



Unpacking Ontological Perspectives in CEM Research: Everything Is Biased

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Abstract: Methodological debates are nothing new in construction engineering and management (CEM) research. However, when the consequences, and at times even the content, of such debates are considered, what often emerges is both a superficiality and inconsistency in the way research methodologies are understood, mobilized and used to judge the rigor and value of empirical work. CEM research seems reluctant to engage with the nature of reality, the nature of knowledge, or, at times, with any philosophy at all. This paper explores and considers the influence, or lack of influence, that ontological and epistemological positioning has on much of our CEM research, and what that indicates for the findings we generate. With an explicit focus on bias, and the approaches taken within a volume, 173 manuscripts, of the *Journal of Construction Engineering and Management* are examined. We argue that multimethodological perspectives on a problem should be adopted where possible, able as they are to generate more holistic understandings and more comprehensive illuminations of phenomena in practice, and thereby support the development of a more mature CEM research discipline, both in terms of academic scholarship and relevance to practice. DOI: [10.1061/\(ASCE\)CO.1943-7862.0001734](https://doi.org/10.1061/(ASCE)CO.1943-7862.0001734). This work is made available under the terms of the Creative Commons Attribution 4.0 International license, <http://creativecommons.org/licenses/by/4.0/>.

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Introduction

Methodological debates are nothing new in academia, and the field of construction and engineering management (CEM) is no different. From the flurry of articles published in the pages of *Construction Management and Economics* in the mid-1990s (Seymour et al. 1997; Runeson 1997; Seymour et al. 1998), to the special issue on methodologies published by the *Journal of Construction Engineering and Management* in 2010 (Taylor and Jaselskis 2010), researchers continue to question and challenge how we do what we do, and whether it is, all things considered, the best way to be doing it.

However, when the content and consequences of such debates are considered, an unfortunate superficiality and inconsistency in the way research methodologies are understood, mobilized, and used to judge the rigor and value of empirical work emerges. While the grounding of much of CEM research within schools of science and engineering has to some extent inevitably cast our footings within realist ontological and positivistic epistemological paradigms, these are now as much beneficial supporting structures as they are the ties that bind.

It is our intention within this paper to reveal the contemporary methodological state of our discipline, to expose the ontological and epistemological foundations that are currently underpinning our work through an empirical review of publications in the *ASCE Journal of Construction Engineering and Management*, focusing

on the 2017 issue. Through this process the influence, or lack of influence, that philosophical positioning has on much of our CEM research is revealed. We have chosen to highlight one consideration of academic quality within our discussions: that of bias. Bias is a highly revealing term within any academic research, because it is often only through the positioning of bias within empirical work that the underlying methodology is revealed. It is also the methodological positioning of the work that determines the criteria by which bias should be evaluated, accepted, or eliminated, and so judgments of quality made from this perspective should be made using fundamental philosophical understandings. Problems occur when such assessment is made absent philosophy or even methodology, for example, to judge constructionist work (grounded in a relativist ontology) by positivistic (grounded in a realist ontology) criteria would inevitably bring challenges of bias due to the involvement of the researcher in the research, despite the fact that no claim to objectivity is, or even is ever made from within this paradigm. The ultimate impact of these shortcomings in understanding and presenting bias in research is often a reduction in the quality of CEM research, as a consequence of the lack of engagement with the ontological and epistemological foundations upon which the research is intended to build.

Furthermore, we seek to challenge the notion that positivistic research can even itself ever be truly free from bias from both ideological and practical perspectives, given the very nature of CEM research, and suggest that perhaps that too should also be more clearly acknowledged in the research we undertake.

We believe such a discussion is timely, and hopefully welcomed by those in the CEM community. We aim to inspire others to explore their own methodological foundations with more rigor and support, and more robust methodological critique in the work we peer-review, thereby contributing to the development of a more methodologically mature research space. This will not only have positive consequences for both our academic and more industry-focused outputs as a research community, but also in what we pass onto our students as we teach them research methodologies as part of their undergraduate and graduate courses.

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Context

We must first dispel the notion that this paper is a championing or derogation of one research methodology over another. We fully support the argument that multimethodological perspectives on a problem should be adopted where possible and practicable, able as they are to generate more holistic understandings and comprehensive illuminations of phenomena in practice [as proposed by Edum-Fotwe et al. (1997), Seymour et al. (1997), and Dainty (2008) among others]. This argument seems to have gained a general acceptance, as evidenced by, for example, the 2010 *Journal of Construction Engineering and Management* special issue (Taylor and Jaselskis 2010) and generating research that seeks to draw on a variety of methodological perspectives.

However, the engagement of CEM researchers with methodology, as it defines itself, at times seems problematic. As a field, we still seem reluctant to accept that, as Green et al. (2010, p. 125) stated at the very end of their contribution to the JCEM special issue: “all research methodologies operate on the basis of underlying assumptions about the nature of reality and the ways in which it can be accessed.” Yet dalliances with the nature of reality, the nature of knowledge, or indeed with any philosophy at all, remain a rare find within our research outputs.

