PACIS 2019

Factors Influencing the Adoption of Environmental Enterprise Systems

Completed Research Paper

Giang Hoang

Alemayehu Molla

Pak-Lok Poon

Abstract

An increasing number of organizations are shifting from spreadsheet-based tools to enterprise-grade software platforms, which we refer as environmental enterprise systems (EES), to manage environmental data, processes, resources, footprints, and commitments. Despite this trend, and in view of differences in EES modules, form and functions, why organizations choose EES software have not been researched. This is an important issue as it reflects, albeit indirectly, organizations' commitment to environmental sustainability. Under the technology-organization-environment (TOE) framework and ecological sustainability context, this study investigated the factors that influence the adoption of EES in four Australian service organizations. The findings indicate limitations of precursor systems, relative advantages and perceived benefits of EES, and software experience of sustainability managers affect the decision to adopt an EES software. Additionally, IT-dependent environmental strategies, the complexity of environmental portfolio management, and commitments to voluntary sustainability reporting requirements influence both the adoption decision as well as the selection of the specific EES module. These findings contribute more nuanced insights to the body of knowledge on Enterprise Systems and Green Information Systems adoption.

Keywords: Environmental enterprise system, Green IS artifact, adoption, TOE

Introduction

Business organizations contribute not only to increasing green-house gas emissions and degradation of natural resources, but also to innovations to mitigate these negative environmental impacts (Wright and Nyberg 2017). Information System(IS) innovations can foster practices to improve environmental sustainability (Loeser et al. 2017). According to Verdantix's 2017 Environmental, Health, and Safety Software report, a number of large organizations (e.g., Seagate, L'Oreal, and Volkswagen) have started to switch from spreadsheet-based standalone systems to integrated enterprise-grade software services that offer a digital platform to manage their environmental data, processes, resources, footprints, and commitments. We use the term "environmental enterprise systems" (EES) to refer to this emerging type of IS artifacts. With the EES investment, business organizations are harvesting both operational and strategic benefits such as environmental data and sustainability report quality; incident, risk, and cost reduction; and sustainability reputation (Hoang et al. 2017). Recent market research indicated that there is a growing number of EES vendors (e.g., Wolters Kluwer_Enablon, Envizi, Siemens, Sphera (IHS

previously), Intelex, Schneider-Electric, SAP, Oracle, and IBM) (Verdantix 2018). Each of these vendors offers an EES platform with a wide range of modules covering energy and waste management, risk and incident management, environmental compliance, and sustainability reporting (Verdantix 2018). Thus, organizations are faced with the challenge of selecting the most relevant EES software platform with a suitable IS infrastructure and the essential EES modules. Also, more importantly, the critical factors that need to be considered in making these decisions are equally challenging. They require balancing technological (e.g., cloud-based platform technology), business (e.g., organizational performance) and ecological requirements (Butler and McGovern 2012). Failure to do so might result in a substantial penalty and loss of market value (c.f. the case of Volkswagen emission control software scandal that costed the company billions in penalty, settlements, remediation and lost market value (ABC-News 2017)).

EES combine the features of enterprise systems (ES) and Green IS. ES are defined as "large-scale, real-time, integrated application-software packages that use the computational, data storage, and data transmission power of modern information technology to support processes, information flows, reporting, and business analytics within and between complex organizations" (Seddon et al. 2010, p. 305 para 2). Green IS refers to "IS-enabled organizational practices and processes that improve environmental and economic performance" (Melville 2010, p. 2 para 1). EES share some common features (e.g., standardized and cross-functional process automation, and centralized database,) with Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Supply Chain Management (SCM) systems. From previous research, it is clear that ES adoption is motivated mainly by the desire to overcome the shortcomings of legacy systems, improve firm performance, reduce costs (Markus and Tanis 2000; Soja and Weistroffer 2016) and respond to competitive pressure (Jia et al. 2017).

However, EES differ from ES due to their specific functions (e.g., utility consumption management, environmental risk management, and responsible/green supply-chain management). As a result, not only do EES possess ES attributes, but they also possess Green IS attributes. From the systematic reviews of Green IS literature (El Idrissi and Corbett 2016; Sedera 2017; Wang et al. 2015a), organizations are motivated to adopt Green IS mainly due to ecological factors. For example, Green IS studies have demonstrated that employees' and managers' sustainability perceptions (Gholami et al. 2013) and mimetic ecological sustainability pressures (Chen et al. 2011) played critical roles to Green IS adoption decision. On the other hand, Bose and Luo (2011) and Jenkin et al. (2011) postulated that Green IS adoption could be driven by technological, political-economic, socio-cultural, organizational forces and business environmental conditions of organizations. Furthermore, Wang et al. (2015b) linked Green IS adoption to structural features, organizational spirit, managers' leadership, goal ambiguity, and resource dependency.

