IT-Enabled Capabilities for Sustainable Supply Chain Management: An Affordance Theory Perspective

Completed Research Paper

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Abstract

There is an increasing consumer pressure to improve the environmental and social impacts of supply chain activities, forcing organisations to adopt sustainable supply chain practices. However, the management of sustainable supply chain is complex because it is inter-organisational in nature involving different and sometimes conflicting objectives and priorities among various stakeholders. Successful implementation of sustainable supply chain practices requires a set of specific organisational capabilities. Currently, very little is known about what capabilities are required and how information technology (IT) can enable those capabilities. This paper aims to address this knowledge gap by identifying a set of possible IT-enabled capabilities based on Affordance Theory. We put forward a novel approach that demonstrates how Affordance Theory could be applied to discover the roles of IT in capability development to support the successful implementation of sustainable supply chain management (SSCM).

Keywords: sustainable supply chain management, affordance, information technology

Introduction

Supply chain is a network of activities that delivers finished products or services to the customers (Simchi-Levi et al. 2009). It involves managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, distribution, and delivery to the customers. While procuring, transforming and transporting goods create economic value, there are major environmental and social implications. Supply chain activities can have detrimental effects on the planet's natural systems such as straining the earth's rare resources, producing massive air, water, and land waste and threatening biological diversity. There is also growing concern regarding companies conducting socially irresponsible practices such as providing unsafe working conditions, hiring child labours and using hazardous materials (Thornton et al. 2013). The consideration of environmental and social impacts of supply chain operation is known as sustainable supply chain management (SSCM).

Seuring and Müller (2008) define SSCM as "management of material, information, and capital flows as well as cooperation among firms along the supply chain while taking into account economic, environmental, and social factors which are derived from customer and stakeholder requirements." (p. 2). This definition suggests that businesses need to consider profit, people, and the planet (also known as the triple bottom line – TBL) in performing business activities (Elkington 1999). Profit is related to economic value creation by organisations. The people aspect relates to the consideration of the social impacts of a firm's business operations affecting the well-being of its employees, customers, and the community. The planet aspect deals with managing the environmental impacts of business practices, so they do not further degrade the natural environment. Thus, the goal of SSCM is to simultaneously integrate social, environmental, and economic objectives in supply chain activities (Gold et al. 2009).

The goal of SSCM can only be achieved if the entire supply chain has relevant resources and capabilities for implementing SSCM (Bowen et al. 2001). Several studies (e.g. (Dangelico et al. 2013; Gavronski et al. 2011; Shang et al. 2010) examine the necessary capabilities for implementing sustainable supply chain. Nonetheless, they primarily concentrate on the environmental aspect and exclude the social aspect. Existing studies also classify capabilities based on phases in supply chain such as green manufacturing, green marketing, or green design (e.g. (Li et al. 2015; Liu et al. 2017; Shang et al. 2010). These capabilities cannot be generalised to all industries. For instance, green manufacturing is not relevant for service industry. Furthermore, these capabilities cannot be applied to various roles in supply chain. For example, green manufacturing is not applicable to retailers. In addition, other studies refer to such capabilities as sustainable supply chain practices (Gopal and Thakkar 2016; Singhry 2015). Therefore, it is important to clearly define and identify a broader set of SSCM capabilities that are applicable in various contexts and address economic, environmental and social goals simultaneously.

Meanwhile, recent development in the field of sustainable business practices in supply chain has led to a renewed interest in the role of information technology (IT) in helping companies engage in sustainable practices. Most studies about IT and SSCM propose the role of IT in specific practices such as pollution reduction (Dao et al. 2011) or management of product return (Jayaraman et al. 2008). Existing studies also tend to provide the general role of IT such as automation (Dao et al. 2011), improving information flow (Gunasekaran and Ngai 2004), or help decision making (Jayaraman et al. 2008). While such general roles are useful, these studies do not inform us about how we can use IT to develop relevant capabilities to support SSCM practices. In fact, IT is expected to act as a crucial enabler in SSCM especially in building the required capabilities to successfully implement SSCM practices (Dao et al. 2011; Kurnia et al. 2012).