For example, within the same CEM special issue Abowitz and Toole (2010) provide an excellent reminder of the need for rigorous and robust considerations of sample, operationalization of indicators, and testing of empirical data, but these are not themselves philosophical concerns. Despite the authors’ use of the term *methodology* within the paper, they actually present discussions about the validity and reliability of various methods as mobilized within a realist ontology and positivistic epistemology, a methodology which itself remains unacknowledged. Whereas the authors research design discussions are certainly most welcome, given the many weaknesses in research of this kind as it is frequently executed, it is the unspoken adoption of positivism as *the* default methodological position that has further consequences for CEM research overall, including those around the concept of bias.

Note on Quantitative and Qualitative Data

Another commonplace, and potentially much more problematic example, is the notion that there are such things as quantitative and qualitative *methodologies*. This is a conceptualization that emerges frequently in CEM research, and one that should be robustly challenged: they are simply different types of data (i.e., numbers or words) and nothing more. *How* you collect and analyze that quantitative or qualitative data, within the accepted practices and protocols of your stated research paradigm and its parameters of validity, reliability, and generalizability, to ultimately support the claims then made—that is methodology. However, statements such as “quantitative and qualitative methods are rooted in particular ontological and epistemological positions” (Zou et al. 2014, p. 320) can be found within CEM methodological-focused papers [the example of Zou et al. (2014) specifically focuses on methodologies as associated with health and safety research within construction], despite the fact that qualitative data can be, and indeed frequently are, treated as positivistically as quantitative data in many cases. Indeed, this indicates that the assumption that one can use “research methods as a proxy for research methodologies” (Zou et al. 2014, p. 322) is spurious at best. Although there may indeed be *traditional* associations, the use of *qualitative research* (a label which is itself methodologically meaningless) does not reflect methodological diversity in and of itself, despite claims to the contrary (see for example Fellows and Liu 2008). In fact,

the straightforward adoption of *social science approaches* to CEM research was always unlikely to bring significant methodological change as despite more widespread use of qualitative data much of sociology, psychology, and other disciplines within this field remain highly positivistic in terms of their underlying realist ontology (Augoustinos et al. 2006). We have, in many cases, simply adopted more of the same approaches, yet methodologically claimed otherwise.

Have We Not Been Here Before? How Bias Can Help

Such struggles with methodology are perhaps unsurprising within CEM research outputs, given that it is a field that sits at the intersection of physical and social sciences (Love et al. 2002), and as noted these struggles have been explored before. However, this does not indicate we should consider such debates and discussions *done with*, particularly when the consequences of such methodological ossification continue to have ongoing repercussions for current research direction and the shape of CEM research as a whole.

We now continue to develop our discussions of methodology around the aspect of bias. Bias, quite simply, is “any tendency which prevents unprejudiced consideration of a question” (Dictionary.com 2018). Because bias involves the introduction of a systematic error within empirical work by selecting or encouraging one outcome over another (Merriam-Webster 2018), it can therefore significantly affect the validity of the work. Bias is particularly important because its use, or misuse, enables the labeling of *good* or *bad* research, and as such can be considered a significant contributor to the outputs and shape of our research field. Bias is here explored from an ontological perspective, the level of methodological grounding which sets out what Green et al. (2010) encouraged us to evaluate: the assumptions about the nature of reality itself.

To this end, the three fundamental ontological positions are discussed here: realist and rationalist, which are considered together, and relativist, which sits very much apart. We acknowledge that a key problem of methodology is the variation in *labeling* found within many philosophical works. For example, Burrell and Morgan’s (1979) *functional* paradigm sits within a realist ontology under our terminology, whereas their use of an interpretive sociology, which in turn links to phenomenological epistemology, would here be positioned within a relativist ontology. We must be clear that we are deliberately not referencing epistemology or other theoretical approaches in our discussions, because this would create considerable complexity. Here, we are specifically looking to the very deepest foundations of philosophy, that of ontology, and so hope that readers can position their own methodological approaches within this fundamental framework of understanding.

Bias within Realist (and Rationalist) Ontology

Realist ontology asserts that there is a real world *out there*, an objective reality that exists independently of those who inhabit it (Runeson and Skitmore 2008). This acceptance in turn prescribes that there are ways to determine the *rules* that govern this reality and dictate how variables will interact therein: as articulated through positivist epistemology. Realist ontology forms the foundations of what is often considered to be *true* scientific enquiry—and the laws of physics, chemistry, and engineering all ground themselves within this paradigm.

Developed from realist foundations are notions of postpositivism (Love et al. 2002), an epistemological position which sits within a rationalist ontology, yet which is more accepting of the complexities of reality, particularly those that involve people and social phenomena. Rationalist ontology proposes that social representations are

underpinned by an objective reality and, although there is an acceptance that such representations may not necessarily be true, the understanding remains that through positivistic explorations of such representations, drawing on the notion of the “mind as a mirror” (Rorty 2009) which accurately reflects the world as it is (Gergen 1999), knowledge can still be gained about reality.