These lead us to argue that the factors that influence the adoption of EES might include a mix of ES and Green IS imperatives combining technological, organizational, environmental and ecological drivers. The above discussions lead to the research question:

RQ1: What factors influence the adoption of environmental enterprise systems?

The rest of the paper is organized as follows. First, we reviewed the literature on the adoption of ES and Green IS. This is followed by section 3 which highlights the research settings; section 4 the result of the interview transcription analysis. In section 5, we present and discuss the contextualization of EES adoption. The paper concludes with implications for practitioners and Green IS literature as well as the suggestions for future studies.

Literature Review

As EES are rooted in ES and Green IS, this paper examines the literature of ES and Green IS adoption under the lens of the Technology-Organization-Environment (TOE) framework and ecological sustainability context. The TOE framework accounts for three sets of factors affecting the adoption of innovation (Tornatzky et al. (1990). It has been widely used in IS research as a generic foundation to structure and explain the antecedents for the adoption, implementation, and use of different innovations (Bose and Luo 2011; Chong and Olesen 2017). For example, organizations are motivated to adopt

enterprise systems because of technological (e.g., shortcomings of legacy systems and system integration); managerial and strategic performance (e.g., cost reduction and process improvement) considerations (Oliver and Romm 2002; Velcu 2007); and as a response to suppliers' and partners' norms and competitive pressures (Soja and Weistroffer 2016). However, the ES literature has not analysed the importance of energy and carbon management, environmental risk management, and sustainability goal achievement expectations at either managerial or strategic levels nor does it cover the nuances of environmental data and process management challenges.

We also researched the Green IS literature. Six categories of factors have been suggested as critical in the adoption of Green IS. These categories are technological, political-economic, socio-cultural, organizational, ecological (Jenkin et al. 2011) and environmental performance factors (Wang et al. 2015b). Similar to ES literature, technological factors include the relative advantages of new systems, compatibility with the existing IT infrastructure and complexity of new technologies (Chong and Olesen 2017); whereas, organizational factors reflect the leadership, internal stakeholders (including staff members and senior managers), processes, structures, policies, strategies and financial considerations (Chong and Olesen 2017; Jenkin et al. 2011). Political-economic factors are related to environmental regulations and laws (Jenkin et al. 2011). The socio-cultural factors refer to institutional pressures or industrial/social norm (Chen et al. 2011; Molla and Abareshi 2012). Finally, the desire to improve environmental and ecological performance could foster the adoption of Green IS (Molla 2009; Wang et al. 2015b). A systematic literature review of Green IT/IS adoption has also indicated that, in addition to external pressures (e.g., external stakeholders' requirements and legitimacy), employees' environmental responsibility and engagement played an important role in motivating Green IS adoption (Sedera (2017) conducted. Nevertheless, the Green IS literature has focused on the "generic" Green IT/IS adoption (e.g., green manufacturing technologies, smart building, and video conferencing), but not on the specific IS artifact for environmental sustainability using enterprise-grade service platform (i.e., using EES-software to manage environmental impact).

The literature on ES and Green IS adoption provided sensitizing insights to address the research question. We build on this literature to explore and identify the specific factors that organizations are considering in their decision to adopt EES and select relevant modules.

Research settings

Research method

A case study method was selected for this research based on two reasons. First, EES are emerging, and complex types of Green IS (Wang et al. 2015b). They also reflect a new direction of organizational efforts to manage and reduce environmental impact. Thus, a case study is a useful methodology to explore a contemporary and complex phenomenon (Yin 2014). Second, a case study is relevant to explore specific factors (Yin 2014). EES share attributes of both Green IS and ES. But as a specific IS artifact for environmental sustainability management using enterprise-grade platform service technology, it is important to identify the EES specific factors that organizations consider in their decision; the extent to which these factors are dominated by either ES or green imperatives and the balancing act of both green and business goals

Because EES is an emerging product, a full list of organizations that have implemented EES is not available in the market. To identify the case organizations that have adopted EES in Australia, one of the authors attended the 2017 Melbourne Sustainable Performance Forum, where newly developed functions of EES products and successful business cases of EES implementation were reported. A number of organizations (large Australian organizations from different sectors that had implemented EES for more than a year) were identified and approached to participate in the study, but only four agreed to participate. The four cases use EES products from two different software vendors. One of the vendors focuses more on energy management while the other includes various aspects of environmental management. The four organizations were also spread across education, real estate, finance, and utility sectors. For each of the four cases, data were collected through in-depth interviews (60-90 minutes each) and related archival documents. The target interviewees were the persons that play a crucial role in selecting, adopting and implementing EES.