One of useful and relevant theoretical lenses to study the potential of IT is Affordance Theory. The use of Affordance Theory in Information System (IS) research examining various phenomena in various contexts is growing (see for example, (Canning et al. 2017; Strong et al. 2014; Zheng and Yu 2016). However, limited studies have applied this theory in the SSCM context. The studies of (Hanelt et al. 2017; Seidel et al. 2013) suggest six IT affordances in driving sustainability transformation which include reflective disclosure, information democratization, output management, delocalization, technological flexibility and digital eco-innovation. However, their studies are confined within an organisational boundary and do not discuss the actualization of those affordances. Overall, there is limited understanding of how IT supports the development of SSCM capabilities beyond an organisational boundary.

This study aims to enhance the current understanding of how IT supports the development of the required SSCM capabilities across the supply chains. It fills the gaps in the SSCM literature by (i) synthesizing the required sustainable practices to support the successful implementation of sustainable supply chain, (ii) exploring the necessary capabilities to support SSCM practices, and (iii) proposing the possibilities for action provided by IT to enable the required SSCM capabilities by applying Affordance Theory as a theoretical lens. The research question addressed is as follows:

How does IT enable the development of SSCM capabilities across the supply chains?

By addressing the above question using Affordance Theory, we develop a theoretically grounded understanding of how IT enables the development of SSCM capabilities across the supply chains. This paper is structured as follows. First, we briefly introduce the methodology used in the study, followed

by a review of previous related studies. We then synthesize SSCM practices, the required capabilities, and IT affordances. Finally, we discuss the study findings, highlight our study contributions and conclude the paper by outlining a number of limitations and possible future studies.

Methodology

In this study, we conducted an interpretive literature review to synthesize SSCM practices and the required SSCM capabilities (Schultze 2015). First, the relevant literature sources were identified, and a search strategy was implemented. Since SSCM is a cross-disciplinary field, the researchers investigated relevant sources across various conference proceedings and journal articles in Scopus and EBSCO. The search strategy consisted of three steps:

1. Identifying SSCM practices.
    a. This was done by applying a set of keywords including "Sustainable Supply Chain Management" OR "supply chain sustainability" OR "triple bottom line" OR "green supply chain" OR "corporate social responsibility" OR "environmental management," "social sustainability." These set of keywords are combined with OR function to get a complete view of the current of the state of SSCM.
    b. The next step is setting the criteria for inclusion of the papers. The criteria for inclusion include those papers that 1) investigate SSCM in organisational or supply chain contexts; 2) suggest SSCM practices; and 3) are written in English.
2. Identifying the required capabilities for SSCM
    a. The set of keywords used include:
        i. "sustainable supply chain management" OR "supply chain sustainability" OR "triple bottom line" OR "green supply chain" OR "corporate social responsibility" OR "environmental management" OR "social sustainability"
        ii. "capability," "competency," OR "skill." These two sets of keywords are combined with AND function.
    b. The next step is setting the criteria for inclusion of the papers. The criteria for inclusion include those papers that 1) investigate SSCM in organisational or supply chain context; 2) suggest SSCM capabilities; and 3) are written in English.
3. Identifying IT affordances.
    a. This step includes a set of keywords such as
        i. "information system," OR "information technology" OR "information and communication technology (ICT)" OR "information management system" OR "software." These keywords are combined with OR function to get complete literature about IT.
        ii. The previous set of keywords is combined with this set "affordances" OR "capabilities" by using AND function.
    b. Applying the criteria for inclusion over the retrieved papers. The criteria are: 1) investigate SSCM in organisational context; 2) suggest IT affordances; and 3) are written in English.

The retrieved papers were read and filtered based on the respective inclusion criteria. References of highly relevant papers were also examined and added to the existing database. The final number of papers were 71, 40, and 70 for each search. We then conducted data analysis using open, axial, and selective coding procedures, using NVivo version 11. NVivo assisted us in applying, storing, and retrieving codes generated from reading the data. The codes were then compared, analysed, and combined into categories.

