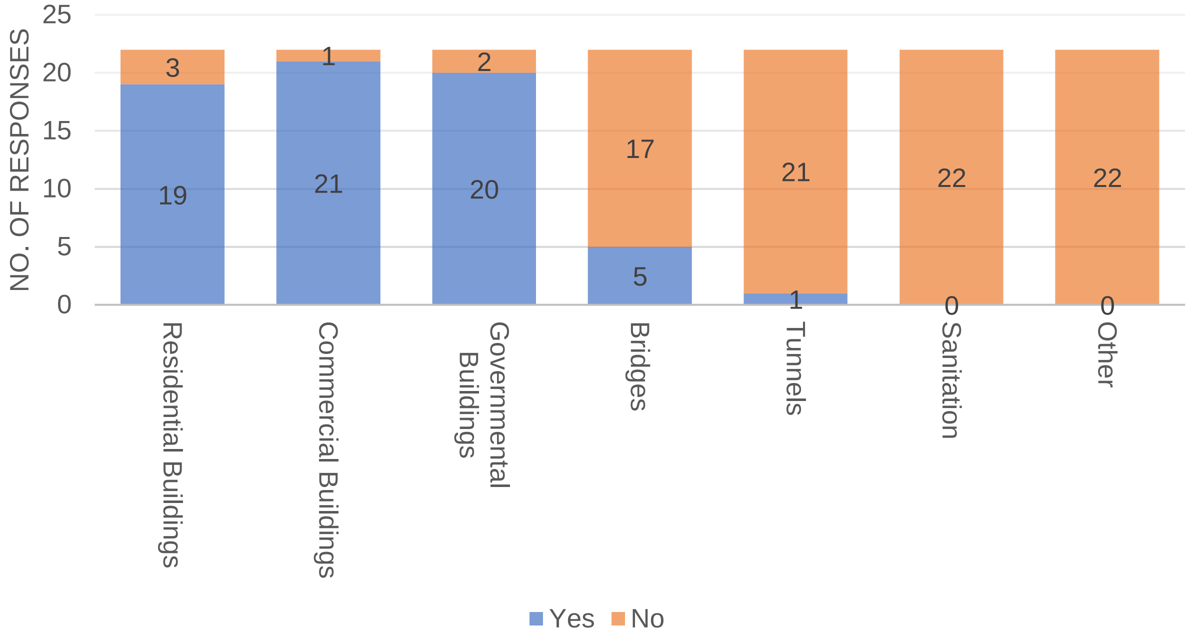

Chart 10-105: Types of Projects

10.3.2.6.4 Chart 10 – 116 Analysis

The evidence presented in this chart revealed that above 85% of factories manufacture construction material. Including majorly concrete to residential, commercial and governmental projects. Meanwhile, under 25% for other types of projects like tunnels and bridges.

10.3.2.6.5 Chart 10 – 117, 118 and 119

The charts below recognises whether concrete factories generate waste on manufacturing and determines the types of waste if generated. In addition to, distinguishing the adopted approach of discarding waste along with the factors contributing to adopt their selected approach.

These aspects provided by participants using both Likert Scale and Yes/No questions. The bars in this chart represents the responses of participants based on the question seen below.

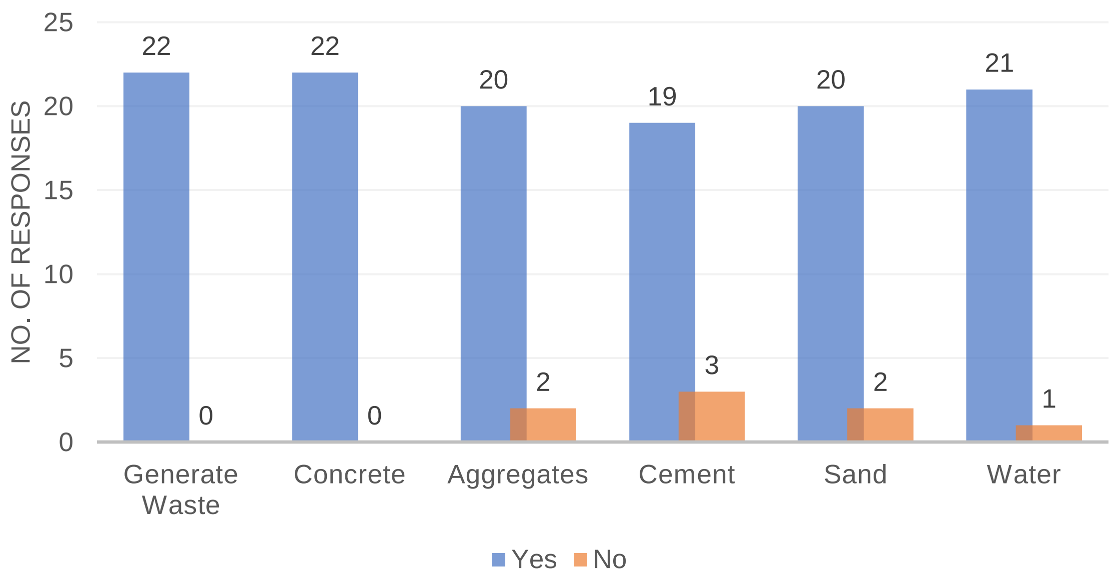

Chart 10-106: Types of Waste Generated

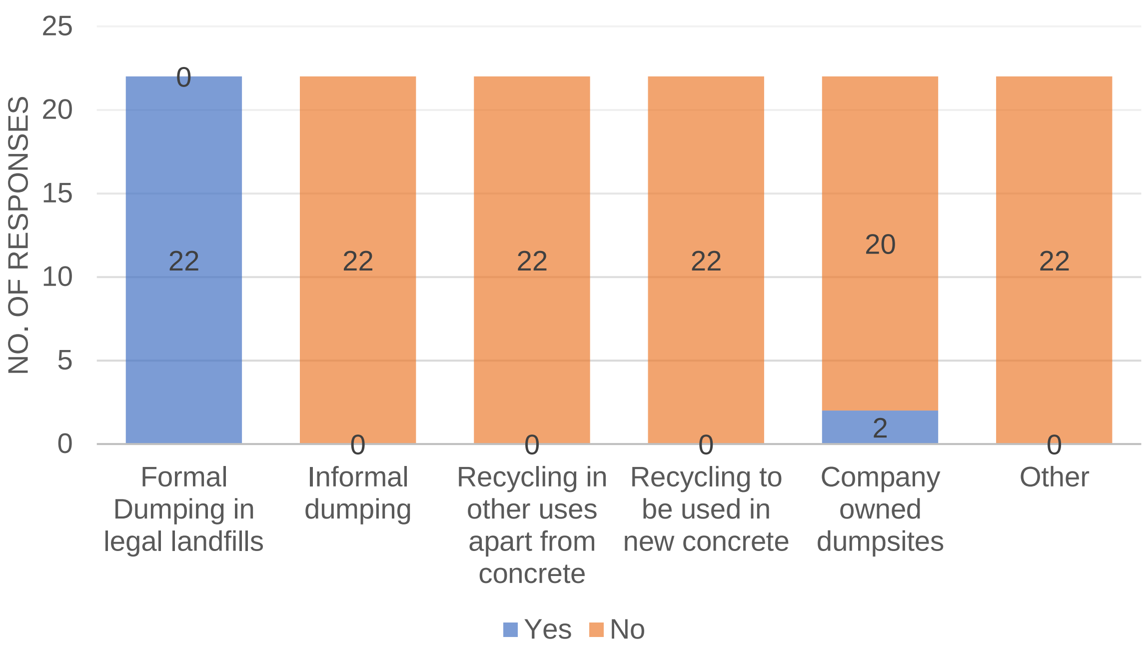

Chart 10-107: Discarding Approach of Generated Waste

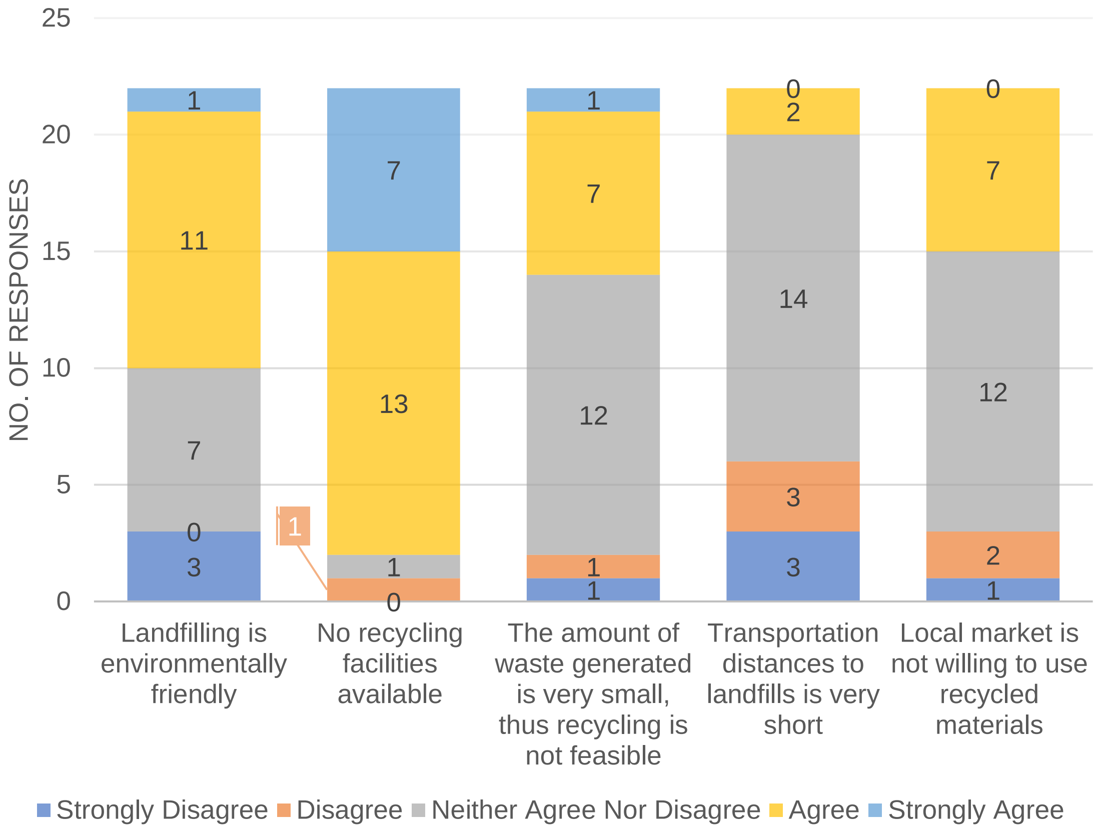

Chart 10-108: Reasons Associated with Discarding Approach

10.3.2.6.6 Charts 11 – 117, 118 and 119 Analysis

Overall, these charts support the view that all factories generate waste from the manufacturing process. Estimates of range of 85% to 100% of respondents agreed that the types of waste generated varies. Comprising concrete and all its components including aggregates, cement, sand and water.

Chart 10-118 is a good illustration of all factories in discarding the generated waste by formally landfilling it in legal landfills. However, below 10% use their own landfills as demonstrated in the data collection section for land reclamation purposes. This attitude is majorly attributed to the absence of recycling facilities. A range of 30% to 55% of respondents agreed that factories adopt the formal dumping. Due to the small amount of waste generated from them, observing locals not willing to use recycled material and considering as an environment solution.

10.3.2.6.7 Chart 10 – 120

The charts below assess the willingness of constructions actors towards using recycled aggregates in new concrete mixes under the constraints of design codes.

These aspects provided by participants using Yes/No question. The bars in this chart represents the responses of participants based on the question seen below.

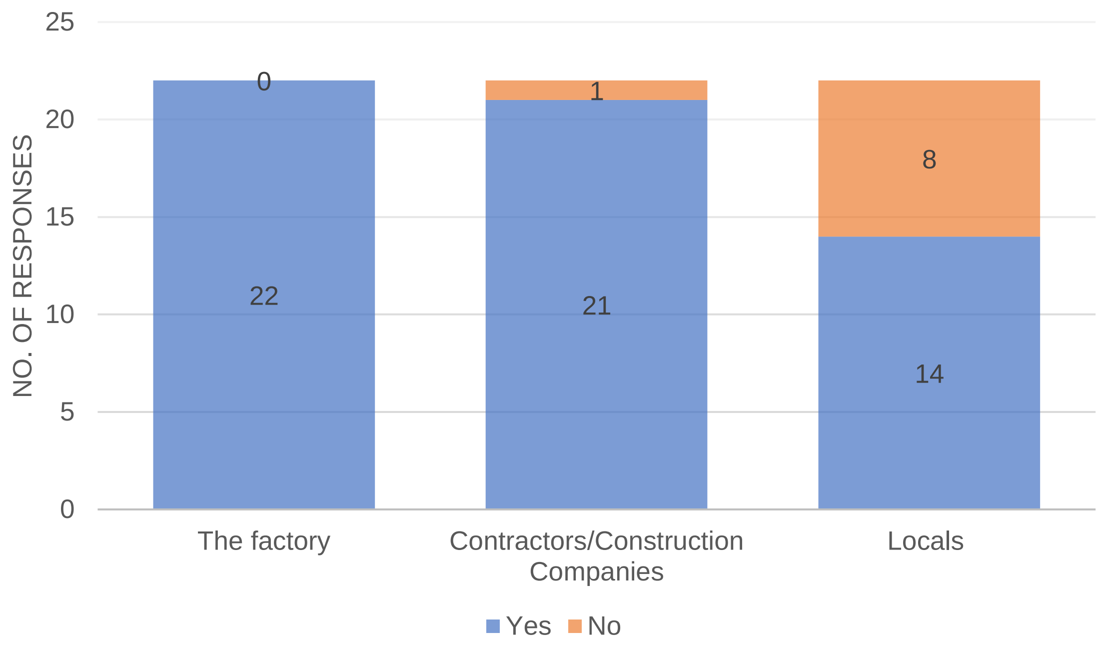

Chart 10-109: Willingness of Actors

10.3.2.6.8 Chart 10 – 120 Analysis

The analysis of this chart shows that above 95% of factories and construction contractors and companies are willing to use recycled aggregates in new concrete mixes if designed under recycled material codes.

Meanwhile, respondents have shown their hesitance in respect to locals. As only two thirds agreed that locals would be willing to use recycled aggregates in new concrete mixes if designed under recycled material codes.

10.3.2.7 Clients' Questionnaire

This section presents a discussion of analysis of clients' survey.

The total number of participants in this questionnaire was 43. This questionnaire has covered several aspects comprising:

1. The aspects that local clients consider during design, construction or demolition.
2. Evaluation of the significance of informal dumping of C&D waste.
3. The actors' responsibility on such an attitude.
4. Measuring the need for a C&D waste management in the country.
5. Impacts associated with the informal dumping of C&D waste on the society.
6. Assessing the willingness of clients.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No and Likert Scale.

10.3.2.7.1 Chart 10 – 121 and 122

The charts below ascertain the aspects that clients take into consideration when constructing and demolishing projects in Jordan.

These aspects provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

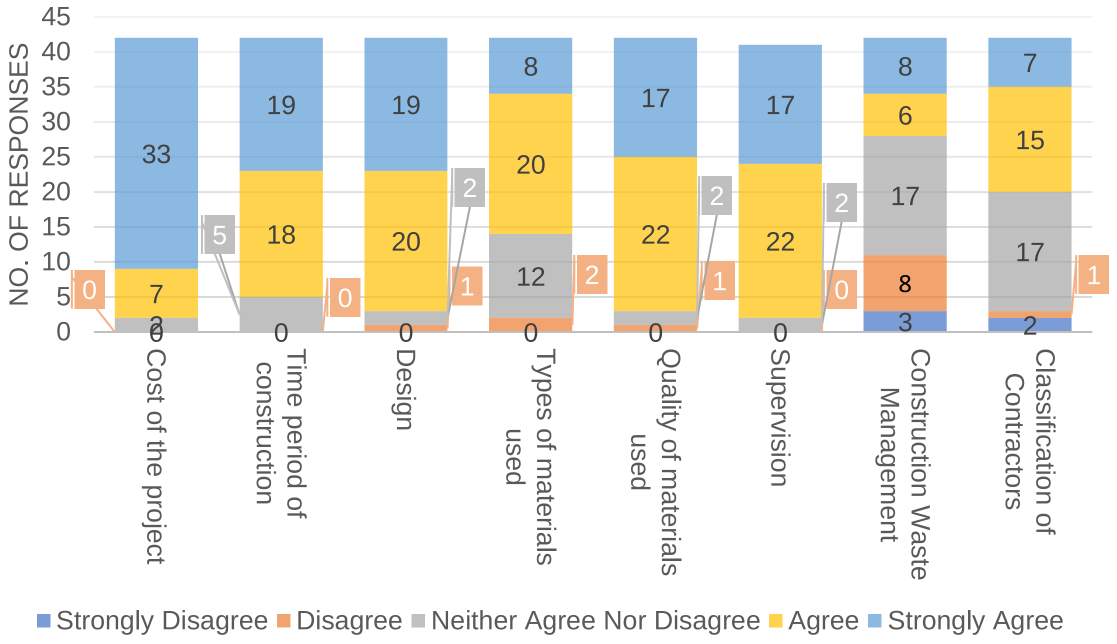

Chart 10-110: Considerations During Construction

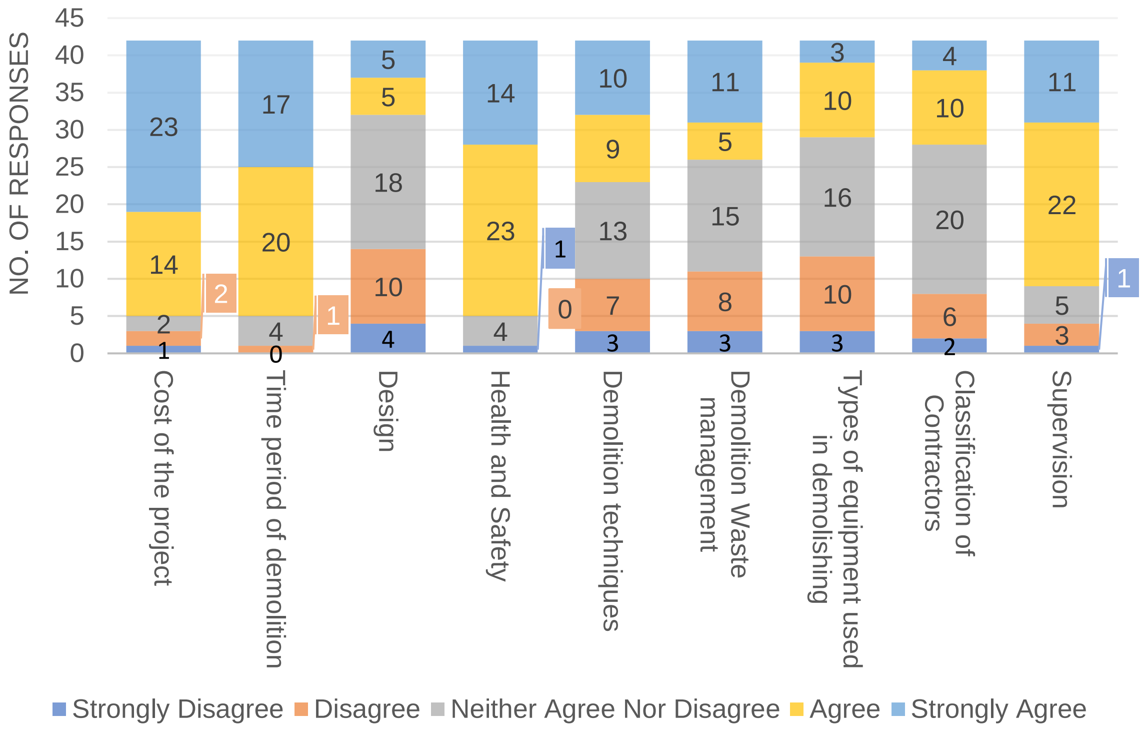

Chart 10-111: Considerations During Demolition

10.3.2.7.2 Chart 10 – 121 and 122 Analysis

Chart 10-121 very clearly demonstrates that over 85% of clients revealed that they consider several aspects such as cost, time, design, quality of material used and supervision when constructing projects. While only a range of 50% to 66% of them consider types of material used and classification of contractors.

As expected just under one third of the same clients shown their consideration to construction waste management. As regards the demolition process, **chart 10-122** shows that above 75% of clients take into consideration cost, time, health and safety and supervision. Just below one third of clients to nearly 45%, indicated that they consider the demolition techniques and demolished waste management. In addition to types of equipment used and classification of contractors when demolishing structures. As anticipated almost 75% of clients do not consider the design when demolition projects.

10.3.2.7.3 Chart 10 – 123 and 124

The charts below distinguish the observation of clients on the significance of the issue of informal dumping of C&D waste. Also, assess the need for a C&D waste management based on its significance.

These aspects provided by participants using both Likert Scale and Yes/No questions. The bars in this chart represents the responses of participants based on the question seen below.