Cases background

Each of the cases are briefly introduced after the summary information in Table 1.

Table 1: Case studies background information

	Education	Finance	Real Estate	Utility
Interviewee job title and [experience]	Utility Manager [3 years]	Director of Sustainable Business [2 years]	Sustainability Manager [9 years]	Risk, Insurance & Compliance Manager [3 years]
Additional information	Website, "Sustainability Program"	Website, "Sustainability"	A Case Study of Partnership with EES vendor.	Presentation Slides at the Sustainable Performance Forum
EES vendor	ENVIZI	ENVIZI	ENVIZI	ENABLON
Year adopted	2013	2015	2010	2014
Mode of adoption	Cloud-based	Cloud-based	Cloud-based	On-premise
Main use	Energy efficiency	Carbon neutral & Reporting culture	Co-development of building optimization	Enterprise Risk Management
Modules implemented	Sustainability Reporting, Interval Meter Monitoring, and Solar Monitoring	Sustainability Reporting, Program Reporting Measurement & Verification	Sustainability Reporting, Building Energy Optimization, and Asset Performance Management	Enterprise Risk Management
Project Champion	Property Services – Chief Operating Officer (COO)	Sustainable Business Division, COO & Chief Financial Officer (CFO)	Sustainability & Assets Management Division	Risk, Insurance and Compliance Division & CFO
Primary users (number & role)	*Number*: One *Role*: Asset and verification manager (x1)	*Number:* Fifteen *Role:* Administrator (x1), Facility Manager (x1), Sustainable Business Manager (x1), and Analytic and Reporting Managers (x12).	*Number:* Nineteen *Role:* Administrator (x1), Analytic and Reporting Managers (x6), and Building operational managers (x12).	*Number:* Seven *Role:* Administrator (x1), Analytic and Reporting Managers (x6).
Indirect users	Students, researchers, senior managers, and investors	Investors, community, suppliers and senior managers	Maintenance contractors, senior managers, customers and investors	Field-based teams to input data and senior managers

Education is Australia's largest and most global tertiary university, with over 80,000 students and over 5,000 staff. Its property portfolio comprises over 130 buildings within Australia and a number of buildings on overseas campuses. Its sustainability report aligns with the Global Reporting Initiative-G4 sustainability reporting framework and the United Nations Global Compact. The University is firmly committed to transforming its own built environment to create sustainable and resilient cities.

Finance is one of the largest and oldest Australian companies with several branches and more than 12 million customers. It is a multinational financial institution, operating all over the world. However, most of its office buildings are leased. Finance has a carbon neutrality sustainability strategy, achieved that strategy several years ago and planned to maintain it up to 2020.

Real Estate is one of the largest commercial property portfolios in Australia, a publicly listed Australian real estate investment trust. It develops, owns and manages a diverse portfolio of commercial retail, office and logistics buildings predominantly across Australia's seaboard. Its property portfolio contains about AU$20 billion in assets under management. In the last decade, Real Estate has implemented a facility management optimization strategy based on the ISO 14001 Environmental Management System. This strategy integrates the optimization of building-level asset management, energy management, operational efficiency, and waste and water management to enhance the performance of the buildings across its portfolio.

Utility is a public service provider of drinking and recycled water and manages water supply catchments, sewage treatment and rivers, creeks and major drainage systems. Utility manages a significant number of natural assets such as over 150,000 ha protected catchments, several storage reservoirs (capacity around thousands of billion liters), and around 1,500km underground drains. It also controls several treatment plans, hundreds of monitoring stations and urban lakes, thousands of rivers and creeks. The volume of drinking water supplied, and sewage treated is over hundreds of billion liters.

