

# Exploring ICT-enabled Sustainability Innovations Development: A Conceptual Study

*Research-in-Progress*

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## **Abstract**

*There have been global concerns with the sustainability of our planet for future generations. Organizations have been paying attention to harness the potential of information and communication technology (ICT) to support the development of innovations that can address global sustainability issues. However, currently little is known about how organizations can develop innovations that yield economic, environmental and social benefits simultaneously. In this research-in-progress paper, we propose a conceptual model that shows how integration of organizational capabilities in ICT, innovation and sustainability areas may lead to the development of sustainability innovations that are likely to enhance organizations' triple bottom line. To guide future empirical studies, we then develop a taxonomy of sustainability innovators to distinguish organizations based on the level of ICT-enabled sustainability innovations. This research-in-progress paper offers modest contribution to research and practice at the intersection of ICT, sustainability and innovation.*

**Keywords:** Sustainability, innovation, ICT capability, triple bottom line

## Introduction

Sustainability concerns have been recognized globally due to rapid deterioration of our planet and its natural resources, coupled with increasing social issues (Oliveira Neto et al. 2018). Regrettably, organizations that drive national economic activities are major contributors to these global sustainability problems (Hanelt et al. 2017). According to UNCSO (2012), business activities contribute to a significant proportion of waste and undesirable greenhouse gas emissions. Therefore, organizations have been challenged to incorporate the *sustainable development* principle into their business processes. The principle advocates ‘development that meets the needs of the present without compromising the ability of future generations to meet their needs’ (World Commission on Environment and Development 1987, p8). Incorporating this principle into business practices helps organizations enhance economic, environmental and social performances simultaneously, known as the triple bottom line (TBL) (Elkington 1999).

Meanwhile, the potential of information and communication technology (ICT) to address the global sustainability concerns has also received a growing attention from organizations. Over the past several decades, ICT has been a major driver for many innovations that have contributed to addressing organizational and human problems (Choudrie et al. 2017). ICT has in fact enabled organizations to innovate their business processes, products, services and business models to bring economic, environmental and social benefits (Hilty and Aebischer 2015). In this study, ICT-enabled innovations that improve organizations’ TBL performance are referred to as ‘*ICT-enabled sustainability innovations.*’

Developing ICT-enabled innovations, however, requires substantial investments and usually involve significant changes in business practice and culture within and across organizational boundaries (Samson and Gloet 2018). Currently there exist limited insights into how organizations can utilize the potential of ICT in conjunction with other organizational capabilities to address sustainability concerns through innovations (Samson and Gloet 2016). Although, there are several published success stories, systematic investigations and theoretical explanations behind them are still lacking (Ansari and Kant 2017). To help organizations address the challenges in developing ICT-enabled sustainability innovations, research efforts are needed to improve the current understanding in this area. Hence, the research question addressed in this study is:

*How can organizations successfully develop ICT-enabled sustainability innovations that yield economic, environmental and social benefits?*

In this research-in-progress paper, we develop a theory-driven preliminary research model to guide the investigation into how organizations develop and manage ICT-driven sustainability innovations to create desirable TBL impacts. We further outline the empirical study that is currently in a process of undertaking to apply the conceptual model. When completed, our study will contribute to research on ICT-enabled sustainability innovation development which is currently lacking rich empirical studies (Ansari and Kant 2017, Eitiveni et al. 2017). It will also contribute to practice by providing practitioners a set of guidelines developed based on the proposed conceptual model and detailed empirical studies on how organizations can integrate and bundle their ICT, sustainability and innovation capabilities to develop various sustainability innovations that can improve their TBL performance.

## ICT and Sustainable Innovations

The importance of innovations for organizations to survive in changing business environments has been well recognized (Samson and Gloet 2018). With the current pervasiveness of ICT in individual and organization’s life, the potential contributions of ICT to sustainable development efforts have also been acknowledged (Hilty and Aebischer 2015). In practice, many ICT-enabled innovations have benefited the environment and enhanced the welfare of the community (Porter and Kramer 2011). For example, Linfox has developed innovative technology applications to optimize its logistics operations and vehicle utilization, which improves the safety and well-being of truck drivers, reduces fuel consumption and carbon emission, and increases cost savings. Likewise, Nestle has developed mobile applications to help local farmers in developing countries to access information such as weather, market prices and