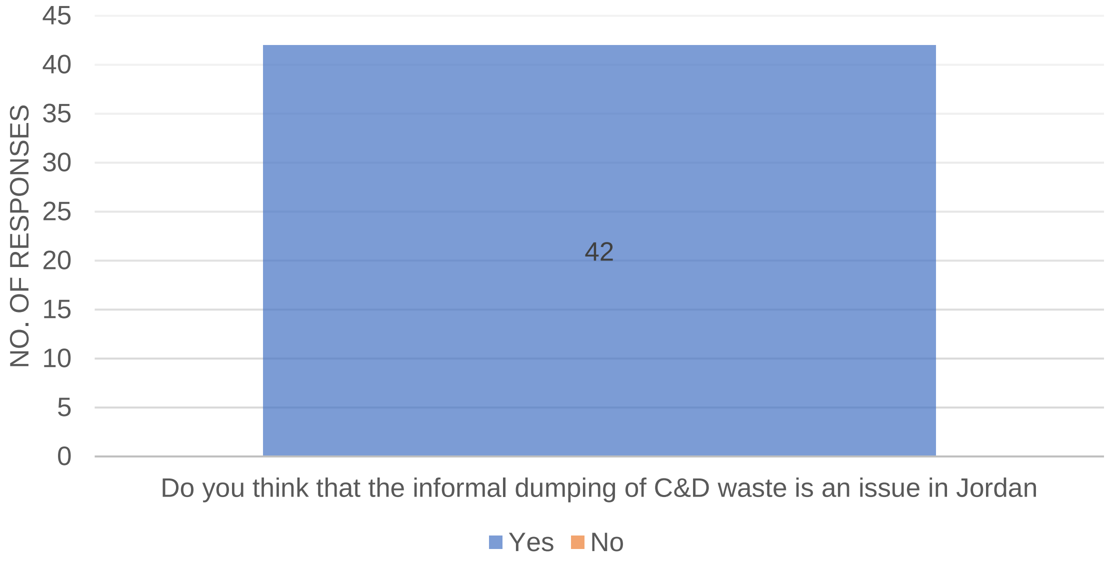

Chart 10-112: The Significance of Informal Dumping

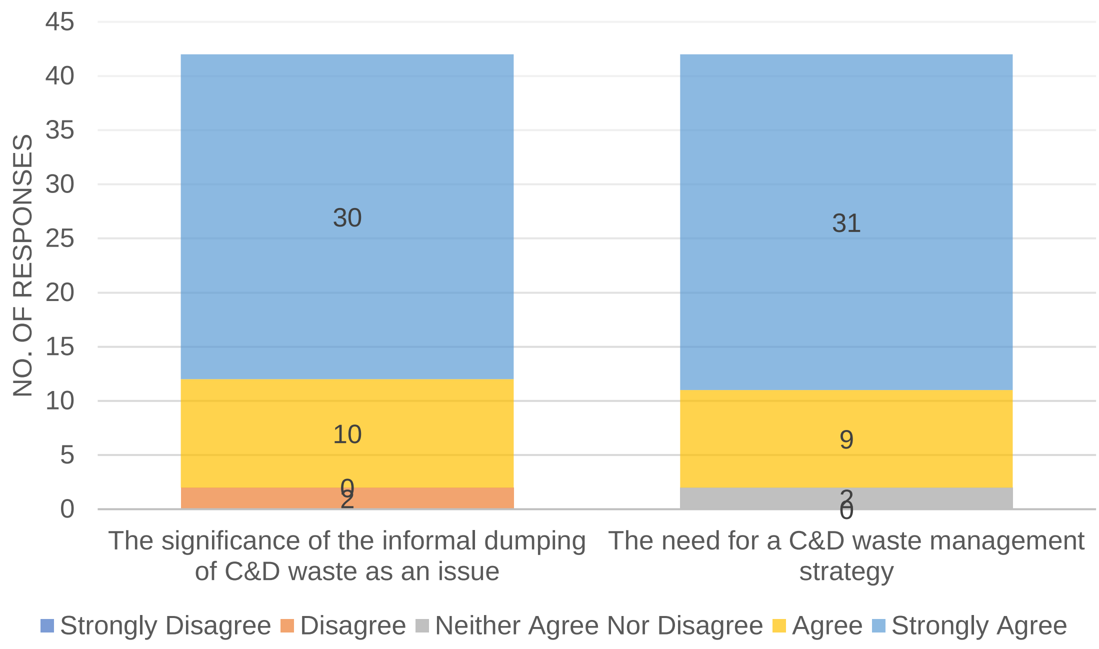

Chart 10-113: Significance and the Need for C&D Waste Management of Informal Dumping

10.3.2.7.4 Chart 10 – 123 and 124 Analysis

These charts demonstrate that just over 95% of clients believe that the informal dumping of C&D waste is an issue. Additionally, 93% of them reveals that this issue is very significant. This indicates that C&D waste in Jordan is, therefore, becoming a public concern in the country. Also, the case reported here confirms that above 90% of clients observes that there is a great importance for the country to have a C&D waste management.

10.3.2.7.5 Chart 10 – 125

The charts below assess the accountability of actors on the issue of informal dumping of C&D waste in Jordan.

These aspects provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

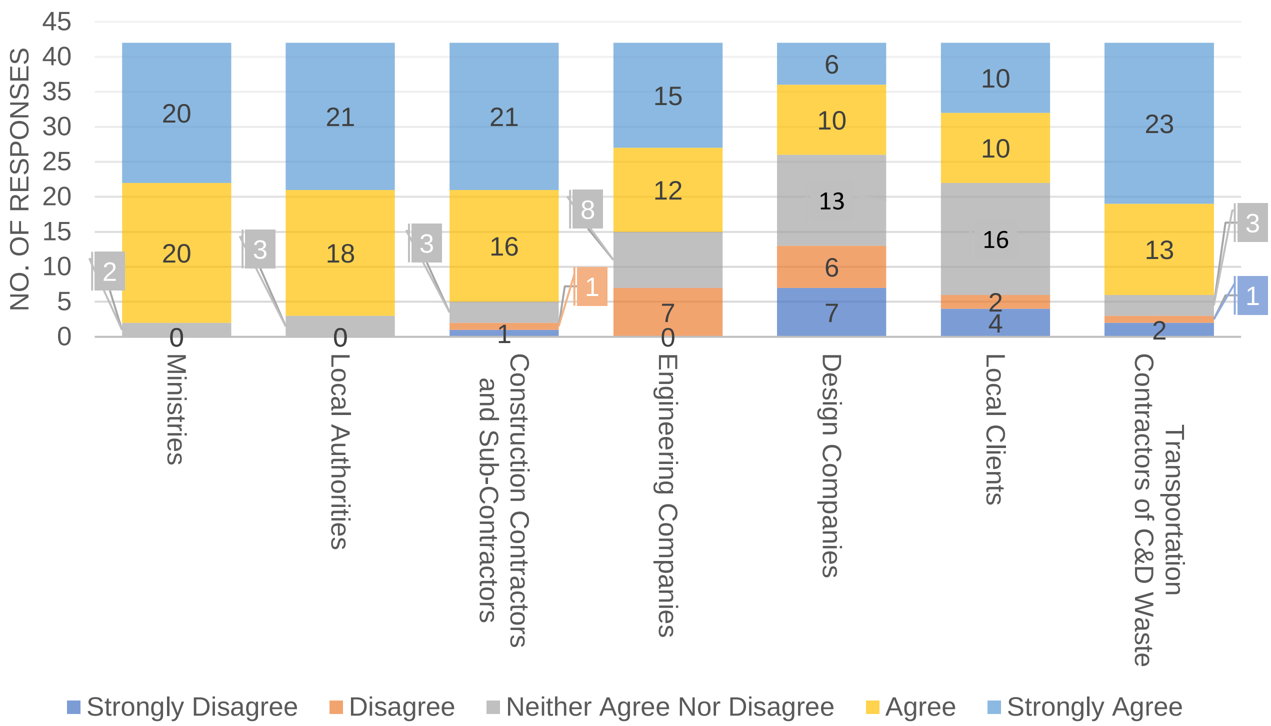

Chart 10-114: Actors Responsibility on Informal Dumping

10.3.2.7.6 Chart 10 – 125 Analysis

This chart demonstrates how clients scale several construction industry's actors' responsibilities to the issue of the informal dumping of C&D waste.

Above 80% of these clients referred this issue to the government including ministries and local authorities, construction contractors and companies and transportation contractors. Meanwhile, a range of 35% to just under 63% of them suggested that a strong link may be exist between engineering and design companies and local clients.

10.3.2.7.7 Chart 10 – 126

The charts below offer an adequate explanation on possible social impacts that could be associated with the informal dumping of C&D waste.

These aspects provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

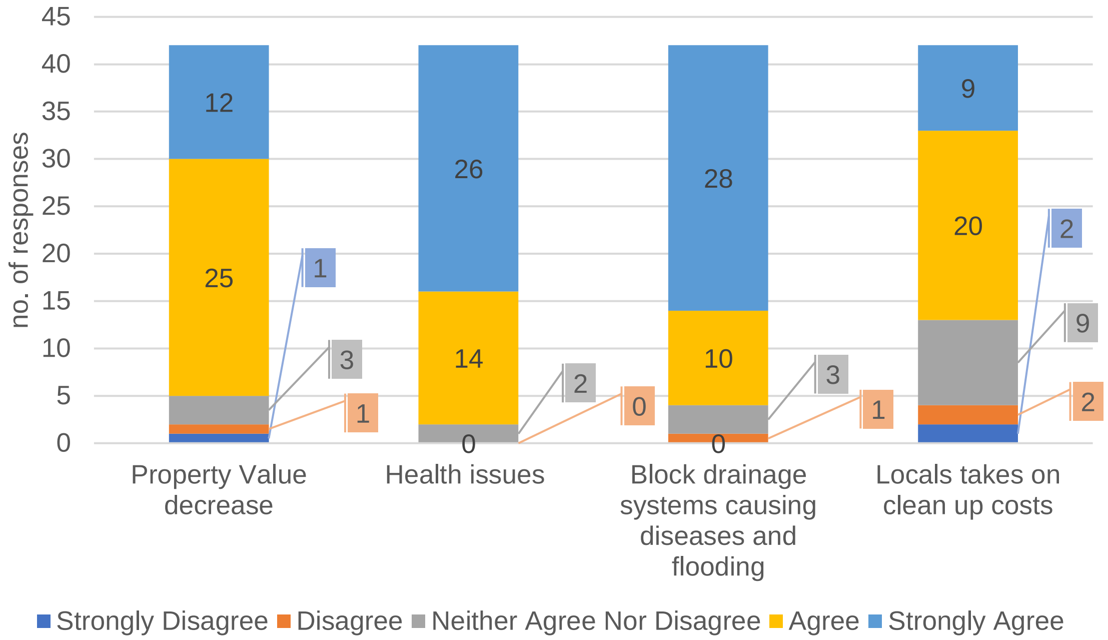

Chart 10-115: Social Impacts

10.3.2.7.8 Chart 10 – 126 Analysis

The evidence presented by just over 85% of clients that informal dumping has several impacts on society, including:

1. The value of the property decreases.
2. Health issues increase.
3. Drainage gets blocked causing diseases and flooding.

Meanwhile, almost 70% of them indicated that the informal dumping of C&D waste plays a causal role to locals taking the costs of cleaning up.

10.3.2.7.9 Chart 10 – 127, 128 and 129

The charts below provide the sufficient considerations of clients towards adopting any approach for design out waste of construction or demolition projects. To properly manage C&D waste whether it was design for reduction/prevention/deconstruction. In addition to, determining the reasons that could be associated with their responses regardless they were willing or not to adopt it.

These aspects provided by participants using Likert Scale and Yes/ No questions. The bars in this chart represents the responses of participants based on the question seen below.

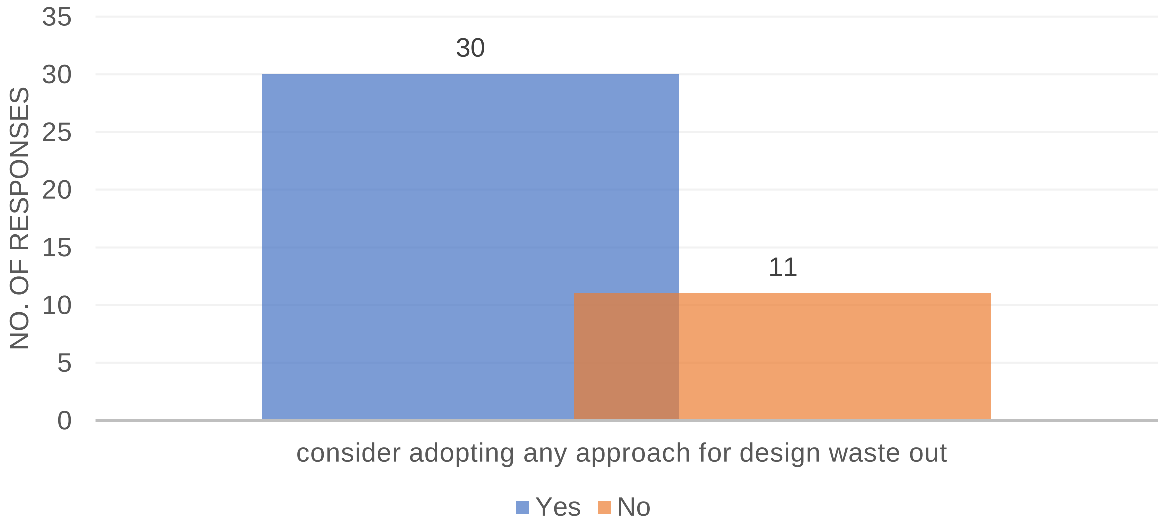

Chart 10-116: Considerations

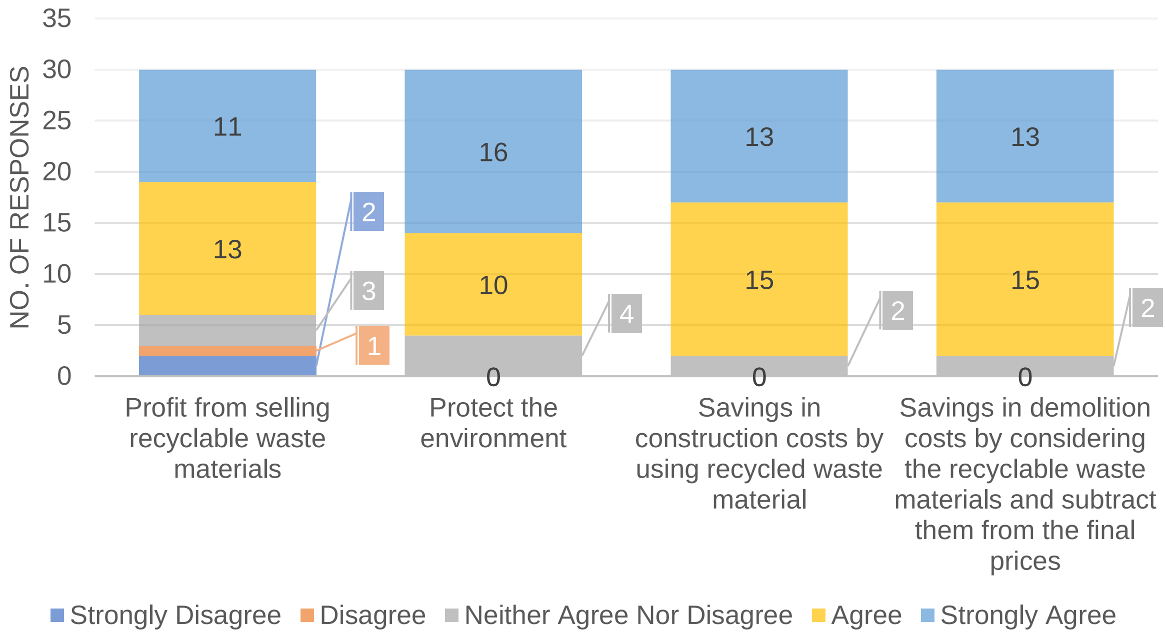

Chart 10-117: Reasons Associated with Adopting Design Out Waste of Projects

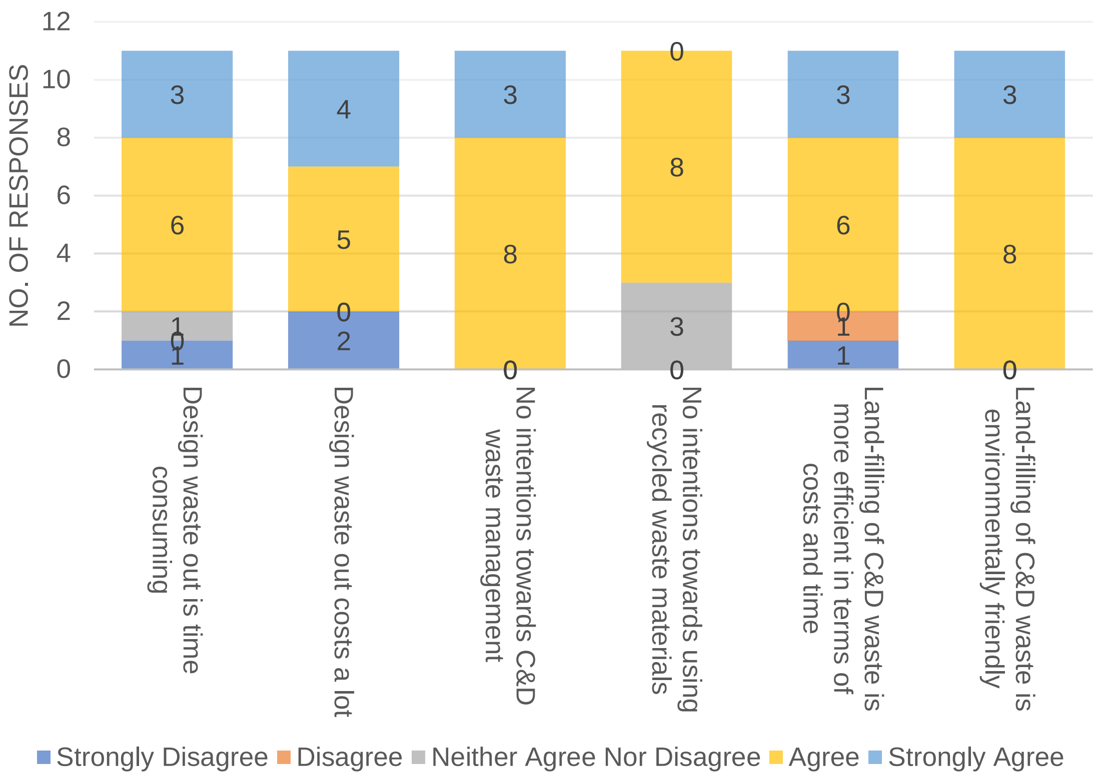

Chart 10-118: Reasons Associated with not Adopting Design Out Waste of Projects

10.3.2.7.10 Charts 10 – 127, 128 and 129 Analysis

As seen above in **chart 10-127**, almost 70% of clients revealed that they would consider designing out waste on projects to properly manage C&D waste. Where the rest 30% has revealed the contrast consideration. Because of observing the design out waste as a time and cost consuming approach. Alongside the cost of landfilling that seems to be less cheap than this. In addition to having no intentions towards using recycled waste material and observing landfilling as an environmental solution.

As for clients who have shared their interest to adopt this approach have indicated several determinant factors to their response, including:

1. Obtaining profits from selling recycled waste material.
2. Protecting the environment.
3. Obtaining savings in costs by using recycled waste material and demolition costs by subtracting the recyclable waste material from the total cost of demolition

10.3.2.7.11 Charts 11 – 130, 131 and 132

The charts below assess the willingness of clients towards using recycled aggregates in new concrete mixes. If constrained by design codes or not and offer an explanation to client's responses whether they were willing or not.

These aspects provided by participants using both Likert Scale and Yes/ No questions. The bars in this chart represents the responses of participants based on the question seen below.

