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IT affordances for sustainable innovations in for-profit and nonprofit organizations

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Abstract

Given the public's increasing concerns about sustainability, organizations are under pressure to promote sustainable development and gain competitiveness by balancing their environmental, social, and economic impacts. Sustainable innovations provide a strategic way for organizations to address sustainability challenges. This study aims to explore how for-profit and nonprofit organizations can harness IT to enable the development of sustainable innovations from an affordance perspective. Based on the analysis of multiple case studies, this study identified five IT affordances for sustainable innovation. Moreover, the actualization of these affordances differs in for-profit and nonprofit organizations, mainly influenced by organizational resources, capabilities, and stakeholder expectations.

Keywords: Sustainability, Innovation, IT Affordance

Introduction

Since the establishment of the climate goals outlined by the Paris Agreement in 2015, an increasing number of organizations have committed to the net-zero transition. Along with this trend, organizations also faced significant challenges over recent years, such as the COVID-19 pandemic, disrupted supply chains, persistent inflation, etc. To address these challenges and maintain the momentum toward net zero, organizations are under great pressure to strategically promote sustainable development, which necessitates a comprehensive consideration of their impacts on the environmental, social, and economic facets (collectively known as the triple bottom line, TBL). Therefore, organizations are expected to undertake ambitious actions such as innovations that positively contribute to organizational TBL performance (i.e., sustainable innovations) (Boons et al., 2013, Cillo et al., 2019).

Information technology (IT) has been recognized as a critical enabler of sustainable innovation by previous literature (Bengtsson and Ågerfalk, 2011, Chen et al., 2008, Pan et al., 2022). Not only do technological innovations emerge to improve efficiency and reduce waste throughout the product lifecycle (green IT), but also IT can complement and reinforce sustainable innovations (Bengtsson and Ågerfalk, 2011, Bose and Luo, 2011, Hanelt et al., 2017). Although extant studies examined the positive impacts of IT on organizational sustainable innovation performance, most of them focus on the environmental facet (Bose and Luo, 2011, El-Kassar and Singh, 2019, Hanelt et al., 2017). Additionally, previous studies mainly focus on innovation performance (i.e., whether or not organizations develop sustainable innovations) (El-Kassar and Singh, 2019, Hanelt et al., 2017, Zhao et al., 2021) rather than innovation development (i.e., how organizations develop sustainable innovations). Hence, there is still a lack of an in-depth investigation into how IT can be utilized to facilitate sustainable innovation development.

Affordance theory provides arguably the most appropriate theoretical lens to explore the relationship between IT and innovation development (Chatterjee et al., 2020) since it links technical objects and users by presenting potential actions provided by using the technical objects to achieve users' goals (Markus and Silver, 2008). Previous studies adopted affordance theory to gain an in-depth understanding of the utilization of IT. For instance, Seidel et al. (2018) investigated IT affordances for environmental business transformation, explaining how IT can be utilized to facilitate such transformation. Nevertheless, there is still a lack of study on IT affordances for sustainable innovation, particularly with comprehensive coverage of the TBL.

Therefore, this study aims to address the research gaps and explore *how organizations can harness IT to enable sustainable innovation from an affordance perspective*. Considering the significant roles played by both for-profit and nonprofit organizations in developing sustainable innovations (Sarros et al., 2011), this study involves both types of organizations.

The rest of the paper is structured as follows. In the next section, we present our literature review on sustainable innovation and IT affordances. Then, the research methodology is explained, followed by the multiple case study findings and discussion. Finally, we conclude the paper, outline study limitations, and suggest areas for future investigations.

Literature Review

We conducted a literature review to understand the current state of the art in the related fields, including sustainable innovation and IT affordance. We searched for papers published in key journals (such as MIS Quarterly, Journal of Strategic Information Systems, Information Systems Journal, Business Strategy and the Environment, etc.) in the past ten years. Our literature review suggests the lack of a well-developed discussion of IT affordances for sustainable innovations in organizations. Below we provide a brief overview of the literature review related to sustainable innovation and IT affordance.