Related Studies

The SSCM literature is still at infancy. Existing studies focus on building theory while practical guidance is limited (Eitiveni et al. 2017). Large amount of literature is devoted to identifying sustainable practices in various contexts, while studies about required capabilities to carry out those practices have

been relatively scanty. Few studies are found that provide a detailed explanation about the role of IT in achieving SSCM that motivate further investigation in this trajectory. Dao et al. (2011) identified four major roles of IT in SSCM that include automating business processes to make them more efficient and more accurate; delivering relevant information to the right stakeholders in a timely manner; transforming assets, capabilities, and processes; and providing a platform for all the other roles to be carried out. Another prominent role of IT in SSCM is to ensure transparency and traceability via its information sharing capability (Schniederjans and Hales 2016). While useful, the existing studies tend to treat IT as a standalone system that improves performance in solitude. The interaction between IT and user is largely ignored. In fact, the capability of IT to deliver changes is significantly affected by the user's goal and capability to realise the expected changes (Strong et al. 2014). This concept is known as affordance.

The notion of 'affordances' was first used by (Gibson 1986) to describe actor-environment mutuality as an inseparable relationship of animals or human beings with objects. It refers to a range of possibilities for actions that can be provided by the environment. The existence of affordances is independent on the abilities of the actors to perceive them. The same object can afford different opportunities by different actors depending on their needs and their capabilities (Gaver 1991). To produce an outcome, a goal-directed actor needs to trigger (Volkoff and Strong 2013) or actualize them (Strong et al. 2014). The actualization of those actions depends on the abilities of the actor, features of the environment and the relations between them (Chemero 2003; Hutchby 2001).

The concept of affordances has been employed in many fields such as healthcare (Anderson and Robey 2017; Burton-Jones and Volkoff 2017; Hoon et al. 2014; Savoli and Barki 2016), e-commerce (Bang et al. 2014; Tan et al. 2017; Tan et al. 2016), social development (Zheng and Yu 2016), and learning (Canning et al. 2017). In information system literature, functional affordance is defined as "…the possibilities for goal-oriented action afforded to specified user groups by technical objects" (Markus and Silver 2008, p. 266). It has been widely adopted to investigate IT-associated organisational change as it permits the examination of IT effect in a non-deterministic view.

Yet, very few studies have examined the application of Affordance Theory as a lens in exploring the role of IT in SSCM field. Seidel et al. (2017) were among those few. They proposed four functional affordances of IT in enabling environmental sustainability transformation in an organisation such as reflective disclosure, information democratization, output management, and delocalization. The other is (Hanelt et al. 2017) who added two more affordances of IT in enabling sustainability transformation, namely, technological flexibility and digital eco-innovation.

This study aims to extend previous studies that investigate IT affordances in SSCM within organisational boundary by extending investigation beyond an organisation. By utilising Affordance Theory, we provide a comprehensive framework that illustrates the relationship between IT affordances, SSCM practices, and the required capabilities.

Identifying IT Affordances in SSCM

A Synthesis of SSCM Practices

The development of sustainable supply chain requires the implementation of SSCM practices (Seidel et al. 2013). SSCM practices are the applications of sustainability concept in supply chain operations. It considers the TBL dimensions in every activity of the supply chain. Below, we define seven SSCM practices explicitly based on our analysis and synthesis of previous studies.

Sustainable design – This is a practice that considers the impact of product design on energy and material requirements for manufacturing, usage, and secondary usage (Tsoulfas and Pappis 2006) as well as improvement in human well-being and livelihood (Margolin 2002). Sustainable design helps improve firms' TBL performance by enhancing product functionality while also reducing environmental and social impacts. It leads to reduction in business waste and environmental cost while increasing customer satisfaction (Zhu et al. 2008). It addresses the social aspect of design through the use of Social Life Cycle Assessment (Dreux-Gerphagnon and Haoues 2011). Sustainable design aims to solve human problems, fulfill people's needs, and contribute to social well-being.

Sustainable purchasing - Sustainable purchasing considers the environmental and social aspects of purchasing activities. It consists of material selection, supplier selection, development, and evaluation. It provides a number of benefits such as lower disposal and liability costs, promoting resource conservation, and boosting the public image of the organisation (Min and Galle 2001; Tsoulfas and Pappis 2006). Particularly, supplier evaluation will increase the visibility required to enhance collaboration in value-added activities (Wisner et al. 2005). Supplier development is also crucial for improving the quality of the goods produced, increasing customer satisfaction and ensuring an uninterrupted flow of materials.