agricultural advice, which lead to increased incomes for those farmers and improved quality crops (Porter and Kramer 2011). More recently, using a smartphone application, Uber has revolutionized the transportation industry in 53 countries by facilitating private ride-sharing within the local communities, which has the potential to reduce traffic congestion and thereby reducing carbon emissions (Samson and Gloet 2016). In addition, new practices such as telework, online shopping, videoconferencing, e-procurement and e-marketing have reduced business operating costs, road traffic, fuel consumption, while increased convenience, equitable access to products and services and wellbeing of individuals (Hilty and Aebischer 2015). In the food industry, innovative online platforms based on the concept of e-market have been developed in many countries to shorten supply chains which increase transparency along the supply chains, provide alternative distribution channels for local food producers to distribute excess produce, reduce food waste and provide fresher food to consumers (Kurnia et al. 2017).

However, developing impactful ICT-enabled sustainable innovations and managing their impacts on organization, supply chain, industry and wider community requires complex decision-making process involving top management team and key stakeholders within the organizations and sometimes trading partners (Samson and Gloet 2018; Kurnia et al. 2014). It often requires considerable investments from organizations to acquire necessary resources and manage the associated change (Samson and Gloet 2016). It also involves novel and creative use of ICT and a set of complementary resources and capabilities particularly in the areas of innovation, ICT and sustainability. In addition, depending on the extent to which sustainable development considerations is integrated within organizations and supply chains, organizations may introduce significant changes to existing business models, business strategy, products, processes, supply chains and industry structures (Nidumolu et al. 2009; Beske et al. 2013). The extent to which sustainable development principle is incorporated within the organizations and their supply chains, in turn, influences the degree of improvements in the TBL performance.

Previous literature review-based studies combining ICT and sustainability areas indicate that although there has been a growing number of studies at the intersection of these areas, limited studies exist that have deeply explored the role of ICT in supporting sustainability practices (Eitiveni et al. 2017). There is also a shortage of comprehensive studies incorporating the three aspects of sustainability and most studies are conducted in the USA, UK and Germany (Ansari and Kant 2017). Furthermore, although there have been several theoretical models proposed and many previous studies employ qualitative research methods (Ansari and Kant 2017; Nikolaou and Tsalis 2018), there is no model that can be used to explore and understand how organizations can develop ICT-enabled innovations to address the sustainability issues. Overall, research at the intersection of ICT, innovation and sustainability is still in the early stage. Thus, this study addresses several knowledge gaps identified in the previous studies.

## **The Conceptual Model and Initial Propositions**

To address the research question, a conceptual model is proposed as shown in Figure 1. The key constructs included in our model are briefly defined in Table 1. Initial propositions to address the research question are also formulated. The model is expressed at two levels: a high-level view and a detailed view. At the high-level view, the model shows the theoretical foundation of the proposed model. We integrate concepts from resource-based view of the firm (RBV), dynamic capabilities, sustainable development and organizational learning theory (Barney 1991; Teece 2009; Argyris 1977) to develop a set of propositions regarding how organizations can develop ICT-enabled sustainability innovations to improve their bottom line. These four theories complement each other and provide a useful combination of theoretical lenses to explore why and how organizations learn over time to reconfigure their resources strategically as a response to the sustainability problems.

The detailed level then shows that to develop ICT-enabled sustainability innovations, strong sustainability vision, leadership and commitment captured as 'sustainability orientation' is required to systematically develop complementary organizational capabilities. Guided by the principles of the underlying theories, we argue that senior management of organizations need to continually monitor their business environment and seize the opportunity to create sustainable competitive advantage by creating strategic resources that cannot be easily imitated (Barney 1991; Teece 2009). Organizations that are aware of the global sustainability concerns are expected to respond by revisiting their business

strategy and incorporating the sustainable development principle into their business processes. Organizations need to establish appropriate sustainability orientation which will in turn guide the development of relevant capabilities including ICT, sustainability and innovation capabilities that help them create innovations that have positive impacts on economy, environment and society.

