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Smart Cities and Sustainable Development, Adoption of Green IS Projects in Local Authorities

Research in Progress

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Abstract

Smart city teams working in local authorities may have an important role to play in pursuing Sustainable Development Goals at local level. However, the successful adoption of their projects has been problematic. This research in progress addresses this problem by focusing on the adoption process of Green IS projects led by smart city teams in local authorities and the factors that enable or constrain that process. It presents key findings from a systematic literature review; research gaps and future research directions; a research methodology including a draft framework to guide data collection; and anticipated theoretical and practical contributions.

Keywords: *Green IS, sustainable development, smart cities, technology adoption, public sector*

Introduction

Achieving sustainable development is one of the most important challenges the world is facing at present. Human activity is negatively affecting the natural environment with consequences such as the increase in harmful emissions, loss of biodiversity, erosion, waste and contamination of water (Elliot 2011). In 2015, the United Nations adopted the 2030 Agenda for Sustainable Development, which contains 17 Sustainable Development Goals (SDGs) (UN 2019). Goal 11 focuses on cities and reflects their importance in pursuing the Agenda. Cities represent a big proportion of environmental degradation due to factors such as mobility, energy and water consumption, and waste production (Brauer et al. 2015). As policy makers and catalysts of change, they are well placed to link global goals with the local community (United Cities and Local Governments 2015).

The concept and practice of smart cities has the potential to help deliver the SDGs at local level (Ismagilova et al. 2019). Although it is a popular concept, there is not an accepted common ‘smart city’ definition (Ismagilova et al. 2019; Yigitcanlar et al. 2018;). For the purpose of this study, I selected the following:

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“Smart cities seek to leverage advanced communication technologies and IS in order to improve all areas of city administration, enhance citizens’ quality of life, engage citizens and provide more sustainable and resilient public services” (Corbett and Mellouli 2017 p. 428). In many local authorities, smart city teams have been set up to manage smart city programmes. Generally, they are teams created as emerging governance structures within city authorities that work across city silos and manage or oversee the testing or implementation of new technology and systems. They focus on searching for, testing and implementing emerging technology without engaging in the day-today IT service provision responsibilities (Maccani et al. 2019; Maccani et al. 2020; Ojo et al. 2014) often in collaboration with internal and external stakeholders such as academia, technology companies, international consulting firms and government departments and agencies. They work in complex and collaborative environments rather unique in the public sector. Importantly, in many cases, part of their project portfolio addresses SDGs at local level. However, the successful adoption of their projects has been problematic (Kitchin et al. 2017). Many projects do not achieve business sustainability and others encounter barriers along the way (Borins 2001; Edmondson et al. 2001; McNulty and Ferlie 2004 in Piening 2011). This was a problem also emerging from the practical experience of one of the authors who worked in a smart city team in an Irish local authority.

Initially, technology was seen as a contributor to environmental degradation through its lifecycle. However, there has been a growing awareness that IS can and should be an enabler of sustainability (Chen et al. 2008; Elliot 2011; Gholami et al. 2016; Melville 2010; Vom Brocke et al. 2013; Zheng 2014;; Corbett and Mellouli 2017). This research in progress focuses on the adoption process of environmental smart city projects in local authorities and the factors that enable or constrain that process. Academically, it is positioned in Green IS, which has emerged as a subfield that studies the role of IS in sustainability. Green IS refers to “the design and implementation of information systems that contribute to sustainable business processes” (Watson et al. 2008 p. 2).

This paper presents the findings from a systematic literature review that links Green IS, IS/technology adoption and public sector; research gaps and suggestion for future research directions; proposes a methodology including a draft framework to guide data collection; and it finishes by outlining anticipated theoretical and practical contributions.

Systematic Literature Review

The literature review was completed following Okoli’s (2015) process. The first step is to define the literature review purpose. In this case, the objective is to identify, analyse and synthesise previous academic work in the intersection of the three fields identified above to establish a research gap and formulate a research question.