Sustainable manufacturing and packaging – Based on green manufacturing definition proposed by (Dangelico et al. 2013; Gavronski et al. 2011), sustainable manufacturing is the integration of environmental and social issues into product development in manufacturing processes. Sustainable manufacturing and packaging can improve environmental performances via efficient use of energy in production processes, using renewable energy sources, and pollution and waste prevention (Dangelico et al. 2013). Other initiatives include conducting life cycle analysis, applying ISO 140001, and implementing environmental management systems (Gavronski et al. 2011). The social performance can also be improved via the provision of safer and healthier working condition during manufacturing and packaging processes.

Sustainable delivery/distribution - Sustainable distribution is concerned with the delivery of products and services from the point of origin to the point of consumption efficiently by optimising the use of resources (Ninlawan et al. 2010). This practice can contribute to improving sustainability through efficient use of water, electricity, and storage spaces in distribution centres, optimal route in the distribution process, and elimination of redundancy in distribution process (Ninlawan et al. 2010; Singhry 2015). Social aspects can also be addressed by providing safe and healthy facilities while transporting products as well as transportation facilities for employees with disability.

Sustainable marketing - Sustainable marketing is an act of promoting products, services, and activities which are not harmful to the environment, employees, and communities in which an organisation operate in (Rath 2013; Shang et al. 2010). Shang et al. (2010) revealed that companies which excel at green marketing show superiority in performance. This is due to their ability to promote their sustainable practices to customers which lead to a sustained competitive advantage. Various initiatives can be attributed to their success such as proactively communicating environmental and social issues on their websites. They also publicize their sustainability activities, products, and services to the customers and relevant stakeholders.

Sustainable consumption - Sustainable consumption refers to the consumer's act to choose and consume environmentally and socially responsible products and services (Sharma and Jha 2017). Consumers increasingly prefer products and services that use minimal natural resources and harmful materials while producing minimal waste and pollutants. They also concern about social problems that happen over the life cycle of supply chain. Sustainable consumption is critical as it has substantial impacts on the environment, individual, public health, and the economy (Shaban and El-Bassiouny 2017). Sustainable consumption will drive companies to produce sustainable products and services (Handfield et al. 1997). Companies may not produce sustainable products and services if there is no demand from the customer (Gopal and Thakkar 2016).

Reverse Logistics - Reverse logistics is "the process of planning, implementing, and controlling the efficient, effective inbound flow, inspection and disposition of returned products and related information for the purpose of recovering value" (Srivastava et al. 2006, p. 7). Reverse logistics can improve sustainability performance via several processes such as acquisition that includes collection, sorting, grading, disassembly, proper packaging and labelling, reuse/resale; product upgrade consisting of repairing, refurbishing and remanufacturing; material recovery including cannibalization and recycling; and waste management that includes incineration and landfilling (Koppius et al. 2014; Singhry 2015).

Sustainable supply chain is driven by interacting strands of sustainable practices. The implementation of one practice can lead to the activation of other practices. For instance, sustainable design such as using recyclable packaging or non-hazardous materials can ease waste management and value recovery

process in reverse logistics (Carter and Carter 1998). The correct design may also allow efficient transporting which will reduce emission produced in delivery (Lai et al. 2008). Sustainable consumption influences all other practices because manufacturers are naturally forced to select licensed suppliers, create healthy and safe products or use renewables sources in their production. The implementation of any sustainable practices can smooth the execution of sustainable marketing (Carter and Carter 1998).

A Synthesis of Capabilities Required in SSCM

Capabilities are firm's abilities developed from a complex bundle of resources including skills, practices, relationships, accumulated knowledge and organisational processes that enable it to conduct certain tasks or activities (Grant 1991; Huq et al. 2016). Capabilities are regarded as a source of competitive advantage since they are harder to acquire or imitate than other resources such as capital equipment or finance (Collis and Montgomery 1990). SSCM capability is defined as "an organisation's capacity to deploy its resources exercised through organisational processes involved in sustainable practices" (Kurnia et al. 2014, p. 6). Based on our literature analysis, below is a synthesis of SSCM capabilities.

Sustainability data collection is "the ability of an organisation to efficiently gather a range of data related to sustainability practices and the impacts within the organisation and across the supply chain" (Kurnia et al. 2014, p. 6). Sustainable practices require traceability and visibility along the supply chain to ensure each activity is conducted responsibly. Sustainability-related data that need to be collected include, among others, waste management, labour condition, suppliers' activities, and transportation routing.

