Bag, S, Dhamija, P, Bryde, DJ and Singh, RK

Effect of Eco-Innovation on Green Supply Chain Management, Circular Economy Capability and Performance of Small and Medium Enterprises

Article

Bag, S, Dhamija, P, Bryde, DJ and Singh, RK (2021) Effect of Eco-Innovation on Green Supply Chain Management, Circular Economy Capability and Performance of Small and Medium Enterprises. Journal of Business Research, 141. pp. 60-72. ISSN 0148-2963

Effect of Eco-Innovation on Green Supply Chain Management, Circular Economy Adoption and Performance of Small and Medium Enterprises

Surajit Bag
Department of Transport and Supply Chain Management,
School of Management,
College of Business and Economics,
University of Johannesburg, South Africa
E-mail: surajit.bag@gmail.com

Pavitra Dhamija
Department of Construction Management and Quantity Surveying,
Faculty of Engineering and the Built Environment, University of Johannesburg,
Johannesburg, South Africa
E-mail: pavitradhamija@gmail.com

David J. Bryde
Liverpool Business School
Liverpool John Moore's University
Liverpool, Merseyside L3 5UG, UK
E-mail : D.J.Bryde@ljmu.ac.uk

Rajesh Kumar Singh
Department of Operations Management
Management Development Institute, Gurgaon, India
E-mail: rajesh.singh@mdi.ac.in

Abstract

The social structures in organisations constitute essential enablers for the betterment of small and medium enterprises (SMEs) performance. Our papers explore such enablers in the context of SMEs' contribution to the Circular Economy (CE), through the lens of institutional and dynamic capability view theories. We focus on the relationships between institutional pressures, eco-innovation, green supply chain management (GSCM) practices, CE capability, big data driven supply chains (BDSC) and performance for CE supply chains. We used a survey to collect data (n=240) from people working in SMEs in manufacturing sectors in South Africa. Drawing from institutional theory, we find that coercive, normative and mimetic pressures have a positive relationship with eco-innovation. Furthermore, eco-innovation is positively associated with GSCM, with these two concepts significantly related to the building of CE capability. The final element in our framework shows a positive relationship between GSCM and CE capability. Our findings reveal some nuances in terms of the relationships between the concepts. For example, whilst BDSCs have a moderating influence on the relationship between CE capability and firm performance for CE supply chain, no such influence is evident for the relationship between GSCM practices and performance. Further work needs to focus on explaining this and other findings and on validating our theoretical framework.

Keywords: Circular economy, Eco-innovation, Green supply chain management, Firm performance, Big data driven supply chains, Institutional theory, Dynamic capability view, SMEs, South Africa

1. Introduction

One of the major concerns for governments of every country, whether classed a developed or underdeveloped, is to better understand the environmental impact of initiatives aimed at achieving economic stability (Del Giudice et al., 2020; Jain et al., 2020). If a nation ensures economic growth, whilst not adversely affecting the planet and its people, it is delivering true sustainable development (Foster, 2012; Nascimento et al., 2019). The circular economy (CE) is a response to the desire for sustainable development and hence it is recuperative or reformative by intent and by strategy (EMT, 2013; Geissdoerfer et al., 2017). It extends innovative environmental management by synthesizing three major dimensions of industrial waste management: *reduce, reuse, recycle* into the process of production and consumption (Kristoffersen et al., 2020; Fehrer & Wieland, 2021), creating opportunities for human society to interact with dynamic aspects of nature (Farooque et al., 2019; Confente et al., 2020). It further focuses on the prevention of resource depletion (Genovese et al., 2017; Dey et al., 2020), whilst allowing for sustainable growth and development (Jia et al., 2020; Parida et al., 2019). Once can see characteristics of a CE at both micro (businesses and patrons) and macro (towns, districts and authorities) levels (Liu et al., 2018a, 2018b; Kristensen & Mosgaard, 2020).

Various industries, such as construction (Gelhard & Delft, 2016) and manufacturing (Fehrer & Wieland, 2021; Katz-Gerro & López Sintas, 2016) are contributing to the CE across the globe; though there is a paucity of evidence in the current literature reflecting the contribution of small and medium enterprises (SMEs) to CE developments (Lloret, 2016; Lim, 2017). The extant literature is focused on the challenges confronting SMEs to adopt CE (Lieder & Rashid, 2016; Lahane et al., 2020), the need to contribute to the CE, whilst meeting other environmental management-related challenges like eco-innovation (Milios et al., 2019; Patwa et al., 2020) and demands to practice green supply chain management (GSCM) (Rosa et al., 2019; Barbieri & Santos, 2020).

In our study, we extend the existing, and rather limited, existing knowledge on SMEs' contribution to the CE through empirical investigation of the context of SMEs and by modelling the relationships between CE and its antecedents.

Our research seeks answers to three research questions in relation to SMEs' contribution to the CE. Below, we introduce the derivation of each question. The first question focuses on the relationship between institutional pressures on firms and eco-innovation and utilises institutional theory. Harnessing the power of the social structures that exist in firms constitutes an essential element for the successful development of SMEs (Dubey et al., 2018). Such developments potentially include an enhanced contribution to the CE, and, in this respect, institutional theory offers a useful lens through which to view SME's development (Mazzoni, 2020). Institutional theory explains the influences of the psychological intentions and social behaviours of individuals that influence the performance of SMEs, including, potentially, their responses to environmental concerns. Under the umbrella of institutional theory DiMaggio & Powell (1983) describe three types of pressures on organizations: coercive, normative, and mimetic. Institutional theory is used to provide a framework on which sustainable business models for SMEs are built in order to establish manufacturing practices that contribute to the CE (Bag et al., 2021a, 2021b). What is not yet clear in the literature is what relationship exists between the types of pressures facing firms, as classified by institutional theory and outcomes relating to eco-innovation. Hence our first research question, which is: do institutional pressures (coercive, normative and mimetic) shape eco-innovation in SMEs?

