Deployment of Information Systems for Sustainability Reporting and Performance

Completed Research

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Abstract

Though the potential of information systems in sustainability reporting and performance is known, its deployment and impact in business organizations are unclear. Using a qualitative methodology and semi-structured interviews of senior managers in mandatory sustainability reporting context in Australia, and Technology-Organization-Environment (TOE) framework as a theoretical basis, this study analyses the adoption of information systems to sustainability reporting. Some of the salient factors limiting the influence of sustainability information systems found in our study are decentralised nature of sustainability data, inadequate use of the existing systems due to paucity of skills, knowledge and training, narrow focus on compliance, absence of disaggregated insights for operational managers to work on sustainability improvements, time lag between reporting and action, and no serious integration of insights into capital investment decision making processes. Though reporting on sustainability performance enabled by information systems has contributed to cost savings, no clear link to sustainability performance is observed.

Keywords

Sustainability, information systems, Reporting, TOE framework

Introduction

The Information systems are considered a key resource for facilitating the transformation of organizations into more sustainable entities (Watson et al 2010). Facing increasing pressure from governments, customers and other stakeholders to reduce carbon emissions and improve environmental sustainability, business organizations have been enhancing their efforts in the measurement, reporting and improvement of sustainability performance (Melville 2010). Realizing its business value, firms are increasingly adopting sustainability strategies and technologies (Klettner et al 2014). Recognising the link between sustainability and organizational performance, firms have started developing and implementing innovative sustainability practices and reporting them (Eccles et al 2011).

Information is considered a prerequisite for assessing the impact on environment (Gholami et al 2016) and appropriate use of information is fundamental to the improvement of an organization's efficiency (Allenby et al 2001). Therefore, gathering, managing and reporting environmental-related information has been identified as central to the achievement of environmental sustainability (Hertel and Wiesent 2013). In addition to measurement and reporting of sustainability related information, information systems can support the drive for sustainability by enabling changes to organizational processes and/or practices (Brooks et al 2012). Firms are now regularly reporting their sustainability initiatives and performance - some separately and others within their annual financial reports (Melville 2010).

Importance of information reporting and the role of information systems in achieving sustainability goals were highlighted in a recent report by Global Reporting Initiative (GRI) (2017). This report highlighted the importance of accessibility, and advocated integration of sustainability data into reporting cycle as well as into managerial decision-making processes (GRI 2017). Though its relevance and importance are well recognised in the literature, its contribution to the sustainability transformation of organizations is not

known (Seidel et al 2013). Despite potential cost savings and projected improvements in corporate image, managements are hesitant to invest in sustainability initiatives mainly because of the costs and their potential impact on firm's competitive advantage (Nidumolu et al 2009).

Research on sustainability information systems (IS) is still in nascent stage and its emergence as an academic discipline is relatively slow (Gholami et al 2016). Past research focused on benefits of green information systems (Sarkis et al 2013) and empirical work on impact of these information systems on sustainability performance is limited (Benítez-Amado and Walczuch 2012). More empirical research on the sustainability information systems and the information systems-enabled change is called for by many researchers (Gholami et al 2016, Melville 2010 and Cooper & Molla 2017).

Studies on the determinants of environmental reporting have found negative relationship between environmental performance and reporting (Patten 2002) implying that the firms with low levels of sustainability initiatives find it useful to publish extensive sustainability reports. A recent empirical study by Schreck and Raithel (2015) also found an imperfect positive correlation between sustainability reporting and performance and suggested that firms are engaging in 'window dressing' and diverting attention from their unfavourable performance" (Schreck and Raithel, 2015: 766). In fact, Solomon et al (2013) suggest that such reports are mere cosmetic and empty exercises. Thus, it appears the literature is not conclusive with regard to the positive link between sustainability reporting enabled by information systems and sustainability performance. Though literature has explored specific types of systems, beliefs and benefits (Sarkis et al 2013), empirical studies with focus on organizational and geographical contexts and operational details are limited (Watson et al 2010).

