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Sustainable Information and Communication Technology (ICT) Initiatives in UK and Irish Universities and Colleges: Identifying and Overcoming the Barriers to Implementation.

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Abstract: Energy is one of Ireland's and the UK's biggest commercial and environmental concerns. Despite government campaigns for everyone to play their part in minimising its consumption, reports suggest an estimated 20–30% of energy generated is wasted. Further and higher education institutions (FHEs) are no exception to this wastage using an extensive collection of ICT equipment and technology for teaching and research. Such technology is often left running when not in use creating energy waste, increasing running costs and carbon emissions. Conducted over the course of three consecutive stages, this research employed positivistic and anti-positivistic paradigms, utilised inductive, abductive and deductive methodologies and employed comparative, correlative and evaluative research methods that answer the research question and sub questions. This research showed that a gap in knowledge within the sector existed. That gap in knowledge – the identification of barriers to FHEs implementing sustainable ICT initiatives – is central to this research, as is how the gap was eventually bridged. Data were gathered throughout this research using surveys and questionnaires. Seven barriers to implementing 'greener' ICT initiatives were eventually identified with three of them (stakeholder engagement, lacking managers and cuts in funding) found to be widespread. Each of the barriers existed to various extents, in both countries and were experienced by a range of FHE managers with most underpinning one another. Finally, this research demonstrated that overcoming the barriers proved possible via the use of a smartphone web app named the ED web app. This simple to use and inexpensive ICT solution is easily replicated and engages with stakeholders in tackling energy waste in any organisation. These findings validated this research's theory and ultimately answered the research question and its sub-questions.

Keywords: Sustainable, Information Communication Technology (ICT), Universities and Colleges, Stakeholders, Barriers.

Introduction

From 2010 to 2014 there existed a series of problems relating to environmentally unsustainable practices within the Scottish, UK and Irish further and higher education sector. One of the most pressing environmental problems pertained to energy use and even worse, energy waste. Such poor unsustainable performance typically results in wasted resources, disgruntled managers and dissatisfied students (Enochs, 2012; People and Planet, 2012; EAUC, 2016b). Universities and colleges are typically long-lived institutions that operate like small villages where the investment of time and money into robust environmental frameworks will prove frugal and socially responsible (Hammond-Creighton, 2006; Reza, 2016; Zou et al., 2015). However, implementing sustainable initiatives is rarely a simple, quick or even straightforward process (Hogan, 2009; James and Hopkinson, 2009; Velazquez et al., 2006; Sharpe, 2002). In reality such initiatives are complicated and fraught red tape. Fortunately, for each obstacle and barrier to implementing an energy saving initiative, there exists a solution, underpinned by sufficient funding, adequately resourced managers and

engaged

stakeholders.

Sustainable ICT

The institutional benefits of using sustainable ICT equipment are numerous (Worthington, 2010). The most obvious one is the financial savings that can be gained by utilising more energy efficient equipment (James and Hopkinson, 2009; Baroudi et al., 2009). Consuming less electricity also means releasing fewer CO₂ emissions so carbon targets are achieved (Carbon Trust, 2016a; GOV.UK, 2014a) and savings made year on year in energy costs, through the use of more sustainable ICT equipment, can far exceed initial purchase costs. In fact, such cost can be recouped in as little as two years (Jeffrey, 2011; James and Hopkinson, 2009). ICT is even being used as an enabler for improved sustainable performance as smart meters facilitate the reporting of real-time energy consumption and mobile devices allow for social activism of stakeholders (Bull et al, 2014; LoveCleanStreets, 2016; Suliman, 2018.). The SMART 2020 report revealed that ICT's unique ability to monitor and maximise energy efficiency, both within and outside of its own sector can lead to emission reductions five times the size of the sector's own footprint (GeSI, 2016). However, improving an institution's environmental performance firstly involves identifying any barriers that may be causing poor environmental performance to begin with. This research does exactly that, specifically focussing on barriers to implementing sustainable ICT initiatives. It also offers a solution to overcoming these barriers in the form of a webapp, called the ED web app.