The second research question focuses on the interplay between the variables of eco-innovation, green supply chain management (GSCM) and CE. Here our focus is informed by dynamic capability view theory (DCV). DCV theory establishes a link between environmental disturbances and possible ways to reduce resource spoilage, in order to enhance operational performances (Patwa et al., 2020); with the harnessing of a firm's dynamic capabilities a means of gaining competitive advantages, especially during periods characterised by turbulent environmental and economic conditions (Wu 2012; Gente & Pattanaro, 2019). The concepts of CE and GSCM are environmental and economy related and hence are particularly pertinent in such conditions (Zhu et al., 2005, 2011; Milios et al., 2019). The CE provides growth opportunities for firms and economies across the globe, especially emerging economies, to identify the unleashed potential of eco-innovations (Afshari et al., 2020; Duan & Aloysius, 2019; Pan et al., 2019). The growing literature on eco-innovations and CE is evidence of their importance among researchers, academicians and policy makers (Ripanti & Tjahjono, 2019; Del Giudice et al., 2020); however, we lack a comprehensive understanding as to the relationships between eco-innovation and GSCM and the building of capability to contribute to the CE in SMEs (Costantini et al., 2017; Lu et al., 2019). Hence, the second research question is what are the relationships between eco-innovation, GSCM and CE capabilities in SMEs?

Our third and final research question focuses on the topic of big data-driven supply chain management (BDSCM). BDSCM is a method to attain sustainable business processes, especially in the context of manufacturing organizations (Dewick & Foster, 2018). These technology-oriented supply chain management practices deliver desired products and services whilst deploying less time and cost (Adams et al., 2017). With the driver of delivering sustainability, such supply chains further contribute towards CE practices whilst extending benefits for the individual SMEs. The existing body of knowledge confirms that eco-innovation, the development of goods and services that lead to sustainability and GCSM, combining sustainable practices with traditional supply chain management are crucial pathways to achieve CE objectives (Vinuesa et al., 2020; Mazzoni, 2020). Therefore, our final research question is does GSCM practices, under the moderating influence of BDSCM, result in enhanced firm performance for those SMEs contributing to the CE?

Our empirical focus is on the country of South Africa. South Africa is a country classed as a developing country, despite an abundance of resources and activities in various industries. SMEs comprises of sixty to seventy percent of businesses in South Africa. South Africa industries are under pressure to contribute to sustainable development (Saavedra et al., 2018; Türkeli et al., 2018). The country has been the focus of research in relation to SMEs, which is useful in providing context for our study. For example, Frigon et al. (2020) suggests difficulties that might hinder the effective functioning of SMEs in South Africa in the context of eco-innovation, which also apply in relation to contributing to the CE. These difficulties include stringent government regulations (Chiarini, 2017; Costantini et al., 2015, 2017), intense competition (Pizzi et al., 2020), underrated markets for SMEs products (Jain et al., 2020) and inadequate human skills/expertise to set-up SMEs (Chappin et al., 2020). Furthermore, moves to a CE impact on SME firms' business models (Chiarini, 2014; Gente & Pattanaro, 2019) and organizational approaches, designs and methods employed (Ripanti & Tjahjono, 2019; Figge et al., 2020).

We structured our paper as follows. Firstly, we explain the theoretical underpinning of a study, the hypotheses development and we introduce the theoretical framework. Then we describe our survey-based methodology; the operationalisation of our constructs, the sampling strategy, which collected data from SMEs in South Africa and the data collection methods. We detail the methods for dealing with potential bias. We follow this with a section covering the data analysis, incorporating the use of Structured Equation Modelling (SEM), how we dealt with common method bias, how we tested for endogeneity and we present the measurement model. We finish the section with the results of the hypotheses testing. We then discuss the results and highlight the theoretical, practical and policy implications of our study. We end the paper by stating our main conclusions and outlining areas for further study.

2. Theoretical underpinning

2.1 Circular Economy

A circular economy (CE) is a series of abstractions (Ripanti & Tjahjono, 2019), whereby there is conversion of resources, circulation, utilization and reclaiming of products and related raw materials (Del Giudice et al., 2020). CE is the process of converting environmental resources into varied usable products and services (Lloret, 2016), which are eventually circulated among consumers, firms and markets (Lim, 2017). The evolution of CE shows its multidisciplinary background; wherein approaches from a variety of disciplines, such as engineering, economics and ecology have contributed to its development (Pizzi et al., 2020). Due to the often convoluted, vigorous and dynamic nature of sustainable businesses (Patwa et al., 2020), CE needs innovations that enable delivery of environmentally friendly products and services – which is conceived as eco-innovation (Hopkinson et al., 2018).

2.2 Eco-innovation

Eco-innovations are technological advancements especially focussed towards sustainability (Greco et al., 2020); with such advancements inviting lots of attention over the last decade (Gligor et al., 2019; Li et al., 2020). Eco-innovations comprise of two main aspects: (1) the impact of an innovation on the environment, whether positive/negative and (2) the intent with which the innovator has initiated an innovation (product/service), keeping in mind its environmental effect (Barbieri & Santos, 2020). Innovations that do not consider environmental aspects are not classed as eco-innovation (García-Sánchez et al., 2020). For example, if an automobile company increases the fuel efficiency of motor bikes, by improving the engine's performances, with no concern towards the environmental side effects of the change, it is not an eco-innovation (Su et al., 2020).