Sustainability performance reporting capability is defined as an organisation's ability to produce reports related to sustainability practices and impacts to inform internal and external stakeholders including government (Kurnia et al. 2014). Internally, reports that include both environmental and social dimensions are delivered to all layers of management. Externally, public and the relevant bodies are also informed. A firm that implements self-disclosure reporting of its sustainability practices through reporting program such as Global Reporting Initiative (GRI) is found to acquire and maintain a competitive advantage (Brown et al. 2009). Voluntary sustainability reporting is also found to improve the behaviour of stakeholders toward sustainable practices by internalising the sustainability principles into practices (Iveroth and Bengtsson 2014).

Sustainability benchmarking capability is "the ability of an organisation to compare the sustainability performance across various units (internal) and supply chain members (external)" (Kurnia et al. 2014, p. 6). Furthermore, benchmarking can also be conducted against competitor's sustainability performance (Nair et al. 2016) and existing standards such as Dow Jones Indexes, ISO14001, and SIGMA guidelines. Similarly, sustainability benchmarking can be performed using tools proposed by (Bjorklund et al. 2012; Colicchia et al. 2011; Hemming et al. 2004; Hong et al. 2012; Presley and Meade 2010).

Sustainability training capability is an organisation's capacity to create an awareness of the importance of sustainability practices among stakeholders and empower them to carry out those practices (Kurnia et al. 2014; Rodriguez et al. 2016). Training is a key to successfully implement sustainability. It helps build necessary capabilities in the companies and their supply chain partners (Gopal and Thakkar 2016). It plays crucial roles in internalizing sustainability practices (McPhee 2014). Investment in training could create psychological safety when facing uncertainty in dealing with sustainable practice adoption (Kirchoff et al. 2016). Training should be delivered to employees at all levels, supply chain partners, and consumers.

Sustainability risk analysis capability is defined as an organisation's ability to assess potential negative consequences of implementing an SSCM practice affecting the implementation success of SSCM practices (Kurnia et al. 2014). The importance of risk analysis capability to SSCM implementation is paramount because supply chain may span across continents with numerous possible catastrophes. Companies should consider the risks of their supply chain activities on the environment, employees, and community. Firm and its partners should conduct cost and implementation risk assessments of sustainability initiatives that include all dimensions of TBL (Faisal et al. 2006; Mentzer et al. 2001).

Sustainability governance capability is "the ability to manage and align the sustainability goals across organisational units and supply chain members" (Kurnia et al. 2014, p. 6). Since a firm can only be as sustainable as its supply chain, sustainability across supply chain can only be actualized effectively if sustainability goals are internalized and enforced across the supply chain (Rauer and Kaufmann 2015). Achieving this requires strong commitments and clear vision from top management (Kumar and Rahman 2016). Then, they need to be supported by appropriate organisational culture and constant monitoring against sustainability goals and visions (Ahmad et al. 2016).

Finally, we define **sustainability collaboration capability** as the ability to work across organisational boundaries to build and manage sustainable processes to better meet customer needs. A high degree of collaboration up and down the supply chain is required to implement sustainability practices successfully (Dangelico et al. 2013; Dao et al. 2011; Huq et al. 2016; Klassen and Vereecke 2012; Liu et al. 2017). It involves sharing of resources including information, people, and technology among supply chain members to create synergies for competitive advantage. Through collaboration, firms can also share competencies, responsibilities, and benefits to achieve common goals (Liu et al. 2017). This will boost efficiency and performance in all dimensions of TBL (Vachon and Klassen 2008).

A Synthesis of IT Affordances in Enabling SSCM Capabilities

Based on the definition from (Leonardi 2011), we define IT affordances as the ability of IT to "afford different possibilities for action based on the context in which they are used" (p 153). Based on our synthesis, we identify eight IT affordances to support various SSCM capabilities as summarized in Table 1.