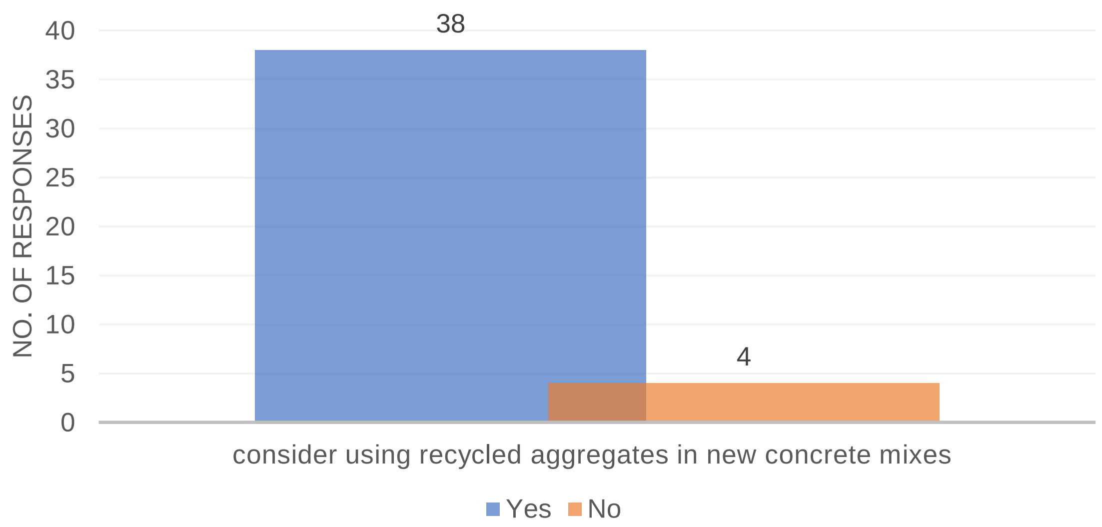

Chart 10-119: Willingness

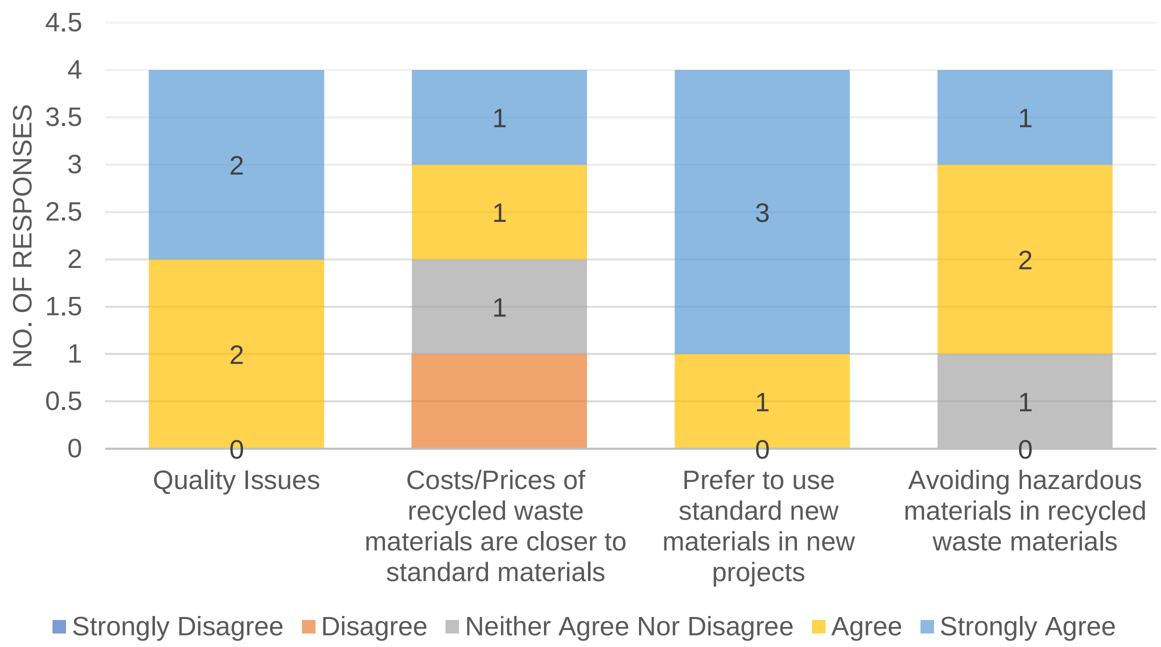

Chart 10-120: Reasons Hindering Clients' Willingness

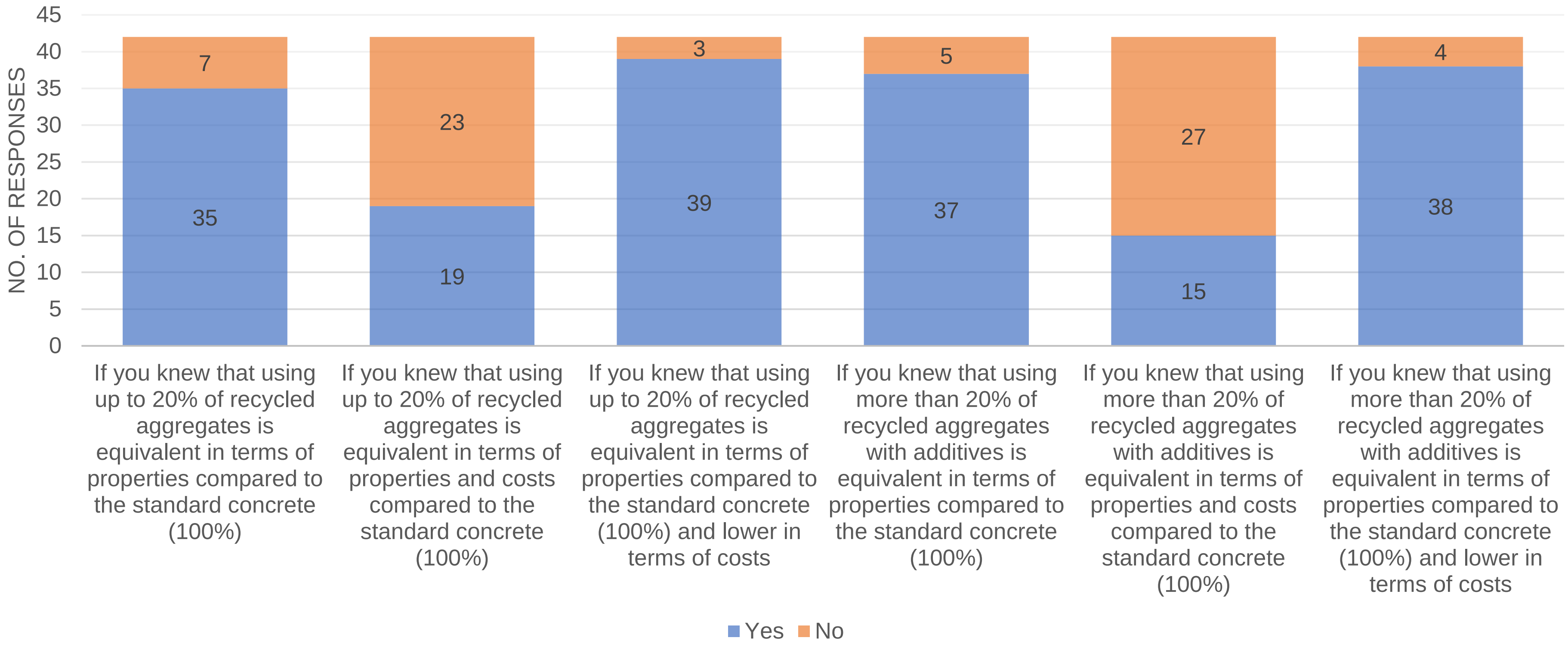

Chart 10-121: Willingness

10.3.2.7.12 Charts 10 – 130, 131 and 132 Analysis

Chart 10-130 has shown that most of clients nearly 88% agreed that they are willing to use recycled aggregates in new concrete mixes in new projects. However, if only designed by specific codes and specifications.

These results have been further investigated covering the benefits and behaviour of concrete mixes when using such material. It has been revealed as expected that almost 90% of clients agreed that they are willing to use such material. If concrete shown equivalent behaviour to the standard one but with less price regardless the percentage of recycled aggregates used. Although, a range of 33% to 44% of clients shown the contrast if costs were equal to the standard one.

10.3.2.8 Academics Questionnaire

This section presents a discussion of analysis of clients' survey.

The total number of participants in this questionnaire was only 5. This questionnaire has covered several aspects comprising:

1. Several aspects related to C&D waste and in particular informal dumping.
2. Evaluation of the significance of informal dumping of C&D waste.
3. Actors' responsibility on such an attitude.
4. Measuring the need for a C&D waste management in the country.
5. Observations on the current adoption of design companies.
6. Determines the reasons associated with their current adoptions.
7. Reasons hindering the presence or establishment of recycled waste material design codes.
8. Determining the possible approaches that could contribute to adopt design out waste of projects.
9. Reasons hindering the implementation of C&D waste management.
10. Evaluating the actors' considerations in the industry.

This section outlines analysis of data collected from different types of questions as seen below comprising Yes/No and Likert Scale.

10.3.2.8.1 Chart 10 – 133, 134 and 135

The charts below draw an estimation to the percentage of informal dumping of C&D waste from the total generation of C&D waste. In addition to offering an adequate explanation to the strongly related factors of informal dumping and the possible approaches that could mitigate the informal dumping of C&D waste.

This distinction and estimation are provided by participants using Likert Scale question. The bars in this chart represents the participants anticipation responses based on the question seen below.

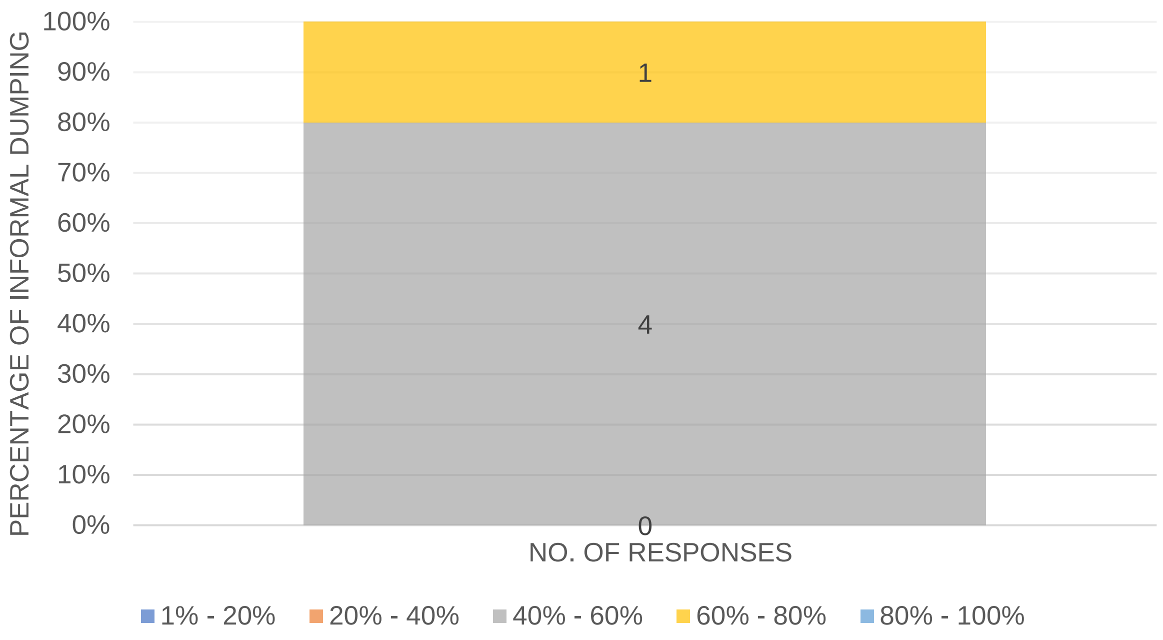

Chart 10-122: Percentage of Informal Dumping

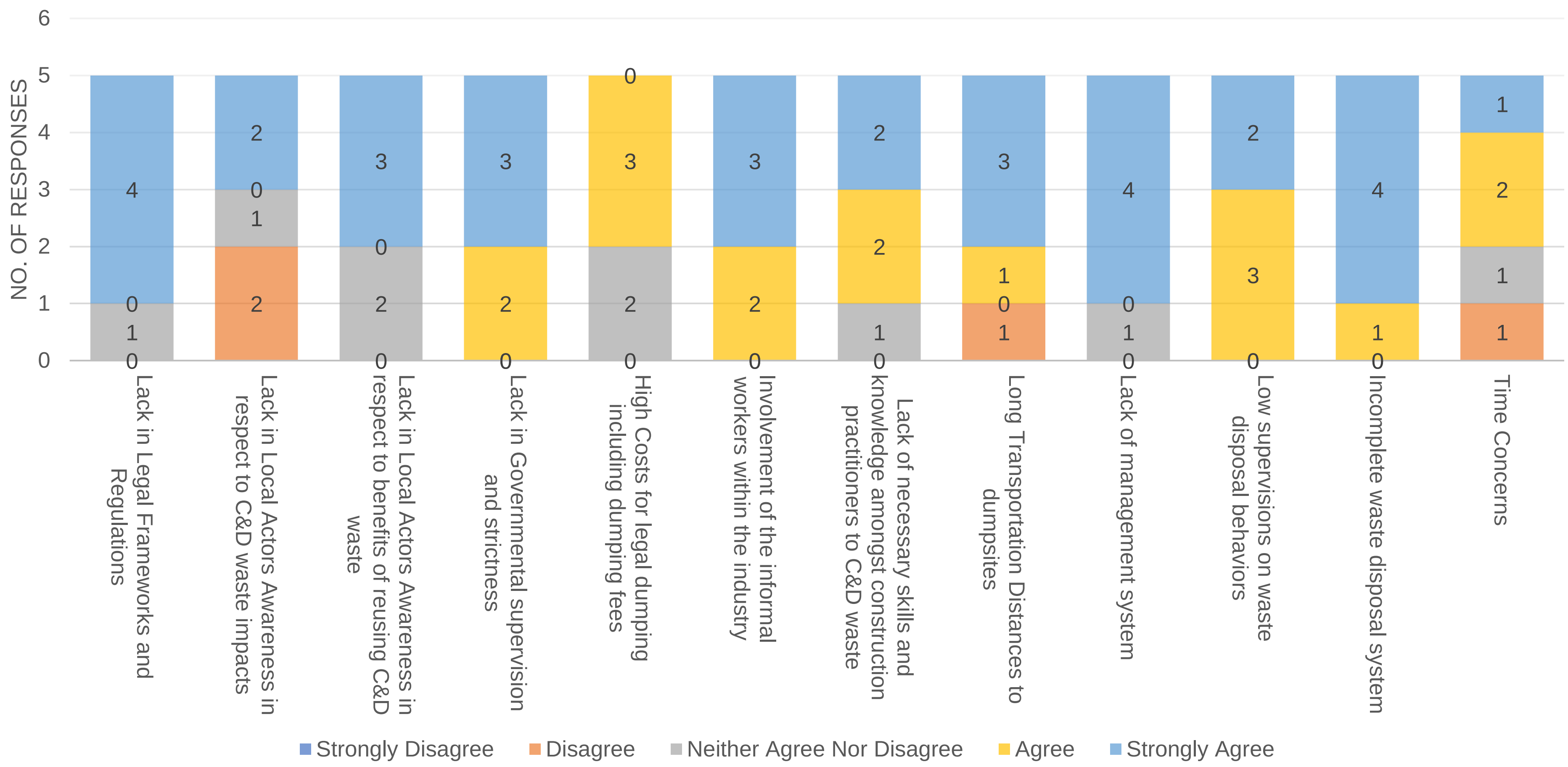

Chart 10-123: Causes of Informal Dumping of C&D Waste

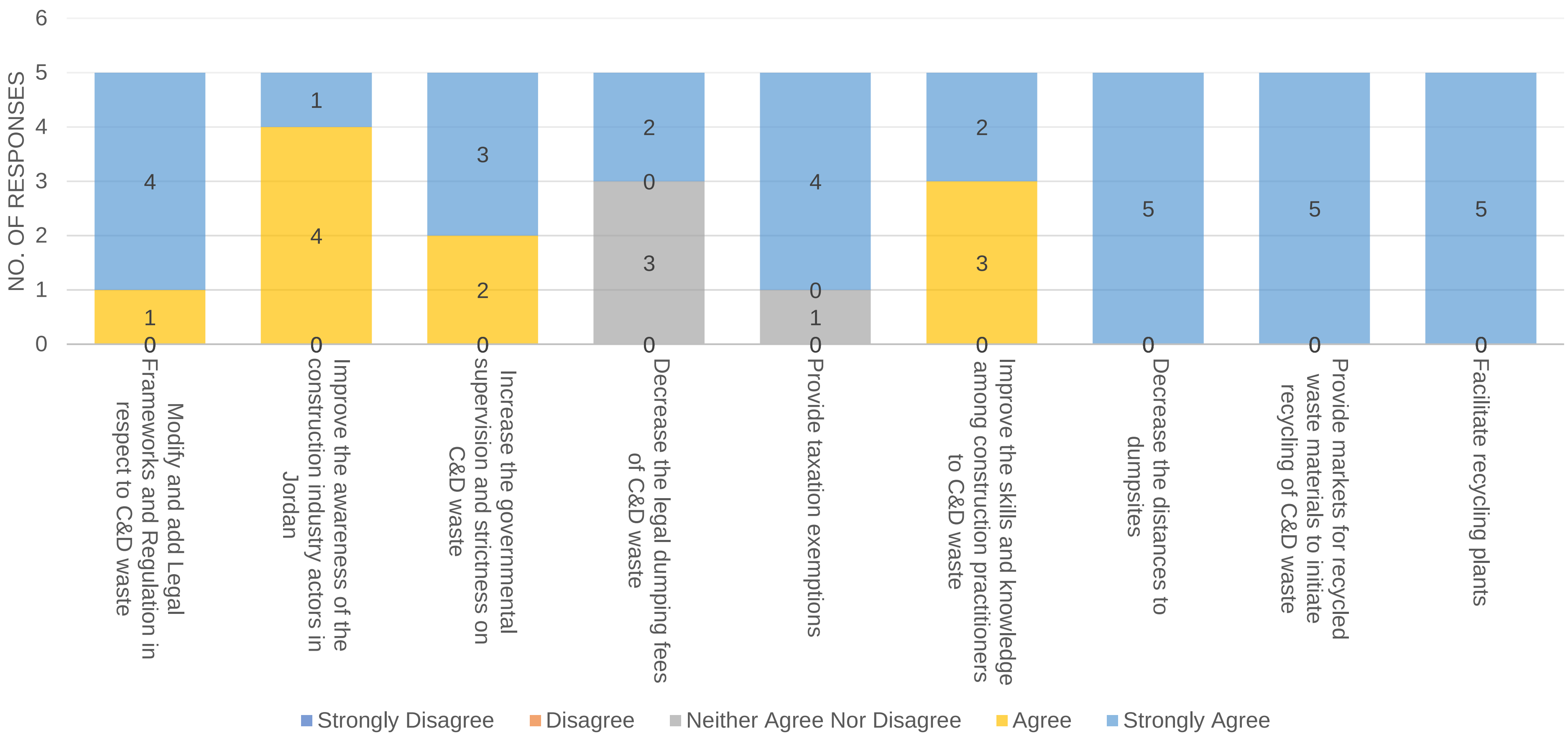

Chart 10-124: Approaches to Mitigate the Informal Dumping of C&D Waste

10.3.2.8.2 Chart 10 – 133, 134 and 135 Analysis

Chart 10-133 has reported that 80% of respondents revealed that 40% - 60% of C&D waste generated is dumped informally. Meanwhile, the rest 20% ascertained that the informal dumping of C&D waste occurs to 60% - 80% of the total C&D waste generated.

This huge percentage has been associated with several reasons as stated by these academics. As just over 80% of respondents agreed that several factors known to influence the percentage of the informal dumping, such as:

1. The lack of regulations, legal framework and legislations.
2. Poor management systems.
3. Lack of necessary skills and knowledge amongst construction practitioners to C&D waste.
4. Low governmental supervision and strictness.
5. The involvement of the informal workers within the industry.
6. Incomplete waste disposal systems.
7. Low supervisions on waste disposal behaviours.
8. Long transportation distances to dumpsites.

Estimates of respondents range from 40% to 60% indicated that the informal dumping is influenced by the lack of local actors' awareness in respect to C&D waste impacts and benefits. In addition to the high costs of legal dumping including dumping fees and time concerns.

Moving on now to consider the approaches that could contribute to mitigating the informal dumping. Where just over 80% of respondents showed that several contributory elements could aid in mitigating such an issue, including:

1. Modifying and adding legal frameworks and regulation in respect to C&D waste.
2. Improving the awareness of the construction industry actors in Jordan.
3. Increasing the governmental supervision and strictness on C&D waste.
4. Improving the skills and knowledge among construction practitioners to C&D waste.
5. Providing markets for recycled waste material to initiate recycling of C&D waste.
6. Decrease of distances to dumpsites.
7. Providing taxation exemptions.
8. Facilitating recycling plants.

However, only 40% of academics participated has revealed that decreasing the legal dumping fees of C&D waste can derive mitigation to this attitude.

10.3.2.8.3 Chart 10 – 136 and 137

The charts below distinguish the observation of academics on the significance of the issue of informal dumping of C&D waste. In addition to, assessing the need for a C&D waste management based on its significance.

These aspects provided by participants using both Likert Scale and Yes/No questions. The bars in this chart represents the responses of participants based on the question seen below.

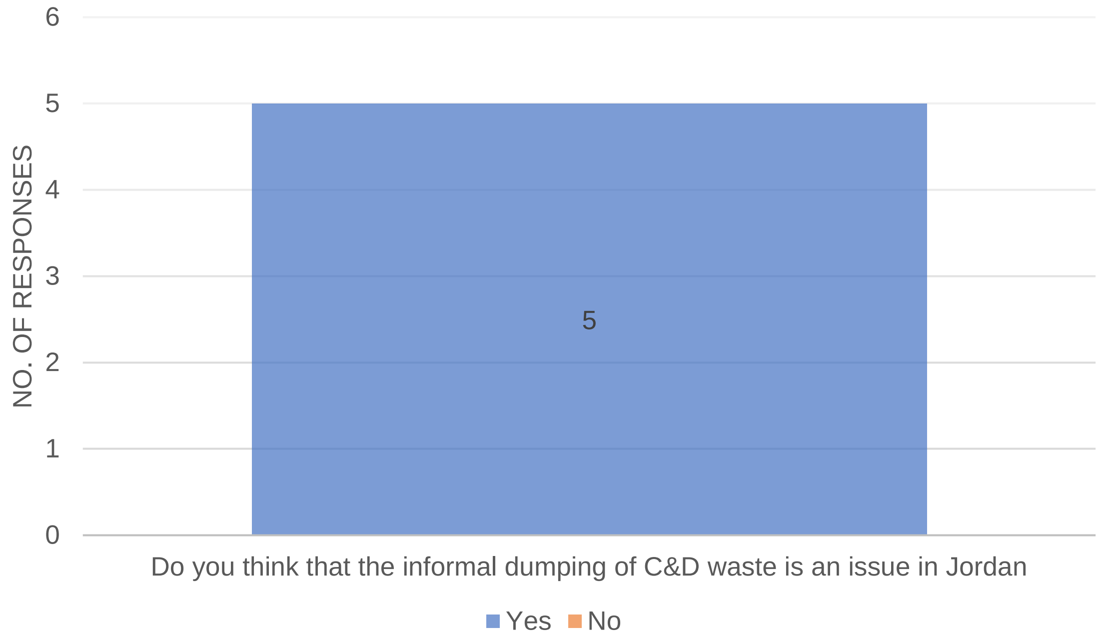

Chart 10-125: Determining the Significance of Informal Dumping of C&D Waste

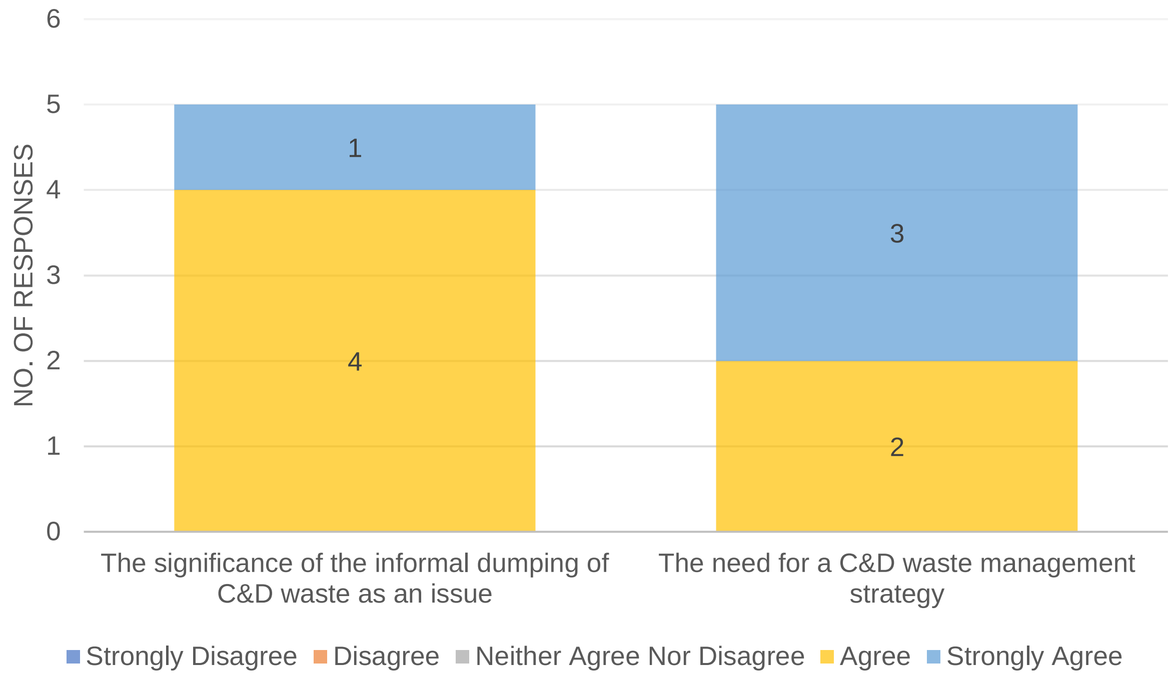

Chart 10-126: Significance of Informal Dumping and the Need for D&D Waste Management

10.3.2.8.4 Chart 10 – 136 and 137 Analysis

Chart 10-136 reports that all academics participated in this survey has indicated that the C&D waste is an issue in the country. Additionally, 100% of those surveyors has evaluated that the issue associated to C&D waste (informal dumping) is very significant. Thus, assessed the need for a C&D waste management strategy to be very critical.