Using a technology-organization-environment (TOE) framework as a theoretical basis, and case study research methodology, our study analyses the technological, organizational and external factors that would influence adoption of information systems for sustainability reporting and performance management. This paper first provides a brief review of the literature followed by a description of the research methodology employed in the study. It will then discuss findings and conclusions.

Literature Review

Because of their strategic importance, sustainability issues are investigated by researchers from accounting, environmental engineering, management and information systems disciplines. Sustainability information systems facilitate implementation of sustainable business processes (Watson et al 2010) and helps in the efficient capture, tracking, reporting and management of sustainability information (Sarkis et al 2013). A majority of past research on sustainability IS was on the development of research agendas and theoretical frameworks and empirical studies are limited. For example, Wang et al (2015) developed a multi-theoretical framework to understand adoption and impact of green IS initiatives by incorporating adaptive structuration theory, isomorphism and resource-based view, at technological, organizational, individual and environmental levels. Similarly, Siedel et al. (2013) developed a theoretical framework to better understand IS-enabled organizational change for sustainability, through an interpretive case study of an IT firm. A few empirical studies, however, have emerged in the recent past. Grauler et al (2013), for example, have investigated the attitudes and beliefs of senior managers towards green initiatives while Yang et al (2016) examined the relationship between the green IS infrastructure and green culture.

Though cost savings by implementing IS-enabled sustainability programs are expected (The Climate Group 2008), managements fear that implementing environmentally sustainable technologies and processes may simply add costs and may place their firms at a competitive disadvantage (Nidumolu et al 2009). Investigating how information systems can support environmental sustainability through changes in processes has evolved as a subfield of the discipline of information systems. It is necessary to develop information systems and relevant reporting processes that could provide information on environmental costs and environmental consequences of the choices made by individuals to influence the perceptions of individuals (Watson et al 2012). Adoption of sustainability initiatives is the result of a complex decision-making process that is strongly influenced by the social nature, non-economic priorities and behaviour (Watson et al 2012) and cannot purely be achieved based on economic benefits and self-interest.

A recent report by Global Reporting Initiative (GRI) highlighted the importance of information and information systems in achieving sustainability goals (GRI 2017). Their report identified several challenges including the difficulties of securing a buy-in for environmental information systems, collating

sustainability data across diverse decentralised systems and/or transitioning to new more innovative systems to manage information (GRI 2017). Mismatch between existing cost accounting systems and the inability of existing information systems to capture sustainability related information is also a challenge and limits the ability to prepare reliable sustainability reports (Lee 2011). Financial and non-financial information on environmental costs and impacts in terms of energy, water and other resources and wastes is not available in the current information systems environment (Burritt et al 2002) and new organizational capabilities are required (Melville and Whishant 2012). Though some firms have sophisticated sustainability information systems, their role in sustainability decision making is not known (Frost et al 2012).

Role of information systems in environmental reporting and their transformative power in managing the sustainability performance is not fully known and further empirical studies with focus on operational perspectives and organisational processes are necessary (Melville 2010; Watson et al 2012; Gholami et al 2016; Sarkis et al 2013). Though much of the literature has explored specific types of systems, beliefs and benefits (Sarkis et al 2013), empirical studies with a focus on organizational and geographical contexts and in different types of organizations (other than in IT firms) are rare (Rayman and Akhter 2010). Though some firms have sophisticated information systems that can capture and report sustainability information, their use in decision making context is limited and not known (Frost et al 2012). Though software vendors such as SAP and Oracle, and others such as Intelex, Envizi, Emisoft, Medgate, Startk have introduced applications to support sustainability performance management, their deployment, use and impact on sustainability performance is not known. Given the combination of data types required, absence of standardized methods and processes, and variety of solutions available in the market, the nature of adoption and challenges in different organizational contexts and in different regulatory regimes are not known. This study aims to fill this research gap.