Table 1. The Relationship between IT Affordances and SSCM Capabilities

SSCM Capabilities / Affordances	Data Collection	Reporting	Benchmarking	Training	Risk Analysis	Governance
Recordability and Monitorability	(Glowalla et al. 2014)	(Argyris and Monu 2015)	(Argyris and Monu 2015)	(Argyris and Monu 2015)	(Argyris and Monu 2015)	(Argyris and Monu 2015)
Information Democratization	(Seidel et al. 2013)	(Seidel et al. 2013)		(Seidel et al. 2013)	(Schniederjans and Hales 2016)	(Seidel et al. 2013)
Benchmarking		(Azevedo et al. 2016)	(Azevedo et al. 2016)			
Persuasive				(Sakamoto and Nakajima 2015)		(Sakamoto and Nakajima 2015)
Risk Analysis					(Thöni and Tjoa 2015)	(Schniederjans and Hales 2016)
Process & Output Management				(Seidel et al. 2013)	(Seidel et al. 2013)	(Seidel et al. 2013)
Delocalisation	(Seidel et al. 2013)	(Seidel et al. 2013)	(Seidel et al. 2013)	(Seidel et al. 2013)	(Seidel et al. 2013)	(Seidel et al. 2013)
Collaborative	(Argyris and Monu 2015)	(Boudreau et al. 2016)	(Luna-Reyes et al. 2014)	(Boudreau et al. 2016)	(Albano et al. 2017)	(Boudreau et al. 2016)

Recordability and Monitorability - First, IT/IS affords recordability and monitorability which refer to the ability to capture and store data and observe firm's activities (Argyris and Monu 2015; Burton-Jones and Volkoff 2017). All the necessary SSCM capabilities require data, and thus recordability and monitorability affordance support all of them. IT/IS enables automated data capturing through the use of technologies such as Electronic Data Interface (EDI) (Gunasekarana et al. 2002), social media (Argyris and Monu 2015), remote sensing, GPS and GIS, barcode, electronic tag, RFID tag (Bosona and Gebresenbet 2013). These technologies provide greater efficiency, higher visibility, and traceability across supply chain which will discourage irresponsible practices, reduce cost, and minimise waste.

Information Democratization - IT also offers information democratization affordance which facilitates information sharing about sustainability among internal and external parties (Argyris and Monu 2015; Seidel et al. 2013). By definition, this affordance supports data collection and reporting capabilities. Information democratization affordance also enables training and governance (Seidel et al. 2013) as well as risk analysis (Schniederjans and Hales 2016). Iveroth and Bengtsson (2014) studied IT affordances provided by a web-based ordering system that has data collection and reporting features. This system covers various sustainability-related key performance indicators such as, among others, amount of CO2 emissions, transport cost, and distance covered. Based on this data, intervening actions can be taken. Furthermore, decision support system (Repoussis et al. 2009), EDI (Repoussis et al. 2009), social media (Zheng and Yu 2016), ERP (Repoussis et al. 2009), and cloud computing (Schniederjans and Hales 2016) provide information democratization affordance as well.

Benchmarking - IT can afford the ability to benchmark by measuring and comparing a firm environmental and social performance against its target, supply chain partners, and competitors' performance (Azevedo et al. 2016). This affordance also enables reporting capability because benchmarking produces a very limited value unless it is reported to appropriate stakeholders. It can provide detailed calculation and historical trends. Then, improvement can be made via the selection of the best combination of practices made available by the benchmarking tool (Björklund 2010) along with their impact on performance. One popular technology that affords benchmarking is business intelligence systems (Petrini and Pozzebon 2009).

Persuasive - IT provides the ability to persuade human behaviour to internalise sustainability principles into their everyday activities (Sakamoto and Nakajima 2015). This affordance is able to support governance and training capabilities. In their study, (Sakamoto and Nakajima 2015) used video games to modify people's attitude and behaviour in a smart city. Their research revealed that digitally mediated virtual objects like video games could persuade people to behave more responsibly by offering more attractive and realistic way of learning. Social media such as microblogging platform also provide this affordance (Zheng and Yu 2016).

Risk Analysis - IT affords the ability to perform risk analysis through the use of quantitative approaches such as the application of fuzzy sets, multicriteria approaches, quantitative modeling, and big data analytics (Thöni and Tjoa 2015; Yoshida 2008). Risk analysis affordance can be used to support training and governance since the visualization of risks of conducting irresponsible practices can stimulate organisations to reduce or avoid those risks. IT utilises available information and simulate a set of scenarios of how the future may materialize. Cloud computing, for example, provides this affordance (Schniederjans and Hales 2016).