Sustainable innovation

In this study, sustainable innovations are defined as *new or significantly improved products, services, or processes that enhance organizational environmental, social, and economic performance* (Dey et al., 2019, Kusi-Sarpong et al., 2019, Maletič et al., 2016, Rogers, 2003). Previous studies have highlighted the significant impact of sustainable innovations on organizational performance (Dey et al., 2019, Maletič et al., 2016, Wu, 2017). These innovations contribute to enhanced sustainability performance by either reducing negative impacts, such as waste reduction (Bose and Luo, 2011, Dey et al., 2019,

El-Kassar and Singh, 2019), or creating positive impacts, such as supporting disadvantaged groups (Srivastava and Shainesh, 2015). Apart from directly enhancing organizational sustainable performance, sustainable innovation also has mediating effects. For example, Shafique et al. (2017) and Silva et al. (2019) found that sustainable innovations play a mediating role between sustainable supply chain management practice implementation and its performance. Therefore, it is critical for organizations to understand how to facilitate the development of sustainable innovations to enhance their sustainability performance strategically.

IT has been recognized as a key enabler of sustainable innovation (Bengtsson and Ågerfalk, 2011, Chen et al., 2008). With the advancement of technologies, IT can “green” itself by improving technological efficiency and reducing electronic waste along its lifecycle (Bose and Luo, 2011). In addition, IT can act as a “supporter” that complements and supports sustainable innovations, leading to enhanced impacts on sustainability performance (Bengtsson and Ågerfalk, 2011, Hanelt et al., 2017). Notably, information technology alone is unlikely to ensure the successful development of sustainable innovations. Rather, the effectiveness of IT utilization by the organizations plays a vital role in enabling sustainable innovation development (El-Kassar and Singh, 2019, Hanelt et al., 2017, Leal-Millán et al., 2016, Zhang et al., 2022).

However, previous studies have limited coverage of IT-enabled sustainable innovation. Many studies merely focused on environmental sustainability (Bose and Luo, 2011, El-Kassar and Singh, 2019, Hanelt et al., 2017), while a few studies considered social sustainability (Ardito, 2023, Srivastava and Shainesh, 2015). Only two studies, Zhao et al. (2021) and Bengtsson and Ågerfalk (2011), adopted a comprehensive view of sustainability (i.e., considering environmental, social, and economic aspects). Additionally, most existing studies focused on the impacts of IT on innovation performance (El-Kassar and Singh, 2019, Hanelt et al., 2017, Zhao et al., 2021). Studies considering innovation development merely focused on a particular phase, such as innovation initiation (Ardito, 2023) and innovation adoption (Bengtsson and Ågerfalk, 2011, Bose and Luo, 2011). Hence, there is still a lack of studies that consider all three dimensions of sustainability and offer an in-depth understanding of how IT enables sustainable innovation development.

IT affordance

IT affordances are defined as “*the possibilities for goal-oriented action afforded to specified user groups by technical objects.*” (Markus and Silver, 2008, p. 622) They represent the action possibilities (or possible uses) provided by IT objects for certain users to achieve their goals. Therefore, IT affordances reflect what a particular user (or a group of users), who has specific capabilities and goals, can do with a certain technical object (Markus and Silver, 2008, Strong et al., 2014). In the information system (IS) research domain, the concept of affordances has been slightly expanded from the individual level to the group or organizational level. As explained by Volkoff and Strong (2013, p. 823): “The potential for coordinated action by a group can be thought of as an organizational affordance.”

Previous studies have proposed different IT affordances. Table 1 provides an overview of studies on IT affordance in various contexts. In terms of technology, Ciriello et al. (2018) and Tomlinson et al. (2021) focused on a specific type of technology, including standard and widely adopted technology PowerPoint and more advanced technology blockchain. Moreover, most of the studies focused on environmental sustainability, while Ciriello et al. (2018) and Chatterjee et al. (2020) do not have any sustainability focus. Among those studies concerning sustainability, merely Hanelt et al. (2017) have a focus

on innovation. Nevertheless, they explored innovation adoption rather than innovation development. Overall, none of these studies adopts a comprehensive view of IT-enabled sustainable innovation by taking into account all the dimensions of sustainability and innovation development. Furthermore, how these IT affordances are actualized in for-profit and nonprofit organizations to generate desired outcomes remains underexplored.