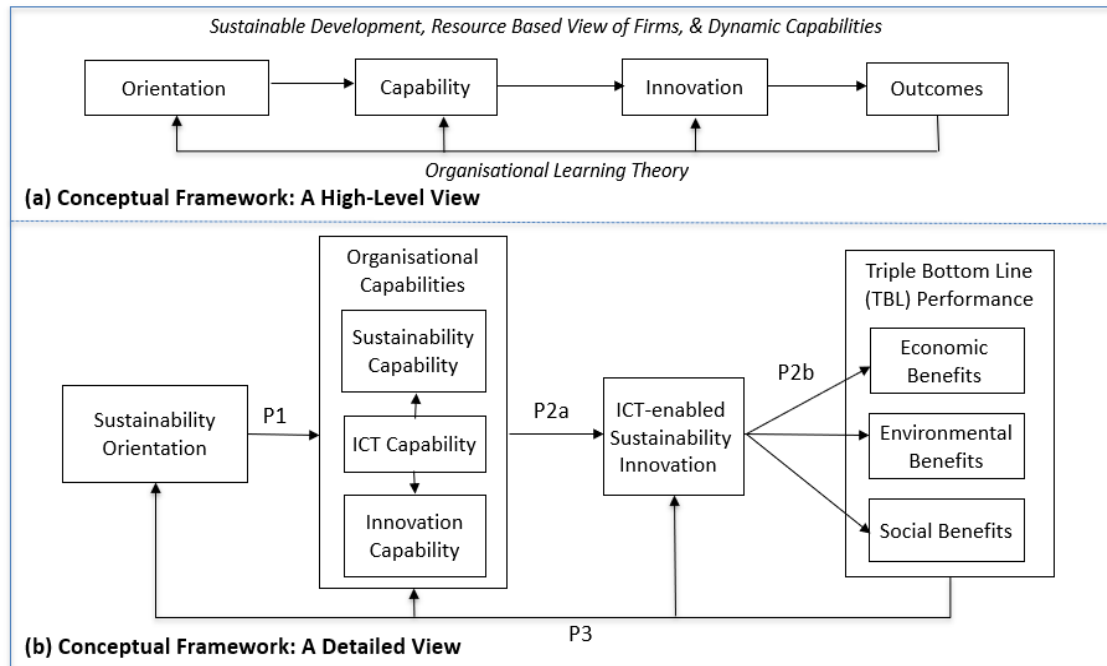


Figure 1: The Conceptual Model

Table 1. Definition of Construct

Constructs	Definition
Sustainability Orientation	Top management’s proactive stance toward the improving the triple bottom line performance of the organization (Dubey et al. 2017).
Sustainability Capability	Organization’s capacity to deploy and reconfigure resources to enable the implementation of business practices that enhance economic, environmental and social outcomes. It affects organizations’ ability to comply to government sustainability regulations and meet the expectations of societies (Samson and Gloet 2016; Kurnia et al. 2014).
ICT Capability	Organization’s ability to mobilise and deploy IT-based resources (e.g. hardware, software, operating systems, applications) and communication resources (e.g. network, Internet, mobile infrastructure, mobile standards and protocols) to support key business processes (Bharadwaj 2000)
Innovation Capability	Organization’s ability to conceptualise and develop new products, services, or processes that address the market needs, and to introduce them to the market successfully (Samson and Gloet 2016)
ICT-enabled Sustainable Innovation	A novel initiative/idea related to a device, system, process, product, service, etc., which is built based on effective use of ICT, geared towards promoting sustainable practices in the community (Hanelt et al. 2017). It is the deliverable that an organization produces by promoting synergic integration of ICT capability with sustainability capability and innovation capability.
Economic Benefits	Organization’s outcomes measured in monetary or non-monetary indicators. For corporations, economic benefits encompass three areas: (1) financial performance (e.g. profits, return on assets, and return on investment); (2) market performance (e.g. sales and market share); and (3) shareholder return (e.g. total return and economic value added). For non-profit organizations, economic benefits are associated with reputation, image and influence (Nikolaou and Tsalis 2018).