Yet, to maintain an approach which seeks to empirically verify a real world, scientific considerations of control, standardization, and objectivity are required and so bias is something to be clearly acknowledged, avoided, and eliminated. It is something to be designed out of studies, through the precise and considered collection of appropriate data, using appropriate methods, from representative samples and ensuring the carefully managed interactions of researchers with their participants (Oppenheim 1992). As previously noted, Abowitz and Toole’s (2010) paper is itself grounded within a realist ontology and so also, quite rightly, they make a clear evaluation of bias from within this paradigm, specifically highlighting issues of individual bias in self-reported data and bias inadvertently introduced during the data collection process by the design of the data collection tool or the researcher themselves.

When qualitative data are sought from within a rationalist ontological perspective, management of bias is just as critical, as the same quality measures remain as valid as if the data were quantitative. For example, when qualitative data are collected through interviews, researcher bias can be introduced in myriad ways including inadvertent changes in question structure, intonation, body language, and even the researcher themselves—their gender, race, or age has the potential to be influential in the responses given depending on the composition of the sample (Kvale 2007).

Bias unarguably has a significant role to play in research grounded in a realist or rationalist ontology, and a lack of attention to bias can easily make the difference between good and bad research. The way in which biases have been controlled within any research study should be clearly explicated. As recent missives on the CNBR network (a closed email group of construction management academics) have shown, noting issues such as bias in sampling (G. Holt, email to CNBR network, 2018), generalization, response rates, methods of analysis and use of literature to support the researchers’ own bias (P. Edwards, email to CNBR network, 2018), this remains an ongoing concern in our field.

Bias within Relativist Ontology

Relative ontology asserts that even if the external world of realism should exist, it is completely inaccessible. All that can be accessed are the representations themselves, as set out within the rationalist position, but rather than accepting such a frame to access reality, relativism instead argues that such representations cannot be judged or evaluated for their validity or accuracy (Burr 2003). In challenging the concept that knowledge is a direct perception of reality, the only realities become those which are constructed by individuals or societies in specific contexts (Gergen 1999). They are therefore in constant flux; there is no such thing as an objective reality or fact (Burr 2003), instead within a relativist paradigm there are multiple realities and therefore multiple truths (Taylor 2001).

Such an approach does not negate the validity or utility of research grounded in this paradigm. Commonplace within social sciences, research grounded in relativist ontology has been used to develop different practices and interventions to produce change and solve problems in various social contexts (Gergen and Gergen 2004; Wiggins and Potter 2007), including developing recommendations for training and the design of work environments and equipment (Taylor 2001), and UK Government reviews of

child abuse within society (Stainton-Rogers and Stainton-Rogers 1999).

This ontological position inevitably has consequences for bias. As noted, from within a relativist paradigm there is no single truth, no one *reality*, and we cannot go *beyond* the representational data to make interpretations or seek facts; therefore, bias in this context differs significantly in its conceptualization from bias as it affects methodologies grounded in realist or rationalist ontologies. For example, bias within the data as collected is inevitably mitigated by the collection process, because naturally occurring data which have not been generated by the researcher for the purposes of the research are prioritized, and therefore has no researcher bias associated with it (Potter and Mulkay 2007). Where data are elicited, for example through interviews, the approach is also very different because the role of the interviewer within the interview must be considered, and so the interaction is analyzed as a whole, considered as an interactional and active engagement (Potter and Hepburn 2005, 2007) in which the researcher is as important as the interviewee. Once the notion that interviews can reveal *the truth* is abandoned, then there is no need for complex approaches to attempt to remove issues of bias, and interviews can instead be used to explore the participants variable interpretive practices they employ to construct their versions of the social world through conversation (Potter and Mulkay 2007).

Within the relativist paradigm, researchers cannot extract themselves from the research, it is simply considered impossible, and this has therefore led to the inclusion of reflexivity within the research process (Taylor and Bogdan 1998; Gibbs 2007). Any account of a social phenomenon will inevitably reflect the researchers’ partial understandings or special interests in the situation (Taylor 2001) and be influenced by their cultural, social, gender, class, and political position (Creswell 2007). Therefore, reflexivity is a necessity, and researchers should clearly position themselves in the project—clearly stating and reflecting on their own motivations, background and therefore *biases* (Denzin and Lincoln 2005) as may affect the research and the research process. Indeed, the need for reflexivity has been called for from within CEM research itself, where qualitative research is still being undertaken from an alleged objective and bias-free perspective (Dainty 2008).

Such open and explicit acknowledgment of bias within relativistically grounded research indicates that no claim is made to *objectivity*, because that would be nonsensical, and so instead trustworthiness, credibility, and dependability are put forward as suitable replacements for validity (Lincoln and Guba 1985), demonstrated through clear explications of method, analysis, and discussion. Findings are not seeking truth but instead trying to find *fit* with shared understandings, a process validated by *member-checking* (Creswell 2007) with those who experience the phenomenon under scrutiny on a regular basis.

Yet, despite the fact that ontological positioning has such a significant influence on bias, the lack of understanding and acceptance of this philosophical fundamental within the CEM research does at times lead to the same challenges as raised by Runeson (1997), who claimed that any alternative approach to research from realist ontological perspectives would be *antiscientific*, and that such traditional methods were the “...best insurance against bad research” in CEM. To claim that research which seeks opinion as *subjective* and *biased* (Runeson 1997) simply does not address the wider methodological paradigm that may have been mobilized and does not acknowledge that there are equivalent standards of rigor and quality that should be met within such approaches (Seymour et al. 1998). To judge research grounded in a relativist ontology by the standards of that grounded in a realist ontology, standards that it has not set for itself, will, where bias is concerned, always be found wanting.