Theoretical Framework

An extensive amount of prior research has examined the adoption and use of technological innovations in firms and used different theories and their combinations in a variety of contexts. The technology-organization and environment (TOE) framework by Tornatzky and Fleischer (1998) is considered appropriate to understand the phenomenon at organizational level when compared with theories such as Technology Acceptance Model (TAM) by Davis et al (1989), diffusion of innovation theory by Rogers (1985), Ajzen's (1991) theory of planned behaviour and Venkatesh et al (2003) unified theory of acceptance and use of technology. TOE framework explains the organizational adoption and use of technology through three elements of a firm's context – organizational, technological and environmental contexts. These influences can represent constraints as well as benefits of technological innovation and can influence each other (Tornatzky and Fleischer, 1998).

This TOE framework considers external factors such as government regulations, firm size, structure of industry sector and competition; internal organizational context refers to the characteristics and resources of the firm such as human resources, skills, culture, management structure and degree of fit, and the technology characteristics that may include the equipment, systems and related processes (Feldman et al 2016, Li et al 2010). This framework helps in explaining the benefits, challenges as well as the impact of the adoption of technologies and integrates the contingent organizational, environmental and technological factors faced by organizations. It has consistent empirical support across various technology and organizational contexts (Oliveira and Martins 2011). Therefore, basing on this broad theoretical framework, data was collected using a semi-structured questionnaire.

Research Methodology

Considering the nature of research questions, a qualitative research methodology that involves case study research was considered appropriate and used in this study (Yin 2009). In doing this research, we have broadly followed the guidelines for conducting interpretive case study research by Klein and Myers (1999). It is a cross-sectional field study (Lillis and Mundy 2005) with focus on the nature of adoption of information systems and its role in facilitating sustainability reporting and performance, and related organizational processes. Semi-structured interviews of senior managers responsible for sustainability strategies and reporting were undertaken in order to understand their perceptions and perspectives.

From a publicly available list of organizations presently reporting greenhouse gas emissions and sustainability performance information under the National Greenhouse and Energy Reporting (NGER) Act in Australia, 150 organizations from a range of industries were selected and approached for participation in this study. Respondents who were senior managers and responsible for sustainability strategy, reporting and performance within each organization were identified, approached and interviewed. This process continued, and new organizations and respondents were identified and interviewed until theoretical saturation was achieved (Strauss and Corbin 1998). Semi-structured interviews were used to develop an understanding of the relevant issues from individual respondent's perspective. In total, 18 respondents from twelve business organizations in finance, mining, construction, logistics and manufacturing were interviewed. All the respondents had an average of 7 years of experience in their organization and were responsible for the preparation of sustainability reports for the firm for at least five years.

Based upon the main research question and the TOE framework, interview questions were broadly designed around two themes. The first theme sought information about the nature of information systems adopted and used to capture and report sustainability information in the case study organizations and associated processes and structures. Second theme refers to the identification of the technology, organization and environmental factors that facilitate and affect their enabling role and their influence on sustainability performance. These questions were loosely structured to give flexibility for the researchers and respondents (Yin 2009) and to take into consideration the variations in the sustainability data, organizational priorities, processes and reporting contexts. The aim is to explore the enabling role of information systems in the production and publication of sustainability reports, consequent process innovations that may potentially lead to sustainability performance improvements and the potential influence on the decision-making processes.

Before collecting the data, two pilot interviews were conducted to test the structure and process of questioning and the validity and relevance of the questions to the study context. Each respondent was interviewed by the researchers for a duration of about 60 to 90 minutes. These research interviews were recorded with prior permission from individual respondents and transcribed for further analysis to improve data validation. Further, data validation was carried out by obtaining validation and confirmation from the individual respondents on the issues captured in the transcripts and by cross-checking with the notes of observations by the researchers. Analysis of interview transcripts was guided by grounded theory techniques to allow important constructs and relationships to emerge from the data, informed by researchers' preconceptions (Strauss and Corbin 2008). Further, publicly available annual sustainability reports and other relevant documents made available by the respondents to the researchers were analysed and used for data validation. Using TOE as a generic framework, interview data was coded to establish key dimensions and checked for inconsistencies. Both the researchers were involved in the interviewing, coding and analysis stages of the research. The next section presents the analysis and findings.