The Three Stages of this Research

This research ran from 2010 to 2016 and evolved over the course of three different stages. **Stage 1** of this research pertains to the outcomes of the Scottish and UK ICT Carbon and Energy Management Project. Both projects examined the energy use of ICT equipment in 16 FHEs and offered free consultancy support for participants willing to gather data pertaining to their ICT energy use. Participants were also asked to replace their old energy inefficient equipment with 'greener' technologies (at their institutions expense) and then share their findings relating to energy savings with the sector. Participation by FHEs in both projects proved much slower and intermittent than anticipated and after some investigation, it was discovered that a combination of a lack of time and of resources to devote to either of the projects were the predominant reasons given for such poor participation. In short, it was realised that barriers to more sustainable management of their ICT equipment existed but required more investigation.

It was also during Stage 1 of this research that the research question – *Identification of principal barriers to optimal sustainable performance in universities and colleges and how a series of ICT-related solutions can overcome those barriers* – was conceived along with the conceptualisation of what other possible barriers might exist. Those possible barriers are explained below :

1. **Lacking Managers.** This principally refers to, but is not exclusive to, ICT managers. It includes sustainable and environmental managers, estates managers, energy managers etc. The term "lacking" refers to managers who are struggling to perform optimally in their roles for various reasons.
2. **Poor Stakeholder Engagement.** In the context of this research, this refers to poor inter-departmental engagement on green ICT issues. It refers to a department requesting information from another but not receiving it, receiving it only in parts or in an untimely fashion. It also refers to departments that consider sustainable ICT issues as being

unimportant and not “core business” to their institution, outside of their remit or the responsibility of someone else.

3. **Institutional Culture.** This refers to institutions that have no history of engagement with sustainability via either their operations, curriculum or research and may consider them unimportant.

4. **Government Organisations as Weak Drivers.** This refers to government organisations that penalise institutions that do not reach their carbon targets.

5. **Budget-holders and Decision-makers’ Collective Action/ Buying of ICT/IT equipment.** This pertains to procurement departments and senior managers who inhibit the purchase of sustainable ICT equipment for various reasons including not being part of a purchasing framework and/or not supporting staff in their need to purchase greener ICT.

6. **Sustainable Technology.** This occurs when sustainable technology does not produce the cost and carbon saving results it promised and institutions deciding to no longer continue participation in green ICT projects.

7. **Cuts in Funding/Revenue Streams.** This is when institutions can no longer participate as a result of cuts in funding to their institution and/or their department. This includes cuts affecting staff workload, allocated number of hours and salary.

Stage 2 of this research involved the circulation of a large and detailed survey whose questions were based on the possible barriers listed above. Circulated to over 200 FHE managers in the UK and Ireland, the results of this ‘main research survey’ indicated that all seven barriers had been experienced by a variety of FHE managers, to varying degrees with the existence of those barriers varying between institutions in both countries.

After establishing that all seven barriers existed, the next stage of the research, **Stage 3**, was to find an ICT based solution that would overcome those barriers. Named the ED webapp, it demonstrated how when used in conjunction with a smartphone allowed for at least three of the barriers to be overcome. The webapp administered data in relation to energy wastage while at the same time allowed staff and students to engage with the concept of participating in the sustainable operations of their campus.

Research Paradigms, Methodologies and Methods

This research employed different research paradigms, methodologies and methods in each of the 3 stages of this research. Stage 1 involved case study research with the case studies being a Scottish and UK based Energy and Carbon Management Plan. As the research progressed, a series of seven barriers were identified. Research into the barriers was therefore considered inductive and the methodological approach was anti-positivistic, employing qualitative methods of research. As the research evolved further in the form of examination of the results of the main survey and examination of the outcomes of case studies, it became positivistic and abductive, employing mixed methods of research as data were being tested against a set of parameters. Finally, armed with new knowledge on barriers to implementation of ICT initiatives, ‘barrier-free’ action research took place, in partnership with engaged and coordinated stakeholders (Costello, 2003) that was positivistic and deductive, employing quantitative data. This final stage of the research is known as Stage 3.

The Research Question Surveys

The research question which evolved out of Stage 1 of the research asked: what are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives?

Its follow on sub-questions asked; what are the key implications of those barriers? and How can a sustainable ICT solution alleviate those barriers?

The UK and Irish main research surveys were circulated via e-mail to over 215 UK and Irish FHE sector managers in November of 2014. Six of the seven questions offered a "Yes, No or Somewhat" response option with follow-up answer options asking why respondents may have chosen that answer. The UK survey was circulated to the EAUC-London JISCMail mailing list and to members of Ireland's An Taisce's ICT mailing list. The UK survey achieved a 41% (60/146) response rate and the Irish survey a 23% (16/69) response rate, averaging out at a 35% (76/215) response rate. The surveys were conducted online using SurveyMonkey and included a total of nineteen questions.