10.3.2.8.5 Chart 10 – 138

The charts below assess the accountability of actors on the issue of informal dumping of C&D waste in Jordan.

These aspects provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

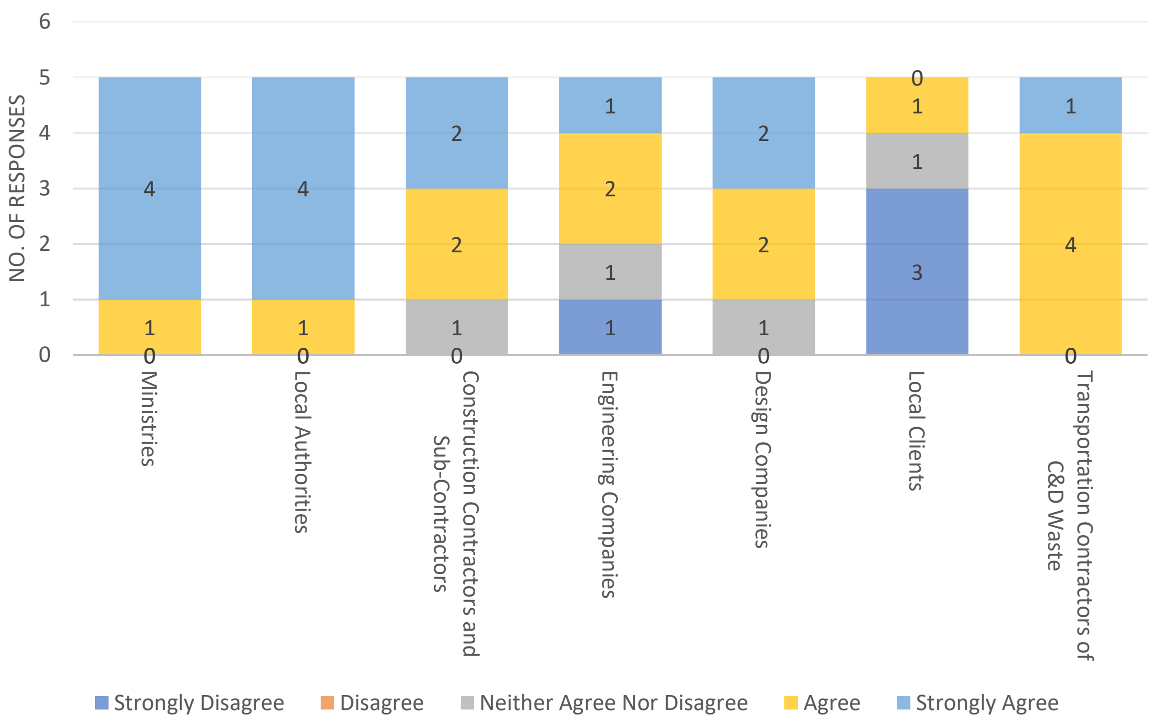

Chart 10-127: Actors Responsibility

10.3.2.8.6 Chart 10 – 138 Analysis

This case has shown that the government including ministries and local authorities. Besides the transportation contractors of C&D waste had the highest proportion of respondents 100% in respect to their accountability to the informal dumping of C&D waste.

Meanwhile, over three thirds of respondents agreed that this issue is dependable on construction contractors and design companies. Meanwhile, just under two thirds of participants indicated that the informal dumping of C&D waste is associated with engineering companies. However, 80% of those surveyors suggested a weak link may exist between local clients and the informal dumping.

10.3.2.8.7 Chart 10 – 139

This chart below determines the underlying causes that could be contributory to arise the generation of construction waste only.

These causes are assessed by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

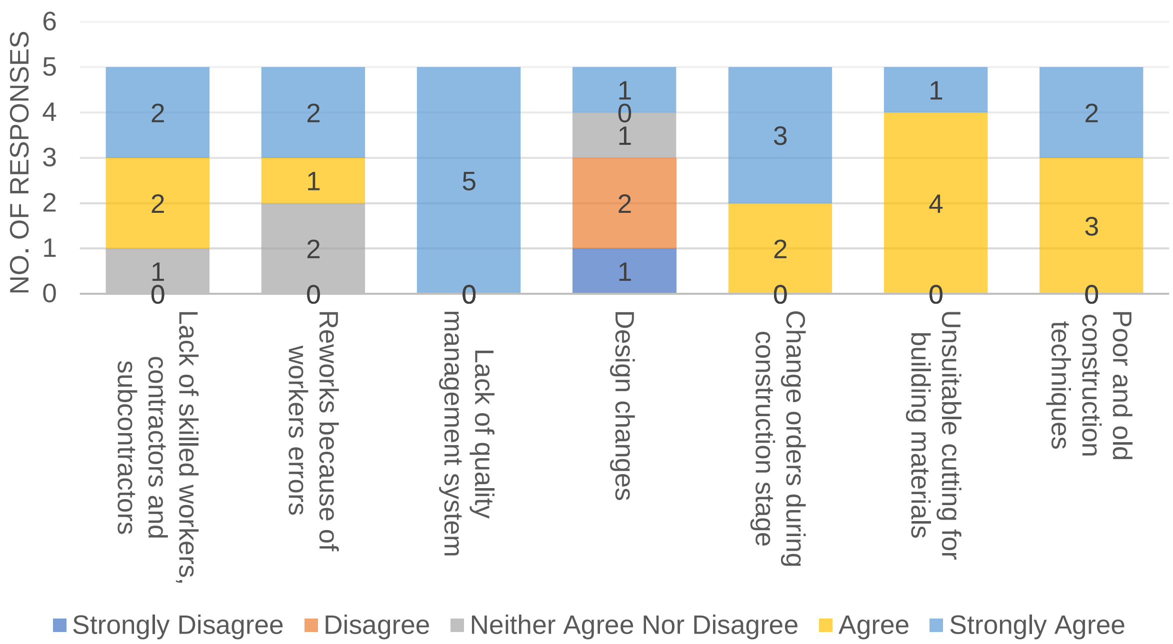

Chart 10-128: Causes of Construction Waste Generation

10.3.2.8.8 Chart 10 – 139 Analysis

All academics have reported here that there are important driving factors of construction waste arise including:

1. The lack of quality management system changes during the construction phase.
2. Unsuitable cuttings for building material.
3. Poor and old construction techniques.

Whereas 60% to 80% of respondents suggested that construction waste arise has been associated with the lack of skilled workforces, contractors and subcontractors. In addition to the occurrence of rework because of work errors. Although only 20% of them indicated that design changes play a vital role in arising of construction waste.

10.3.2.8.9 Chart 10 – 140

The chart below distinguishes the adoption of design companies towards designing waste out of projects.

This is provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

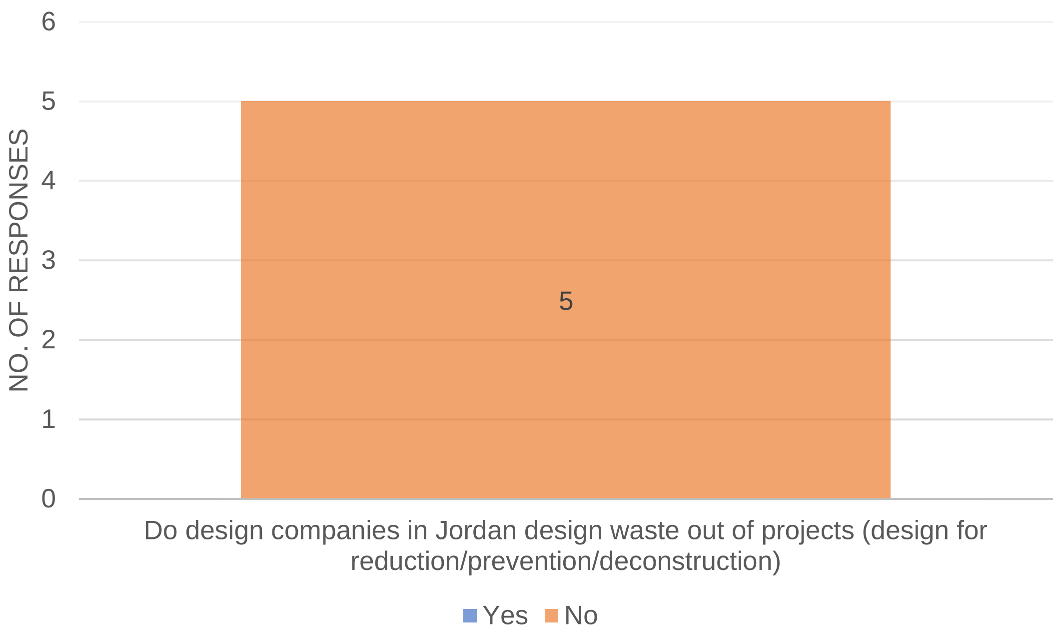

Chart 10-129: Adoption of Design Out Waste

10.3.2.8.10 Chart 10 – 140 Analysis

As seen above, 100% of academics participated in the survey clarified that design companies do not design out waste of construction or demolition projects as evidenced in the literature.

10.3.2.8.11 Chart 10 – 141

This chart determines the underlying causes that could be associated with hindering the designing waste out of projects.

This is provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

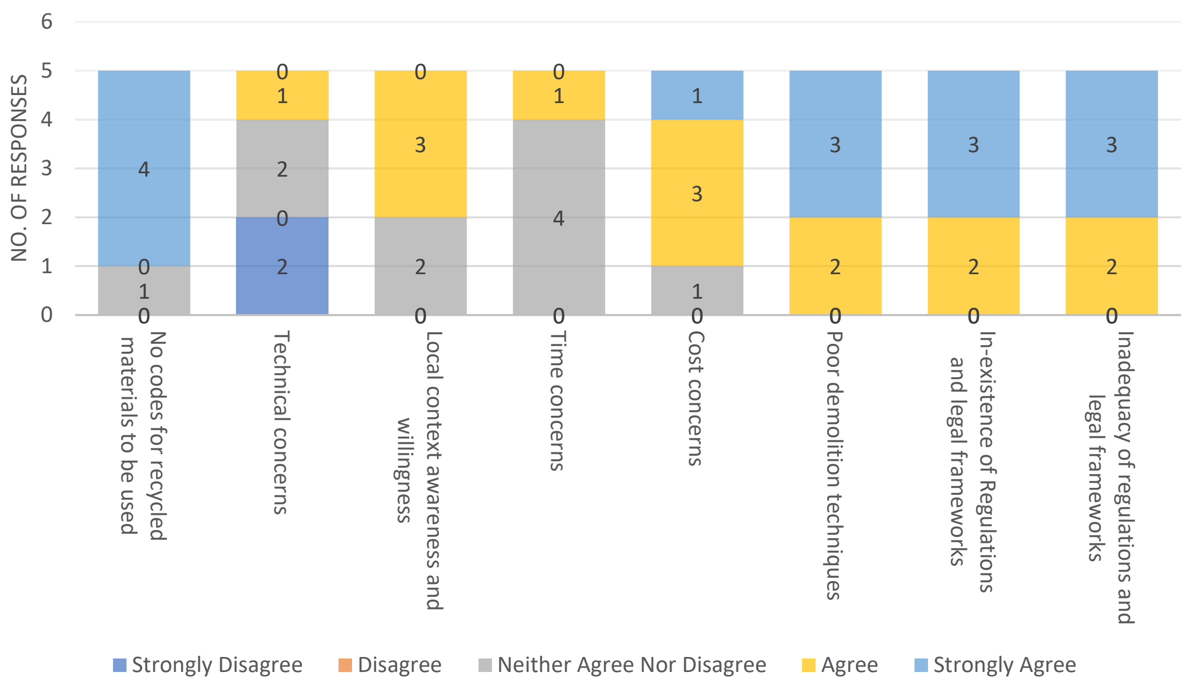

Chart 10-130: Reasons preventing the Design of Waste Out

10.3.2.8.12 Chart 10 – 141 Analysis

The results confirm that above 80% of respondents revealed that there are dominant factors preventing the design of waste out of project, including:

1. The absence of design codes for recycled C&D waste material.
2. Cost concerns.
3. Poor demolition techniques.
4. Absence of legal frameworks and regulations.
5. The inadequacy of these current regulations and frameworks.

Meanwhile, 20% to 60% of surveyors agreed that the time concerns and awareness and willingness of locals may be linked to the behaviour of design companies not to design out waste of projects.

10.3.2.8.13 Chart 10 – 142

This chart outlines the contributory causes that could be related to hinder the existence of recycled waste material design codes.

This is provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

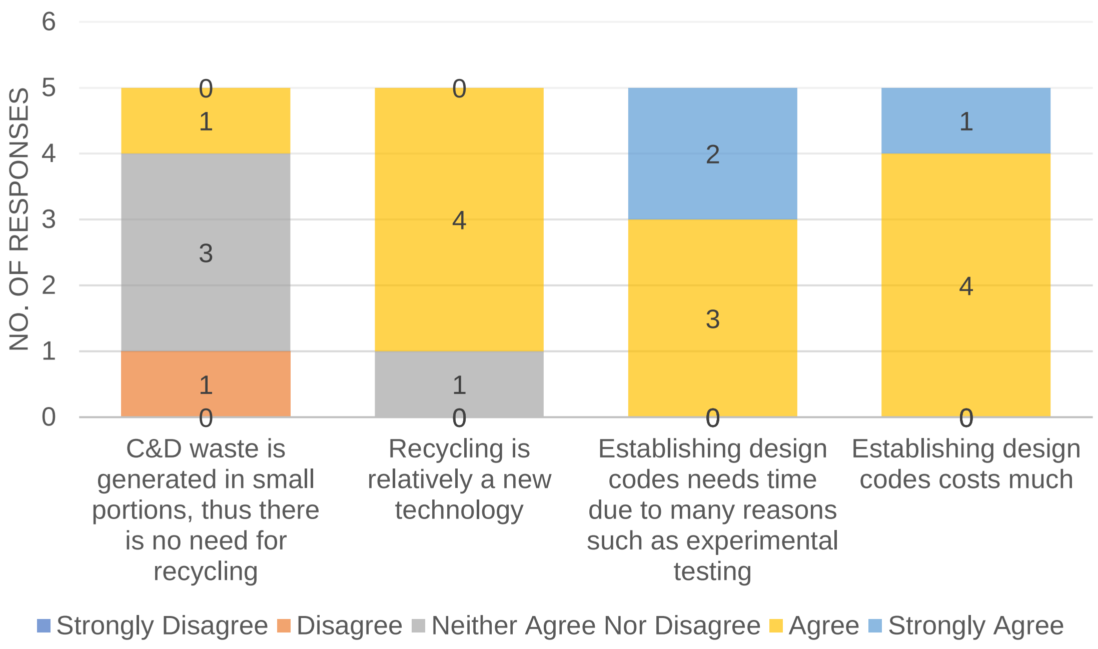

Chart 10-131: Reasons Hindering the Existence of Recycled Material Design Codes

10.3.2.8.14 Chart 10 – 142 Analysis

The survey has demonstrated that above 80% of participants identified that design codes of recycled waste material are not established. Owing to the time and cost consumed due to experimental testing. Besides, considering relatively the recycling of C&D waste as a new technology.

Although, it was clear that academics have bear in mind that C&D waste is not generated in small quantities. Thus, excluding such a reason hindering the establishment of design codes.

10.3.2.8.15 Chart 10 – 143

This chart provides an evaluation of the possible approaches that could contribute to adopt design out waste of projects.

This is provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

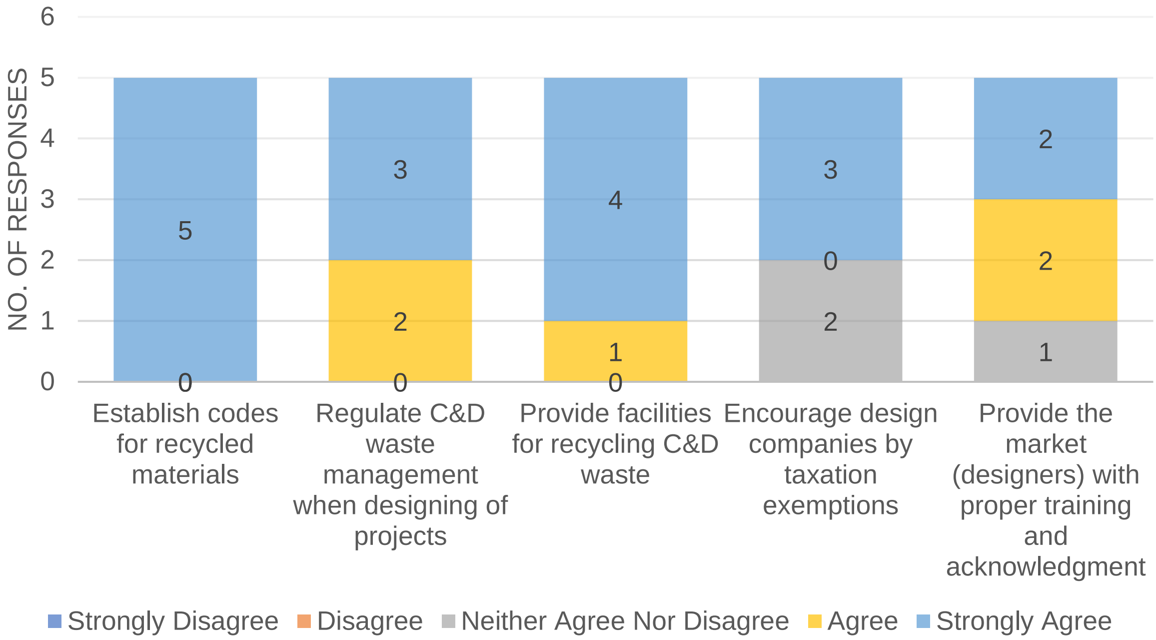

Chart 10-132: Approaches Contributing the Adoption of Design Out Waste

10.3.2.8.16 Chart 10 – 143 Analysis

The results taken from this chart indicate that 100% of academics revealed that establishing design codes and regulating C&D waste management when designing projects. In addition to providing facilities for recycling C&D waste material may have a great impact on adopting designing waste out of projects.

In addition, only 60% of those academics indicated that design out waste of projects would be promoted or initiated by encouraging design companies through tax exemptions.

10.3.2.8.17 Chart 10 – 144

This chart offers an adequate explanation to reasons preventing the collection, sorting, recycling and landfilling from taking place within a C&D waste management.