Bias Inherent in CEM Research

The function of CEM research is often considered to be "... to improve the effectiveness and efficiency of the construction industry" (Lucko and Rojas 2010, p. 127). We are an applied field, and therefore our research should be relevant and useful (Edum-Fotwe et al. 1997). If our outputs are not useful, then "... research may fail to inform the development of approaches which resonate with practice perspectives" (Zou et al. 2014, p. 316).

However, this arguably creates bias within the field in several ways. Bias towards research that has the ability to add commercial value through action-oriented outcomes (Edum-Fotwe et al. 1997, p. 450) inevitably indicates our research is perhaps not asking the awkward and challenging questions it should on behalf of the workers to improve their lot, rather than a lot of the shareholders (Sherratt 2017). That CEM workers are also hard to access, may not have email, or spend much of their day sitting at desks with time to spend answering questionnaires or phone interviews, further skews CEM research as a whole, particularly in terms of sample compositions.

Bias is also generated by the need for *industry engagement* and the perceived need to "... collaborate with industry practitioners to establish credibility" (Lucko and Rojas 2010, p. 127), which in turn adds bias to which phenomena are deemed suitable or prioritized by industry for examination. Indeed, as Edum-Fotwe et al. (1997, p. 451) note, "there is therefore an evolving situation whereby research in construction management must rely on the partnership with industry not only for its relevance, but also for part or all of its funding."

It would also probably not be too bold a statement to suggest that the construction and engineering industries may not even want to care about ontology. They want to support and fund research that proves things, that determines things, that can tell them that if you do (a) and (b) then (c) will follow, and so bring positive change to your organization and its projects. Generalizability is therefore prioritized, as is a quest for facts and the truth. Yet, this generates a clear bias in the methodological design used in CEM research, because research grounded in a realist ontology will allow you to do just that, rather than present the more nebulous, yet equally valid, conclusions that can be drawn from relativist work.

However, as noted in the introduction, adhering to a realist ontology may not always be the "best way to do it." The requirement for CEM research to also consider the social are well noted, as is the argument that we should perhaps move away from the inevitable predisposition to measure people and their social world as if they were steel beams and superstructures, utilizing scientific methods to do so (Love et al. 2002). People are inconsistent, changeable, and awkward (Sherratt et al. 2012), they behave and respond to questions or observations variably, depending on context, on who they are with, what they have been tasked to do, or even if anyone is watching them—in often highly discernible ways (Donaldson and Grant-Vallone 2002). Therefore, applications of scientific approaches to people often prove pointless (Midgley 2001). As Abowitz and Toole note, surveying people through positivistically developed constructs is a challenge, and that there are some constructs that simply cannot be measured directly (2010, p. 111), even when using robust approaches from within that particular paradigm.

The fact that we are an applied field should make us more reflexive in the research we carry out, no matter where we have philosophically grounded ourselves. Not only should we continually make open and critical evaluations of what research we are doing, and why, and perhaps importantly who is paying for it, but also acknowledge the ways in which this influences our methodological approaches. The latter certainly has the potential to specify and

perpetuate the dominant ontological paradigms within our field and is likely to be a contributor to the self-perpetuating definitions of what makes good CEM research and how it should be evaluated.

Summary: Everything Is Biased?

Here, we have suggested that yes, perhaps everything is biased. There is bias within our dominant ontological paradigm of realism, and there is also bias within research carried out from a rationalist perspective. In both cases, there are ways to eliminate, mitigate, or acknowledge such biases, and it is the effectiveness of these actions should be using to judge the quality of the work, by the standards each paradigm sets itself. What is lacking in contemporary CEM research is perhaps the knowledge to make such judgments of good and bad research from within these different paradigms, because the continued assertion that *qualitative research* is somehow inevitably methodologically different to quantitative research appears to demonstrate.

That we are reliant on industry engagement will also add bias to our work, in terms of what we study, how we are able to access such phenomena, and what research methods are deemed appropriate by those funding our work. Although many social sciences are highly accepting of the fact that people are variable and changeable and so realism is not the best foundation for their evaluation, industry often demands actionable research. It still holds to the dream that "... all evils can be cured by appropriate technological steps" (Berlin 2001, p. 52), stemming from the misapplication of scientific game theory in the 1990s, and has led to the development of a target driven system that is currently failing, as people are simply not controllable in this way (Curtis 2007).

Bias is therefore something that has the potential to influence the field of CEM research in a number of ways. It has the potential to define and shape our discipline, to set acceptable standards of good and bad research in terms of what and how we research. However, as this paper suggests, everything is biased (including this paper!), and we are at risk of methodological ossification if we do not start to grasp methodology, philosophy, and our understandings of reality with more rigor. We now look at a targeted sample of the current canon of work and seek to understand the extent of these phenomena within our field.