The questions asked included:

(i). When implementing "greener ICT" in your institution, were stakeholders (staff and students, other organisations etc.) engaged? I.e. were they willing to adjust to changes in job roles, train in the use of greener technologies etc.?

(ii). Is participating in green ICT projects typical of your institution's culture?

(iii). Of the government organisations listed (HEFCE, DEFRA, DECC, Salix, Local Authorities, Other Government Funded Organisation) please state how they have affected your institution's participation in green ICT projects (Excellent Driver to Very Poor Driver).

(iv). Do you feel that green technology delivers on the financial and carbon savings promised by IT companies?

(v). Have recent cuts in funding to the educational sector affected your institution's ability to participate in sustainable ICT projects?

(vi). Assuming your institution is part of a framework (e.g. LUPC) that includes criteria for the purchase of sustainable technology, do you feel you are supported in your choices to purchase more sustainable technology?

(vii). Do you feel your institution's ICT manager(s) are "lacking" by exhibiting any of the characteristics below?

The individual results of both survey coupled with a three-way cross-comparison of their results are too numerous and detailed to be included in this conference paper so the researcher has chosen to summarise them in a single table, Table 1.

Table 1. Summary of Presence or Absence of Barriers by Geographical Location and Category of FHE Manager.

Groups Analysed → Barrier Identified ↓	UK Insts.	Irish Insts.	London Insts.	Rest of UK Insts.	ICT /IT Mgrs.	Env/Sust. Mgrs.	Other Mgrs.
Poor Stakeholder Engagement.	✓	✓	✓	✓	✓	✓	✓
Inst. Culture.	✓	✓	✓	✓	✓	✓	✓

Govt. Orgs as Drivers.	✓	✓	✓	✓	✓	✓	✓
Green Tech. delivering on Financial and CO ₂ savings promised by IT comps.	✓	✓	✓	✓	✓	✓	✓
Cuts in Funding.	✓	✓	✓	✓	✓	×	✓
Actions of Budget-Holders and Decision- Makers/ Institutions being part of a Purchasing. Framework.	✓	✓	✓	✓	✓	✓	✓
Lacking Managers.	✓	✓	✓	✓	✓	✓	✓

Results of the surveys validated the theory that each of the seven barriers existed and ultimately answered the research question. A cross comparison of three different data sets of results from both surveys were then examined to establish any patterns regarding each of the barriers.

Summary of Results of Comparison of Responses between UK and Irish Surveys

Results of the UK and Irish surveys included a mixture of both similar and differing opinions regarding each of the seven barriers. Some answers indicated a strong similarity between the two countries yet in other instances, they had opposite views on whether a barrier existed or not and to what extent. Results of the UK and Irish surveys were then cross-compared from three different aspects and showed that London institutions appeared to be more sustainably minded and appear to take action where practicable. There also appears to be a strong sense of community within the London universities as evidenced in the large number of responses to the survey. The largest lacking characteristic recognised was being negatively influenced by institutional politics, with the majority of other managers indicating this as a barrier also. In contrast, this was also the least commonly occurring lacking characteristic where ICT/IT managers were concerned. However, when each of the lacking characteristics are totalled, being under-resourced in terms of funding for new technology is the most common barrier to participation in sustainable ICT projects. Other commonly-found barriers include being under-resourced in terms of allocation of support staff, allowances for staff training and having a disinterest in outside green ICT, amongst others. While some respondents indicated that their ICT managers were not lacking in any of the characteristics listed, overall, responses from each category of manager indicated that each of the barriers exists to varying degrees. In short, results of both surveys confirm the presence and absence of each of the seven barriers and highlighted considerable overlap in many of the responses. They also highlighted the disparity in many of the results, where, not only did barriers *not* exist in institutions, they were offered significant support in implementing the use of more

sustainable technology and in engaging staff and students with sustainable behavioural change.

Overcoming the barriers

Having identified the barriers in stage 1 and 2, the researcher focused on finding a sustainable ICT solution that would alleviate those barriers. That ICT solution needed to engage with stakeholders, be a useful resource to lacking managers and help institutions overcome cuts in funding, while at the same time being convenient and easy to use and cost free to the user. From these criteria, the ED mobile web app was created and implemented over four cycles of action research conducted at a London university. These cycles of action research (not included in this conference paper due to limitations of space) was the third and final stage of this research.