Eco-innovation is a way of converting the standard rectilinear system of manufacturing and ingestion into a CE (Milios et al., 2019), with institutions and organizations promoting CE models that harness fundamental and universal eco-innovation to enable the global flow of raw materials (Patwa et al., 2020). Models of CE seek to achieve an economic balance between materials usage and energy consumption by adapting the 3Rs (reduce, reuse and recycle) (Ripanti & Tjahjono, 2019). Re-manufacturing is accepted as one of the efficient methods to overcome closed-loop material use procedures (Lu et al., 2019). Principally, the approach of a CE aims to create new resources, whilst at the same time delivering business value (Türkeli et al., 2018); wherein eco-innovation is categorised as the major driving force of a CE, which addresses environmental concerns (Saavedra et al., 2018).

2.3 Green Supply Chain Management

Green supply chain management (GSCM) extends sustainable development (Lahane et al., 2020) and eco-innovation is one of the major elements that contributes towards GSCM (Fehrer & Wieland, 2021). GSCM comprises of five essential elements: 1) sustainable purchasing, 2) eco-innovation, 3) internal environment management, 4) recovery of investment and 5) customer support for sustainability concerns (Liu et al., 2017; Lieder and Rashid, 2016). Eco-innovation amalgamates ecological deliberations into products and manufacturing procedures to achieve GSCM, which eventually fulfils the ecological demands of the end users (stakeholders, consumers, manufacturing organizations) (Confente et al., 2020). GSCM extends the practical implication of eco-innovation (Farooque et al., 2019).

2.4 Institutional theory

Institutional theory focuses on the social structures that exist in an organizational context (Liu et al., 2018). The theory puts emphasis on the procedures (directions, standards and practices), which are governed by already established social behaviour norms and policies (Jain et al., 2020). Institutional theory provides an understanding of the impacts of these procedures, in order to create models that identify the external factors needed to implement CE in manufacturing organizations (Bag et al., 2021a). The theory is used to understand how environmental initiatives in organizations deliver economic and environmental performance that considers both short-term and long-term perspectives (Dubey et al., 2019a, 2019b). For example, institutional theory explains how social acceptability of sustainable practices is key to achieving sustainability-related goals in organizations (Del Giudice et al., 2020). The application of the theory enables the achievement of eco-sustainability and eco-innovation outcomes (Mazzoni, 2020). It provides a lens through which to see opportunities for eco-innovation practices that enhance sustainable development (Li et al., 2020).

2.5 Dynamic Capability View theory

Dynamic Capability View theory (DCV) focuses on the responses to environmental turbulences through transforming operational practices in organizations (Lloret, 2016). DCV accepts the premise of the resource based view of the firm, which focusses on utilisation of combinations of different types of resources (Peeri, 2020). It provides direction for managers to effectively restructure and realign the organization's resources to achieve operational excellence, whilst, at the same time, responding to environmental pressures (Dubey et al., 2018). The DCV emphasizes the renewal of resources, through novel combinations, for effective operations management (Kock, 2017). DCV enables manufacturers to minimise unwanted environmental disturbances originating from the digitalization of products and services (Jain et al., 2020).

2.6 Theoretical framework

Our model, shown in figure 1, draws from Institutional theory and DCV theories. We express potential coercive, normative mimetic pressures as latent variables, having an effect on eco-innovation. Then eco-innovation is linked to GSCM and CE capability. Finally, both GSCM practices and CE capability feeds into a firm's performance, with big data driven supply chains acting as a moderating variable. The control variables are firm size and industry, as in previous research of a similar nature, found both to have a significant effect on firm performance (Dubey et al., 2018).

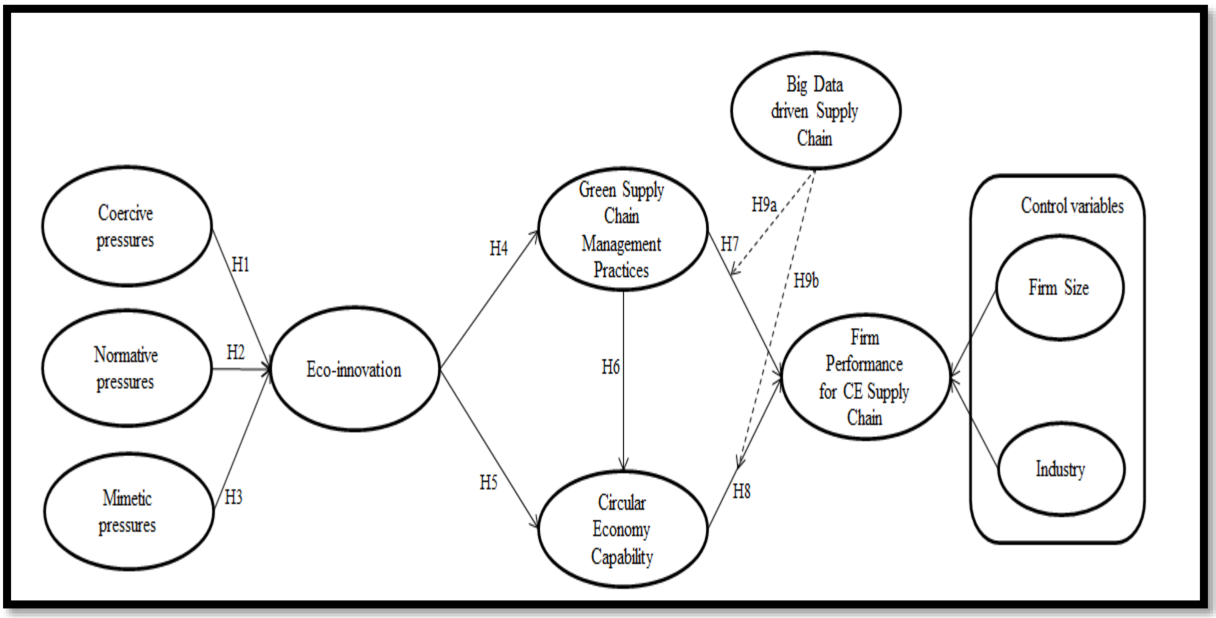

Figure 1. Theoretical framework

3. Hypothesis development

In this section, we build on the theoretical framework, shown in figure 1, to derive the hypotheses (H1 – H9a).