Table 1 – Overview of Studies on IT Affordances

	Seidel et al. (2013)	Hanelt et al. (2017)	Ciriello et al. (2018)	Chatterjee et al. (2020)	Tomlinson et al. (2021)
Context	Developing sustainable work practices in organizations	Facilitating the adoption of eco-innovations in organizations	Enabling or constraining innovation in organizations	Fostering innovation in organizations	Developing sustainable work practices in organizations
Technology	Information system	Supporting information system	Powerpoint	Information technology	Blockchain
Sustainability dimension	Environmental	Environmental	None	None	Environmental
Innovation focus	None	Innovation adoption	Innovation development	Innovation development	None

Methodology

This study conducted qualitative multiple case studies for the following reasons: a) this study requires an in-depth investigation of the use of IT in sustainable innovation development, b) IT-enabled sustainable innovation development is a contemporary social phenomenon, and therefore we acknowledge that real-life context is highly relevant, and c) no quantitative measures established for the constructs (including sustainable innovation development and IT affordances) (Yin, 2018).

When selecting the case organizations, sustainability global ranking systems such as the Dow Jones Sustainability World Index were used to identify the leaders in sustainability. Four for-profit and nonprofit organizations that have successfully implemented IT-enabled sustainable innovations and have adequate secondary data available were selected for this study. Table 2 provides an overview of the case organizations.

Table 2 – Overview of Case Organizations

Organization	Industry	Type	Size (no. of employees)
C1	Logistics	For-profit	Large (~63,000)
C2	Technology	For-profit	Large (~85,000)
C3	Food	Nonprofit	Large (~300)
C4	Disability	Nonprofit	Large (~4,400)

Case organization 1 (C1) is a large logistics company that offers both domestic and international parcel delivery services for individuals, businesses, and communities. The organization was one of the first Australian organizations committed to achieving the UN Sustainable Development Goals (SDGs) in 2016. Case organization 2 (C2) is a global leading technological company, providing technological products and services to

customers. Sustainability has been woven into C2’s businesses for decades. Case organization 3 (C3) is one of the food rescue and relief leaders in Australia and is expanding globally such as in Europe, Africa, and Asia. Case organization 3 (C3) is one of the largest nonprofit organizations in the disability service sector in Australia. The organization has a long history of providing support for people who have physical, intellectual, or multiple impairments.

Data collection

The primary data sources are documentary data and semi-structured interviews. Secondary data includes organizational documents (such as sustainability reports, annual reports, and IT strategy reports), public releases (such as announcements, news, and social media posts), cases, and interviews that were published in 2018-2023. Table 3 outlines the number of each type of secondary data analyzed in this study.

Table 3 – Overview of Secondary Data Collected

Organization	Organizational documents	Public releases	Published cases and interviews
C1	18	46	3
C2	6	17	7
C3	8	57	4
C4	6	20	1

To avoid bias and inaccuracies, semi-structured interviews were also conducted to complement the documentary data. An overview of the case organization participants is provided in Table 4. Interview participants are case organizations’ employees who were purposefully sampled from both the sustainability function (e.g., sustainability managers) and the IT function (e.g., IT managers who have tasks or responsibilities directly related to sustainability initiatives). They are able to provide relevant information and useful perspectives on the utilization of IT for facilitating sustainable innovation development.

Table 4 – Overview of Case Organization Participants

Organization	Participants	Number of Interviews	Follow-up emails
C1	Sustainability Manager	1	No
	Program Manager	1	No
C2	Chief Technology Officer	1	Yes
	IT Director	1	No
	Software Engineer	1	No
C3	Sustainability Manager A	1	Yes
	Sustainability Manager B	1	Yes
	IT Manager	1	No
	Logistics Manager	1	No
	State Operation Manager	1	No
C4	Chief Information Officer	2	Yes
	Innovation Manager	2	Yes

Each interview generally lasts about 45 minutes to one hour and is recorded if consent has been obtained from the participant. Several follow-up emails were sent to some participants. We used an interview protocol to guide the interview process. Specifically,

questions are open-ended and aim to understand a) what sustainability-oriented innovations are implemented in the organizations, and b) how IT enables the development of these innovations.