Analysis and Findings

An analysis of the data and findings are placed within the context of the TOE framework adopted in this study. Starting with the technology related factors, this section, explains the influence of organisational factors such as decentralised nature of sustainability data, inadequate use of systems and inadequate skilling of personnel to use the system, absence of disaggregated insights for managers to act, time lag in feedback for actions on sustainability performance and sustainability reports not embedded in the decision-making processes. Finally, how various external factors such as reputation risk, compliance requirements and assurance services have influenced the adaptation of information systems are discussed.

Technological factors

Our study observed three distinct categories of information systems deployed with varying purposes and functionality in our case study organisations to support sustainability reporting. They are stand-alone customized sustainability information systems, extensions of sustainability application to the existing systems originally deployed for different purposes such as occupational health and safety, and manual systems that are combined with spreadsheets and other tools. These systems are either cloud-based or on-premise solutions and in some organisations, they are simple central repositories for storing and managing the sustainability data. Though, ERP (enterprise resource planning) systems are in operation for several years in the case study organizations and are used to manage accounting and logistics processes, their use

for sustainability reporting is negligible. Sustainability applications offered as extensions by ERP software vendors are not used.

As noted by a senior sustainability manager, "*they are not as good as the systems that are designed purely for that (sustainability reporting) purpose; it's not a cost issue*" (R18), and that the ERP systems are "*clunky, rigid and not amenable to (manage and report) the unique characteristics and level of granularity (required) for reporting sustainability data" (R5)*. For example, many firms with ERP systems adopt automatic settlement of vendor invoices for energy and other sustainability related resources procurement) without explicitly raising of invoices. Though it simplifies the procurement process and reduces administrative costs in ERP-enabled environments, the ability to track sustainability data in both dollar values and quantities and at required level of granularity and detail is lost in many case study organizations. This process though is considered efficient from accounting perspective, it is problematic requiring laborious manual retrieval and manual data entry of energy data for sustainability reporting.

The level of investments made in the nature and sophistication of stand-alone sustainability information systems deployed, are influenced by the voluntariness of reporting rather than their potential impact on sustainability performance. These stand-alone systems though are not 'state of the art' and have inherent limitations, they are 'fit for purpose' (i.e. to comply with regulatory requirements) and not designed to facilitate sustainability performance management. On one extreme, a property management firm (one of the case study firms) has a fully customized cloud-based solution that helps the firm manage its environmental, health, safety, community investment, carbon accounting and supplier management to support its sustainability reporting process. As noted by a manager, "*it does all. It does all environment, health, and safety stuff for the whole organization. Every single site and every single asset has somebody that can access the system, some portion of it; it is either the same OHS person or another person that puts the energy stuff in; there are other people who do our community data. There'll be three, four hundred people who will have access to various parts of it*" (R4).

At the other extreme, spreadsheet templates, power point templates, word templates are used. In some organizations where the reporting is for compliance purposes, data maps with time lines, detailed guidelines on the linkages for aggregation, process maps with clear identification of responsibilities to collect data from the field, and the sources from which the information is to be collected, or a combination of these things are deployed as a proxy for sustainability information system. As pointed out by the corporate head on sustainability "*it is first in spreadsheet, and then the system; they will do a bit of parallel, just so they can check what is missing*" (R4).

In both cases, information is captured and transmitted (either through a centralised system or manual transfer) by individual managers responsible for different units on a periodic basis. At corporate level, the information is manually consolidated (in case of a manual system) or validated (in a centralised system) and sustainability reports are produced catering to the requirements of various reporting regimes. Sustainability information systems enable streamlining of data collection process that relates to carbon emissions (required to comply with the NGER Act) and manual processes are used to collect and collate information from other areas such as waste, water, human resources and social indicators. As noted by a respondent, there are "*other heaps of data that we gather at a group level through different processes, rather than pulling everything neatly into Envizi (sustainability info system), we still use existing processes to cover other areas*" (R16). Thus, sustainability info systems when deployed, predominantly are configured to deal with carbon emissions that comply with external legal requirement and manual processes for other sustainability data. It clearly demonstrates the emphasis and focus on compliance rather than on sustainability performance. Thus, the level of investment and sophistication of the systems adopted and used are primarily determined by their cost effectiveness and ability to comply regulatory requirements.