The second step involves applying a practical screen (inclusion criteria) and searching for literature. In terms of inclusion criteria, it was decided to start the search in leading IS journals¹ in the Information Management category. When no or very few results were found in leading journals, the search was expanded to any journals in the computer science and business categories. The search was conducted in Scopus between July and December 2019 and updated thereafter. The primary terms selected were "Green IS"; "Green IS adoption"; "Green IS public sector"; and "IS/ technology adoption public sector". Those keywords were complemented with related terms to ensure comprehensive results. The reference section of the most cited Green IS papers and Green IS special issues in leading journals were also analysed. In total, the abstracts of 290 papers were analysed to assess suitability. As a result of this process, 88 papers were systematically ordered, analysed, and considered further.

¹ 4*, 4 and 3 in the Association of Business Schools (ABS) ranking- Information Systems Research, MIS Quarterly, Journal of Management Information Systems, Journal of the Association of Information Systems, Computers in Human Behaviour, Decision Support Systems, European Journal of Information Systems, Expert Systems with Applications, Government Information Quarterly, Information and Management, Information and Organization, Information Society, Information Systems Frontiers, Information Systems Journal, Information Technology and People, International Journal of Electronic Commerce, International Journal of Human-computer Studies, Journal of Computer Mediated Communication, Journal of Information Technology, Journal of Strategic Information systems, Journal of the American Society for Information Science and Technology.

The third step involves extracting data and appraising quality. To classify and analyse the papers an excel table was created. There, each of the 88 papers were listed and classified by (1) objective, (2) contribution, (3) unit of analysis, (4) theory employed and/or developed and methodology and (6) whether they studied public or private sector. Following that, papers were divided into three categories: (1) Green IS general (41 papers), (2) Green IS adoption (22 papers) and (3) IS/ technology adoption in public sector (25 papers). During the quality appraisal the papers' quality is to reduce the final number to be reviewed (Okoli 2015). Given that the final number of papers was manageable, it was not necessary to complete this step.

The last step involves synthesising the studies and writing the review. Given the objective of the study, the literature on Green IS adoption in public sector was considered the most relevant. However, for completeness, the general Green IS, Green IS adoption in private sector and IS/technology adoption papers were also synthesised and analysed. During the first phase of the analysis, sub-categories of papers emerged. This classification was refined further as the literature review continued.

Green IS papers were sub-categorised under "general" (15 papers), which were further divided into editorials, panel discussions, reviews and research agendas and frameworks; "business sustainability" (13 papers); "domain specific" (7 papers), which were further divided into energy, climate adaptation and other; and "technology specific" (6 papers).

Green IS adoption papers (22) were sub-categorised under "general" (3 papers); "adoption factors" (16 papers), which were further divided into organisational and non organisational; "adoption outcomes" (3 papers) and lastly, one paper that combined both factors and outcomes.

The IS/ technology adoption in public sector papers (25) were sub-categorised under "eGovernment" (12 papers), which were further divided into internal organisational adoption (e.g. staff) and external adoption (e.g. citizens); and "non-eGovernment" (15 papers).

Summary of Findings

Green IS papers highlight the potential positive contribution IS can have in environmental sustainability and climate change and point to the need for more Green IS research (Elliot and Webster 2017; Gholami et al. 2016; Lane et al. 2010; Malhotra et al. 2013; Vom Brocke et al. 2013). Green IS is still a growing field. It has been argued that the quality of theoretical contributions based on empirical research has been modest and that there is a need to increase the diversity of Green IS research e.g. in terms of organisational diversity, theoretical perspectives and methodological diversity (Elliot and Webster 2017). (Gholami et al. 2016) also suggests starting with a problem in practice rather than with a particular theory to enrich the field.

The excel table developed during the data extraction step revealed a wide variety of theoretical angles in the Green IS category, perhaps a characteristic of a growing field. It also revealed that research in Green IS tends to focus on private sector. Public sector is a heavily underexplored area with only a handful of papers found. Of those studies, two focus on climate change adaptation (Hasan et al. 2017; Smith et al. 2011); one describes how municipalities can transition to eco-sustainability using digital technologies (Butler & Hackney 2015); and two connect smart cities with sustainable development. Brauer et al. (2015) provide an overview of studies on environmental sustainability in smart cities and present a research framework to guide further research while Corbett & Mellouli (2017) create a model to explain how an integrated information ecosystem enables interactions between the administrative, political and sustainability spheres to support the development of smart sustainable cities.