Data analysis

Data are analyzed following the guideline of Miles et al. (2014) in two rounds of coding. Table 2 gives an example of the two-round coding process. The first-round coding is an open coding process (Corbin and Strauss 2015) which inductively interpreted all the transcribed interviews line-by-line. This process resulted in a number of unique open codes. The second-round coding involved creative coding (Miles et al. 2014) and involved grouping the unique codes in the previous round based on underlying patterns. The two rounds of coding were interactive and iterative. After one of the authors generated initial open codes, all the authors checked, discussed, and agreed on the final codes and conceptual categories. The TOE framework and the ecological sustainability context has then been applied to structure the findings.

Table 2. Examples of two rounds of the coding process

Category - Second Round	Sub-category - First round	Citation log	Source
Limitation of pre-cursor environmental management information systems	• […]	*[…]*	[…]
	• Quality and integrity of data	*You could run multiple spreadsheets with multiple buildings are collecting, for instances, electricity bill information every month on every building. And those spreadsheets very quickly become unwieldy, unreliable or easily corrupted records.*	Real Estate
	• Tracking environmental footprints	*[…] read those [older brick] buildings energy consumption with Excel sheets… would take a lot longer and it would be a lot more involved process […].*	Education
	• Dash-boarding and analytical functions	*What we had historically was a very old custom build system that had its only services over documented incidents, and it did not have anything fancy than that. There is a real requirement to do, to try and that is to produce the analytical pieces […]*	Utility
	• […]	*[…]*	[…]

Findings

The main findings of the exploratory study are summarised in Table 4 and discussed in the following subsections. Generally speaking, there were four categories of critical factors (i.e., technological, organizational, strategic and institutional factors) that influenced the adoption of EES. On the other hand, EES modules' selection was mainly affected by organizational (i.e., the complexity of business portfolio management), and strategic factor (i.e., IT-dependent environmental strategies and voluntary disclosure requirements) did (see Section 4.2 and 4.4 for details).

Technological factors

Although improving environmental sustainability has brought opportunity for new products, services or market development, it imposed a number of challenges on the environmental management information systems (EMIS) of organizations. All the four cases had faced several problems with their precursor EMIS such as the inability to handle high volume environmental data from a variety of data sources, the inconsistency of data and lack of capacity to track environmental performance effectively.

> *So, you could run multiple spreadsheets with multiple buildings are collecting, for instances, electricity bill information every month on every building. And those spreadsheets very quickly become unwieldy, unreliable or easily corrupted records. (Real Estate)*

> *I am talking thousands of risks across [Utility]; they were all being undertaken through Excel spreadsheets, so we have a lot of issues with data integrity. […] There is no way you try to migrate 300-400 risk registers across the organization. […] And again, we have never been able to say when an incident occurred, did we break any compliance obligation and what compliance obligation did we break, what reporting are we require to do externally on that and what are the consequences associated with. (Utility)*

Two out of the four cases were suffering from the lack of data analytic functions (e.g., dash-boarding and analytic tools) for organizational decision-makers:

> *And people are basically not being held to account, not having any meaningful management actions that sit behind that, and just no ability to do sort of data analytics at all. (Utility)*

> *Another limitation that encourages organizations to consider EES adoption is the lack of understanding of environmental risks and incidents as well as environmental footprint when using spreadsheets which lead to difficulties in organizational administration activities. […] one of the biggest drivers was to understand better what our risks were across our whole enterprise and to remove duplication [...] (Utility)*

In view of these limitations, EES offered a number of advantages compared to legacy systems such as the automation of environmental data collection (e.g. energy (electricity, gas, fuel, and solar), water, waste, travel, emission, risk, and incident), consolidated and centralised data management system, and reduction of time and effort required to generate external and internal sustainability reports. These advantages have played a critical role in the decision to adopt EES.

> *A range of connectors allowed automated data transfer into [EES software]. All about electricity billing information is loaded through an electronic connector. So that is a seamless automatic process […] (Real Estate)*

> *Well, it is automatic. They built connectors, and its connections […] All of that is straight up data. […] It integrated with EDI (electronic data interchange). (Finance)*

> *The first time, we had a consolidated risk view, business-wise […] (Utility)*

> *So really it brings out to consolidate to one system which is our driver. (Education)*

> *It would take until April or May [to consolidate and generate a sustainability report from 1st Jan] [...] And there were probably 3-4 people, not full-time, spending a period of time for consolidating […] This year in the first week of January, we push the button to generate a report. (Real Estate)*

Also, having a platform rather than a single system that can easily and efficiently track strategic targets and integrate with other internal and external systems was another driver reported by the cases.