Even though many of these stand-alone sustainability information systems are deployed to manage a complete gamut of sustainability data, capabilities of these systems are neither fully known, nor effectively installed and used in the firms studied. Consistent with the literature (Barki et al 2007), IT use (or lack of it) is a challenge in case study organizations. Further, these systems are not considered robust and efficient (as expected given its nascent stage) when compared with financial systems. As pointed out by a respondent, "*it (sustainability info system) is so slow, clunky; really difficult to navigate around and see what different things it could do" (R16); "its speed is one of its limitations" (R17); "it is so slow, it's a pain to use, and it is easier to just do it in excel yourself" (R16); "it takes a long time to design, test and implement a report,*

because of the type of data that we are trying to get back out of the system; it is quite involved calculations that are going on in the background" (R18). In general, use of these stand-alone sustainability info systems is less than its potential because of lack of knowledge, skills, training and ease of system use. One manager observed that "*it is a fancy spreadsheet without the ability to pull out nice graphs and do analysis. It's not the kind of a system you want to just jump in and have a look around. You really go in, download the report and get out, not friendly at all*" (R17).

Further, managements over time, have discovered that these systems are not capable of supporting all types of sustainability data and processes as envisaged by them before adoption. The focus thus is on "w*here the system adds value or where it is a legal requirement for that data to benefit in quality and compliance*" (R20). With focus on compliance, firms are not seriously looking for systems that have superior strategic capabilities to manage various dimensions of sustainability performance and to interface/integrate with main financial reporting system. Further, they are not building proficiencies through training and skilling to implement, exploit and effectively use the existing features. Inadequate and inefficient use of the existing systems and paucity of skills and training are constraining the ability of sustainability information systems in managing the sustainability performance.

Multiple legacy systems in operation for managing a variety of sustainability data spread across the enterprise as well as outside the enterprise, and the need to meet the requirements of different reporting regimes makes the process of sustainability performance management challenging. Because of the decentralised nature of sustainability data, a combination of manual and local information systems is used by entities/departments in the enterprise for capturing and transferring information to the corporate office for consolidation and reporting. As pointed out by a senior manager, their system is "*very disaggregated*" (R8) and that "*it's not like a single report that comes out of a single site*" (R9). It therefore becomes a manual process wherein sustainability information is entered into these stand-alone sustainability information systems through a combination of direct manual entry by various members and departments. As noted   by a senior manager, "i*nformation goes into that system through a combination of electronic transfer from billing providers, energy companies and water providers; and a little bit of manual entry from others*" (R8).

Organizational factors:

Absence of disaggregated insights at unit level limit innovative sustainability initiatives. Information systems deployed are not designed to have disaggregated insights and timely feedback at unit level. They are designed to routinely consolidate, produce and report sustainability information at the enterprise level. "*We do have targets, but they are at a global level and individual unit managers have no clue where they are standing*" (R5). Absence of such disaggregated insights are limited by the way information systems are configured and used. A manager explains this. "*No, not really; so far the information gets captured and pushed up. That's all about behaviour change and it's about getting sustainability in the front of people's minds*" (R5). Though "*there are process improvements which we've had energy reduction outcomes, but that has not been because of sustainability reporting systems. But that information must flow back. Sustainability at the moment is seen as this kind of annoying thing, ask those annoying questions and that's as much as they know about it*" (R6).

Pointing out to the absence of detail in the report, another manager observed that, "*the fact that those sorts of statistics are making it into the sustainability report wouldn't make any difference to their activities (performance management related)". The level of these data is company-wide and for benchmarking purposes or for energy improvement or efficiency improvement purposes, that's too high a level*" (R15). He/she further stated that "*for the purposes of performance management, nobody's really interested in and nobody is really tracking the year on year performance in relation to energy consumption at unit level and that level of detail does not appear in our sustainability report.*" (R15). Thus, the reports and the process of compiling and producing reports and the information systems that enable them do not permit management of sustainability performance.