Data analysis

The collected data was content analyzed following a thematic approach (Gioia et al., 2012, Krippendorff, 2018). The analyzing process was non-linear (Yin, 2015) and aimed to “improve understanding, expand theory, and advance knowledge” by identifying patterns and relationships (Neuman, 2013, p. 477). The analysis was assisted by qualitative data analysis software NVivo, the output of which was used to facilitate analysis including pattern matching and emerging pattern identification (Yin, 2015, Yin, 2018). However, instead of using NVivo’s automated functions, we conducted all of the coding and analysis processes manually. The analysis of data informed the following data collection process in terms of case selection and data collection protocol (Yin, 2018). Thus, data collection and analysis were conducted simultaneously (Eisenhardt, 1989).

Research rigor

We established the research rigor of this study by following the criteria proposed by Yin (2018). Specifically, three tests are addressed: construct validity, external validity, and reliability. To ensure *construct validity*, a literature review was conducted to identify appropriate definitions for sustainable innovation and IT affordance. Also, we collected data from multiple sources and maintained an evidence chain. For *external validity*, this study involves multiple case studies and adopts affordance theory to guide the investigation. Furthermore, this study used an interview protocol to maintain consistency and structure across interviews to ensure *reliability*. We also developed a case study repository to systematically organize and store the collected data about the case organizations.

Findings

Several potential IT affordances were first identified in each individual case based on the secondary data collected. Then the affordances were validated and revised by analyzing the interviews with case study participants to better capture the usage of IT in their organizations. We have identified five IT affordances for sustainable innovation: sustainability innovation opportunity sensing, process improvement and optimization, sustainability-oriented education and advocacy, sustainability impact and performance reporting, and sustainability regulatory compliance and public welfare affordances. Each IT affordance is explained below.

Sustainability innovation opportunity sensing affordance

Sustainability innovation opportunity sensing affordance enables organizations to internally or externally explore and identify innovation opportunities to enhance their sustainability performance. The case analysis demonstrates that IT facilitates opportunity sensing in two primary ways. Firstly, advancements in technology and the emergence of new technologies allow organizations to identify technological innovation opportunities that can have positive sustainability impacts. Secondly, the use of IT greatly enhances organizations’ flexibility to explore and identify feasible sustainability-oriented innovation opportunities. For example, enabled by the cloud-based platform, all the organizations were able to easily integrate cloud-based solutions for sustainable innovations.

“We have a cloud-first approach in terms of postage of IT solutions. ... So we’re not necessarily procuring hardware to host systems and applications.” (C4 Chief Information Officer)

However, it was found that C1 and C2 utilized IT more efficiently for sustainability innovation opportunity sensing than C3 and C4. Specifically, participants from C1 and C2 suggested that the organizations were able to build in-house technological solutions for sustainable innovations. On the contrary, C3 and C4 had small IT teams (relative to the organization size) and therefore had limited IT human resources and expertise to proactively explore sustainability innovation opportunities.

“The IT team is probably too busy to be strategic [in exploring sustainable innovation opportunities].” (C3 Sustainability Manager A)

Process improvement and optimization affordance

Process improvement and optimization affordance refers to the enablement of IT to improve or optimize processes in the organization. In for-profit organizations C1 and C2, IT is utilized to improve and optimize not only business processes but also the processes that support the sustainability function operations, sometimes exploring new business areas. Although the IT teams in C3 and C4 also made great efforts to improve and optimize organizational processes, they still focused on ensuring a consistent way of operation across different departments due to constraints in IT resources.

“What we’re trying to introduce is a highly consistent single way of operating in terms of our processes... This is not easy as we are such a big company... The IT department is relatively small.” (C4 Chief Information Officer)

Sustainability-oriented education and advocacy affordance

Sustainability-oriented education and advocacy affordance enables the organization to educate stakeholders about sustainability-related knowledge and advocate for sustainable practices. This affordance can be actualized both within and outside the organization. For example, all the case organizations offered regular sustainability-related training to their employees (e.g., wellbeing and safety). C1 and C2 also established an internal platform to share sustainability-related information and knowledge. Externally, the case organizations launched online campaigns to advocate sustainable practices. In addition, C3 and C4 provided food- and disability-related online employability training programs respectively.