3.1 Coercive pressures and eco-innovation

Coercive pressures on organizations, from buyers, government agencies, regulatory norms and policies, are crucial for the successful introduction and implementation of eco-innovations (DiMaggio & Powell, 1983). Hellström (2007) highlights the significance of technological involvement, environment management and eco-innovation for SMEs. The former assists to address administration, cooperation and information exchange concerns relating to environmental issues (York & Rosa, 2003; Lee et al., 2020; 2021). Whereas the latter extends knowledge of the technological requirements needed for eco-innovation (Foster, 2012). Pertinently, the introduction of eco-innovations, whilst giving due consideration to coercive pressures and environmental laws, enhances the competitive positions of the SMEs (Li et al., 2020; Liu et al., 2018). Some eco-innovations might not be economically benign, though addressing appropriate regulations and policies can result in a smooth route to acceptability (Prieto-Sandoval *et al*., 2018a, 2018b). Hence, we hypothesise:

H1: Coercive pressures have a significant and positive impact on eco-innovation in SMEs

3.2 Normative pressures and eco-innovation

Normative pressures are holistic struggles of an organization to achieve effective eco-innovation (DiMaggio & Powell, 1983). The supply of goods and services essentially contributes towards effective functioning of eco-innovations in SMEs (Jain et al., 2020). The depletion of non-renewable sources of energy due to enhanced consumption activities (Greco et al., 2020), followed by extreme industrialization across the globe, highlight the need for advanced eco-innovation (Del Giudice et al., 2020). The deployment of eco-innovations is only possible with effectively integrated technological capacities and environmental management (Foster, 2012). The availability of effective supply services is one of the most influencing factors for the implementation of eco-innovations (Lee et al., 2020). Studies have considered supply management as part of strategic initiatives to avail the benefits of eco-innovations (Kock, 2017). Given the multidimensional nature of innovations, it is worthwhile to understand the association between the supply side, in the form of normative pressures to act, and eco-innovations (York et al., 2010). Therefore, we hypothesise:

H2: Normative pressures have a significant and positive impact on eco-innovation in SMEs

3.3 Mimetic pressures and eco-innovation

Mimetic pressures arise due to the imitation of practices among organizations; here the practices relating to eco-innovation (DiMaggio & Powell, 1983). Demand for similar eco-innovations is one of the root causes of mimetic pressures (Lee et al., 2020). In other words, the demand side plays a significant role in the building and dissemination of innovation (Costantini et al., 2015; Lim, 2017). On-time availability of demand-related requirements reduces production uncertainties of technology and markets (Demirel & Kesidou, 2019) and it further allows goodwill to build among suppliers seeking to pursue investments in eco-innovations (Cai & Zhou, 2014). The fulfilment of production demands is a crucial way in which to keep businesses moving forward, especially in the current era of cut-throat competition (Li et al., 2020, 2021). Su et al. (2020) evidences that the rise in demand for environmentally friendly products, while achieving technological sustainability, is the motivation to adopt eco-innovations in SMEs (Hojnik & Ruzzier, 2016). Thus, we hypothesise:

H3: Mimetic pressures have a significant and positive impact on eco-innovation in SMEs

3.4 Eco-innovation and green supply chain management practices (GSCM)

Technology-orientated activities and industrialization are posing severe environmental challenges for SMEs, especially in terms of managing supply chains (Chin et al., 2015). Harmful emissions and toxic packaging material create an advanced level of industrial pollution (Sezen & Cankaya, 2013). GSCM is considered to be an effective approach to reduce these and other environmental hazards (Costantini et al., 2017; Liu et al., 2018). This environmental innovation combines aspects of the environment and regular supply chain activities into an eco-innovation (Dewick & Foster, 2018), which is based on sustainability (Lee et al., 2020). GSCM includes green procurement, green manufacturing and green distribution (Hojnik & Ruzzier, 2016). Kock (2017) explains that from the perspective of sustainability, both eco-innovations and GSCM practices can deliver positive outcomes (Li et al., 2020). We hypothesise:

H4: Eco-innovation has a significant and positive impact on GSCM practices in SMEs

3.5 Eco-innovation and Circular Economy (CE) adoption

CE adoption highlights the importance of environmental issues across the globe (Adams et al., 2017). CE revolves around the notions of environmentally friendly ecosystems (Kock, 2017), instead of following a linear economy philosophy (Costantini et al., 2015). Eco-innovation and CE share a positive association as they have similar issues, such as green and sustainable innovation (Foster, 2012), corporate social responsibility (Hojnik & Ruzzier, 2016), and technologically equipped business models (Lim, 2017; Smol et al., 2017). Deza & Sánchez (2018) argued that CE promises sustainable development but does not necessarily lead to an increase in economic growth. Eco-innovation, be it organizational/non-organizational or institutional/non-institutional, can be accompanied by different levels of technology (Roos Lindgreen et al., 2020). However, Lahane et al. (2020) confirms that CE can deliver good results when coupled with eco-innovations in SMEs. Hence, we hypothesise:

H5: Eco-innovation has a significant and positive impact on CE adoption in SMEs

3.6 GSCM practices and CE adoption

GSCM and CE adoption delivers sustainable growth and development (Jia et al., 2020). GSCM and CE are designed to provide a targeted improvement from the perspectives of the environment and the economy (Liu et al., 2018); however, the approach of each is different (Hellström, 2007). GSCM is focussed on providing environmentally friendly activities and to some extent, it contributes towards economic upliftment (Costantini et al., 2015). CE caters for economic development, while considering the environment and the optimum utilization of available resources in SMEs (Liu et al., 2018). GSCM can extend the positive acceptance for CE adoption (Kock, 2017). CE adoption facilitates eco-industrial activities, which synergises with GSCM practices, thereby, delivering sustainable manufacturing practices in SMEs (Su et al., 2020). Therefore, we hypothesise:

H6: GSCM practices have a significant and positive relationship on CE adoption in SMEs

3.7 GSCM practices, firm performance and CE supply chains

GSCM denotes sustainability-oriented supply chain management (Smol et al., 2017) and the concept of GSCM has a close connection with SMEs' performance (Foster, 2012). It is important to establish CE supply chains (Adams et al., 2017) and it is the sustainable aspect of SMEs' performance that assures environment friendly GSCM practices (Hojnik & Ruzzier, 2016). GSCM allows SMEs to minimise the usage of non-renewable resources and establish more eco-friendly measures, in order to operate manufacturing processes (Genovese et al., 2017). Deza and Sánchez (2019) opines that a clear and positive relationship between GSCM and firm performance can deliver the best possible outputs. This association can remove several barriers to achieving operational excellence in SMEs (Barbieri & Santos, 2020). Thus, we hypothesise:

H7: GSCM practices have a significant and positive relationship with firm performance for CE supply chain in SMEs

3.8 CE adoption, CE supply chains and firm performance

Human beings are using up more and more natural resources for their survival (Frigon et al., 2020). Globally, an increase in population, as well as income-related rises, are contributing to this phenomenon (Demirel & Kesidou, 2019) and, hence, the amounts of various material resources are reducing and some might disappear completely in future (Liu et al., 2018). The concept of CE and its adoption provides an opportunity for firms to lessen their use of primary non-renewable resources (Kock, 2017), thereafter extending the possibilities of using more environmentally friendly materials (Geissdoerfer et al., 2017). CE adoption facilitates different CE models, which can support SMEs to minimise waste and to practice appropriate utilization of resources (Deza & Sánchez, 2019). It is important to understand that increased needs and wants of consumers is putting extreme pressure on the environment (Foster, 2012). However, the CE can enable firms to realise the importance of green recovery (Barbieri & Santos, 2020). Subsequently, we hypothesise:

H8: CE adoption has a significant and positive relationship with firm performance for CE supply chain in SMEs

3.9a Big data driven supply chains (BDSCs), GSCM practices and firm performance

Climatic changes are critical factors for SMEs to consider (Roos Lindgreen et al., 2020) and, in this respect; BDSCs are delivering good results across the globe (Farooque et al., 2019). Adams et al. (2017) highlights that GSCM practices are important facilitators of CE supply chain performance and existing literature confirms an indispensable role of BDSCs in developing GSCM and leading to enhanced SME's performance (Costantini et al., 2015). BDSCs provide a proactive approach to create sustainable business practices, while overcoming hurdles related to time-constrains and cost-pressures (Dewick & Foster, 2018). The recycle and reuse methods of CE and BDSCs extend an environmentally friendly approach for organizations in relation to their business operations (Greco et al., 2020). Big data technologies can help SMEs to predict events and avert risks in supply chain (Bag et al., 2021a).

Del Giudice et al. (2020) indicated that BDSCs act as a moderating role of the relationship between CE HR management and firm performance. Hence, we hypothesise:

H9a: The higher/lower is the strength of BDSCs, the higher/lower is the effect of GSCM practices on firm performance

3.9b BDSCs, CE capability and form performance

CE adoption is gaining increased credibility due to its potential contribution to sustainability (García-Sánchez et al., 2020). CE couples economic growth and development with reducing resource wastage and enhancing environmental benefits in SMEs (Cai & Zeng, 2017). Frigon et al. (2020) state that technologically equipped supply chains (BDSCs) is a route towards more sustainable CEs (Barbieri and Santos, 2020), thereby allowing better firm performance (Costantini et al., 2015). BDSCs enable resource efficiency by technological involvement towards CE adoption and CE based supply chains (Liu et al., 2018). Due to BDSCs, firms can make quick and informed collaborative decisions for CE capability development (Dewick & Foster, 2018). It is the strong enabler of real time product information related to manufacturing, refurbishing and recycling activities (Jia et al., 2020), which facilitates improved firm performance (Su et al., 2020). Del Giudice et al. (2020) indicated that BDSCs act as a moderating role of the relationship between CE HR management and firm performance. Therefore, we hypothesise:

H9b: The higher/lower is the strength of BDSCs, the higher/lower is the effect of CE adoption on firm performance

4. Methodology

In this section we explain the process whereby we operationalised the study's constructs, our sampling strategy and method for data collection, how we dealt with the potential issue of non-respondent bias, the techniques used to explain the selection and operationalization of constructs, the formulation of our sampling strategy and approach to data collection.