The survey is considering only the most 3 contributory hindrances. This is provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

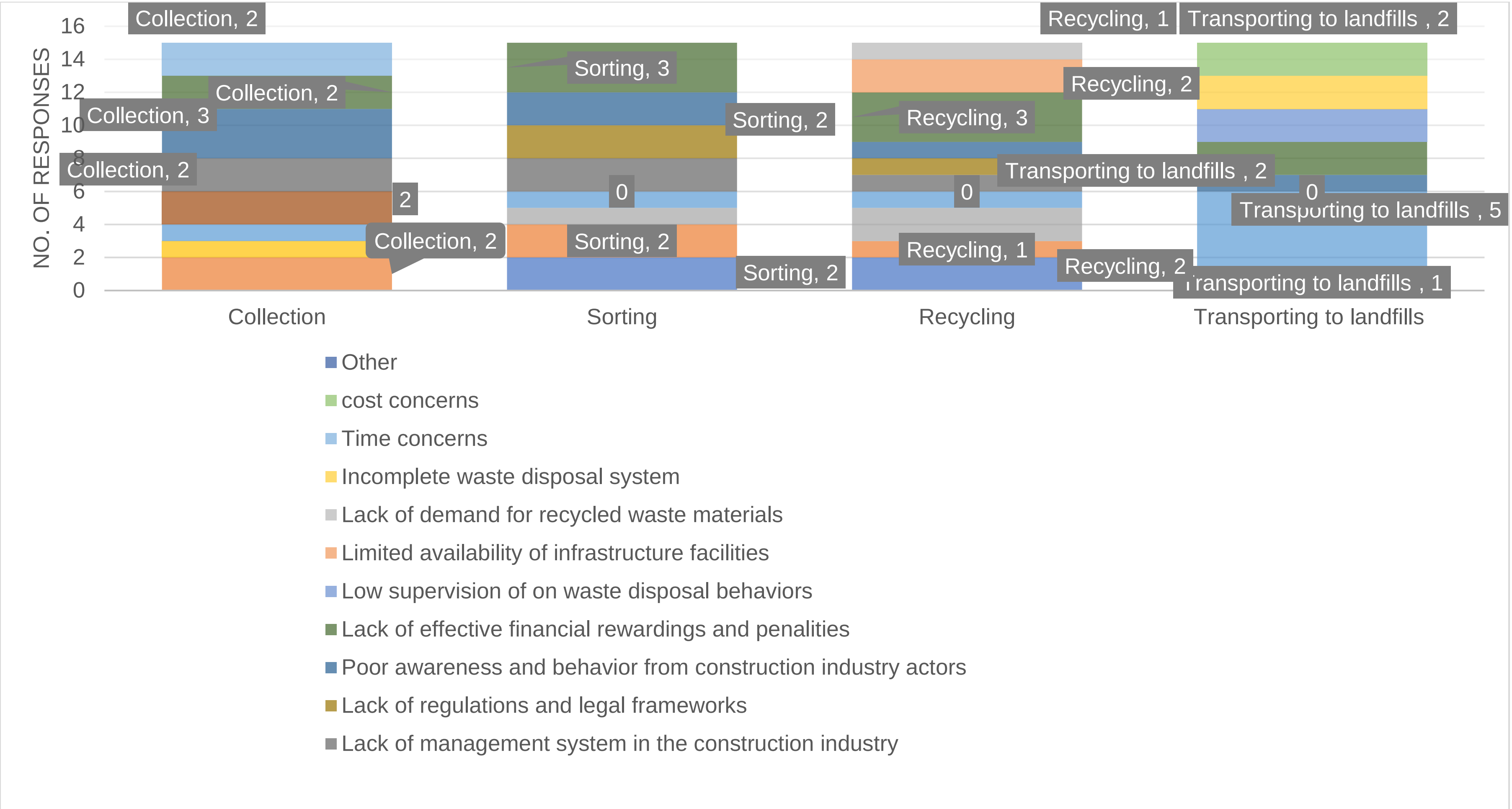

Chart 10-133: Reasons Preventing C&D Waste Management Activities

10.3.2.8.18 Chart 10 – 144 Analysis

The survey revealed that under 60% of academics clarified that several factors play a major role in hindering the collection process within the C&D waste management on site, including:

1. Poor awareness and behaviour from construction industry actors.
2. Time concerns.
3. Lack of effective financial rewarding and penalties.
4. Lack of management system in the construction industry.
5. Small portions of C&D waste generated.
6. Involvement of the informal workers within the industry.

Meanwhile, the rest of factors have been factors weakly related to collection prevention as responded by less than 20% of participants. Including lack of necessary skills and knowledge among construction practitioners to C&D waste and long transportation distances to landfills.

With respect to sorting, estimates of the most likely causes hindering such an activity on site range from 40% to 60% of respondents which are:

1. Lack of effective financial rewarding and penalties.
2. Poor awareness and behaviour from construction industry actors.
3. Lack of regulations and legal frameworks.
4. Lack of management system in the construction industry.
5. Involvement of the informal workers within the industry.
6. Lack of equipment.

Although, a maximum of 20% of respondents have linked this hinderance to the absence of design codes and the long transportation distances to landfills.

Several factors have been revealed to affect recycling, as agreed by a range of over 1 third to almost 2 thirds of those surveyed, such as:

1. Limited availability of infrastructure facilities.
2. Lack of effective financial rewarding and penalties.
3. Absence of design codes.
4. Lack of equipment.

In addition to these factors, less than a third of those who responded (20%) indicated other factors to be determinants towards recycling hindrance, such as:

1. Lack of demand on recycled waste material.
2. Poor awareness and behaviour from construction industry actors.
3. Lack of regulations and legal frameworks.
4. Lack of management system in the construction industry.
5. Long transportation distance to landfills.
6. Involvement of the informal workers within the industry.

Turning now to landfilling as the least preferable solution for C&D waste, 100% of those academics indicated that the long transportation distances to dumpsites is the most underlying factor to prevent proper landfilling. Meanwhile, just 40% of them referred the prevention of landfilling to:

1. The incomplete waste disposal system.
2. Cost concerns.
3. Lack of effective financial rewarding and penalties.
4. Low supervision on waste disposal behaviours.

Only 20% of those academics associated the prevention of landfilling with poor awareness and behaviour from construction industry actors.

10.3.2.8.19 Chart 10 – 145

This chart outlines the reasons that could be associated with hindering C&D waste management post landfilling.

This is provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

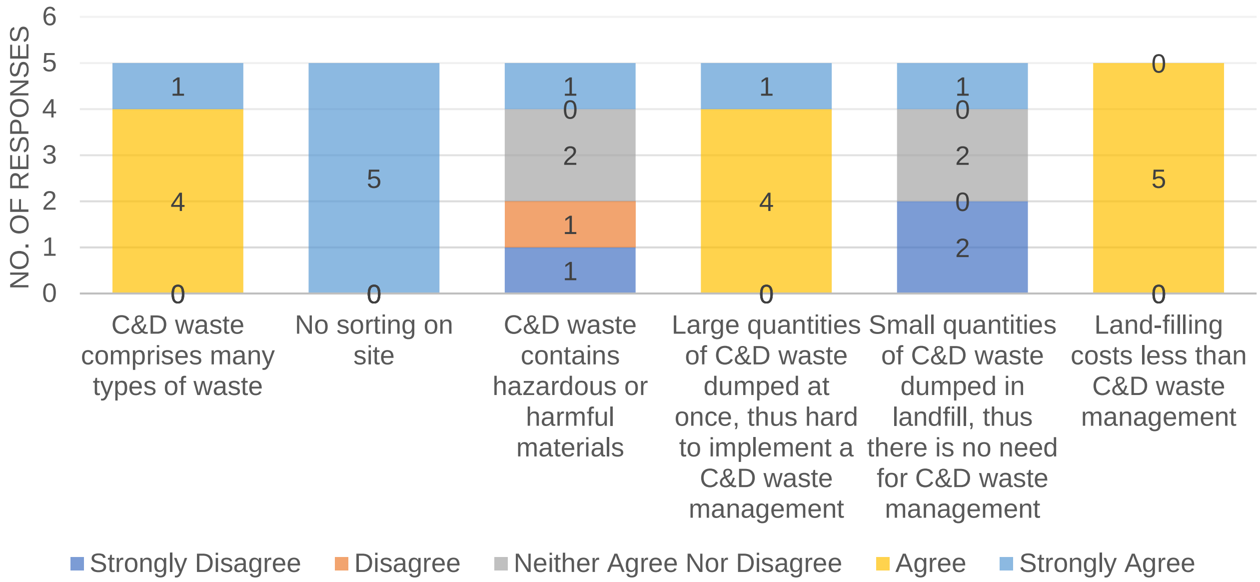

Chart 10-134: Reasons Hindering C&D Waste Management post Landfilling

10.3.2.8.20 Chart 10 – 145 Analysis

The chart above allows the observer to identify important driving factors to this hindrance such as the composition of C&D waste varying lots of types. This factor has been strongly associated in several questionnaires with the absence of sorting on site as 100% of respondents agreed on that. In addition to, large quantities of C&D waste that is dumped at once in landfills. In addition to, the cost of landfilling that seems to be less cheap than C&D waste management as seen in the main body. Meanwhile, just 20% of those surveyors referred this hindrance to the small quantities of C&D waste that is dumped in landfills. Making C&D waste management not feasible and the composition of C&D waste containing hazardous material.

10.3.2.8.21 Chart 10 – 146

This chart considers the field of study that should be focused on by research. Through drawing a distinction between the areas that should be furtherly studied.

This is provided by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

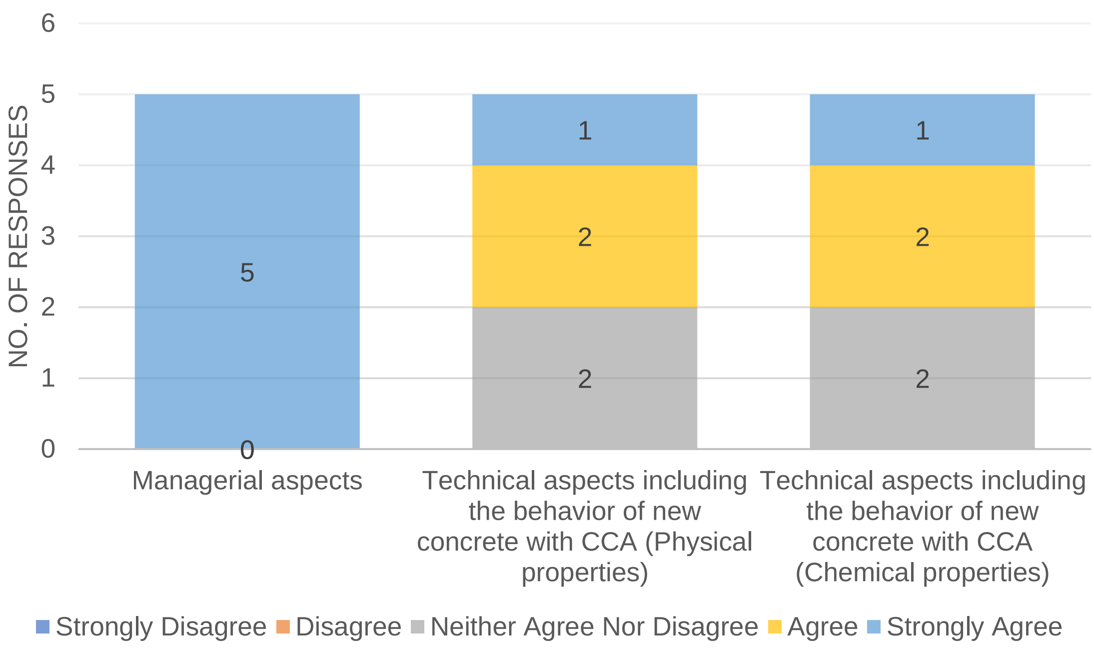

Chart 10-135: Field of Study

10.3.2.8.22 Chart 10 – 146 Analysis

This chart demonstrates the need for better studies in the managerial aspects as agreed by 100% of academics. Meanwhile, only 60% of them shown that the studies should cover the technical aspects including the physical and chemical properties of CCA in new concrete mixes.

10.3.2.8.23 Chart 10 – 147

This chart assesses the accountability of actors that should be involved in research studies according to their importance.

These actors are distinguished by participants using Likert Scale question. The bars in this chart represents the responses of participants based on the question seen below.

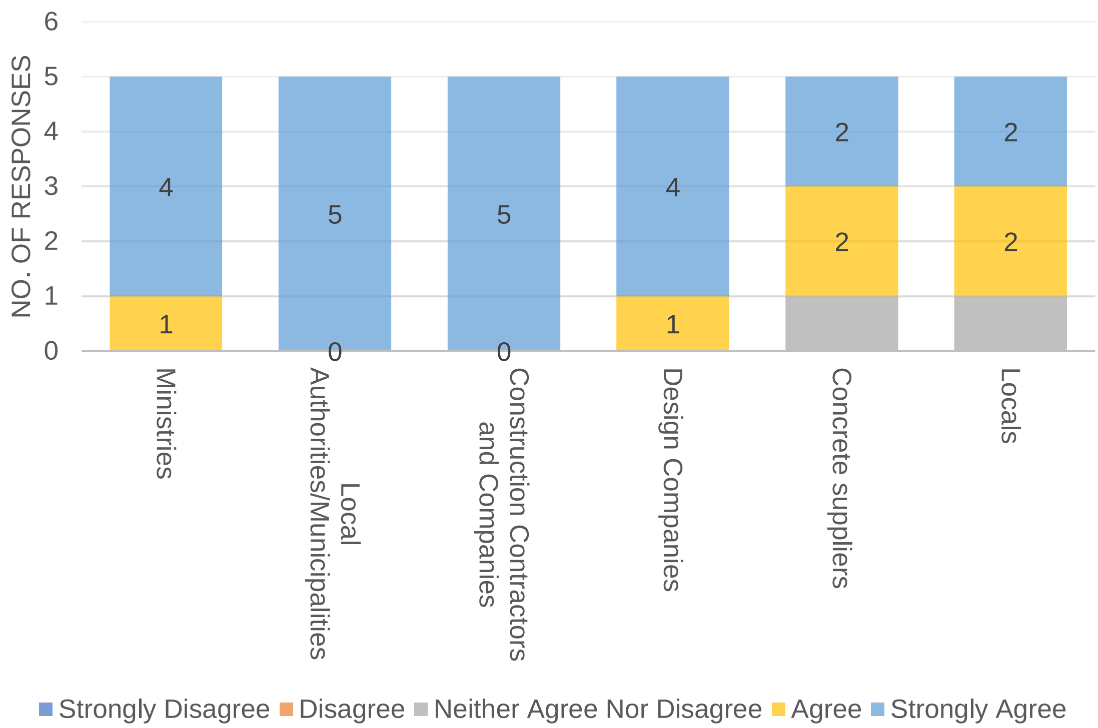

Chart 10-136: Actors Involved

10.3.2.8.24 Chart 10 – 147 Analysis

The results reported here illustrate that 100% of respondents observed that the government including ministries and local authorities, construction contractors and design companies should be importantly in such surveys. Above 80% of them agreed that concrete suppliers and locals should also be involved in these studies.

10.3.2.8.25 Chart 10 – 148 and 149

This chart assesses the willingness of actors through taking into consideration the environmental, social and economic concerns.

These actors are distinguished by participants using Yes/No question. The bars in this chart represents the responses of participants based on the question seen below.

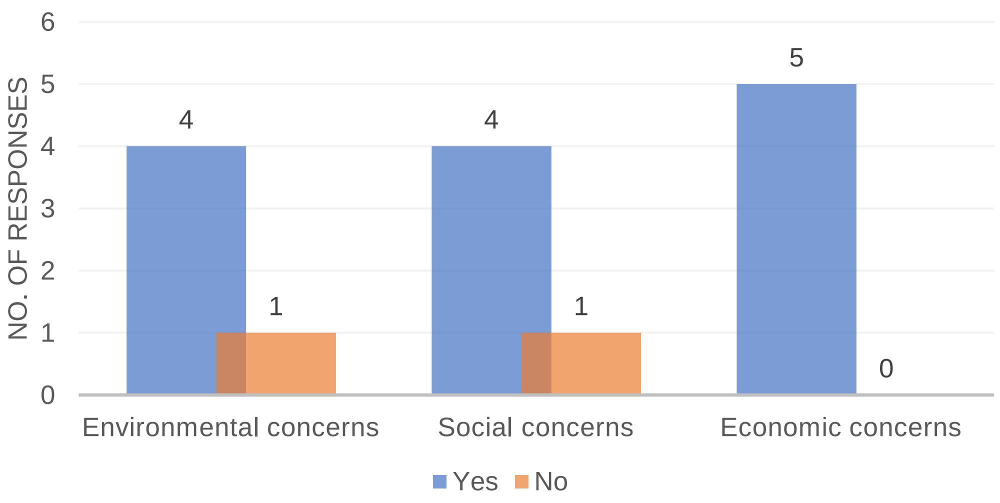

Chart 10-137: Considerations

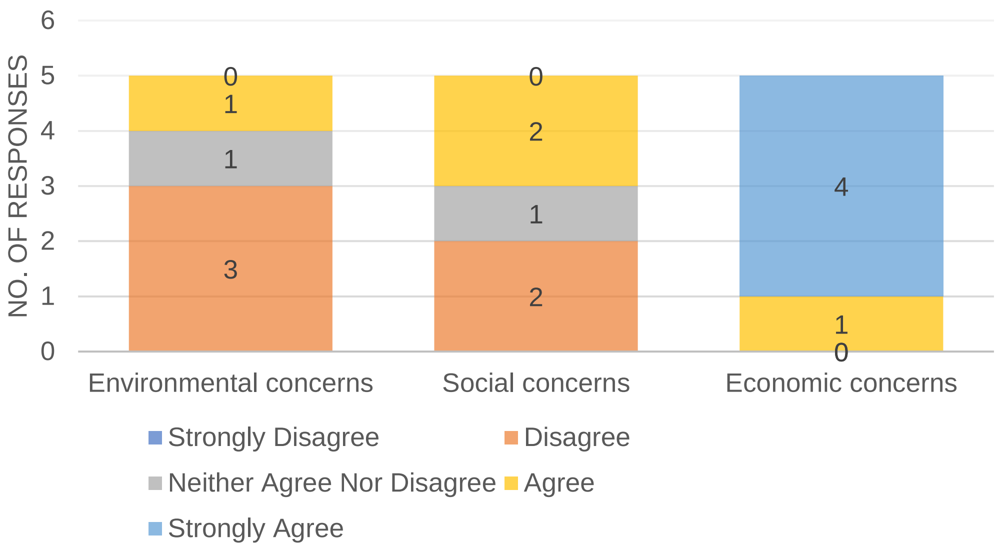

Chart 10-138: Considerations

10.3.2.8.26 Chart 10 - 148 and 149 Analysis

The results of the charts are good illustration of considering all concerns including environmental, social and economic ones by the construction industry actors as reported by above 80% of respondents.

However, estimates range from 20% to 40% revealed that the environmental and social concerns are not strongly taken into consideration. In contrast to the economic concerns as 100% of them seen that the construction industry actors take it the most amongst other concerns.

10.4 Appendix IV – Interviews Results

10.4.1 Current Situation

Numerous MPWH participants provided a sufficient justification for bidding with the lowest price that does not conform to the standards. According to the investigation, if it is determined that the bid with the lowest price is not compliant. The government appoints an expert committee to:

1. Review the bid.
2. Request that the contractor in question clarifies any unclear aspects of the bid.
3. Request the contractor to amend the bid to comply with the pricing and specification requirements.

If the contractor successfully completes this clarification and modification process in a logical and fair way. The modified proposal will be considered alongside other compliant bids.

As stated previously, the contract will be awarded to the contractor who submits the lowest bid. The contract will include a clause indicating that no further price adjustments will be required and that the project would be performed in accordance with the specifications and local pricing.

According to interviewees, this type of process should be subjected to C&D waste as well if the contract includes a clause for C&D waste. Contractors may disregard certain jobs they deem unnecessary or unduly demanding. Such as disposing of C&D waste in a permitted landfill, according to participants. Declaring that any contractor who violates the contract clause for C&D waste. Either by ignoring lawful dumping pricing or by lowering its price incompatible to local prices, would be terminated by the committee in the same manner as previously specified.

In conclusion, if the contract contains stipulations requiring the contractor to include the cost of the specified waste disposal option in their bid, the contractor must do so. Waste disposal contract provisions are just as critical as any other contract clause. Any requirements for cost, specialised equipment, or waste transport distance should be examined and factored into the contractor's bid. According to a JCCA participant, there are no arguments for the contractor to argue that disposing of C&D waste results in increased costs or time. Because all tasks in the contract should have been valued and thus covered by contract value.

With regards to landfilling, a few participants brought up the topic of land reclamation, which was previously covered in chapter 4. This concept is comparable to legal landfilling authorised by municipalities but is owned by private landowners. A JGBC participant raised an objection to this approach. Questioning whether it is appropriately implemented by performing environmental research and taking precautions to dump this type of waste in such lands. This indicates that this is likely done without the presence of research or environmental precautions. Resulting in soil and ground water contamination. This is likely due to a lack of understanding on the part of governmental bodies, landowners, contractors and waste transporters. Additionally, it has been determined that this notion impedes the implementation of a nationwide C&D waste management system.

According to an engineer at GAM's Construction Monitoring Department, municipalities are constantly enforcing the strictest regulations, penalties and fines. Against any actor violating the current landfilling regulations, as previously stated. Even as actors continue to reverse their attitudes, as explained below. A JCCA participant said that non-compliant actors can also be adjudicated or compelled. To comply with the contract's provisions through arbitration if necessary. If the responsible actor is not identified, the C&D waste becomes the municipality's duty. Which the municipality shall by then award a bid to clean and transport the C&D waste to a licensed landfill. Concerning these informal attitudes, an engineer in the MoE - Solid Waste Department. Stated that the ministry is only responsible for making recommendations to municipalities in response to local complaints about informal dumping of C&D waste. Such as increasing monitoring in this area.

These complaints surface as a result of the massive impact on nearby residents. Most notably the blocking of sewage and rain drainage systems, as plainly noted by a JCCA participant. In contrast to all interviewees and questionnaire respondents, he has denied that these attitudes exist in the country. It is worth noting that this sole denial could be drawn from his refusal to acknowledge that contractors do not adhere to the regulations as per his position.

As mentioned in **chapter 6**, the new solid waste management law has three key failings:

1. It does not fully elucidate sorting at source, as it lacks the necessary amount of depth and elements of sorting.
2. Considering C&D waste as a special type of waste, therefore exempting it from this law.

This law is the first to make the claim that waste should be sorted at the source. But it does not adequately define the concept. According to numerous engineers in the Ministry of Environment's Solid Waste Department, this law does not elucidate sorting. As it fails in defining how this activity should be carried out, who should be involved and what categories of waste would be handled.

Additionally, the classification of C&D waste as a special type of waste is necessary. Because it still faces several management challenges in terms of studies. Demonstrating how this waste should be sorted and recycled, what waste material can be processed for re-use and the technical viability of waste material.

Along with the dispersion of responsibilities across the country. As each municipality in Jordan is accountable for waste within its geographical jurisdiction. It is difficult for the government to bring all municipalities together under one roof.

As a result, this law necessitates additional research, rules, legislation and directions. To ensure that the required degree of depth and all required elements are included.

Although, like with the new solid waste law, we need keep in mind that these concerns may take an extended period to overcome. As it took about 11 years of intensive work by numerous governmental institutions to establish the solid waste 2020 law. Such as the Ministry of Environment, GAM and MLA. This is largely owing to Jordan's decentralised nature to waste management. In which responsibility for waste management is divided across various municipalities. This is attributed to the fact:

1. Numerous actors are involved.
2. The solid waste composition contains a variety of waste types.
3. The local context is receptive to solid waste management and, more precisely, sorting as one of the primary activities.

4. The country has a hierarchical structure of authorities.

10.4.2 Hindrances to Construction and Demolition Waste Management

As seen in **figure 6-5**, these impediments, as agreed by 26% of participants from the MoE, MLA and 43% of contractors. That the scarcity or absence of recycling facilities have a detrimental influence on C&D waste management.