“We have regular training to inform employees on how we are going in our sustainability journey, and how our products can help our customers in their sustainability journeys.” (C2 Software Engineer)

Sustainability impact and performance reporting affordance

Sustainability impact and performance reporting affordance enables the organization to collect sustainability-related data, measure and analyze sustainability impacts, and report sustainability performance. Based on the analysis of organizational reports (e.g., annual reports, social responsibility reports, sustainability reports, etc.), we found that nonprofit organizations C3 and C4 measured and reported their sustainability impact and performance more systematically and comprehensively through centralized systems. Nevertheless, C1 and C2 harnessed IT to measure environmental sustainability (e.g., energy consumption) while social sustainability (e.g., workplace safety) received less

attention. The reason for this difference could be stakeholder expectations vary for different types of organizations, as indicated by C3 sustainability manager A:

“Because [C3] is nonprofit, ... we need to report how we used the money. ... We have to honor the wishes of our donors”

Sustainability regulatory compliance and public welfare affordance

This IT affordance enables the organization to comply with relevant regulations and contribute to public welfare. It encompasses activities such as improving cybersecurity, ensuring compliance with sustainability regulations, and promoting public welfare. For example, the C3 IT manager highlighted that IT needs to perform as a “gatekeeper” to prevent data-related sustainability risks. The main differences between the case organizations were reflected in the public welfare. Given that public welfare is central to C3 and C4’s mission, the two organizations implemented many IT-enabled projects. However, C1 and C2 only invested IT resources in a few public welfare programs, which are directly related to their main businesses.

Discussion

Addressing the research question

It is found from the multiple case studies that organizations can harness IT to enable sustainable innovation in five approaches: a) sustainability innovation opportunity sensing, b) process improvement and optimization, c) sustainability-oriented education and advocacy, d) sustainability impact and performance reporting, and e) sustainability regulatory compliance and public welfare. Additionally, the effectiveness of IT utilization differs in different types of organizations. For-profit organizations demonstrated more effective utilization of IT in terms of sustainability innovation opportunity sensing and process improvement and optimization, which requires more IT resources and expertise. Nonprofit organizations have fewer resources available, and therefore mainly focus on maintaining existing businesses and processes. However, nonprofit organizations performed better in sustainability impact and performance reporting and sustainability regulatory compliance and public welfare than for-profit organizations. Due to the nature of nonprofit organizations, they are expected by the stakeholders to have extraordinary sustainability performance, leading to higher requirements on sustainability measurement and reporting as well as public welfare. On the contrary, for-profit organizations are expected to prioritize their main businesses while addressing sustainability challenges. Consequently, sustainability projects draw more attention if they are directly related to main businesses or specifically demanded by stakeholders. Therefore, it can be seen that the way organizations utilize IT for sustainable innovation development is influenced by resources and capabilities owned by the organizations as well as their stakeholders’ expectations.

Implications

This study contributes to the literature on sustainable innovation by comprehensively analyzing the role of IT. We bring new insights into how for-profit and nonprofit organizations utilize IT in different ways to facilitate the development of sustainable innovations. Theoretically, this study examines the applicability of affordance theory in the sustainable innovation context and proposes five IT affordances. By referring to the affordances, top management in both for-profit and nonprofit organizations can have a better understanding of the value of IT in promoting sustainable innovations. Therefore,

they are expected to harness IT more effectively to facilitate sustainable innovation development and enhance their organization's sustainability performance.

Conclusion

This research explored how for-profit and nonprofit organizations can utilize IT to facilitate the development of sustainable innovations through an affordance perspective. Based on the secondary data and semi-structured interviews, we have identified five IT affordances, the actualization of which is primarily impacted by the organizational resources, capabilities, and stakeholder expectations.

This study has several limitations. First, this study is exploratory and involves large organizations from limited industries. Future research can investigate organizations of different sizes and from other industries (e.g., construction) to further verify and refine the proposed IT affordances. Second, alternative theoretical perspectives, such as resource orchestration theory, may complement this study's findings and contribute to a more comprehensive understanding of IT-enabled sustainable innovation. Third, the analysis of the research findings is mainly at the organizational level. Future research may unfold new knowledge by extending the analysis to individual and supply chain levels.

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