State of Play

Method

To provide some evidence of the current state of methodology, a review of current literature was undertaken. Considering the special ASCE Journal 2010 special issue on research methodologies, the most recent complete volume of JCEM at the time this study was conducted, was reviewed to explore the influence this special issue had on the field. All 173 research papers from 2017 were collected and reviewed with an emphasis on the language used to explicate the research design. The manuscripts were coded into a spreadsheet to capture common elements related to the research undertaken.

The process of reviewing a volume of JCEM manuscripts, out of necessity, required some procedural steps and guidelines to ensure consistency and reliability of the results. After collecting the full volume, each manuscript was coded into an Excel spreadsheet to capture key factors—authors, number of authors (range of one to six authors, with a median of three), primary type of data (quantitative, qualitative, or mixed), and explicit reference to methodology. This was a simple requirement of whether the text used the word *methodology* as the descriptor to define the research approach. In addition to reviewing each of the abstracts for the topic

and approach, each manuscript was reviewed with a focus on the research process undertaken. Whereas there was typically a specific section within each script, with such titles as methodology, *research process*, *research design*, or *research methods*, among several other terms, many of the papers delved directly into the data collection or analysis without such a section preceding it. The papers were also reviewed to capture if their research design explicitly addressed methodology or focused exclusively on the methods or techniques.

Beyond exploring the methodology, explicit references to epistemological viewpoints were sought, references to ontological positioning, and, in particular, the discussion of bias in any form. This was done first, by performing a review of the relevant research design sections and results, discussion, and conclusions. To ensure the topics were not missed, an additional text-based search was conducted, focusing on these key terms and appropriate derivatives (methodology, epistemology, ontology, and bias) to attempt a complete capture of papers exploring explicit discussions of ontological or epistemological discussions.

Findings

What Are We Doing?

To begin, a brief overview of the topics explored in a single volume of JCEM will help to provide suitable context for the positioning of the researchers, and the range of bias discussions that were, or were not, undertaken in the presentation of their research findings. The broad topics touched upon are highlighted in Fig. 1, ranging from safety (28%) as the most common topic, to materials applications (4%) and scheduling analysis (3%), with approximately 20% of the topics grouped under *Other*. This *Other* categorization was needed to capture topics that only occurred in one or two of the published manuscripts. The topics ranged from knowledge management, to quality, to international market share by contractors, to prefabrication, and culture. One of the elements that emerges from reviewing the topics, is more than 50% of the papers address social topics in some manner, from the safety of people on construction sites to organizing or procuring project teams. Even among topics that could be identified as commonly fitting into realist, positivistic

paradigms, such as economics, estimating, and technology, forays into human aspects such as assessing risk in project costs or financing, bid strategy, and factors affecting the adoption of technology were also often the focus of the research.

How Are We Doing It?

Whereas methodology was explicitly referenced in 47% of the papers (excluding bibliographic citations), epistemology as an explicit term only occurred in two papers, and ontology in four. For example, Sunindijo and Kamardeen (2017) note in the first sentence of their research method, “The epistemological paradigm of this research is realism, whereby knowledge is created by understanding the real experiences of people . . .”

As Zou et al. (2014) also found, many papers simply do not state a methodological position, but this can be determined through the method used, and claims made around reliability, validity, generalizability, and bias. In the volume analyzed, nearly half (47%) of the studied papers used the term methodology. However, less than five papers explicitly mobilized ontology and linked it to theoretical and epistemological perspectives of the studied topics. The majority of papers simply assumed a realist ontology and positivistic epistemology and focused on analyzing quantitative data. 74% of papers used primarily quantitative data in the presented analyses, though the type of data quantified was quite diverse, such as perceptual survey data on risks by Liu et al. (2017); to the lifecycle cost analysis of flat-roof performance by Marrana et al. (2017) or performance data, such as Hu et al. (2017) in their compaction parameter data of asphalt resurfacing. Another 18% using mixes of both qualitative and quantitative data, frequently began with qualitative data, most often interviews, before moving to surveys or related methods to collect larger pools of quantitative data; although, the data were still considered from a realist ontological position.

For many, a positivistic perspective and quantitative data were arguably quite appropriate to the topic under examination. For studies that compare methods for compaction of soils (Karatai et al. 2017), computer modeling of the performance of asphalt or other materials (Imran et al. 2017), or the differentiation of empirical methods of schedule analysis (Ballesteros-Perez 2017), positivism provides a highly appropriate lens for the analyses undertaken. However, less than 20% of the papers focused on these types of studies, primarily in scheduling, estimating, or material-related research. In the remainder of the manuscripts, the ontological and epistemological position should be, at the very least, identified to clearly enable evaluation of the research itself, even if this is positivistic and not a theoretical lens we (the authors of this nihilistic treatise) would perhaps suggest as an alternative. However, we must be clear that we are not making a call for a full philosophical debate to be undertaken in all papers before the authors turn to method and the details of data collection and analysis. In many instances, this could be quite clearly and effectively stated in just one sentence, which would then enable the reader to set their philosophical benchmarks for validity, reliability, and generalizability that hopefully the authors go on to explore within the explication of their method.

What of Bias?