> *The portfolio benchmarking is possible with a single enterprise-wide platform provides executives with insights into which buildings are lagging behind in performance and which investments are most successful and are appropriate for a broader roll-out. (Real Estate)*

> *So, another third-party platform [solar monitoring platform] and what we want to do is integrated that and then bring into one source of truth. (Education)*

These limitations and relative advantages gave rise to the business factors (e.g., leadership, financial benefits, and continuously improving efficiency) that organizations have to face with.

Organizational factors

Related to the relative advantage of EES, decision makers' expectation of benefits was an important factor in influencing EES adoption. The most common anticipated benefit across all cases was environmental data reliability and efficiency gains. Other benefits include building environmental leadership and reputation for the Finance and Utility companies and meeting the expectation of communities (Finance and Real Estate cases).

> *We would make significant efficiency gains, data reliability gains by moving to a web-based database type system. […] an Australian company is being ranked in a best practice globally and in managing those environmental impacts. (Real Estate)*

> *So, it is efficiency performance and assurance too; it is better than having majority spreadsheets. Carbon neutrality is something we have committed to, […] and it is an important component of our commitment to Green Star rating. (Finance)*

> *One of the biggest drivers at that stage, we are trying to jump into the leadership thing that was why we needed it, […]. (Utility)*

The four cases differ in terms of business assets, resources, and risk portfolios. The complexity of managing these portfolios effectively, which is commonly known to be a weakness of legacy EMIS, was another consideration in strengthening the need for EES adoption. For example, the variety of environmental risks and incidents was one of the key factors that stimulated the Utility company to implement EES. On the other hand, for the Education and Real Estate cases, effectively managing a number of buildings and associated energy consumption were important. The Finance case was interested in managing energy-related and other carbon emissions.

> *We did everything go into the risks and incidents across the organization, from an environmental perspective that could be: odor issues, noise, land contamination, many issues of flora or flooding or bushfire or grass fire; water pollution events, spills […] (Utility)*

> *… when you got about 140 [buildings] that a lot, a lot of works to do. (Education)*

> *We include Scope 3 emission sources [other indirect GHG – CDP framework], so paper, fleets, air-travel, waste-water, building areas, accounting assets performance. (Finance)*

> *Because we have many buildings across the number of states, the measurement in Accounting Practice to understand that environmental footprint was a very laborious, difficult process. […] So, there is a degree of effort required on both parts […] to understand all of these various classifications of group, portfolio, building, meter, account, level. (Real Estate)*

Table 4. Critical factors of that influence EES adoptions

Critical factors			Education	Finance	Real Estate	Utility
Technological factors	Limitations of pre-cursor environmental management information systems	Handling a variety of data with volume	✓	✓	✓	✓
		Quality and integrity of data	✓	✓	✓	✓
		Dash-boarding and analytical function	✓	✓		✓
		Tracking of environmental footprints	✓	✓	✓	✓
		Understand risk and environmental footprint				✓
		Severity of environmental data and information management challenge in an organization	✓	✓		✓
	Relative advantage of EES	automate environmental (energy, water, waste, emission, risk, incident) data collection	✓	✓	✓	
		consolidate and provide a single source of truth for environmental information	✓		✓	✓
		reduce the time and effort required to meet external and internal reporting requirements	✓	✓	✓	✓
		provide a platform rather than a single system approach	✓	✓		
		easily and efficiently track strategic targets	✓	✓	✓	✓
		integrate with other internal and external systems	✓	✓		✓
Organizational factors	Perceived benefits	Efficiency gains & Data reliability gains	✓	✓	✓	✓
		Leadership/ Reputation gains		✓		✓
		Community satisfaction gains		✓	✓	
	Complexity of portfolio management	Asset portfolio management	✓		✓	
		GHG emissions (energy) portfolio	✓	✓	✓	
		Waste portfolio	✓			
		Risk portfolio				✓
	Software experience of sustainability managers	Entrepreneurial orientation of sustainability managers about EES, ES, EMIS projects	✓	✓	✓	✓
Strategic factors	IT-dependent sustainability strategies	Building control and optimization	✓		✓	
		Carbon emission (includes Energy consumption) reduction	✓	✓	✓	
		Risk reduction				✓
		Better reporting and accountability culture		✓	✓	✓
	Voluntary external reporting commitments [1]	United Nation Global Compact – UNGC	✓			✓
		Global Reporting Initiative - GRI	✓	✓		
		Carbon Project Disclosure – CDP		✓	✓	
		Dow Jones Sustainability Index – DJSI		✓	✓	
Institutional factors	Mandatory environmental reports	NGERS - National Greenhouse and Energy Reporting Scheme	✓	✓	✓	
		NABERS – National Australian Built Environment Rating System		✓		

[1] One may argue that "voluntary external reporting commitments" can also be regarded as institutional factors. We thank the anonymous reviewer for this point of view.