Time lag between the action and report constrains the sustainability performance. For example, significant time lag between when the energy is consumed and when the report is produced negatively influences the ability to act to improve sustainability performance. If it is too late, it denies any opportunity to investigate and initiate corrective action. This time lag has financial implications for the firm. A manager explained like this: "*For instance, if a part of a ventilation system isn't working properly, then you don't find out about*

that until a month later, and then suddenly you have got a significant increase in your bill. It would be beneficial from that point of you (to have real time timely information produced by your system). But of course, there is a lot of administrative effort in terms of setting up and maintaining a system. You'd have to balance that (costs) against the benefits" (R26). Thus, absence of a process and IT/IS infrastructure to capture information at local level and ability to provide timely feedback to individual assets (entities) is important. Setting up such a capability in the information system has cost implications. If is therefore important to weigh the costs of configuring and setting up a system (with such capabilities) against the potential benefits of such information in terms of sustainability performance and cost savings. Existing information systems and the reporting processes are merely used to collect and report the sustainability information, with no possibility of using that information to improve sustainability performance (for example to reduce energy consumption). Thus, sustainability information system in case study organizations, by itself, did not directly contribute to sustainability performance.

It is ideal if the sustainability performance data that is collected and reported is channelled into the managerial decision making about resource allocation and capital investments. Anecdotal evidence from this study, however, is disappointing. Most of the organizations do not have a process that embeds this sustainability information into capital budgeting and resource allocation decisions - whether it is investing on solar power, or electronic meter reading, or c-generation of power, or waste recycling facility or onsite gas fired power station or installation and customization of a sustainability information system or other sustainability initiative. A manager explains: "*We had a power tendering process, building a new facility, had project meetings, to look at green star accreditation as part of that process; but it does come down to dollars available for the capital build and despite the push to try and build green, there is still the divide between two pots of money. Unfortunately, when it comes to value added, the value adds are often the environment ideas that get ruled out*" (R12). Unfortunately, the environmental ideas though are adding value, are not receiving adequate attention in executive capital budgeting decisions when compared with investments for operational improvement. Though there is an increased awareness of the environmental impact, proven results of initiatives and good paybacks achieved, there appears no serious integration of these insights into capital investment decision making in case study organizations.

Firms submit sustainability information voluntarily to various regimes such as Carbon Disclosure Project (CDP), Global Reporting Initiative (GRI), National Pollutant Inventory (NPI), Dow Jones Index and other industry-based indices. Each of these regimes have different requirements in terms of the nature of sustainability data, level of granularity, calculations, standards and formatting, and make it hard for any single capable of meeting their requirements. Firms typically employ manual processes for reporting sustainability data to ensure compliance with varying requirements of these reporting regimes. Similarly, firms submit information relating to social, community data (for example gender diversity, health, charities and community service etc.). For this non-mandatory data, record keeping is not stringent and manual processes are used to collate and report data into an enterprise level repository for reporting purposes.

Environmental factors:

NGER Act introduced by the Australian government in 2007 was a driver and key external factor that drove sustainability reporting in Australia. Though some firms were voluntarily preparing these reports earlier, this regulatory regime accelerated their focus on sustainability reporting and led to the adoption of appropriate sustainability information systems. Though measurement is considered important for and few firms viewed reporting as a catalyst for long term improvements, there is no evidence of its influence on the sustainability initiatives in the case study organisations. Though all the case study organisations have deployed resources - human resources and information systems, for capturing, analysing and reporting sustainability performance, they are primarily deployed to mitigate the reputation risk. One manager commented: "*one of the key drivers for continuing to produce this report is reputation. In the course of assembling this report, I come across all sorts of intricate information that's just not known beyond the sites where it is occurring. There's certainly a corporate image component of it. There is an internal communication component of it – in terms of internal interest for employees. And I'd have to say that those two are probably the most important drivers for producing the report.*" (R15).