Building upon this limited philosophical framing, across all the papers less than 1/3 (28%) even raise the concern of potential bias in the research as part of their explicit discussions, summarized in Fig. 2. Even among that 28%, four mention bias solely in the context of the literature review or problems with bias identified in previous studies, without discussion of bias present in their own work. Two papers note bias, without explaining the source or concern at all, much less how this potential bias was potentially mitigated or removed. Additionally, with the focus on quantitative

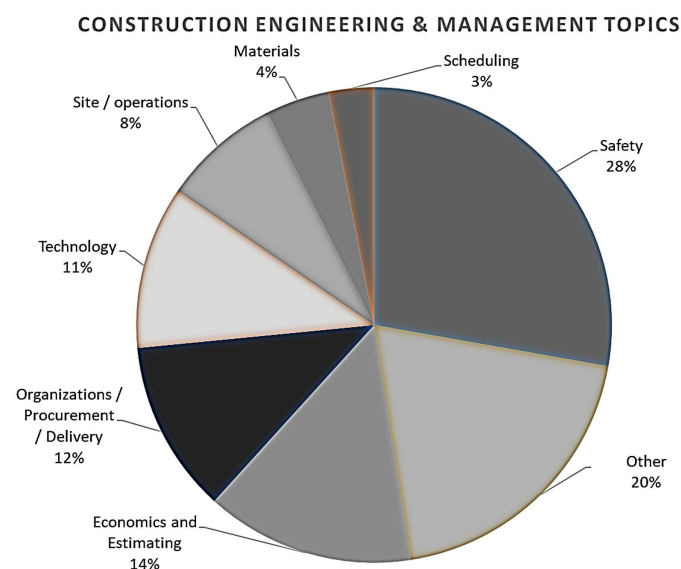


Fig. 1. Topics addressed in the 2017 Volume of the ASCE *Journal of Construction Engineering and Management*.

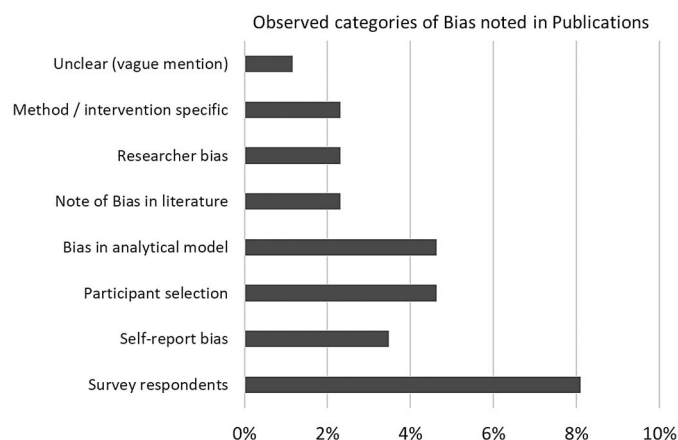


Fig. 2. Bar chart summarizing percent of papers noting categories of bias.

data and analytical modeling, eight of the papers focus on bias introduced in forecasting values using specific analytical methods. These typically focused on bias introduced by selection of variables used to model forecasted values, such as cost estimates (Shrestha et al. 2017) or in a specific variable, such as timing of business cycles (Kapelko and Abbott 2017).

The most common discussion of bias related to survey data collection, either in the selection of the respondents (eight papers), potential self-selection bias in the participants that respond (six papers), and most commonly bias in the responses by the survey respondents (14 papers). In many cases, these discussions were well situated to highlight how bias was a concern regarding the topic selected, and the attempts made to mitigate or remove the bias in the approaches taken. For example, in Sunindijo's and Kamardeen's (2017) study of work stress on gender diversity, the researchers explicitly discuss their realist framing, employ a thoughtful survey design along with sampling and data collection process that Abowitz and Toole (2010) would applaud. Despite all their efforts, they also include an explicit discussion of bias that highlights how the self-selection of the respondents could introduce bias into the sample simply through motivation to participate or that the subject matter might appeal to a specific audience. This reflexive element within the presented research provides a good example of the type of bias that perhaps needs to be better explicated in other CEM research.

At the other end of the spectrum, Leung et al. (2017) in their study of stressors and performance in expatriates also employ a survey for data collection. However, they do not discuss their epistemological or ontological framing, and in their conclusions, state, "However, remedial actions have been taken to address the potential risk of common method bias... therefore, the final result of current study is reliable." This lack of discussion is challenging because the research process undertaken was well designed, employed purposive sampling, and applied appropriate analytical techniques to draw reliable conclusions. Building upon the concerns raised by Sunindijo and Kamardeen (2017), the self-selection of the respondents could have skewed the population toward either those who felt strongly about the topic, or due to its sensitivity, could also have skewed it away from participants that were themselves unduly stressed. In addition, whereas the conclusions are intriguing, the context of the respondents, or the chosen location (Hong Kong) of the targeted expatriates could influence how the results are transferred to other regions.