Environmental Benefits	The extent to which the quantity and quality of natural resources can be preserved and maintained. It can be measured in terms of air and water quality, energy and water consumption, natural resources, solid and toxic waste, and land use (Shokravi and Kurnia 2014, Nikolaou and Tsalis 2018)
Social Benefits	The extent to which the welfare of the society is improved. It can be measured by education level, equity and access to social resources, safety, health and well-being, quality of life, and social capital (Taticchi et al. 2013)

Existing research indicates top management's proactive stance toward sustainability paves the way for considering investment decisions in building organizational capabilities to address sustainability issues in supply chain management (Dubey et al. 2017). Furthermore, with top management encouragement employees are more likely to participate in contributing towards necessary capability building to support sustainability initiatives and efforts. Thus, managerial support helps enroot sustainability behavior among all employees, which is indispensable since otherwise sustainability issues and innovation efforts could be neglected in day-to-day behavior (Marshall et al. 2015, Kirchoff et al. 2016). We thus argue that understanding and attitudes towards sustainability and how top management positions their organizations in the market by incorporating the sustainable principles would affect their efforts and support given to building organizational capabilities needed to produce sustainability innovations. Hence, the following proposition is suggested:

*P1: A strong sustainability orientation of an organization is likely to lead to development of organizational capabilities in relevant areas including ICT, sustainability and innovation.*

We further argue that an integration of sustainability capability with innovation capability using the merits of ICT can be considered an efficient and effective way of creating successful sustainability innovations since ICT has enabled the development of various business innovations in the last few decades (Samson and Gloet 2016). Drawing on the concepts from RBV and dynamic capabilities, an organization is in an improved position to design, implement, and use a sustainability innovation when it seizes opportunities and develops a bundle of capabilities in the areas of ICT, sustainability, innovation to create strategic resources (sustainable innovations) that enable them to address sustainability concerns and create sustainable competitive advantage through improved TBL performance. Bundling and reconfiguring existing ICT, sustainability and innovation capabilities complementarily are necessary to inspire organizations to continuously innovate in their products, services, and process to improve their TBL performance (Teece 2009; Beske et al. 2013; Hilty and Aebischer 2015). Depending on the degree of radicality, such innovations may involve significant transformation in products, services and processes of the organizations. TBL performance can be considerably improved when that bundle of capabilities is used to create ICT-enabled sustainability innovations that can transform all organizational aspects including product development, business processes, business model, corporate culture and reward systems and their impacts are well managed (Marshall et al. 2015, Samson and Gloet 2016). Hence, proposition P2a and P2b are suggested:

*P2a: The ability of an organization to systematically integrate ICT, innovation and sustainability capabilities is likely to inspire the organization to continuously innovate, which will lead to effective development of ICT-enabled sustainability innovations.*

*P2b: Effective development, use and impact management of ICT-enabled sustainability innovations across all aspects of an organization will lead to improvement in the TBL performance.*

Based on organizational learning theory, we argue that organizations reflect on how their ICT-enabled sustainability innovations impact the TBL performance over time (Argyris 1977). After carefully reviewing the gap between the expected impact and realised impact, top management would revisit their current sustainability orientation and may reposition their orientation. This may result in reassessing and reconfiguring their organizational capabilities for enhancing existing sustainability innovations as well as deciding to proceed with developing new sustainability innovations to establish the desired level of impact on their TBL performance (Leal-Millán et al. 2016). Hence, proposition P3 is suggested:

*P3: Reflection on the TBL performance of an organization over time will lead to revisiting and reconfiguring its sustainability orientation, organizational capabilities, and sustainability innovations.*

## The Proposed Taxonomy of Sustainability Innovators

Built upon the proposed model and previous works on sustainability orientation and organizational capability (Dubey et al. 2017; Samson and Gloet 2016; Kurnia et al. 2014), we propose a Taxonomy of Innovators as shown in Figure 2. This taxonomy helps distinguish different types and extents of ICT-enabled sustainability innovations, the scales of expected transformation/impacts based on the sources of value creation driven by sustainability orientation of an organization, and the degrees of organizational capabilities. The sustainability orientation of an organization is likely to influence the extent of transformation. At lower level of sustainability orientation, transformation focuses at business process. At moderate level transformation is concerned with introducing a radically new sustainable product or service, while at higher level business model is likely to undergo a major transformation. On the other hand, organizations with higher organizational capability would not only be willing to proactively invest in developing and extending greater capabilities but would also emphasize on the successful integration of those capabilities with an intention to create a synergic impact on TBL performance. Thus, less investment in capability building is expected for organizations with limited organizational capability.