Potential cost savings is another factor. As noted by a manager, "*it's not just being done because we want to reduce carbon emissions. There were going to be some potential strong financial benefits for, and that is the most material area for business. And the initiatives including the acquisition of sustainability*

information systems are mainly being driven out of wanting to enhance our reputation and lower our costs" (R26). Thus, enhancing the reputation of the firm as well as the potential cost savings are the driving factors for investing in right sustainability initiatives. With focus on scope 1 and 2 emissions under the NGER Act, entire sustainability information management processes and systems are geared for compliance purposes.

Engaging outside agencies and consulting firms to produce energy related reports and carbon accounting has led to uncovering of inefficiencies and subsequent consolidation of energy contracts and cost savings. Though it is not mandatory, all the carbon reports produced by the case study organizations are audited regularly. Considering the risks of such non-compliance and inaccurate reporting, data on carbon emissions are regularly audited by external firms before they are finally submitted. Typically, these auditors give assurance of a few material issues that cover a significant portion of the materiality and carry out checks on datasets, sources, management processes, calculations and the information compiled and reported by the information systems. Given the heavy penalties under NGER Act, organizations change the level of assurance ever year balancing the value gained with the money spent.

Conclusion

In this study, we have investigated the role of information systems deployed for sustainability reporting. Organizations have developed, highly customized sustainability information system primarily to manage carbon foot print and other sustainability data, or simple manual processes as well as an extension and customization of the systems that were originally deployed for safety, health and other data for sustainability reporting. External regulation though has accelerated the adoption of appropriate information systems for sustainability reporting, they are not as mature as current financial systems in business organizations, our study found. The nature and variety of information systems and the level of sophistication of those system is dependent upon the complexity of organizational reporting requirements, multiple legacy systems used to support a variety of sustainability related data, complexity of organizational structure that has sustainability data dispersed, and the flexibility offered by manual processes and tools. For non-mandatory sustainability data, however, stringent record keeping is not maintained with heavy use of manual processes, primarily due to its voluntary nature and is viewed as a mere public relations exercise.

Though there is no discernible link between sustainability reporting and introduction of sustainability initiatives, reporting has led to some cost savings at the corporate level. Though the systems of data capture and reporting are deployed primarily to comply with the legislative requirements, influence of information systems is limited. Non-availability of disaggregated sustainability performance information to the unit managers, absence of communication processes downwards to individual operational managers that could help them improve sustainability performance, and generally poor sustainability culture in most of the organizations are some of the factors. Further, our study found no attempts at integrating the sustainability performance data into managerial decision making including in resource allocation and capital budgeting decisions. Thus, improvements, if any in sustainability performance, are mostly incidental to the reporting regime in business organizations. For many, it is a mere reporting exercise and important for corporate image as well as for effective stakeholder management.

Our study thus highlighted the nature of information systems used for sustainability reporting and provided insights into operational perspectives leading scholars have called for. From a theoretical perspective, this research supplements and extends previous studies on IT/IS adoption and use in sustainability context by explaining the influence of technological, organizational and environmental factors. As with all research, our study has limitations. Our study adopted a cross-sectional qualitative field study, where all the respondents that have represented their firms are from Australia. In addition, there are limitations associated with qualitative research methodology such as relying on few informants within each case study organization. Further, respondents in our study represent large business organizations in Australia that are required to report sustainability information (greenhouse gas emissions in particular) under the NGER Act. Our findings, therefore, are bounded and situated in a specific context and could be considered context sensitive. Finally, while our study used TOE framework as the lens to study the phenomenon, other theories may also offer fresh and useful insights. Further empirical studies that will analyse the differences between different systems, between the data required for mandatory and voluntary reporting and on the link between voluntary reporting and sustainability performance are necessary. Given the fragmented nature of the sustainability data unique to organizations in an industry, detailed in-depth case studies to explain the

processes and challenges in those contexts are necessary. Adapted and used effectively, information systems can play a significant role in improving the understanding of sustainability data and initiatives in business organizations and in transforming business processes that could lead to improved sustainability performance.

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