Of the 50 or so papers even mentioning bias, very few actually identify bias as a concern to be raised as an element of the research process design, or as unique elements of the research topic and approach studied. An example of a paper that does examine bias is that by Karakhan and Gambetese (2017), which explores the potential for sustainable design to introduce safety risks in construction. The authors identify researcher bias in the evaluation of the safety risks associated with specific LEED points. In an attempt to eliminate the potential bias, the risks were verified through technical reports or publications linking the sustainable element associated with the LEED point to the safety risk. In a different approach to studying the effectiveness of safety, Marín and Roelofs (2017) identify the potential bias introduced by surveying participants immediately following safety training. To help combat this influence, the researchers performed time-lagged follow-up surveys 6 months after the training. Additionally, they point out the potential self-selection bias of the respondents that choose to participate in the lagged survey. These manuscripts stand out due to their identification of unique ways in which the researchers and the process could introduce bias to the specific research questions, and the authors demonstrate how they have attempted to remove or mitigate the bias through their research process.

What Do We Do About Bias?

Beyond the consideration of bias as an element to be considered in research design and selection of both methodology and methods, the approach to biases when raised was disconcerting. The overreliance on Cronbach's alpha as the sole mechanism for demonstrating a lack of bias could be considered both alarming and disappointing. Originally developed in the context of psychometric tests in the 1950s, such as the five-factor model, Cronbach's alpha is generally used to determine the relation of a set of different measures or questions as an estimate of the average correlation for measuring a consistent construct (Nunnally 1978). It has grown in use within the social sciences as an element of internal consistency for reliability of test scores—intercorrelations among test items should be maximized if the questions posed are measuring the same construct. However, there are numerous studies that show that Cronbach's alpha can take on high values even when measuring unrelated constructs (see for example Green et al. 1977; Schmitt 1996). Even considering these limitations, there are multiple stages of the research process in which researcher bias can be introduced both before and after the data collection that would not be indicated in the measure.

Despite the limited explication of bias and philosophy among the pool of JCEM papers, there are several papers that are both well founded within theory and develop thoughtful research designs, e.g., Poleacovschi and Javernick-Will (2017) study how *expertise* is assessed in the area of knowledge exchange within engineering firms. The authors collect extensive qualitative data and quantitative data to pursue a hermeneutic methodology to the space that leads to both interesting and insightful considerations for how we frame the expertise of our colleagues. The authors explicitly note the use of *reflective memos* as an element of the interview process. In the research design, the importance of the context and contextual sensitivity in the interview processes undertaken is explicit and considered in the analysis. The authors further employ reflections of the interviews to build upon the best practices emerging from the methodologies employed in relativist ontological interpretations that lend themselves to the question of how different individuals interpret expertise. However, despite the well designed and executed study, the authors do a disservice to the CEM community by limiting their discussions of the issues of bias that are

implied in the approach taken, and so they are unfortunately not explicated for the benefit of the wider community.

Discussion and Conclusions

There are several challenges that arise from such limited discussions of bias (and, of course, other benchmarks for research *quality* that have not been explored here), and the underlying epistemological and ontological positioning of any research project.

First, and perhaps most concerning, is the publication of research that contains critical flaws with relation to bias inherently within its design. For example, one paper presented research seeking to explore the relationship between cultural dimensions of the Hispanic construction workforce as an element of higher injury and fatality rates of Hispanic workers. The research design presents no information about the methodology employed and dives directly into the survey development process, focusing on testing the clarity of the questions and the survey distribution. When designing the actual data collection, the authors survey English-speaking managers, rather than the Hispanic workers to understand safety behavior. The authors then rely on these responses to interpret cultural challenges. In particular, the authors introduce bias in their expectation of culture as an explanation, and then wholly ignore more mundane explanations, such as the language barrier, that are also likely factors in the behavior observed by the managers that responded to the survey, serving as the sole source of data presented. As noted by Alsamadani et al. (2013)—single language work crews have significantly higher safety performance than multilingual construction crews. It is also noted that the authors of this initial paper did develop their work through another paper that helps address our areas of concern, by employing methods to engage the Hispanic workforce directly, in a different context (offsite) that explores their perceptions first-hand; however, the fact remains that the first paper was published as a stand-alone submission.

However, it is surely the role of editors and reviewers (i.e., all of us within the CEM community) to ensure that benchmarks are in place to avoid such flaws, and to request more explicit discussion of research design within the methodology section of any submission. Perhaps the prevalence of the positivistic paradigm has enabled and even supported a lack of attention to the fact that the potential for bias exists within it in a wide variety of ways, including those clearly set out by Abowitz and Toole (2010). Bias should therefore be explicitly addressed in positivistic research design, beyond simple Cronbach's alpha testing, and we suggest reflections on bias should also take into consideration the funding of the research and its ultimate aims—be they interventions, process developments, or other organizational changes.

As the prevalence of research of the people in construction grows, the ability to effectively design such research, and engage in meaningful consideration and discussion of the ontology and epistemology underpinning it, needs to be engendered in the CEM research community. This is perhaps not helped by the lack of clarity in how we articulate underlying research philosophy in our presented work; we do not clearly set out the acknowledged quality benchmarks, and consequently what claims to validity, reliability, and generalizability can actually be made, and so how they should be evaluated by our peers. Yet, as previously noted, this is not a call for extensive philosophical discussions as a precursor to any published work; constraints of space would quickly render that a pedantic nonsense. Key here is the term *meaningful*, and the appropriate inclusion of clearly stated ontological and epistemological foundations and their justification within a few sentences would arguably go a long way to enhance our current offerings, and ensure both reviewers and

readers are able to make clear judgments of their own regarding research quality. This would also provide a *natural home* for reference to bias, which could then be judged by appropriate benchmarks, and authors could also consider other forms of bias in their work at this time as well, including those around sample, researcher involvement, and that inherent in the selected tools of enquiry.