The Green IS adoption papers offer a wide range of factors that might influence adoption at organisational level e.g. strategy definition, organizational support, motivation, and traceability (Seidel et al., 2010); institutional pressure (Chen et al. 2011); strategy (Zheng 2014); manager's personal beliefs, values, attitudes, psychological drivers and awareness (Baggia et al. 2016; Esfahani et al. 2017). Four papers resonate with the focus of this study- exploring the adoption process of Green IS projects in local authorities and the factors that enable or constrain that process – and the experience in practice of one of the authors who worked on a smart city team. Lei and Ngai (2012) present a theoretical framework on the assimilation of Green IS in organisations; two studies (Esfahani et al. 2015; Hedman and Henningsson 2016) mention the role of champions, a figure that can be central to support the development and adoption of smart

cities projects; and finally (Esfahani et al. 2015) found that the decision to adopt is based on a mix of pragmatic (e.g. financial and legal) and idealistic (e.g. moral and ethical) factors.

Papers in the IS/ technology adoption in public sector category also show a variety of angles. Some papers focus on particular types of technology in a certain context and others in certain specific factors e.g. compulsory adoption of electronic communication (Henriksen and Damsgaard 2007); ICT adoption to improve interactions between government and staff in a government organization in a developing country (Gupta et al. 2008); how layers of authority influence the adoption or rejection of technology (Standing et al. 2009); factors that influence internal adoption decisions to use social media applications (Mergel 2013); adoption of electronic health records (EHRs) in ambulatory medical practices (Sherer et al. 2016); automatic use of technology beyond conscious awareness based on habit or automaticity (Kroenung et al. 2017). The excel table revealed that the papers in this category are less varied theoretically. They tend to employ well-known technology adoption models such as UTUAT.

While both the studies in the categories of Green IS adoption and IS/ technology adoption in public sector cover a variety of angles it was found that none studied holistically, empirically and comparatively the adoption process of Green IS developed in complex and collaborative environments as the ones in which smart cities teams operate. In that context, usually, there are internal and external stakeholders implicated in the process and a variety of factors that may influence at different stages, some maybe unique to the public sector such as political support and public procurement policies. They also seem to neglect to consider when factors appear, how they influence the adoption process or how the teams employ them to their advantage (enablers) or overcome them (barriers).

Research gaps

The SLR revealed several gaps in Green IS literature that point to possible future research areas:

- Green IS studies in public sector organisations. Out of forty-one papers in the Green IS category, only five focused on public sector. In the Green IS adoption category the number was zero.
- Green IS studies focused on smart city projects. Only two papers were found and the authors believe that the complex and collaborative environments as the ones in which smart cities teams operate merit separate attention.
- Holistic empirical studies that explore the organisational adoption of Green IS as process. Lei and Ngai (2012) present a theoretical framework on the assimilation of Green IS in organisations; however, the empirical study was not published.

Green IS literature also points to important gaps:

- Studies that theoretically contribute to Green IS based on empirical research (Elliot and Webster 2017).
- Studies that increase the diversity of Green IS research e.g. in terms of organisational diversity, theoretical perspectives and methodological diversity (Elliot and Webster 2017).

Based on those findings, a research question and research objectives were formulated:

R.Q: How do different factors influence the adoption process of Green IS projects led by smart cities teams in local authorities?

This research question was broken down into four sub-objectives:

1. To gain an in depth understanding of the adoption process of Green IS projects led by smart cities teams in different local authorities in Ireland and UK in order to capture its complexity and assess similarities, differences and influencing factors.
2. To identify macro (e.g. national policy), meso (organisational) and micro (individual/technology) level factors that may influence the process at different stages.
3. To identify stakeholders present during the process and explore their experiences to achieve a comprehensive understanding from different perspectives and capture the multi-stakeholder nature of these projects.
4. To generate knowledge to guide the adoption process of Green IS projects in local authorities.

Proposed Methodology

The adoption process of smart city projects can be very complex and context dependent, with various stakeholders involved and factors at different levels that influence the process. Therefore, in order to achieve the four objectives stated above it was decided to employ a qualitative, inductive approach.