The scarcity or absence of recycling facilities has been determined to be substantial, slightly more so than the absence of defined responsibilities and regulations. With a proportion of 26% of MPWH and JGBC members and a contractor, as illustrated in **figure 6-4**. This could be related to the fact that even if all prior barriers are overcome. The strategy will be harmed by a lack of or an inability to build recycling factories to process waste material. As a result, waste material will be bundled together without further processing to be reused in future projects.

The absence of facilities may also influence C&D waste management. As the initiation costs may result in the production of recycled waste material at inflated prices. Discouraging local actors from using them, as they, as previously stated, link every construction and demolition movement to cost and time.

Additionally, 21% of interviewees claimed that this impediment may be related to a lack of clear responsibilities and regulations. In addition to the prices or costs of recycled waste products classified as profitable and feasible. Meanwhile, the lack of defined roles responsibilities and regulations appeared to be less of a concern than other factors, as just 21% of participants agreed. However, it continues to have a moderating influence on the adoption of C&D waste management strategies. Particularly given that it has been dubbed an orphan sector because none of the country's institutions is totally responsible for it.

Additionally, the government's current regulatory mindset is seen problematic. Since it prefers to enact regulations only when they are demonstrably necessary. This appears to be an issue, particularly given that present regulations authorise landfilling as an alternate solution for C&D waste. In addition to, implying that the government does not need to adopt new regulations or clarify existing ones, as predicted by 24% of participants.

The lack of clearly defined responsibilities and regulations has an intermediate effect on the effectiveness of C&D waste management strategy. Particularly given that no country institution is entirely accountable for it. In addition to, the current regulatory mindset of the government that prefers to create regulations only when necessary. This seems to be problematic especially when the existing regulations authorise landfilling as an alternative disposal method for C&D waste. Thus, the government does not need to enact new regulations or clarify existing ones.

In terms of profitability and practicality, as seen in **figure 6-4**, interviewees from MPWH, GAM and a contractor agreed that none of the local actors would use recycled waste material. If the costs were comparable to or lower than those of standard construction material. Additionally, it could be hindered by the absence of design codes and competitors, as 16% of participants expect. Additionally, 11% of participants expressed concern about not utilising recycled waste material in the future as a hindrance to the national strategy. Which might be related to the lack of design codes or the concept of land reclamation, as anticipated by 13% of participants. As perceived by 16% of participants, the absence of design standards could be a hindrance to the C&D waste management strategy. As using recycled waste material is impossible in the absence of design codes. Even if a contract clause required the use of recycled waste material in a project. As this would enable for contradicting information to be included in the contract documents in ascending sequence, as described previously. As a result, recycled waste material would have no further value if design codes did not exist. Although just 8% of respondents indicated that establishing design codes would aid in the strategy's execution.

Land reclamation is similar to landfilling in that it has been found to impede strategy execution but with just 13% of participants. As it performs a similar function to public landfills or even better due to its geographical proximity to sites.

Meanwhile, a very small percentage of participants (less than 5%) identified a barrier to the implementation of a national strategy. This could be due to low awareness among local actors, a lack of investment in recycling and low demolition rates regardless of the anticipated life span of concrete. As most structures in the country are residential and the local context does not seem to be concerned in demolishing to build new structures. These small percentages indicate that there is inconsistency across responses. Implying that these causes are unlikely to constitute significant impediments to the country's C&D waste management. Thus, based on participant consistency, the absence of research and workshops, as well as cost and time waste, could be viewed as contributing to C&D waste management above other barriers.

10.4.3 Approaches, Improvements and Encouragements to Promote Construction and Demolition Waste Management

These two key approaches or encouragements discussed in chapter 6 do not preclude the influence of additional approaches. Such as tying contractor upgrading or JCCA certification to recycling efforts, as evidenced by 28% of numerous governmental organisations and contractors in **figure 6-7**.

As illustrated in **figure 6-7**, 24% of participants from various governmental bodies and a few contractors stated that clarifying regulations. In addition to 16% for providing recycling facilities would contribute to the promotion of a national strategy. Additionally, 8% of participants were responsible for establishing design codes and offering individual waste disposal firms.

A very low percentage of 4% indicated that less contributory factor could aid in the promotion of a national strategy. Such as stiffening penalties and fines and taking an additional approach that includes allowing contractors to own waste and giving them the freedom to use of it.

The current investigation has contributed to improving the implementation of C&D waste management by focusing on less significant factors. Such as enforcing recycling and the use of recycled waste material in their projects. Particularly when the current regulations regulate an alternative method of waste disposal. Along with providing recycling facilities or plants, establishing design codes and appointing individual waste disposal companies. To be accountable for the waste sector from generation to disposal. Bringing an end to the absence of clearly defined responsibilities between governmental organisations. By appointing fewer actors to be accountable for C&D waste disposal, which is currently controlled by several municipalities.

10.4.4 Reasons of Informal Dumping of Construction and Demolition Waste

The reasons outlined in chapter 6 do not preclude the influence of additional contributory factors, albeit less significant. Such as contractor commitment, which accounts for approximately 33% of several participants as depicted in **figure 6-11**. In addition to the low awareness among local actors, including clients, which accounts for nearly 17%. Additionally, the country's landfill shortage, low-bid procurement process, lack of laws and the engagement of informal workers at a rate of approximately 8% for each.

Although, findings have shown that the mixing of several factors apply a minimum effect upon the informal dumping of C&D waste, such as:

1. The lack of regulations.
2. The low bidding procurement method.
3. Shortage of landfills.
4. The involvement of informal workers in the industry.
5. The low awareness of local actors including clients.

Participants have clearly declared that the issue of C&D waste informal dumping is not strongly associated with the lack of regulations. As they precisely permit to dump waste in permitted landfills. That is why only 8% of participants have referred this attitude to the lack of regulations. Thus, most of participants have correlated it with the lack of monitoring.

Similarly, while low-bid procurement may not significantly contribute to informal dumping. It may encourage contractors to cheat or disregard unimportant work in order to minimize the project's expenses to win on biddings.

As a result, the country's lack of landfills may also contribute less to informal dumping. As contractors will have few legal locations to legally dump waste throughout the country. This has been confirmed as there are no landfills in the southern region, as described in chapter 4.

Similarly, as predicted by just 8% of participants, informal worker involvement may be marginally connected to informal dumping. As informal laborers, they may be unaware of the potential benefits of C&D waste or the influence this mindset has on the environment and society. Similarly, the low level of awareness among local actors regarding the consequences of informal dumping is viewed as a less significant concern. As it has been demonstrated that local actors frequently fail to consider the environmental and social consequences of their actions.

10.4.5 Approaches to Reduce the Informal Dumping of Construction and Demolition Waste

The approaches discussed in chapter 6 do not preclude the influence of other approaches. Such as lowering the cost of landfilling and improving present regulations by about 21%. Additionally, 13% of interviewees expressed a desire to improve licensing agreements. While 17% expressed a desire to reduce landfill distances.

This mindset could also be changed by establishing independent waste disposal companies and rewarding actors who legally dump C&D waste. As indicated by a receipt from landfills with a participation rate of 8%.

Additionally, there are additional approaches with a percentage of roughly 4% for each. Such as minimizing C&D waste generated by modern building areas and facilitating recycling stations.

10.5 Appendix V – Acceptance of Proposals

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Percentage of Agreed participants
Improved Legislation / Government Regulation						
Transforming the current procurement method from lowest price selection into a more competitive system for construction and demolition projects by: • Substituting the past rules of lowest price selection with more competitive systems such as multiple and best-value one and framework.	1	6	1	--	1	**78%**
Proposing to have a common set of main C&D waste management activities in governmental stipulations as a requirement by: 1. Augmenting the current stipulations to include sorting and waste recovery movements. 2. Augmenting the current regulations of recovery movements that stands only on backfilling. To include the use of recycled CCA for less utilisations that do not require design codes such as platform and sidewalks.	--	8	1	--	--	**89%**

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Disagree**	**Percentage of Agreed participants**
Clarifying the regulations and responsibilities in the waste regulatory system by: 1. Elucidating and assigning clear responsibility guidelines in the waste sector. 2. Removing confusion and uncertainty over the differences in regulations and responsibilities.	3	6	--	--	--	**100%**
Industry and Workforce Development						
Equipping the industry with sorting equipment and recycling facilities or plants. This could be through either purchasing equipment by: 1. The public sector. 2. Offering incentives to the private sector to purchase such equipment.	1	7	1	--	--	**89%**
Encourage suppliers to provide the market with recycled material. As this will increase the number of suppliers supplying such material instead of standard material, thus avoiding monopolist.	2	5	2	--	--	**78%**

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Percentage of Agreed participants
Establishing individual waste disposal firms responsible on the waste sector. To have less actors involved in the waste sector to be accountable for waste. Thus, avoiding the unclarity in responsibilities in the sector.	2	5	2	--	--	**78%**
Improving the ability to developing markets for salvaged and recycled material.	1	2	4	1	--	**33%**
Enforcing well-trained, skilled and formal workers to work in the construction industry. This could be done by:	**4**	**19**	**--**	**--**	**--**	**100%**
1. The creation of the so-called Environmental Project Manager (EPM) on sites.	4	4	--	--	--	
2. Raising awareness of labors to reduce the problems associated with C&D waste.	--	7	--	--	--	
3. Increasing the monitoring on construction companies' compliances to the current labor law that ensures Jordanian skilled workers to be working in the construction field.	--	8	--	--	--	

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Percentage of Agreed participants
Improved Planning and Development of Strategies						
Promoting the design out waste on projects either for prevention, reduction or deconstruction by: 1. Allowing designers to set the direction and interaction with clients, contractors and material suppliers. 2. Allowing designers to make use of Computer-Aided Design to make more accurate measurements to reduce excess waste material.	2	5	2	--	--	**78%**
Establishing recycled waste material design codes similar to standard construction material. As the government needs to provide a regulatory environment to develop the recycling market, requiring certain quality standards for recycled waste material.	5	3	1	--	--	**89%**
Increasing the monitoring and supervision of governmental departments to control the obligations and responsibilities of the construction contractors throughout:	**5**	**22**	**--**	**--**	**--**	**100%**

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Percentage of Agreed participants
1. Developing a tracking system for waste transporters.	4	5	--	--	--	
2. Expanding the time period of monitoring on a 24-hour basis instead of 8:00 am to 5:00 pm.	--	9	--	--	--	
3. Increasing the number of people responsible on monitoring to cover the number of contractors responsible on landfilling.	1	8	--	--	--	
Encouraging the industry actors such as contractors, transporters and investors towards C&D waste management by:	**1**	**74**	**3**	**14**	**--**	**81%**
1. Offering more built-up area upon the regulated built-up area.						
2. Offering tax-exemptions or discounts on licensing for contractors.	--	7	--	2	--	
3. Augmenting to add an optional parameter to upgrade contractors who adopt a C&D waste management from class	--	8	--	1	--	

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Percentage of Agreed participants
to another (an upgrade parameter similar to equipment, number of engineers and total amount of expenses on projects done).	--	9	--	--	--	
4. Offering certificates or awarding for recyclers.	--	6	1	2	--	**81%**
5. Reduce the expenses of C&D waste transportation to permitted landfills by:	**--**	**25**	**1**	**1**	**--**	
• Providing discount coupons for waste transporters or contractors.	--	9	--	--	--	
• Building closer landfills to construction and demolition sites.	--	8	--	1	--	
• Reducing the fuel prices.	--	8	1	--	--	
6. Apply high fines and penalties for polluters. Under the aspect of polluters must pay which elucidates the greater the amount of waste deposited, the greater the charge to be paid. Thus, greater incentive to recycle. Additionally, charges for polluters	1	8	--	--	--	

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Percentage of Agreed participants
or non-compliance obliges construction companies to keep track of the generation of waste across the project.						
7. Increasing landfill taxation to prevent or reduce this activity.	--	7	--	2	--	
8. Increasing the prices of standard material to make recycled waste material less expensive and more competitive. Particularly, when consumers perceive less value in recycled material. Thus, leads to a reduction in costs and encourage recycling of C&D waste.	--	4	--	5	--	**81%**
Increase the number of landfills across the country especially at the southern region by either: 1. The government. 2. Cooperation between landowners and government to increase the number of landfills. As the case in private landfill sites.	2	6	1	--	--	**89%**
Prevent or develop the concept of land reclamation by:	**1**	**8**	**--**	**--**	**--**	**100%**

Proposals	Recognition and Acceptance					
	No. Participants					
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Percentage of Agreed participants
1. Preventing this concept from being adopted to halt landfilling. **OR**	--	1	--	--	--	
2. Developing this concept to be compliance with both environmental and social measures to halt the impacts of land reclamation.	1	7	--	--	--	**89%**
Lessening the regional disparities between governmental organisations, particularly in the waste sector.	2	3	--	2	2	**56%**
Suggestions	5					**56%**

Table 10-17: Results of Proposals Acceptance

10.5.1 Analysis of Results

The overall results demonstrate to a large degree that the research's proposals are both rational and effective. Although, based on their depth of expertise, several participants expressed their ideas and comments on how some proposals may be made more effective.

This section uses charts to evaluate the data presented in **table 10-96**. Additionally, participants' proposals, points of view and views are mentioned. To synthesize the results to generate a final set of proposals for Jordan's current national C&D waste management strategy. The final set of proposals is discussed in chapter 7 of the thesis's main body.

The charts below are categorised as per the main taxonomies of proposals as mentioned previously in **section 7.5**, as follows:

1. Improved Legislation / Government Regulation.
2. Industry and Workforce Development.
3. Improved Planning and Development of Strategies.

10.5.1.1 Charts of Improved Legislation and Governmental Regulation

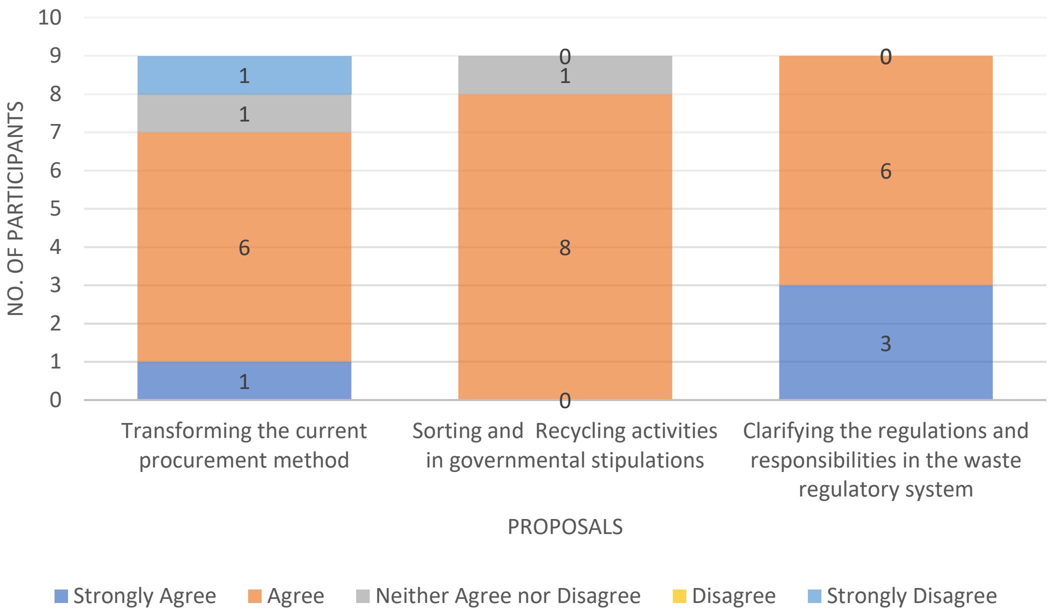

Chart 10-139: Proposals of Improved Legislations

10.5.1.1.1 Analysis

This section evaluates the first taxonomy of improved legislations and governmental regulations. Respondents were asked whether changing the current procurement method, incorporating sorting and recycling activities into governmental stipulations and clarifying the regulations and responsibilities within the waste regulatory system would effectively improve Jordan's current C&D waste management.

Over 75% of individuals questioned said that altering the present procurement process to one that is more competitive benefits Jordan's C&D waste management. Although one significant distinction between responders was noticed by an MPWH participant. Indicating that the lowest price selection technique might be construed as a competitive procurement process. Because contractors are competing with one another to win on biddings. Additionally, the MPWH member said that the technique of determining the lowest price is related to the bill of quantities and specifications. Thus, to enhance C&D waste management in Jordan, provisions containing C&D waste management, including recycling and reusing recycled waste material, should be included into specifications and bill of quantities. However, the MPWH participants noted that choosing the lowest price may be associated with a few quality issues.

Proceeding now to address governmental requirements, almost 90% of participants said that sorting and recycling operations should be included in governmental requirements. The statistics presented here tend to corroborate the above-mentioned MPWH participant assumption.

Concerning the second sub point of the second proposal, which calls for the use of recycled waste material in lower-utilisation applications without regard for design codes. Only three individuals (academic, MoE and MPWH) expressed concern about this aspect. The MPWH participant clarified that such material should be tested even when used for lower-utilisation applications. However, the remainder of this section has established that a great deal of construction work on sites may be accomplished without regard for design codes. Additionally, it could be instrumental in initiating C&D waste management.

Additionally, this part examined the suggestion to clarify the waste regulating system's regulations and responsibilities. The findings indicate that all participants agreed that waste regulatory regulations and obligations should be defined to enhance present C&D waste management. The reason for this has been the topic of heated discussion throughout study interviews, with the conclusion that this sector faces uncertainty over its obligations. Two participants from MPWH and academic proposed that these regulations and responsibilities be delegated to an independent commission or the Ministry of the Environment.

10.5.1.2 Charts of Industry and Workforce Development

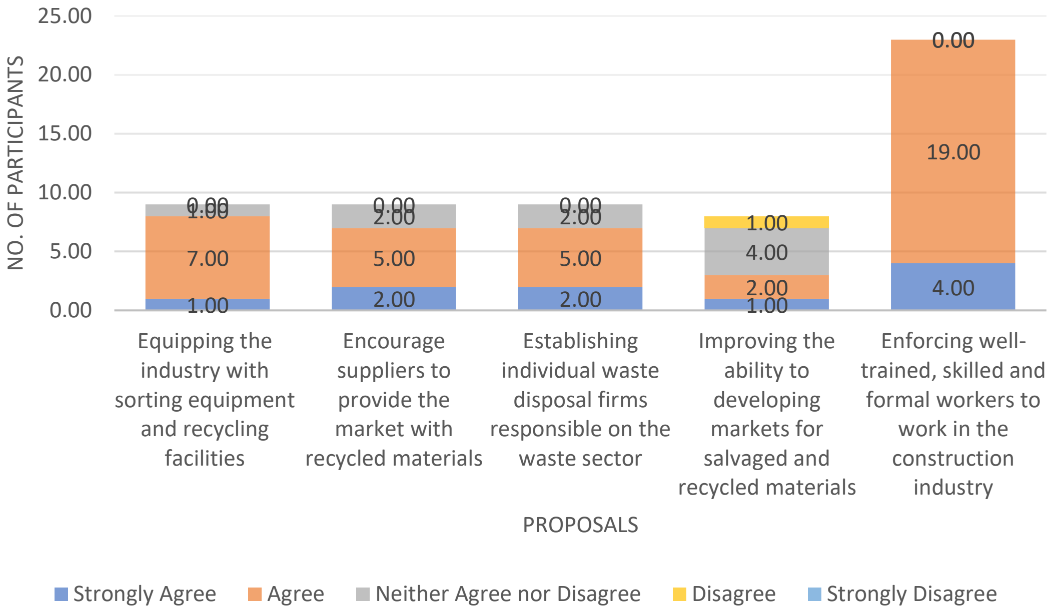

Chart 10-140: Proposals of Industry and Workforce Development

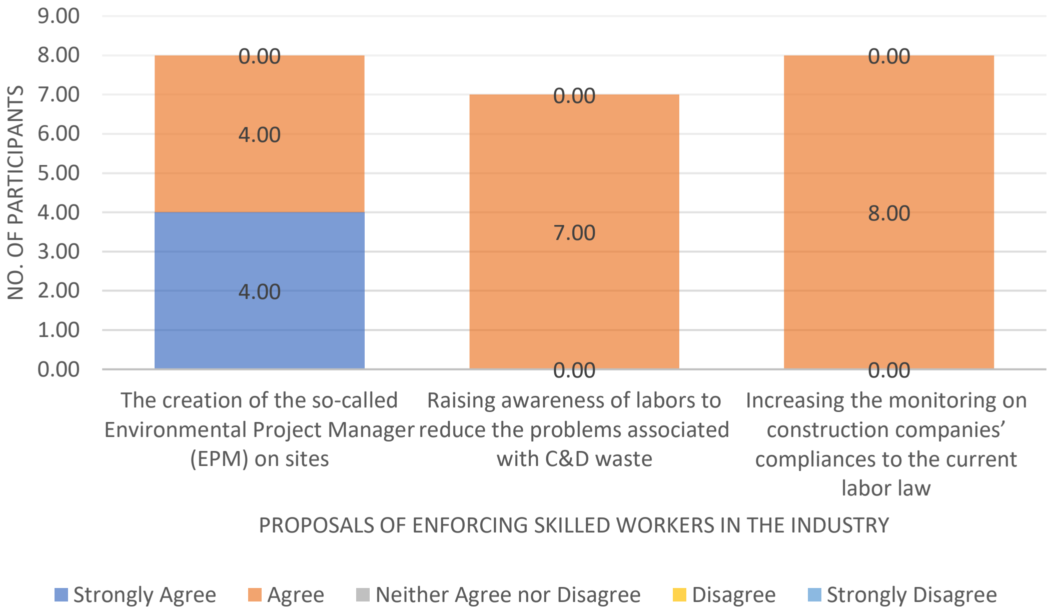

Chart 10-141: Proposals of Enforcing Skilled Workers in the Construction Industry

10.5.1.2.1 Analysis

Having evaluated the proposals of legislation improvements, the research moves on now to discuss the proposals of industry and workforce development. This taxonomy has included several proposals as follows:

1. Equipping the industry with sorting and recycling equipment.
2. Encouraging suppliers to provide the market with recycled waste material.
3. Establishing individual waste disposal companies.
4. Improving the ability to developing markets for salvaged and recycled material.
5. Enforcing well-trained and skilled workers to work in the construction industry.