Closer to home, the CEM community needs to define what is important—methodologically. “Social science informs the human context in which projects are completed” (Chinowsky 2011, p. 7), so where is the social science? Are we effectively conducting meaningful research, and more importantly are we spreading the values, understanding, and proper conduct of research out into the broader community? What will be accepted? Will unfamiliar methodologies such as critical discourse analysis, ethnography or phenomenological work, be welcomed by editors and reviewers, or will they be judged by inappropriate benchmarks and so deemed *bad research*? Indeed, how do we combat the perpetuation of primarily positivist and realist paradigms in research when those are the dominant perspectives accepted for publications, that industry *understands* and so funds, and which are therefore those measured for tenure or academic advancement?

We suggest the first steps are for the community as a whole to strive to enhance and develop our knowledge and understandings of methodology; to go beyond methods and back to the ontological and epistemological roots that are vital in supporting robust research. As Mahoney (1977) found, academics can be very strongly biased against research that reports results or findings that contradict their own theoretical perspectives, and so when a realist meets a rationalist, bias within our own peer-review processes is something of a predictable phenomenon. We need a level of tolerance and indeed humility. When an unfamiliar methodology is found in work for review, we should either take the time to perform our own research to make an informed evaluation of its merits or confess all to the editor. We should not judge others by benchmarks they have not set themselves. Yet for this to occur we need to be explicit in our work and avoid obfuscation behind meaningless labels, such as *qualitative research*. The onus is on us, the writers, reviewers, and editors, to rise to this challenge. And we also need to make our arguments more forcibly to industry, many other sectors (such as education or social work) are comfortable with diverse ontologies, including those grounded in a relativist ontology, and there is no reason the construction industry, at least the social and people-focused aspects of CEM, should not also become convinced of this if we pour our philosophical foundations correctly.

But Are We Not Biased?

Of course we are! And so is this paper.

We selected ASCE JCEM as the primary venue for analyzing the lack of ontological and epistemological variety, knowing in advance that it was lacking. This was partly intentional, to highlight the extent to which the problem persists even within a community that, at least partially, recognizes its own limitations as noted by the 2010 special issue, yet seven years on things do not seem to have significantly changed this dearth of ontological and epistemological discussion.

We should also clearly position ourselves, the authors, within this research:

Fred Sherratt is a social constructionist; her work is firmly grounded in a relativist ontology and her research on safety explores how people construct this concept on construction sites, revealing it to be fluid, highly changeable, and not at all as measurable as safety climate surveys may suggest. She has faced significant criticism of

her work over the years, which apparently is not representative in terms of sample, not generalizable, and therefore *weak science*. These are all criticisms that she is very happy to accept if you are going to insist on judging her work from realist ontological perspectives, but she would really rather you did not.

Rob Leicht is a construction engineer and recovering empirical positivist, having developed and published several studies that would clearly fit into the default CEM research paradigm. While having explored and pursued alternative methods over the years, such as one of the manuscripts in the JCEM special issue related to observational studies, he has only recently endeavored to explore the paradigms and philosophical framing that give meaning to the data we collect and analyze.

This study is, perhaps surprisingly, grounded in a realist ontology and positivist epistemology. The empirical work involved counting, measuring, and the quantification of qualitative data (the papers) into statistics for analysis. Bias here was controlled by the method employed, keyword searches mechanizing the process and therefore limiting researcher bias. But this was of course a highly appropriate, effective, and insightful way to approach this phenomenon and our data, and that is our fundamental point. As noted, the sample carried bias in selection, but was purposefully given the noted special issue in the same journal several years before—partially to see how the results had been adopted into the community. In addition, we attempted to demonstrate examples of both alternative methodologies and well-developed research designs that appropriately consider bias were present, though sparser than we would like (again—we are biased).

We are ultimately advocating for multimethodological approaches and well-designed research processes appropriate to the approach. Although we must acknowledge our inherent concern whenever positivist and realist perspectives are brought to bear on social topics within the CEM research community, there are a variety of topics in which this has and can continue to provide value, and it would be folly to advocate abandoning them. However, we wish to see an increase in alternative approaches where appropriate paradigms are mobilized and even combined to provide a holistic evaluation of the phenomenon under scrutiny. Yet, for that to become a reality, we need to develop our understandings of what and how alternative methodological paradigms should be mobilized within their own definitions of validity, reliability, generalizability, and, of course, bias. We therefore hope this paper can stimulate debate, but also champion tolerance and reflexivity in all that we do, and so support the development of a more mature and relevant CEM research discipline, in terms of both academic scholarship and applicability to practice.

Data generated or analyzed during the study are available from the corresponding author by request.

Data Availability Statement

Some or all data used during the study are available from the corresponding author by request (e.g., CNBR emails).

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