Process and Output Management - IT provides process management affordance which governs work processes and resource allocation and output management affordance that deals with calculating and reducing harmful impact of work practices. Process and output management affordances can be actualized by providing centralized configuration features that control the use and access of devices or other resources in a firm (Seidel et al. 2013). The impact of each work practice can also be visualized to gain more understanding and increase awareness. Thus, this affordance enables training, risk analysis, and governance capabilities. ERP (Repoussis et al. 2009), cloud computing (Schniederjans and Hales 2016), EDI, social media (Zheng and Yu 2016) and intelligent distribution system (Validi et al. 2014) are also examples of potential technologies to enable this affordance.

Delocalisation - Another IT affordance identified is delocalisation which refers to the ability to eliminate the dependency of work practices to a specific location through digitization of artifacts and

work practices (Seidel et al. 2013). This ability can reduce the negative impact of traveling. It can also enable all SSCM capabilities to be developed and carried out anywhere anytime. Delocalisation can be actualized through the utilisation of cloud computing (Schniederjans and Hales 2016), digitized documents and tasks, and e-filing systems, web conferencing, social media (Zheng and Yu 2016), and VoIP.

Collaborative - Collaborative affordance aims to diffuse cooperation within an organisation and across supply chain through the use of IT (Boudreau et al. 2016). IT enables creation, modification, and sharing knowledge across different organisations, which support training and governance capabilities. IT also provides possible actions to collectively gather data, create reports, benchmark performances, and analyse risk. Cloud computing (Schniederjans and Hales 2016), social media (Zheng and Yu 2016), web conferencing, and VoIP support the actualization of this affordance.

To sum up, Figure 1 shows how IT affordances can eventually lead to the creation of sustainable supply chain. The figure shows that the goals of a user direct his/her perception of IT affordances. These affordances are then actualized to support SSCM capabilities. This set of capabilities is a prerequisite for implementing SSCM practices. Finally, if appropriately employed, sustainable practices will lead to the establishment of sustainable supply chain. Thus, this study confirms the importance of IT in supporting sustainable supply chain practices and transforming the supply chain to be sustainable as argued in previous studies (e.g., Dao et al. 2011; Kurnia et al. 2012; Hanet et al. 2017).