Almost 90% of respondents believed that the industry should be provided with sorting and recycling technology to facilitate the handling of C&D waste. Although only one academic has declared that sorting could be done manually without the use of equipment. Areas where differences have been found about whether this approach should be implemented by the public or private sector. Although far more than 50% said that it makes no difference to either of them. However, if the private sector purchases the equipment, the government should grant tax and customs incentives to incentivize the purchase. Additionally, one participant from MPWH proposed that this may be accomplished via a joint venture involving both sectors and non-governmental organisations to raise funding for the purchase of such equipment.

Now, on to the proposal to encourage suppliers to deliver recycled waste products to the market. Just over 75% of participants felt that providers should be encouraged to deliver such items to the market. Several of those participants stated that this may be accomplished via the deployment of a marketing strategy that promotes the usage of recycled waste products. As a result, the demand for such material increases. Additionally, one person from GAM proposed that this might be accomplished by the government offering tax exemptions, however this may be denied by the government.

Additionally, the development of independent waste disposal corporations was explored to ensure accountability in the waste industry. Returned responses from 9 participants yielded nearly 78% agreement rate with this proposal. However, a contractor has urged that the work be supervised and managed by an obliged environmental specialist. Whereas an academic argued that this may be better controlled by the government forming a solid waste management commission, as recommended before.

Finally, but certainly not least, the proposal to improving the ability to developing markets for salvaged and recycled material has been devastatingly critiqued by several interviewees. Who believe that this proposal is identical to the second one mentioned above. Thus, this evidence suggests that this proposal can be achieved through the second one.

Moving on now to consider the enforcement of skilled workers in the industry via the lens of three major proposals:

1. Increasing the monitoring on construction companies to the current labor law.
2. Raising awareness of labors.
3. Creating a job for environmental engineers or project managers.

All participants agreed that the three suggestions above influence ensuring skilled worker to be enforced in the construction sector as seen in **chart 10-152**. However, there was consensus among respondents about the need for environmental engineers on projects. One participant noted that this engineer should be required on all projects, maybe by the Jordanian Engineer Association.

10.5.1.3 Charts of Improved Planning and Development of Strategies

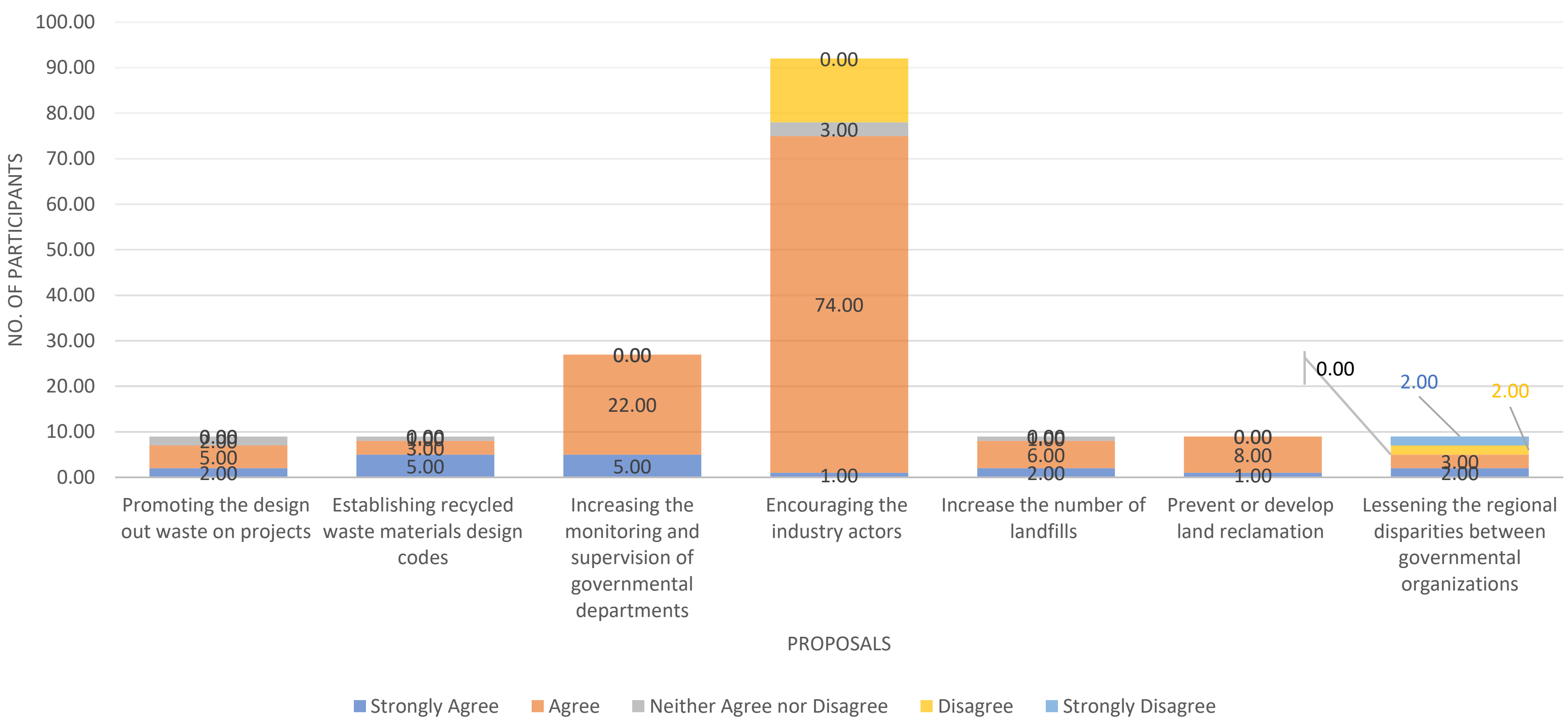

Chart 10-142: Proposals of Improved Planning and Development of Strategies

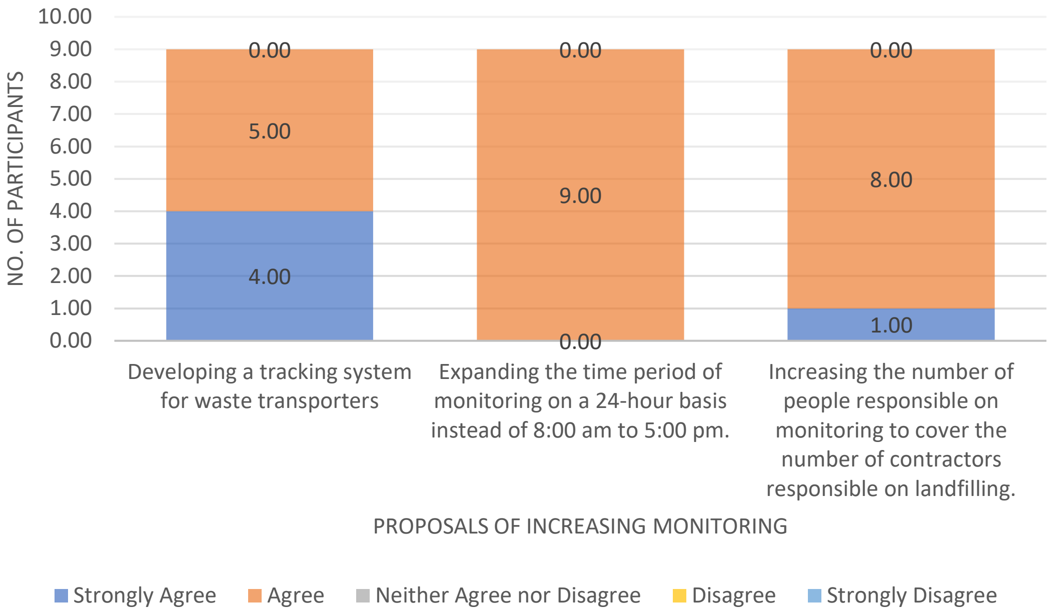

Chart 10-143: Proposals of Increasing the Monitoring and Supervision of Governmental Departments

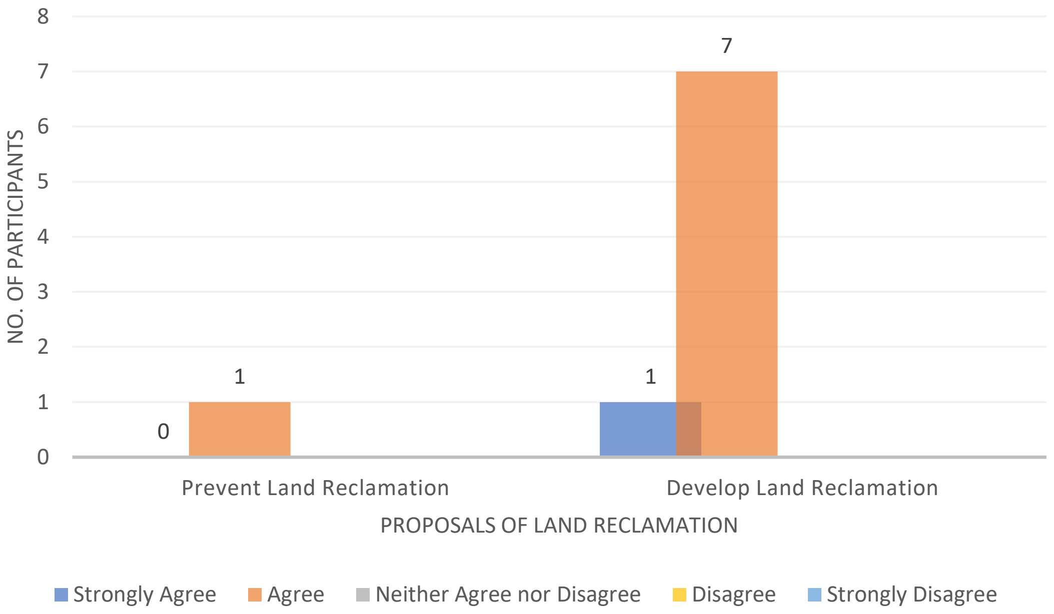

Chart 10-144: Proposals of Land Reclamation Prevention or Development

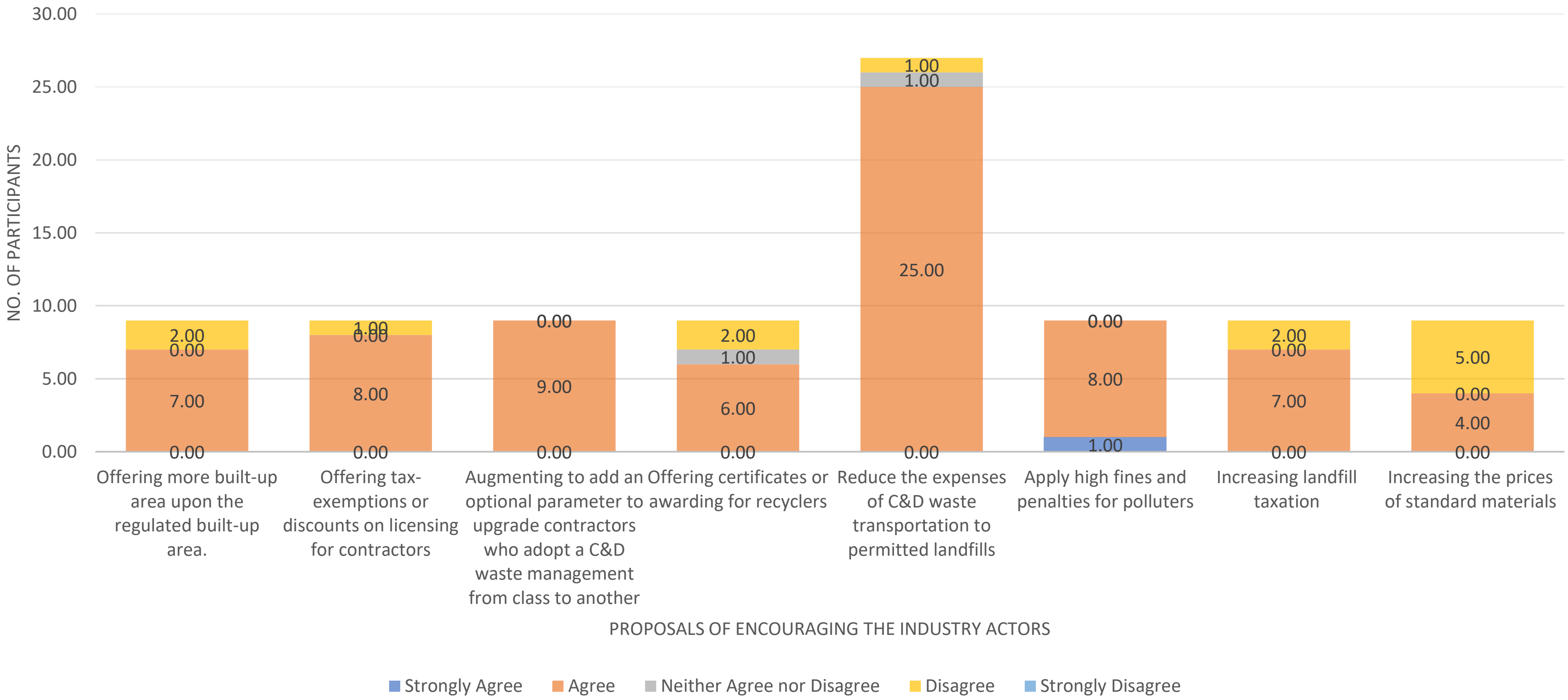

Chart 10-145: Proposals of Encouraging the Industry Actors Towards C&D Waste management

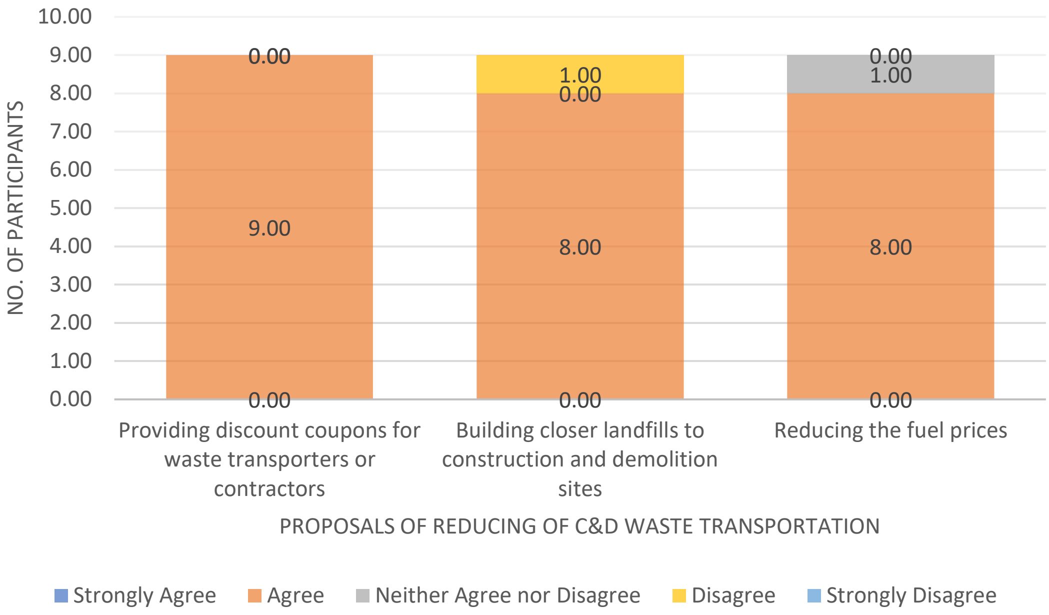

Chart 10-146: Proposals of Reducing the Expenses of C&D Waste Transportation

10.5.1.3.1 Analysis

The improvement of planning and development of strategies are explained in this section. These proposals include the following:

1. Promoting the design out waste on projects either for prevention, reduction or deconstruction.
2. Establishing recycled waste material design codes similar to standard construction material.
3. Increasing the monitoring and supervision of governmental departments.
4. Encouraging the industry actors such as contractors, transporters and investors towards C&D waste management.
5. Increase the number of landfills across the country especially at the southern region.
6. Prevent or develop the concept of land reclamation.
7. Lessening the regional disparities between governmental organisations, particularly in the waste sector.

10.5.1.3.1.1 Promoting the Design out Waste and Establishing Design Codes Proposal

To begin, let us consider the first two suggestions, which are connected to design. The findings indicated that less than 15% of participants from MoE expressed concern about the proposal's effectiveness. This might, however, be a result of their inexperience in this subject. Although those who agreed have said that designers should be the point of contact for waste reduction in the construction sector. Because it eliminates the challenges related with C&D waste in the country from the beginning.

Concerning design codes, virtually all participants felt that developing design codes is a critical feature of improving C&D waste management. Because it influences the design approvals required to commence the construction process. Although one academic has expressed his concerns about the length of time required to develop such codes.

10.5.1.3.1.2 Increasing the Monitoring and Supervision of Governmental Departments Proposal

Concerning the third proposal, all participants agreed that strengthening the monitoring and oversight of government departments may significantly improve Jordan's present C&D waste management strategy as seen in **chart 10-154** by:

1. Developing a tracking system for waste transporters.
2. Expanding the time period of monitoring on a 24-hour basis instead of 8-00 am to 5-00 pm.
3. Increasing the number of people responsible on monitoring to cover the number of contractors responsible on landfilling.

10.5.1.3.1.3 Encouraging Industry Actors Towards C&D Waste Management Proposal

On the suggestion to promote C&D waste management among industry actors such as contractors, transporters and investors. Around 81% of participants believed that this proposal's encouragements may be very successful in convincing industry actors to implement a C&D waste management system. However, one MPWH member indicated that the primary proposal should be to encourage industry actors to recycle C&D waste material. This proposal took the following approaches:

1. Offering more built-up area upon the regulated built-up area.
2. Offering tax-exemptions or discounts on licensing for contractors.
3. Augmenting to add an optional parameter to upgrade contractors.

4. Offering certificates or awarding for recyclers.
5. Reduce the expenses of C&D waste transportation to permitted landfills.
6. Apply high fines and penalties for polluters.
7. Increasing landfill taxation to prevent or reduce this activity.
8. Increasing the prices of standard material.

With regard to the first proposal, roughly 78% of respondents felt that it would be beneficial. Although GAM participants and a scholar saw a disparity in terms of efficacy. As GAM participants stated, the city's design will deteriorate.

With regards to the second proposal, which is to provide tax exemptions and license discounts. The percentage of interviewers who agreed reached 8 in 9. Although one GAM member indicated that offering tax exemptions or reductions is a conditional component that is determined by the government.

Moving on to the third proposal, all respondents said that adding to include an optional criterion of recycling C&D waste material for upgrading contractors would encourage them to practice C&D waste management.

The proposal to issue certificates or awards to recyclers varies significantly amongst participants. As an example, a participant from the MPWH said that this method would be ineffective in enticing industry actors to embrace C&D waste management. Additionally, one scholar has suggested that awarding certifications to industry actors does not directly assist them in terms of encouraging them to practice C&D waste management. On the other hand, he emphasized that the possibility of tying the certificates to tax exemptions is significant.

When reviewing the proposal to reduce the expenses of transporting C&D waste to designated landfill sites. Almost 93% of those interviewed believed that this proposal would be sufficiently helpful in enticing industry actors to embrace C&D waste management. As seen in **chart 10-157**, this proposal includes multiple sub-points. As seen in this chart, there is broad agreement among responders on all of these proposals. The idea to provide discount vouchers to waste transporters or contractors is particularly noteworthy.

Concerning the incentives, all individuals questioned agreed on the need of imposing stiff fines and penalties on polluters. To mobilize industry actors in support of C&D waste management.

The proposal to increase landfill taxes or fees in order to avoid or reduce this behavior elicited few comments. As more than 75% of participants agreed, this method has the potential to influence industry actors' attitudes regarding C&D waste management. Although one member from the MoE concurred and advised increasing the fines in a manner that would encourage actors to seek out other alternatives rather than informal dumping. However, two MPWH delegates expressed concern that this may encourage industry actors to discard C&D waste in an informal manner. Their point was that since disposal costs are so cheap currently, informal dumping occurs at alarmingly high rates.

Significant variations have been discovered in areas such as the proposal to increase the pricing of standard material. As seen in **chart 10-156**, more over half of participants disagreed with this proposal. These participants linked their reluctance to the potential consequences of this proposal from industry actors, especially for individuals who do not want to utilise recycled material. However, those who concurred requested that the rise be researched to equalize the price differential between standard and recycled products. One GAM member recommended that the price of conventional material be increased while the price of recycled material is decreased at the same pace.

10.5.1.3.1.4 Increase the Number of Landfill Sites Across the Country Proposal

Now, on to the proposal to expand the country's landfill capacity. Around 90% of individuals interviewed believed that this tip is very beneficial. Only if the objective was to decrease the amount of informal dumping. As the construction of additional landfill sites would impede the management of C&D waste.

10.5.1.3.1.5 Prevent or Develop the Concept of Land Reclamation Proposal

In terms of landfilling, this subsection discusses the proposal of land reclamation. Nearly 90% of those questioned believed that this topic should be developed. Particularly in the country's southern region, which lacks landfill sites. As a result, developing it would result in a decrease in informal disposal of C&D waste. However, participants expressed worry about implementing this notion in a way that is compliant with environmental measures.

10.5.1.3.1.6 Lessening the regional disparities between governmental organisations Proposal

The last proposal in this taxonomy is to reduce discrepancies between governmental waste management entities. A little more than half of respondents said that discrepancies between governmental organisations should be reduced. On the other side, one member from the MoE who disagreed did not deny the inequality between organisations, albeit he underlined that it had no bearing on the waste sector. Because it is connected to the previously indicated ambiguity of obligations. Another professor who also rejected this suggestion said that this is a sizable request that should be omitted from such proposals.

10.5.1.4 Suggestions

This section discusses the participants' further suggestions for the proposals.