4.1 Operationalisation of constructs

Measurement items for our constructs are taken from already established scales. The three antecedents of eco-innovation: coercive (six items); normative (four items) and mimetic pressures (three items) are adapted from Zeng et al. (2017); Prieto-Sandoval et al. (2018a); and

Dubey et al. (2019). Our eco-innovation construct (eight items) is adapted from Prieto-Sandoval et al. (2018a). Green supply chain management practices (five items) are adapted from Liu et al. (2018) and circular economy capabilities (seven items) from Zeng et al. (2017). We adapted the instrument developed by Maroufkhani et al. (2020) (five items), and also items included from Jain et al. (2020) to measure firm performance (nine items). Finally, big data driven supply chains (four items) are measured using the items from Del Giudice et al. (2020). We provide the full measurement instrument in the Appendix.

4.2 Sampling strategy and data collection

Cross-sectional data collected via a survey are used to examine the research hypotheses. A typical five-point Likert scale is utilised to measure level of agreement with the statements (5 being Strongly Agree and 1 being Strongly Disagree). The questionnaire was developed in two parts. The first part consists of questions related to name, age, domain of work, role in company, experience, number of employees in company etc. The second part of the questionnaire contains items to measure the latent constructs.

We calculated the statistical power and minimum sample requirements in WarpPLS (version 7.0) software using the inverse-square root method, which gave a minimum sample size of 271. We used a simple random sampling technique to select SME companies from the Ezee-Dex database of suppliers in South Africa. An online questionnaire link was sent to 462 potential respondents working in these supplier organisations. After follow-ups, we received 240 completed questionnaires. In South Africa small business development minister Lindiwe Zulu (RSA, 2018) changed the definition of micro, small and medium sized enterprises in 2019. Since that date, two metrics are mainly used to assess the size of an enterprise; firstly, the number of employees and secondly, the total annual turnover. Micro enterprises have up to 10 employees, small enterprises can have between 10 and 50 employees, and medium-sized enterprises can have between 51 and up to 250 employees. In the manufacturing sector, the turnover ceiling for a micro level enterprise is R10 million, for small sized enterprise it is R60 million and for medium sized enterprises, R170 million (where R1 = 0.068 USD).

Table 1 presents the demographic profile of respondents. We received the highest number of responses from senior managers and from individuals working in automotive component manufacturing companies. 27.50 percent of responses were from those in small sized enterprises and 72.50 percent from those in medium sized enterprises.

4.3 Non response bias

Data were collected in two phases: 106 responses before follow up (early responses) and 134 responses after follow-up (late responses). Therefore, we checked for non-response bias using the guidelines laid down by Armstrong & Overton (1977). We compared the first and the last 25% of responses received and found no significant difference between each of the measured items (observed p value >0.05). We also found no significant difference between the profiles and the response pattern of both the categories (early and late respondents). Therefore, non-response bias does not appear to be a significant issue in our data.

Table 1: Demographic profile

Particulars	**Respondents**	**Respondents (In Number)**	**Respondents (In Percentage)**
Designation	Board member/ President/Vice President/General Manager	26	10.83
	Senior Manager	140	58.33
	Manager	22	9.17
	Junior Manager	52	21.67
Experience (Years)	Above 20	178	74.17
	10 to 20	52	21.67
	Below 10	10	4.17
Nature of Business Activities	Automotive component manufacturing	129	53.75
	Light engineering	68	28.33
	Casting manufacturers	23	9.58
	Electronics component manufacturers	20	8.33
Age of the Firm (Years)	Above 20	186	77.50
	10 to 20	50	20.83
	5 to 10	4	1.67
	Below 5	0	Nil
No of employees	10	0	Nil
	10 to 50	66	27.50
	<250	174	72.50

Annual Turnover (South African Rands - R)	Micro	0	Nil
	Small	66	27.50
	Medium	174	72.50

5. Data analysis

Here we provide a justification for the Structured Equation Modelling (SEM) technique used. We set out how we addressed potential common method bias and tested for endogeneity. We finish this section by presenting the results of the SEM in the form of the structural model.

5.1 Use of SEM

We utilised Structural equation modelling (SEM), combining two robust statistical techniques: firstly, exploratory factor analysis and secondly, structural path analysis. Further, the analysis of endogenous variability, which is an element of our analysis, is appropriate to SEM (Lee et al., 2011). Kock (2017) confirms the acceptability of SEM, using Partial Least Squares (PLS), for studies similar to ours in management science-related research. We followed the advice of Hofstra & Huisingh (2014), who provide detailed guidelines as to which SEM method to use i.e., PLS SEM vs Covariance-Based (CB) SEM. PLS-SEM is particularly useful for smaller sample sizes and for where the focus is on theory development, as is the case in our study.

5.2 Common method bias

Common method bias (CMB) can create problems in survey-based research and lead to biased survey results (Pagoropoulos et al., 2017). Therefore, we took precautions when developing the instrument. Simple English language was used to avoid any possible misunderstanding of the questions. A split survey method can eliminate CMB (Peeri et al., 2020), so we collected data independently using two different surveys. The respondents to both of the surveys had related profiles and were selected from a defined population from a similar sampling frame. This procedure mitigates for CMB occurring. In addition, we performed Harman's one-factor test and found that the single factor explained 46.32% of the total variance, which is lower than the accepted cut-off figure of 50%. This confirmed that the data did not suffer from CMB.

5.3 Endogeneity test

We used the WarpPLS software to test and control for model endogeneity caused by the predictor variables coercive pressures, normative pressures and mimetic pressures having an indirect effect on the dependent variable firm performance for CE supply chain. Therefore, we created an instrumental variable - see iC in figure 2 – directly linked to firm performance for CE supply chain, using single stochastic variation sharing technique. The model was drawn and further testing undertaken. The findings show that the p value (0.17) at the 5% confidence level is not significant (refer to figure 2) and therefore, we concluded that endogeneity is not a problem in our model.