As indicated in Table 3, in all four cases, organizational sustainability units, instead of IT departments, championed the implementation of EES. As a result, the information systems experience of organization's sustainability managers and in particular whether these managers have been exposed to or had prior experience of EES products played a significant influence on both how they perceive the potential of EES as well as the decision of which EES vendor to choose.

> *Compare to the previous Educational Institution [where Interviewee used to work with the same EES software]; they [the factors that influenced the adoption of EES software] are more or less the same; it is the same approach. (Education)*

> *I started my career as a consultant of A [one of the Big Four Accounting Firms], there was a lot of Federal Government consulting works; a lot of risk management focuses and also fraud prevention as well. (Utility)*

Institutional factors

With the growing trend of sustainability business globally, business organizations are required and encouraged to provide mandatory sustainability reports to investors and regulators. These requirements fostered the need to report environmental information with accuracy, reliability, traceability, assurance, and integrity. In addition, organizations have to comply with different environmental obligations and satisfy a variety of sustainability reporting frameworks.

> *Our investors encourage us to participate in […] the Carbon Disclosure Project (CDP). … We also report to a Dow Jones Sustainability Index (DJSI) and MSCI-ESG [Morgan Stanley Capital International-Environmental, Social, and Governance] index … And we also report to the Global real estate sustainability benchmark (GRESB). (Real Estate)*

> *Investor's interests [Yes]. That is a part of sustainability reporting and, also CDP, DJSI. (Finance)*

These mandatory requirements encouraged organizations to seek for EES in order to understand better their environmental impact and footprint.

Strategic factors

Business activities which increasingly contributed to the worsening of adverse environmental impact (e.g., natural resources' depletion, greenhouse gases emissions' rise, sea-level rise and climate change) left organizations with no choice but to respond by modifying and altering their sustainability strategies as well as committing to voluntary environmental disclosures.

For example, the commitment of the Education and Real Estate cases to a range of sustainability reporting systems has highlighted the limitations of meeting those expectations with spreadsheet-based systems and added to the business case for a system with better reporting features.

> *And we do have a number of other reporting requirements externally, but they often tend to be voluntary or membership … the United Nation Global Compact (UNGC) […] we make out those requirements through the Global Reporting Initiative (GRI) reports. (Education)*

> *And of course, that interest [accounting for environmental and social impacts] was amplified as programs like the Greenhouse challenge program [Carbon Project Disclosure-CDP] which really encouraged Australian corporations … the need for further amplification was when mandatory requirements came in under the NGERS - National greenhouse and energy reporting scheme act. (Real Estate)*

IT-dependent sustainability strategies are organizational strategies for mitigating its environmental impact that has been developed by exploiting EES advancement. These sustainability strategies were also aligned with the complexity of portfolio management. The complexity of asset and waste-contractor portfolio management may result in a building control and optimization strategy in the Real Estate case, while the carbon emissions and risk portfolio management lead to the raises of a new carbon neutral strategy and sustainability risk assessment strategy in the Finance and the Utility respectively.

> *And then we just released our new strategies, a science-based target around carbon emissions reduction. So, [EES software] enables our commitments around carbon neutral new strategies, … [and] provides the underlying data to those strategic pillars. (Finance)*

> *[…] one of the biggest drivers was to better understand what our risks were across our whole Enterprise […] and implementing [environmental] mitigation strategies effectively in line with our risk appetite. (Utility)*

Although these two cases had different IT-dependency environmental strategies, they, at the same time, based on these strategies to follow a better reporting and accountability culture to satisfy external and internal sustainability reporting requirements as well as communicate to and engage their staffs.