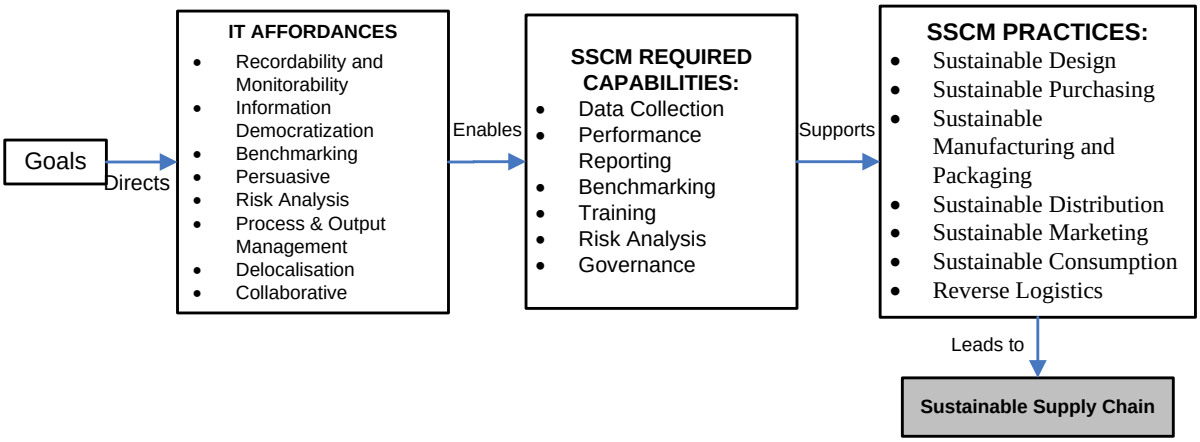

Figure 1. IT-Enabled Capabilities for Sustainable Supply Chain Management

Discussion

This study aims to investigate how IT supports SSCM capability development based on Affordance Theory. By synthesizing SSCM practices, SSCM capabilities and IT affordances to support SSCM capabilities, we have demonstrated how Affordance Theory may be applied to better understand how IT supports SSCM capability development. We propose a set of IT affordances and show how each of IT affordances enables the required capabilities. This study has demonstrated that IT offers various possibilities for action, even beyond its intended purpose. For instance, electronic capturing systems can collect sustainability-related data, besides their predetermined data. Business Intelligence system can also be used to compare environmental and social performances. Social media can be utilised to investigate supplier's approach towards environmental and social issues. This finding is important because we can incorporate sustainability aspects into legacy systems, thus costly system migration can be avoided. Furthermore, conceptualizing IT affordances can help improve the design of IT artifacts and work practices by raising the awareness of possible actions offered by IT in supporting work practices.

This study offers contributions to both research and practice. In terms of research contributions, our study contributes to the SSCM literature in several ways. First, it extends the findings of (Kurnia et al. 2014) regarding a set of capabilities to effectively implement SSCM by including sustainability collaboration capability. By adding this capability, we extend the scope of existing studies that are

generally confined within an organisational boundary. Second, we propose a set of sustainable practices for the entire supply chain which includes sustainable design, sustainable purchasing, sustainable manufacturing & packaging, sustainable distribution, sustainable marketing, sustainable consumption, and reverse logistics. By identifying sustainable practices across the supply chains, this study has suggested how each party in a supply chain could and should contribute to achieving sustainable supply chain. Third, our study also contributes to the SSCM literature which still has limited theoretical grounded studies exploring the role of IT. By adopting Affordance Theory as a theoretical lens, our research enhances the current understanding of how IT supports SSCM and the related implementation across supply chain, which has thus far been largely overlooked by IS scholars. Fourth, it expands previous studies about sustainable practices that focus heavily on environmental aspect, by including the social aspect.

Regarding contributions to practice, the findings will help practitioners to assess their supply chain activities and identify sustainable practices that have not been applied within the company or by relevant trading partners. The findings also assist them in recognising the capabilities required to implement those practices, which will in turn guide them in devising appropriate strategies to address capability gaps. Finally, our study findings can guide organisations in prioritizing their IT/IS investments depending on which SSCM capabilities they need to develop further.

Conclusions and Future Work

There is an increased awareness regarding environmental degradation and social problems caused by business activities. Environmentally and socially conscious customers and governments are forcing companies to adopt sustainable practices. Over the last two decades, there is an increasing number of firms that have integrated environmental and social objectives along with the traditional economic measures. However, it is challenging for organisations to improve these three aspects of performance. Implementing sustainable supply chain requires companies and their supply chain to develop and possess a set of specific organisational capabilities. Nevertheless, there have been limited studies on what capabilities are required to support sustainable practices. Furthermore, there are also relatively few recent studies on how IT can enable the required capabilities. This study aims to address this knowledge gap by proposing a set of IT affordances based on Affordance theory. Studies about IT affordances in various contexts have been analysed and adapted into the SSCM field which produced a more holistic perspective of IT-enabled capabilities. This study offers a conceptualization based on a literature review. We learned through our work that there are many possibilities for actions exist in IT artifacts. We can optimise the existing IT artifacts, by discovering unrealized affordances. By using this approach, company may save costly migration processes because they do not have to change the whole legacy systems. We have also identified relevant sustainable practices and the required SSCM capabilities.

This study has several limitations. First, it is currently still at a conceptual level that needs a further assessment and empirical testing. Second, although we had carefully selected the most appropriate databases, this study only use two databases, so the relevant articles assessed may not be complete. Third, we only use Affordance Theory to examine the role of IT. Combining with other theories may provide different and richer insights. Nevertheless, we believe that this study has offered a modest contribution to both research and practice related to SSCM and the role of IT in supporting SSCM by applying Affordance Theory to identify eight IT affordances for SSCM practices.

To complement the findings of this study, there are a number of possible future studies. First, future studies might test this conceptualization by conducting empirical research. Second, this research might also serve as a base for future studies about the actualization of IT affordances in enabling SSCM related capabilities development. Third, employing other theories such as resource-based view or dynamic capabilities theory might yield useful perspectives regarding required capabilities in SSCM to complement the findings of this study.

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