The ED webapp and how it works.

The webapp is essentially a webpage accessed via a smartphone or PC, which allowed staff and students to report where and when they saw energy being wasted across campus. The ED webpage consisted of a drop-down menu of the list of buildings on campus along with the type of wastage occurring so users could make their choices accordingly. Users could also take a picture of the classrooms or spaces where energy was being wasted as further evidence. They were also asked to prevent further wastage by switching off whichever category of energy waste they saw occurring (lights or ICT equipment left on). All energy wastage reported was stored on a central server that could be accessed by the researcher who monitored the data and frequency of reports. Upon examining the ED reports and comparing them against real-time reduction in energy waste, it was determined that the ICT solution, the ED webapp, worked.

Cost and Carbon Savings via the ED Web App.

In order to gather quantitative and qualitative data the researcher examined reports of energy being wasted over a four-month period, from January to May 2016. In total 305 incidents of energy being wasted were reported and 'actioned' (lights and ICT equipment switched off at the time of reporting), preventing a further 3,522 hours of ICT and lighting energy being wasted. This number equated to savings of approximately £370 and a reduction of 1.02 tonnes of CO₂. These savings were calculated by multiplying the time the switch-off was recorded via the ED web app until 8am the following day. Those numbers of hours, typically between thirteen and fifteen hours per classroom, were then multiplied by the average energy requirement of each piece of ICT equipment and light (varied from room to room and between pieces of ICT equipment) and multiplied by the cost per kWh of energy (0.104p per kWh hour). Calculations estimated that from January 2016 to April 2016 approximately £162.00 was saved by ED webapp users switching lights off. In addition, a total 622.kgs of CO₂ was saved from lights not being left on and 135 kgs of CO₂ from PCs/Macs not left running. Total savings amounted to approximately £190. Carbon emissions were calculated using the Carbon Conversion Factor of 0.40957 as given by the DECC (DECC, 2016).

Overall Discussion and Conclusion of the Research Findings

Results of the surveys have validated, that each of the seven barriers existed. By virtue of their existence, they answered the research question: what are the barriers and limiting factors that inhibit the realisation of the potential benefits to UK and Irish universities and colleges of implementing sustainable ICT initiatives? Results of the surveys and the action research carried out at a London university involving the creation of the ED webapp, also answered the research sub-questions; what are the key

implications of those barriers? and how can a sustainable ICT solution alleviate those barriers?

It can also be concluded that while some barriers are clearly connected, others appear to be separate. It can also be concluded that one barrier underpins the others (Hogan, 2012). For example, when sufficient funding is in place, institutions are afforded the time and resources to complete projects. This includes the provision of staff training and assistance, the purchase of necessary equipment and the engagement with organisations that charge for the service of their advices. Sufficient and continuous funding to the FHE sector is essential to its development and expansion. Without it, institutions cannot remain competitive, the quality of teaching and research suffers and sustainable projects are scrapped or pressured to finish earlier (UUK, 2016a; HEFCE, 2016; THE 2012, Hogan, 2009). As stakeholder engagement in FHEs now includes students and staff, local councils, SMEs and local residents, each contributing to an institution's survival (O' Boyle, 2012), their poor level of engagement resulting in sustainable under-performance, may also be considered a barrier (Allman, Fleming, Wallace, 2004).

Another example is disjointed stakeholder engagement and how it occurred as a result of a breakdown in communication between managers in the same institution or between local councils. This may have been for a number of reasons such as a change in management, job remits expanding and departments downsizing or consolidating. Either way it is a barrier that is often interconnected with other barriers and is rarely found in isolation (Schawbel, 2013; Egeland, 2009; Suryawanshi and Narkhede, 2015). This research has demonstrated the importance of continued stakeholder engagement and to ensure managers are adequately resourced for the full duration of a project which should be considered an essential prerequisite for university initiatives, sustainable or otherwise.