According to one MLA participant, the set of proposals should include a section on scientific research that addresses the following:

1. Investigation of recycled construction material and their potential for use in the manufacturing of structural or non-structural components such as blocks and concrete.
2. Determine if recycled construction material may be used without re-sorting to support other structural systems such as dams.

Another suggestion made by an academic was to limit C&D waste transporters’ ability to deposit waste in disposal sites to a certain time period. For example, between 8:00 AM and 5:00 PM, depending on the time of monitoring.

A contractor also suggested developing an inclusive, integrated and clear protocol with instructions for construction and demolition projects obligating to recycle and use recycled material.

This investigation has offered a thorough examination of the research's proposals. By conducting interviews with professionals in the Jordanian construction industry targeted at obtaining their recognition and acceptance. The study conducted in this article has increased our understanding of the most effective proposals across all taxonomies.

One weakness of this research is that just a few occupations were assessed due to the Covid-19 epidemic. Despite this restriction, the research significantly contributes to our knowledge of the most effective proposals for improving Jordan's present C&D waste management. **Section 7.5** of the main body contains the final draft of the suggested proposals.

10.5.2 Exemplifying the Proposals

This section illustrates the proposals made before as mentioned in **section 7.5** based on the analysis of interviews outlined previously in this chapter. As seen in the tables below, these proposals are exemplified by their implementation in different countries around the world or in Jordan. This exemplification reinforces each proposal by determining their successful effectiveness when applied. Although not all proposals have been found to be adopted around the world. Thus, when feasible, the study attempted to provide a comparable situation for the suggested proposal.

No.	Proposals	Examples
A. Improved Governmental Legislation and Regulation		
1	The government should suggest that governmental requirements include a standard set of primary C&D waste management operations as a necessity. As it clarifies for actors which procedures are permissible or prohibited during contract bidding by: 1. Adding provisions to specifications and bill of quantities to incorporate sorting and C&D waste recovery movements. 2. Amending a provision in specifications and bill of quantities to include the use of recycled CCA for lower utilisations after experimental testing. As a means of quick commencement that does not need the application of design codes, such as platform and sidewalks.	**<u>Point 1:</u>** 1✓. In the UAE, the Dubai municipality enforces green construction requirements via the issuance of building licenses for projects within its jurisdiction (Swain S. , 2021). All new buildings, except for those in the CBD, must divert at least 50% by volume or weight of waste material produced during construction and/or demolition from landfills via reuse and recycling initiatives (Swain S., 2021; Dubai Municipality, 2011). This should be accomplished by: a. Concrete waste is diverted to a construction waste treatment plant. b. Redirecting excavated soil, land-clearing debris, and hazardous waste to locations designated by the concerned Dubai Municipality Department. c. Additional recyclable material such as wood, plastic, and metals may be used on-site. 2✓. Dubai's green building regulations require that construction waste be separated and kept stored on-site prior to collection (Dubai Municipality,

No.	Proposals	Examples
		2011). At a minimum, segregation must include clearly labeled storage for inert aggregates, metals, wood, dry recyclables, and hazardous material (Dubai Municipality, 2011). 3*. For all new structures, recycled content must account for at least 5% of the total volume of material used in the building's construction (Dubai Municipality, 2011). 4✓. According to Bulgarian waste management act (Article 11), the contracting company must prepare a plan for C&D management prior to initiating construction/demolition activities (Deloitte, 2014). Additionally, this act requires that the contracting entity commissioning construction and works, as well as the contracting entity commissioning the removal of construction works, develop a plan for C&D waste management consistent with the scope and content of the ordinance on C&D waste management and the use of recycled construction material (Deloitte, 2014). **<u>Point 2:</u>**

No.	Proposals	Examples
		1✓. Similarly, to the practice of reusing recycled waste material in lower-value applications, Bulgaria's Ministry of Environment and Water ordinance on C&D waste management restricted the use of recycled C&D waste for backfilling to the following conditions (Deloitte, 2014): • The C&D waste used meets the project's requirements. • The person responsible for material recovery is required to possess a permit for material recovery. Material recovery may be used for backfilling only if the C&D waste is inert and processed.
2	The government's waste regulatory system's obligations should be clarified. By removing misunderstanding and uncertainty about obligations and establishing clear norms for accountability in the waste sector.	1✓. Another instance occurred in the Netherlands in the 1980's as a result of the installation of a new policy that included landfill restrictions and recycling targets (EPF, 2016). All stakeholders collaborated to design a national strategy for C&D waste, delegating duties and obligations to each (EPF, 2016). 2✓. In Bulgaria, the waste management act defined what is called "Extended producer responsibility": “an environmental principle applied as a combination of measures aimed at reducing the overall environmental impact of a given product by introduction of obligations and

No.	Proposals	Examples
		responsibilities of the product producer throughout the product's whole life cycle, more specifically for limiting the content of hazardous substances, take-back, reuse, recycling, recovery and disposal of waste formed after use of the product" (Deloitte, 2014). 3✓. Additionally, the waste management act in Bulgaria mandates that control be exercised on several levels and by a variety of actors (Deloitte, 2014). The mayor, or an official authorised, shall exercise authority over the following (Deloitte, 2014): • Operations concerned with the generation, collection, segregation, transportation, and treatment of household and C&D waste. • Industrial and hazardous waste landfilling operations at municipal and/or regional landfills.
Notes	**No.✓:** Indicates that examples could be applicably implemented in Jordan. **No.*:** Indicates that examples could be applicably implemented in Jordan under certain conditions.	

Table 10-18: Improved Governmental Legislation and Regulation Exemplifications

No.	Proposals	Examples
B. Industry and Workforce Development		
1	Acquiring sorting equipment and recycling facilities or plants for the industry by either acquiring equipment by: 1. The public sector, which is represented by ministries or municipalities. 2. The private sector, as represented by businesses. Although the government should provide a few incentives to the private sector for the purchase of such equipment, such as: a. Tax breaks for locally manufactured equipment. b. Customs exemptions for imported equipment. 3. Public-private partnerships with non-governmental organisations.	1✓. In the Netherlands, the government forbade the landfilling of mixed C&D waste, prompting the establishment of new facilities for separating C&D waste, which includes wood, metals, plastics, and inert waste (EPF, 2016). 2✓. According to Silva R.V. et al. (2017), raising landfill taxes and fees encourages waste suppliers to invest in separate collection systems for various types of recovery and recycling (Zhongming, Z. et al., 2009). 3✓. In accordance with AECOM's (2020) Climate Action Plan, GAM will create a material recovery facility and operational tools to facilitate waste recycling. 4✓. GAM is now piloting a program to collect organic waste from commercial operators on a modest scale (AECOM, 2020). This will be developed to accommodate large-scale commercial activities to enable the collection and transportation of organic waste to the landfill and corresponding biogas engines between the municipality and its partners (AECOM, 2020).

No.	Proposals	Examples
2	The government should provide incentives to encourage the industry's numerous suppliers to alter their existing attitudes and mindsets. To provide industry with recycled waste material rather than natural raw material to circumvent monopolies.	1✓. Morocco's government is focusing on developing a scheme that would encourage property developers to build low-cost housing units (Jsf.org, 2019). By offering a range of tax and non-tax benefits to participating businesses to increase their participation (Jsf.org, 2019). This program aims to offer apartments to beneficiaries without including sales tax in the price, in exchange for the Ministry of Finance paying the developer's sales tax (20%) upon completion of the units (Jsf.org, 2019). Additionally, these developers get extra incentives, such as tax exemptions, land registration costs, and ownership transfer fees, to make affordable housing accessible to the Kingdom of Morocco's targeted populations (Jsf.org, 2019).
3	The government and the private sector should collaborate to create marketing strategies for the local market to increase the demand for recycled products.	1✓. OPALIS is an online inventory of the professional sector's salvaged construction material around Brussels. This website serves as a conduit between second-hand dealers and commissioning agencies such as architects and contractors (Opalis.eu, 2016). Which improves the potential for both collecting salvaged material and selling them (Opalis.eu, 2016).

No.	Proposals	Examples
4	Encouraging the formation of actors accountable for the whole waste sector through the following measures to reduce the number of actors engaged and liable for waste by: 1. Private waste removal firms that operate on an individual basis. 2. Commission for the management of municipal solid waste by the government.	1✓. In UK, waste is regulated by requiring licensed waste management companies to transport, recover, deposit, and dispose of waste only at designated landfill sites (Liu Yi. et al., 2017). 2✓. In UAE, the emirate of Sharjah founded the municipal waste management firm "Bee'ah" in 2007 as a public-private collaboration to promote sustainable practices and recycling (UAE Government Portal, 2021).
5	Construction industry associations such as the Jordanian Engineers Association (JEA) and the Jordanian Construction Contractors Association (JCCA) should impose strict requirements for well-trained, skilled and formal workers to work in the construction sector by: 1. The creation of on-site Environmental Project Manager (EPM) or Environmental specialist. This job should be obligatory in any construction or demolition project.	**<u>Point 1:</u>** 1✓. Third step: In accordance with the optional instrument BRL SVMS-007 (the Dutch certification scheme for demolition processes) (BRL SVMS-007, 2016): • Step of Execution: This process is carried out in accordance with the waste management plan, which entails the involvement of specialists in the field of safety and environmentally friendly demolition, as well as the

No.	Proposals	Examples
	2. Increasing laborers' awareness of the hazards linked with C&D waste. 3. Strengthening oversight of construction companies' adherence to existing labor laws.	use of certified demolition contractors and authorised equipment (BRL SVMS-007, 2016). **Point 2:** 1✓. According to AECOM (2020), GAM intends to launch a public awareness campaign emphasizing the advantages of green building design. Due to a lack of understanding and awareness among engineers, companies, and residents on Green Building guidelines (AECOM, 2020). **Point 3:** 1✓. The significance of government support and regulation in terms of as mentioned in taxonomy C of proposal point 2 and 3 (Ghisellini P. et al., 2018).
6	Increase the price of conventional material while decreasing the price of recycled material at the same low pace.	1*. The aggregate levy in the UK, which is presently set at £2.00/tonne, is levied on firms who extract natural resources (Silva R.V. et al,, 2017). The primary advantages of taxing natural resources are to promote aggregate recycling and the substitution of waste and byproducts from other activities for NA. As a result, raw material depletion is avoided, waste generation is

No.	Proposals	Examples
		reduced, and other pollution emissions are reduced during extraction. This, Silva R.V. et al (2017) asserts, will promote more efficient use of NA and will compel customers to seek out more sustainable alternatives, notably processed waste material.
Notes	**No.✓:** Indicates that examples could be applicably implemented in Jordan. **No.*:** Indicates that examples could be applicably implemented in Jordan under certain conditions.	

Table 10-19: Industry and Workforce Development Exemplifications

No.	Proposals	Examples
C. Improved Planning and Development of Strategies		
1	The government and the private sector should encourage the elimination of waste from projects by design, whether for prevention, reduction, or deconstruction, by: 1. Enhancing designers' perceptions of control and reducing designers' perceived issues with waste reduction throughout the design stage. 2. Delegating guidance and engagement with customers, contractors and material suppliers to designers. In other words, designers should serve as a liaison between industry stakeholders. 3. Enabling designers to employ Computer-Aided Design to do more precise measurements to minimize excess waste material.	--
2	The government should collaborate with the private sector, university researchers and academics to develop design codes for recycled waste material.	--

3	The government should increase monitoring and oversight of its organisations and municipalities to ensure that construction contractors adhere to their contractual commitments and responsibilities throughout: 1. Developing a tracking system for waste transporters. 2. Expanding the monitoring period to a 24-hour basis. 3. Restrict the ability of C&D waste transporters to dump waste at disposal sites to a certain period. For instance, between 8:00 a.m. and 5:00 p.m., depending on the monitoring period. 4. Increasing the number of employees in charge of monitoring to compensate for the number of contractors in charge of landfilling.	**<u>Point 1:</u>** 1✓. Two ministries in Jordan have used the tracking system via tracking devices on vehicles as follows: • The Ministry of the Environment: This was imposed on wastewater transporters to discourage informal dumping of wastewater, which resulted in a nearly 70% reduction in this informal behavior. • The Ministry of Public Works and Housing: This was implemented on the ministry's vehicles, resulting in significant cost savings associated with fuel use. 2✓. In Bulgaria, the ordinance on C&D waste management and the use of recycled building material requires the legal responsible for construction waste transportation to maintain a transport diary to track the quantity of waste transported from the construction/demolition site to the recycling facility or landfill (Deloitte, 2014).

		3✓. Ivestigo is a traceability software developed by the French Demolition Association for C&D waste in France (SNED). This platform intends to maintain a waste register for each demolition project in accordance with French regulations, allowing companies to track the wastes they generate in detail and enhance contact with customers (Ivestigo, 2016). 4✓. French regulations compel waste producers to provide a document detailing the way waste is transported from their production location and the nature of waste (Cerema, 2016). This document must be shown before the waste may be accepted in non-hazardous inert waste treatment plants (Cerema, 2016). **Point 2 and 3:** 1✓. According to Du L. et al. (2021) monitoring coverage has an influence on the convenience of informal dumping. This is consistent with Choe C. and Fraser I. (1999) argument that the ideal solution, theoretically, is to implement explicit monitoring of informal waste disposal. The assistance and laws provided by the Chinese government in terms of “mandatory requirements or financial

		incentives, guidelines, and effort in monitoring the industrial behavior of recycling and reusing C&D wastes" has been identified as the most significant aspect in encouraging C&D waste management in China, especially at the beginning stage (Ghisellini P. et al., 2018).

No.	Proposals	Examples
4	The government should incentivize industry actors such as contractors, transporters and investors to recycle C&D waste material via the following measures: 1. Providing additional built-up area on top of the regulated built-up area. Although the city's design should be considered to minimize degradation. 2. Offering tax exemptions or reductions on contractor licensing. 3. Augmenting to add an optional parameter to upgrade contractors that recycle C&D waste material from class to another (an upgrade parameter similar to equipment, number of engineers and total expenditure on completed projects). 4. Providing certifications to recyclers and associating them with tax breaks or other recognition. 5. Reduce the expenses of C&D waste transportation to licensed landfill sites by providing discount coupons to waste transporters or contractors or reducing the fuel prices. 6. Impose high fines and penalties on polluters.	**Point 2:** 1*. The Chinese central government has developed a relatively systematic approach to promoting sustainable construction, regulating and controlling the behavior of industry stakeholders such as developers, builders, designers, and suppliers by economically incentivizing construction corporations to participate actively (Ghisellini P. et al., 2018). **Point 3:** 1✓. As discussed in **section 2.6**, contractors are graded on a variety of factors, including their financial standing, administrative and technical staff, equipment, expertise, etc (Abbasi G.Y. et al., 2005; Department of Jordanian Statistics, 2012; JCCA, 2012; Alkilani S.Z. et al., 2013). An additional optional criterion or a parameter for contractors who recycle might be included.

No.	Proposals	Examples
	7. Increasing landfill taxation or fees to prevent or reduce this activity on a low pace.	**<u>Point 4:</u>** 1✓. The latest version of LEED that includes eight categories of environmental building evaluation summed to a total of 110 possible points which are as follows (USGBC, L., 2017): a. Location and Transportation. b. Sustainable Sites. c. Water Efficiency. d. Energy and Atmosphere. e. Material and Resources. f. Indoor Environmental Quality. g. Innovation. h. Regional Priority. LEED certification has four levels and requires a minimum of 40 points to certify a project (USGBC, L., 2017). If a project earns an overall grade between 80 - 110, it obtains a platinum rating; if the overall score is 60 - 79, it receives a gold rating (USGBC, L., 2017).

No.	Proposals	Examples
		2✓. The latest version of BREEAM in UK, has nine environmental sections similar to those in LEED which are as follows (BREEAM UK, 2014): a. Management. b. Health and Wellbeing. c. Energy. d. Transport. e. Water. f. Material. g. Waste. h. Land Use and Ecology. i. Pollution. j. An additional section for innovation. The ratings and their thresholds set by BREEAM are five ratings and requires a minimum of 30 credits to be certified in this system (BREEAM UK, 2014). If a project earns an overall grade between 85 - 110, it obtains an outstanding rating. Meanwhile, if the overall score is 70 - 84, it receives an excellent rating (BREEAM UK, 2014). 3✓. Another certification scheme, the Pearl Rating System for Estidama, was established in Abu Dhabi. Recycling a minimum of 30% of C&D wastes is a mandated obligation under this system. This

No.	Proposals	Examples
		system offers the following credit-earning opportunities for keeping a portion of the building's structural system: a. 1 credit point for reusing 25% of building structural system by surface area. b. 2 credit points for reusing 50% of the total material. In the material reuse category. 4✓. The Dutch certification scheme for demolition processes, which promotes a high standard of demolition. This program ensures contractors conduct ecologically and safely demolition on-site by following four steps: • Pre-demolition audit: This entails an in-depth inspection of the demolition project and an inventory of all sorts of material to get insight into the nature, amount, and potential contamination of the extracted demolition material. • Waste management plan: Creating a waste management plan that details the process of selective demolition and ecologically demolition, among other things. • Execution as mentioned above.

No.	Proposals	Examples
		• Final report: The delivery of the project takes place in consultation with the involved parties. **<u>Point 6:</u>** 1✓. Numerous nations, including Japan, South Korea, and the UK, apply varying penalties for informal dumping (Gálvez-Martos J.L. et al., 2018). According to Liu Yi. et al. (2017), increasing the rate of informal dumping penalties by 1% results in a nearly 22% drop in illegal dumping. In Japan, as waste treatment facilities and fines have expanded, the informal dumping has lessened (Ichinose D. and Yamamoto M., 2011). Meanwhile, the UK government has made strenuous efforts to curb informal dumping by making it easier to report such an attitude online and increasing the severity of penalties (Liu Yi. et al., 2017). Between 2008 and 2012, just in Scotland, 40 companies were convicted of informal dumping (OCCRP, 2013). Lu and Tam (2013) demonstrated the efficacy on the transition to a more sustainable C&D waste management by a

No.	Proposals	Examples
		combination of mandatory and non-mandatory policies in Hong Kong, such as the polluter pays concept. **<u>Point 7:</u>** 1*. The rate of landfill tax, which has been dramatically raised in several countries, is an efficient way to stimulate the construction and demolition businesses (Silva R.V. et al,, 2017). To generate less waste and to recover/recycle material from C&D debris (Silva R.V. et al,, 2017). The UK landfill tax, which increases annually, is now £2.65 per tonne of material with a loss on ignition (LOI) of less than 10%, compared to £84.4 at the standard rate (GOV.UK, 2016). Additionally, the Netherlands imply that it is an efficient technique for diverting waste to more useful alternatives (Bartelingsa H. and Linderhofb V., 2006). Internalization policies have been demonstrated to be successful in Hong Kong, where the implementation of charging schemes resulted in a nearly 60% reduction in the amount of C&D waste disposed of

No.	Proposals	Examples
		in landfills (Tam and Lu, 2016) (Lu and Tam, 2013) and increased the adoption of on-site sorting and recycling of C&D waste.
5	Increase the number of landfills across the country, particularly in the southern area, if only to curb informal dumping by either: 1. The government. 2. Collaboration between landowners and government to expand the number of landfills (private or reclaimed land).	1✓. The Greater Amman Municipality (GAM) is now preparing to construct an additional landfill cell at the Al Ghabawi landfill site to expand capacity (AECOM, 2020). Meeting the demands of Amman's growing population, guaranteeing appropriate waste disposal, and limit landfill gas emissions into the atmosphere (AECOM, 2020). 2✓. Another example is GAM's establishment of a disposal facility for waste electrical and electronic equipment (AECOM, 2020). Because there is currently no land available for such waste to be disposed of (AECOM, 2020). GAM proposes to invest in a facility

No.	Proposals	Examples
		devoted only to the collection and temporary storage of such waste for off-site repair or recycling by third parties (AECOM, 2020).
6	Develop the concept of land reclamation, even only to curb informal dumping, by: 1. Developing this concept in accordance with environmental and social measures designed to mitigate the effects of land reclamation.	1✓. As noted in **section 4.2.1**, land reclamation is now being developed in Jordan's middle and northern regions. This approach is used to reclaim private lands or valleys by disposing C&D waste. It is worth noting that this approach is more successful than public landfill sites, as quantified by the amount of C&D waste received despite the higher charge schemes. This is mostly due to their closeness to construction and demolition sites. Although, as previously stated, this practice is used in the absence of any environmental or social measures, in contrast to public dump sites. Thus, implementing such a concept in accordance with

No.	Proposals	Examples
		environmental and social measures should help eliminate informal C&D waste disposal.
Notes	**No.✓:** Indicates that examples could be applicably implemented in Jordan. **No.*:** Indicates that examples could be applicably implemented in Jordan under certain conditions.	

Table 10-20: Improved Planning and Development of Strategies Exemplifications

There has been a substantial correlation between the application of C&D waste management approaches and recycling targets in many nations. As an example, before to 1990, the EU imposed no enforceable waste treatment obligations, with the exception of refining waste oil (Fischer C., 2011). Although various directives were developed between 1990 and 2008, one of them is the directive on C&D waste and residential waste (2008) (Fischer C., 2011). Embedding a variety of ways, some of which are included in the tables above. Which has had a beneficial effect on the recycling rates of C&D waste in European nations, as discussed in **section 2.3.4** of the literature review chapter. It is worth noting that a few nations had previously implemented national steps to improve recycling prior to the EU initiatives, although in a small number of pioneering countries (Fischer C., 2011). As most EU countries were largely influenced by EU initiatives (Fischer C., 2011).

Recycling rates in Central and Eastern European countries such as Bulgaria as mentioned in the tables above were approximately 20% of C&D waste produced in the early 1990s (Dimitrova E. and Zaharieva R., 2001). Although this has climbed to almost 90% in 1999 (Hendriks C.F. and Pietersen H.S., 2000). Which indicates the positive impact of these nations' measures on the recycling rates of C&D waste.

Dubai as outlined in the tables has declared a strategy to promote worldwide best practices in sustainable waste management with the goal of eliminating all generated solid waste from landfill sites by 2030 (Council Resolution No. (58) of 2017). Regrettably, the findings of this research do not explain the occurrence of this vision. Since the research to date failed to show subtle changes over time in terms of recycling.

The End