Qualitative studies are suitable to understand complex process. They allow deep immersion in the phenomena being studied to collect rich data (Eisenhardt et al. 2016) with attention to detail, context and nuance (Patton, 2015). They also allow to capture individuals' experiences and interpretations in their own words (Graebner et al. 2012), which is particularly important in this study as the main source of information will be the stakeholders involved in the projects.

The method chosen is in-depth multiple case studies. Case studies are considered a suitable research approach when exploring emerging complex phenomena within real-life settings, such as the one presented here (Benbasat et al. 1987; Eisenhardt 1989). They allow to gather multiple perspectives, from a range of sources, including contextual information (Flyvbjerg 2006; Lauckner et al. 2012; Stake 2006;). The multicase study protocol will be based on the approach proposed by Stake (2006) which has 7 steps: defining the phenomenon of interest, selecting the cases to be studied, researching each case study individually, analyse each case study, write individual case reports, analyse cross-case findings and positioning findings in existing literature.

Sampling

Four projects have been purposively selected in four cities the Republic of Ireland and United Kingdom. They present diverse characteristics to provide maximum variation in the data collected (Saunders et al. 2016). The resulting findings will provide detailed descriptions of the individual cases and important shared patterns that cut across them (Patton 2015). The projects focus on: adoption of smart bins, adoption of air quality sensors, adoption of last mile delivery system in urban centres and adoption of pedestrian, cycles and vehicle sensors.

Draft Framework

Inductive research should start as close as possible to the ideal of no prior consultation of the theory and no creation of hypothesis to avoid bias or limiting the findings; however, theory can be employed as an initial guide for data collection (Eisenhardt 1989; Walsham 1995). With that purpose in mind, the literature review papers and several studies in the IT innovation adoption literature² were explored and the following provisional framework to guide data collection was developed:

² (Kamal 2006), (Lei and Ngai 2012), (Rogers 2003); (Venkatesh et al. 2016)

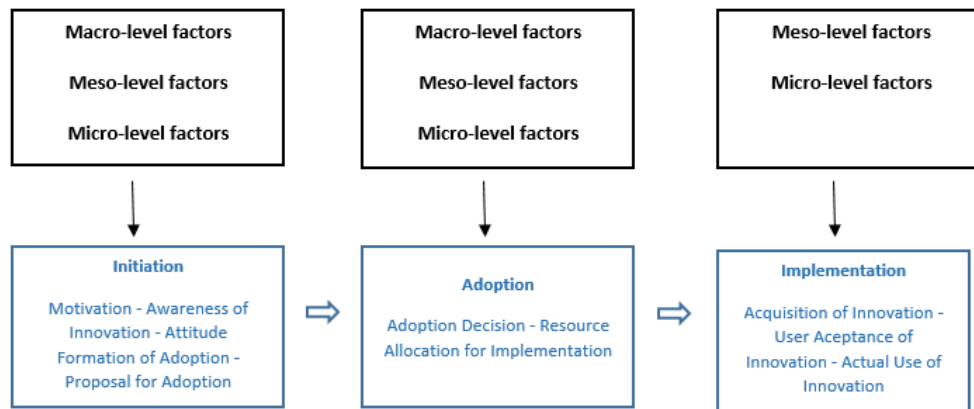


Figure 1 - Draft Framework for Data Collection

Conclusion and expected contributions

This research in progress focuses on the adoption process of Green IS projects in local authorities led by smart city teams and the factors that enable or constrain that process. It has presented the main findings from a systematic literature review; research gaps and suggestions for future research directions; and proposed a methodology including a draft framework to guide data collection.

Theoretically, it is envisaged that this study will contribute to Green IS academic conversation, which has mainly focused on the private sector, extending it to the public sector through a comparative empirical research. It will also contribute to the emerging field that combines of green IS and smart cities following on the footsteps of other authors such as Brauer et al. (2015) and Corbett and Mellouli (2017). From a practitioner's point of view, it aims to provide actionable recommendations about how smart city teams might improve the adoption process, employ enablers and overcome constrains.

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