Any engagement with greener ICT initiatives, that did occur was likely to be as a result of being informed of any changes being made and those changes being implemented gradually. Any disengagement from either region was as a result of a resistance to behavioural change and a lack of confidence in those green ICT initiatives (d'Arjuzon, 2012). It can be concluded that green ICT is more part of the culture of institutions from *both* parts of the UK, than not. This is because of the younger workforce who completed the survey and who are more knowledgeable about technology and its impact on the environment. This younger workforce made a unique contribution to this research (Coughlan, 2017; Garthwaite, 2017; Folkman, 2015).

Overall government organisations were *not* considered to be very strong drivers by institutions in either London or the Rest of the UK (Randerson, 2010; Plumer, 2013). This will have contributed to such poor levels of participation in green ICT projects. Institutions in the Rest of the UK indicated that green technology delivered on the financial and carbon savings promised by IT companies, more so than London institutions. London institutions' sole reason for not believing in the benefits of green ICT was that purchase costs exceeded any saving recouped in reduced energy costs. The disparity between London and the Rest of the UK responses is therefore due to the overall higher cost of living London (Numbeo, 2017; Rej, 2016).

Results of the survey also indicated a lack of education and training in institutions in both London and the Rest of the UK regarding membership of purchasing frameworks and any support such frameworks offer. Barriers that affect London institutions in participating in sustainable ICT projects, also affect institutions across the Rest of the UK and in similar

amounts too. This further demonstrates the similarity in management set-up and operations of all FHEs and that barriers exist in every organisation (Barry, 2007: 2013).

There was a mixture of opinions regarding green technology delivering on the financial and carbon savings promised by ICT/IT companies from each of the three categories of managers. Similarly, this is because each category of managers has a different experience in the use of green ICT and in its delivery of cost and carbon savings (Hogan, 2011a). Cuts in funding affected each of the managers differently with Environmental/Sustainability managers indicating not being affected at all. Similar responses were given in the 2012 Cuts in Funding survey (Hogan, 2012), where FHE managers indicated having less funding as an opportunity for reducing consumerism and thereby reducing their overall environmental footprint. It can also be concluded that there is cross-departmental awareness of purchasing frameworks in UK institutions, but levels of awareness amongst managers is mixed and this sometimes leads to less sustainable decisions being made (Hogan, 2011a; CIPS, 2009 pp3–4).

A key implication of being under-resourced as regards support staff, allowances for staff training and having a disinterest in outside green ICT projects is that, combined, are the most undermining and debilitating characteristics of a lacking manager (Enochs, 2012; Guardian Work Blog, 2013). However, in contrast some institutions have ICT/IT managers who claimed to not be lacking in any way. This is due to their working in silo and having minimal engagement or interaction with stakeholders and therefore were unaware of any issues, environmental or otherwise, that was outside of their remit (Beal, 2017). It might also be that due to their level of personal commitment, motivation, education or remuneration that they were unaware of how their institution may be lacking. Finally, it might also be that some institutions are very well resourced and managers are not lacking in any regard.

Finally, it can also be concluded from the comparison between responses in the UK and Irish surveys that FHE institutions in both countries experienced each of the same barriers when implementing sustainable ICT initiatives, albeit to different extents. Responses indicated a similarity between the two countries when attempting to be greener. Yet in other instances they had opposite views and this is likely to be because the majority of respondents in the Irish survey were ICT/IT managers and none were environmental/sustainable managers. The significance of these findings is that barriers to implementation of sustainable ICT initiatives exist in institutions regardless of geographical location (Allman, Fleming and Wallace, 2004; Wabwoba, Wanyambi and Omuterema, 2012; Wu, 2002).

Impact of Research and How It Improved Practice.

The impact of this research is the way in which it demonstrated the difficulties in implementing change for a more sustainable campus but also how those difficulties could be overcome. Ideally, institutions will ensure that stakeholders are fully engaged and committed, prior to implementing green ICT initiatives, as well as throughout the duration of the project. The aims of sustainable ICT projects should be made clear and communicated to all stakeholders with each participant understanding their role and the impact it has on the broader project. The effects of wasted time and public money will be highlighted and after recommendations are taken on board, significant carbon and cost savings will be made. This research also improved practice as it demonstrated the simplicity in creating an inexpensive webapp using an institutions' existing ICT infrastructure. It also demonstrated why stakeholders may still not engage in its use despite its novel design and promise of a financial reward. Ideally this research should be read by university managers at all levels and responsibilities, as its application is multidisciplinary and outlines the importance of stakeholder engagement in greening projects across campus.

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