The proposed taxonomy has six cells that represent six different scenarios. Leading organizations in sustainable development efforts are positioned in the top and higher right cells (E and F) and they can potentially disrupt current market and the industry. Netflix, for example, is positioned in cell F. Netflix disrupted the movie/entertainment industry through its innovative business model that is far superior from economic, environmental and social perspectives compared to the previous players (e.g. Blockbusters). In line with our model, we further argue that an organization can migrate from a lower cell (e.g. cells A or B) to a higher cell (cell C or D). This is because over time an organization can learn and reflect on its TBL performance, which may then lead to altering its sustainability orientation and improving its organizational capabilities to further innovate. Such a taxonomy is helpful for conducting systematic investigations of the development and management of ICT-driven sustainability innovations by organizations located in different cells. The propositions presented earlier are expected to be applicable to organizations in each of these six cells.

<b>Sustainability Orientation</b>	business model oriented	<b>Cell C: Sustainability Dreamer</b> <ul style="list-style-type: none"> <li>• Appreciate strong sustainability orientation</li> <li>• Has intentions to transform business model but lacks adequate organisational capabilities to support such transformation</li> </ul>	<b>Cell F: Sustainability Leader</b> <ul style="list-style-type: none"> <li>• Proactively strong sustainability orientation</li> <li>• Successfully transforms business model</li> <li>• Uses organisational capabilities to support such transformation</li> </ul>
	product/services oriented	<b>Cell B: Sustainability Compliant</b> <ul style="list-style-type: none"> <li>• Moderately strong sustainability orientation</li> <li>• Customise existing products/service to meet sustainability requirements to a minimum extent</li> <li>• Lacks organisational capabilities for creating new products/services</li> </ul>	<b>Cell E: Sustainability Innovator</b> <ul style="list-style-type: none"> <li>• Strong sustainability orientation</li> <li>• Creates new sustainable products/services</li> <li>• Uses organisational capabilities for creating new products/services</li> </ul>
	business process oriented	<b>Cell A: Sustainability Laggard</b> <ul style="list-style-type: none"> <li>• Cursory sustainability orientation</li> <li>• Focuses on complying on sustainability requirement for waste minimisation</li> <li>• Lacks organisational capabilities for creating new waste reduction practices</li> </ul>	<b>Cell D: Sustainability Defender</b> <ul style="list-style-type: none"> <li>• Moderate sustainability orientation</li> <li>• Focuses on developing new practices on waste minimisation</li> <li>• Willing to use organisational capabilities for creating new waste reduction practices</li> </ul>
		Low organisational capability	High organisational capability
<b>Organisational Capability</b>			

**Figure 2. A Taxonomy of Sustainability Innovators**

## Future Study

The next step of our study involves conducting a multiple case study with 12 organizations. Our selection of case studies is driven by the notions of “theoretical replication” and “literal replication” (Yin 2016). We will have two case studies for each cell in the proposed taxonomy. The multiple case studies will investigate: a) how organizations with different levels of sustainability orientation and capabilities, occupying different cells in the proposed taxonomy, integrate sustainable development considerations into their business models as they develop ICT-enabled sustainable innovations, b) the impacts of each ICT-enabled sustainable innovation developed by case study organizations on their TBL performance, and c) how case study organizations characterized as Sustainability Leaders and Innovators (cells E and F) lead and develop impactful ICT-enabled sustainability innovation and manage their impacts.

Each case study involves interviews, site visits, direct observations and review of organizational documentations. Interviews will be conducted with at least three senior executives (Chief Executive Officer, Chief Information Officer and Chief Sustainability Officer). Qualitative data analysis methods involving rigorous open coding, axial coding and selective coding will be applied (Yin 2016). Cross case analyzes will be conducted to compare the findings across cases. Through the cross-case comparison, emerging concepts will be identified, which will contribute to refinement of the model and propositions.

## Conclusion

Developing sustainability innovations to change current business practices is crucial for organizations to respond to the global sustainability concerns. Currently, there is a limited understanding on how organizations can harness their ICT capability to enable development of innovations that bring economic, environmental and social benefits. This research-in-paper presents an early but important research effort in investigating how organizations can successfully develop ICT-enabled sustainability innovations. The proposed research model and propositions have been developed as preliminary answers to the research question. The proposed taxonomy of sustainability innovators will guide the next step of the study in investigating how different organizations with different levels of sustainability orientation and organizational capabilities develop and manage their ICT-enabled sustainability innovations. It can also guide future research in exploring how organizations improve their sustainability orientation and capabilities over time to further enhance their TBL through development of more impactful sustainability innovations. This study, when completed, will potentially offer significant contribution to IS research and practice in the areas of sustainability and innovation.

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