> *That was the number one aim. All is about the reporting culture […] You are never going to drive a reporting culture across the organization, and that gives no ability to continue to identify where we got control weaknesses and where we need to improve on. (Utility)*

> *Well, we are using [EES software] with full potential […] saying how the energy changes or the water and waste changes based on what we are doing. And using that to communicate and engage with our staffs. (Finance)*

Discussions and Conclusion

As an emerging type of Green IS - environmental enterprise systems (EES) are beginning to diffuse among organizations in some industry sectors. This paper explored what factors influence the EES adoption and EES modules' selection. The overall finding of this exploratory study demonstrates that a combination of technological, organizational, strategic and institutional factors is contributing to firms' decision to switch from spreadsheets to EES adoption as well as the selection of specific EES vendor and modules. Although there are variations across the cases in terms of the importance of different drivers, factors such as the limitations of precursor environmental management information systems to provide high quality data that allows effective tracking of environmental impacts as well as the perceived ease and efficiency of generating sustainability reports from EES and software experience of sustainability manager are common drivers across the different cases. However, the influence of organizational and strategic factors on EES modules' selection is undeniable. For example, given the complexity of environmental portfolio management, IT-dependency of sustainability strategies, and perceived environmental benefits, organizations would select different EES implementation strategy (e.g., platform versus on-premise or subscribe/buy versus co-develop EES model). It means that they adopt EES with unique sets of functionalities, implementation strategies, and operational ways.

Another dimension is the interaction of the TOE factors that motivate organizations to adopt various types of EES functionalities. For example, the Real Estate followed a building control and optimization and energy consumption reduction strategies which reflect the complexity of its assets and energy portfolio management. It was also seeking to increase the energy efficiency of its buildings, improve the quality and reliability of data about the performance (both operationally and environmentally) of its buildings as well as improve its reputation within the community as an eco-responsible business. These factors led the organization to opt for private EES platform co-development in partnership with the software vendor. Whereas, the Finance case had some similarities with the Real Estate such as energy consumption and carbon emissions portfolio management. However, it did not perceive leadership benefit as most of its assets was leased. Instead, its strategy was to develop better reporting and accountability culture. As a result, it opted for public EES platform subscription focusing on modules that control and manage sustainability and compliance reports. Furthermore, the Education case, whose desire was energy and water consumption monitoring and verification from its suite of buildings selected a public EES platform subscription with sustainability reporting and interval meter monitoring modules. On the other hand, the Utility Company chose a completely different vendor to install an EES in-house (software as a product) although there was a platform version available due to its strategy for environmental risk reduction and better reporting culture and its focus on understanding and managing risk and incident portfolios.

These findings add much-needed evidence to Green IS adoption literature. In particular, they add case evidence to the works of Jenkin et al. (2011) and Wang et al. (2015b) that have proposed that Green IS initiatives' adoption can be influenced by organizational/internal forces (e.g., manager's experience, leadership, and sustainability strategies) and external forces (e.g., regulatory-market forces (regulations, laws, and external standards), and technological forces (efficient environmental sustainability technology and processes)). In particular, the paper identifies the importance of strategic consideration as an additional motivational factor in Green IS adoption.

In terms of practice, this research provides an understanding of what factors influence EES adoption, how organizational context factor affected on the decision to adopt EES of business organizations (e.g., functionality selection and EES-dependent sustainability strategies). It is undeniable that each of the organizations with the distinctive requirement of business portfolio management and IT-dependent environmental strategies adopted EES functionalities differently, even some of them adopted the same EES software (i.e., ENVIZI).

This paper has some limitations. First, the number of cases (four cases) and stakeholders per case (one senior manager per case) are limited. Although the data was triangulated through archival documents, future studies with multiple stakeholders will enhance and enrich the findings. Second, our participants mostly came from the service sector. Future studies involving other sectors such as manufacturing, and transport and logistics can help to enrich industry-specific factors for EES adoption that can be shared with other similar organizations. Also, investigating the processes and challenges of EES adoption and module selection offers an additional avenue for future research.

References

ABC-News. 2017. "Volkswagen to Pay Us$2.8 Billion in Emissions Scandal, Judge Orders." Retrieved 23rd August, 2017, from http://www.abc.net.au/news/2017-04-22/volkswagen-fined-billions-in-emissions-scandal/8463180

Bose, R., and Luo, X. 2011. "Integrative Framework for Assessing Firms' Potential to Undertake Green It Initiatives Via Virtualization – a Theoretical Perspective," *The Journal of Strategic Information Systems* (20:1), pp. 38-54.

Butler, T., and McGovern, D. 2012. "A Conceptual Model and Is Framework for the Design and Adoption of Environmental Compliance Management Systems," *Information Systems Frontiers* (14:2), pp. 221-235.

Chen, A., J., Watson, R., T., Boudreau, M.-C., and Karahanna, E. 2011. "An Institutional Perspective on the Adoption of Green Is & It," *Australasian Journal of Information Systems* (17:1), pp. 1-27.