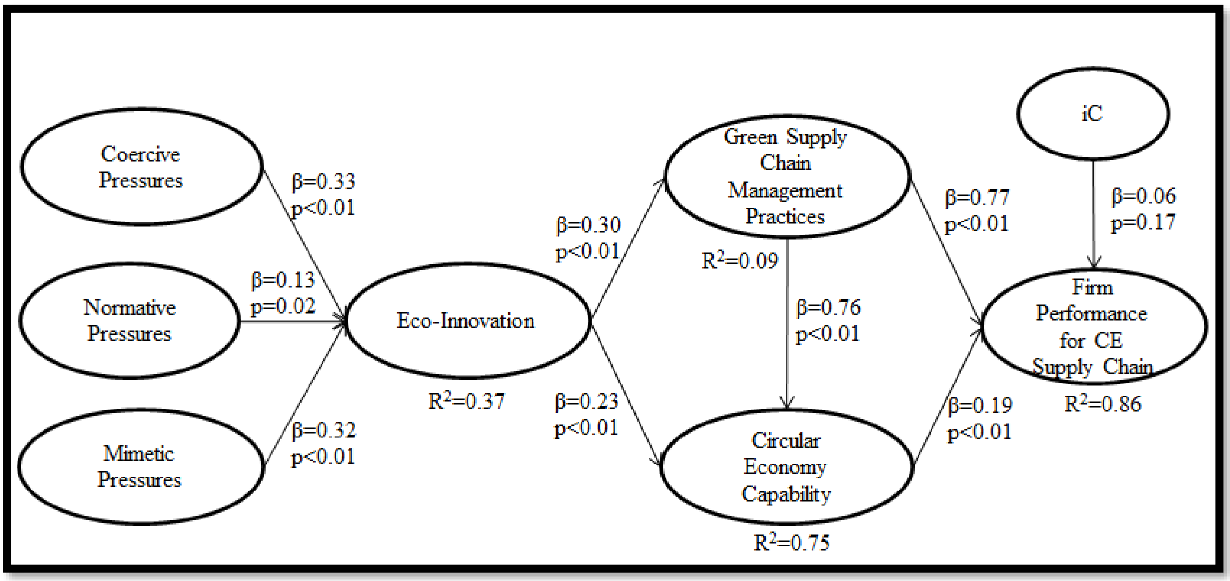

Figure 2. Endogeneity test

5.4 Measurement Model

Data pre-processing showed no columns with zero variance; no identical column names; no rank problems and all columns (indicators) standardized. Model fit was checked and, furthermore, we assessed internal consistency reliability using composite reliability. All constructs exceed the recommended 0.70 level (see Table 2). Convergent validity was measured using AVE. The values for all constructs were satisfactory and greater than the required value of 0.50 (Hofstra & Huisingh, 2017) except for eco innovation (0.443). However, Fornell & Larcker state that if AVE is less than 0.5 but composite reliability is higher than 0.6 then convergent validity of the construct is still adequate (Fornell & Larcker, 1981).

Table 2: Factor loadings, AVE, CA and CR values

Construct	Item	Factor Loadings
Coercive Pressures (CP) (AVE= 0.525; CA= 0.816; CR= 0.868)	CP1	0.831
	CP2	0.780
	CP3	0.751
	CP4	0.671
	CP5	0.625
	CP6	0.668
Normative Pressures (NP) (AVE= 0.527; CA= 0.700; CR= 0.816)	NP1	0.716
	NP2	0.673
	NP3	0.734
	NP4	0.778
Mimetic Pressures (MP) (AVE= 0.612; CA= 0.675; CR= 0.823)	MP1	0.874
	MP2	0.816
	MP3	0.638
Eco-Innovation (ECOI) (AVE= 0.443; CA= 0.788; CR= 0.843)	ECOI1	0.692
	ECOI2	0.849
	ECOI3	0.816
	ECOI4	0.849
	ECOI5	0.816
	ECOI6	0.345
	ECOI7	0.398
	ECOI8	0.119
Green Supply Chain Management Practices (GSCM) (AVE= 0.707; CA= 0.896; CR= 0.923)	GSCM1	0.814
	GSCM2	0.842
	GSCM3	0.846
	GSCM4	0.867
	GSCM5	0.833
Circular Economy Capability (CEC) (AVE= 0.615; CA= 0.895; CR= 0.918)	CIRCI1	0.838
	CIRCI2	0.840
	CIRCI3	0.789
	CIRCI4	0.731
	CIRCI5	0.741
	CIRCI6	0.757
	CIRCI7	0.787
Firm Performance (FIP) (AVE= 0.639; CA= 0.956; CR= 0.961)	FIP1	0.874
	FIP2	0.733
	FIP3	0.750
	FIP4	0.716
	FIP5	0.729

	FIP6	0.768
	FIP7	0.753
	FIP8	0.771
	FIP9	0.813
	FIP10	0.845
	FIP11	0.854
	FIP12	0.810
	FIP13	0.874
	FIP14	0.874
Big Data Driven Supply Chains (BDSC) (AVE= 0.640; CA= 0.802; CR= 0.873)	BDSC1	0.920
	BDSC2	0.706
	BDSC3	0.608
	BDSC4	0.918

We checked for discriminant validity, with the results provided in Table 3. As shown in the table, the correlation between latent constructs was smaller than the square root of AVE for each of the individual constructs, which confirms discriminant validity in our model. We further conclude from our testing that there is construct validity for the data.