Chong, J. L., and Olesen, K. 2017. "A Technology-Organization-Environment Perspective on Eco-Effectiveness: A Meta-Analysis," *Australasian Journal of Information Systems* (21), pp. 1-26.

El Idrissi, S. C., and Corbett, J. 2016. "Green Is Research: A Modernity Perspective," *Communications of the Association for Information Systems* (38:30), pp. 596-623.

Gholami, R., Sulaiman, A. B., Ramayah, T., and Molla, A. 2013. "Senior Managers' Perception on Green Information Systems (Is) Adoption and Environmental Performance: Results from a Field Survey," *Information & Management* (50:7), pp. 431-438.

Hoang, G., Molla, A., and Poon, P.-L. 2017. "An Exploratory Study into the Use and Value of Environmental Enterprise Systems," in: *Proceedings of the Australasian Conference on Information Systems 2017*. Hobart, Australia: ACIS 2017.

Jenkin, T. A., Webster, J., and McShane, L. 2011. "An Agenda for 'Green' Information Technology and Systems Research," *Information and Organization* (21:1), pp. 17-40.

Jia, Q., Guo, Y., and Barnes, S. J. 2017. "Enterprise 2.0 Post-Adoption: Extending the Information System Continuance Model Based on the Technology-Organization-Environment Framework," *Computers in Human Behavior* (67), pp. 95-105.

Loeser, F., Recker, J., Brocke, J. v., Molla, A., and Zarnekow, R. 2017. "How It Executives Create Organizational Benefits by Translating Environmental Strategies into Green Is Initiatives," *Information Systems Journal* (27:4), pp. 503-553.

Markus, M. L., and Tanis, C. 2000. "The Enterprise Systems Experience-from Adoption to Success," in *Framing the Domains of It Research: Glimpsing the Future through the Past*, R.W. Zmud (ed.). Cincinnati, Ohio: Pinnaflex Educational Resources, pp. 173-207.

Melville, N. P. 2010. "Information Systems Innovation for Environmental Sustainability," *MIS Quarterly* (34:1), pp. 1-21.

Molla, A. 2009. "Organizational Motivations for Green It: Exploring Green It Matrix and Motivation Models," in: *Proceedings of Pacific Asia Conference on Information Systems 2009* Hyderabad, India: AIS Electronic Library (AISeL).

Molla, A., and Abareshi, A. 2012. "Organizational Green Motivations for Information Technology: Empirical Study," *Journal of Computer Information Systems* (52:3), pp. 92-102.

Oliver, D., and Romm, C. 2002. "Justifying Enterprise Resource Planning Adoption," *Journal of Information Technology* (17:4), pp. 199-213.

Seddon, P. B., Calvert, C., and Yang, S. 2010. "A Multi-Project Model of Key Factors Affecting Organizational Benefits from Enterprise Systems," *MIS Quarterly* (34:2), pp. 305-328.

Sedera, D. 2017. "Multi-Disciplinary Green It Archival Analysis: A Pathway for Future Studies," *Communications of the Association for Information Systems* (41:Article 28), pp. 674-733.

Soja, P., and Weistroffer, H. R. 2016. "Motivations for Enterprise System Adoption in Transition Economies: Insights from Poland," *Enterprise Information Systems* (10:5), pp. 563-580.

Tornatzky, L. G., Fleischer, M., and Chakrabarti, A. K. 1990. *Processes of Technological Innovation*. Lexington, MA: Lexington Books.

Velcu, O. 2007. "Exploring the Effects of Erp Systems on Organizational Performance: Evidence from Finnish Companies," *Industrial Management & Data Systems* (107:9), pp. 1316-1334.

Verdantix. 2018. "Green Quadrant Facility Optimization Software."

Wang, X., Brooks, S., and Sarker, S. 2015a. "A Review of Green Is Research and Directions for Future Studies," *Communications of the Association for Information Systems* (37:1), pp. 395-429.

Wang, X., Brooks, S., and Sarker, S. 2015b. "Understanding Green Is Initiatives: A Multi-Theoretical Framework," *CAIS* (37:Article 32), pp. 670-704.

Wright, C., and Nyberg, D. 2017. "An Inconvenient Truth: How Organizations Translate Climate Change into Business as Usual," *Academy of Management Journal* (60:5), pp. 1633-1661.

Yin, R. K. 2014. *Case Study Research: Design and Methods*, (5 ed.). SAGE Publishing.