Table 3: Correlations between latent constructs

	CR	NP	MP	ECOI	GSCM	CEC	FIP	BDSC	BDSC*GSCM	BDSC*CEC
CR	**0.73**									
NP	0.54	**0.73**								
MP	0.52	0.63	**0.782**							
ECOI	0.31	0.28	0.353	**0.666**						
GSCM	0.56	0.51	0.552	0.29	**0.841**					
CEC	0.35	0.3	0.368	0.468	0.67	**0.784**				
FIP	0.57	0.52	0.559	0.306	0.912	0.686	**0.799**			
BDSC	0.22	0.26	0.216	0.407	0.308	0.557	0.366	**0.800**		
BDSC* GSCM	0.05	0.16	0.152	-0.07	0.191	-0.008	0.206	-0.09	**1.000**	
BDSC* CEC	0.04	0.07	0.074	-0.24	-0.007	-0.229	-0.007	-0.23	0.72	**1.000**

We checked model fit indices Average path coefficient (APC), Average R-squared (ARS), Average adjusted R-squared (AARS), Average block VIF (AVIF), Average full collinearity

VIF (AFVIF) and Goodness of Fit (GoF). As shown in table 4 the values of APC, ARS and AARS are statistically significant at the 1% confidence level. AVIF and AFVIF are within acceptable limits and the GoF shows a large value, which indicates that our model is strong.

Table 4: Model fit indices

Test	**Results**
Average path coefficient (APC)	0.315, P<0.001
Average R-squared (ARS)	0.520, P<0.001
Average adjusted R-squared (AARS)	0.516, P<0.001
Average block VIF (AVIF)	1.396, acceptable if <= 5, ideally <= 3.3
Average full collinearity VIF (AFVIF)	3.01, acceptable if <= 5, ideally <= 3.3
Tenenhaus Goodness of Fit (GoF)	0.59, small >= 0.1, medium >= 0.25, large >= 0.36

We also checked the data for possible issues relating to causality. We calculated the following quality indices: Sympson's paradox ratio, R-squared contribution ratio, Statistical suppression ratio and Non-linear bivariate causality direction ratio (NLBCDR). As shown in table 5, the test results were all within acceptable limits.

Table 5: Quality indices

Test	**Results**
Sympson's paradox ratio	1.000, acceptable if >= 0.7, ideally = 1
R-squared contribution ratio	1.000, acceptable if >= 0.9, ideally = 1
Statistical suppression ratio	1.000, acceptable if >= 0.7
Non-linear bivariate causality direction ratio	0.900, acceptable if >= 0.7

5.5 Structural Model

The final tested model is shown in Figure 4.

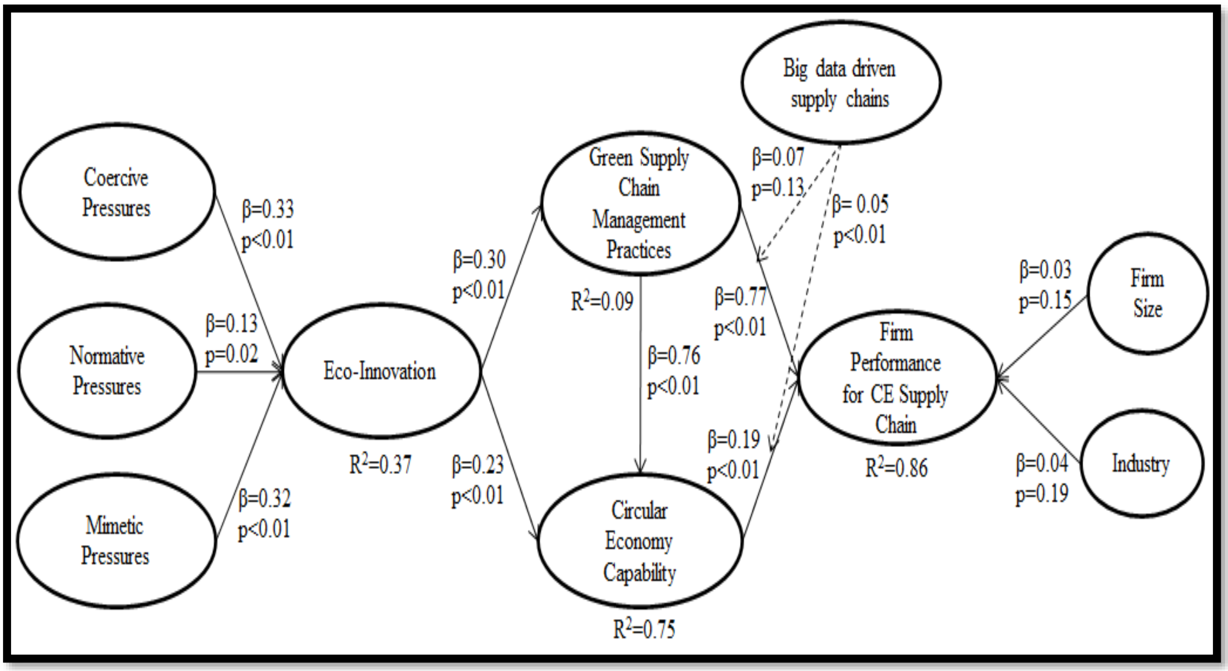

Figure 4. Final Tested model

The results of testing the hypotheses are shown in Table 6. Hypotheses H1 to H9b (except H9a) are supported. H9a is not supported.

Table 7: Results of hypotheses testing

Hypothesis	Effect Of	Effect On	β	p-value	Supported/Not Supported
H1	Coercive pressures	Eco-innovation	0.33	<0.01	Supported
H2	Normative pressures	Eco-innovation	0.13	0.02	Supported
H3	Mimetic pressures	Eco-innovation	0.32	<0.01	Supported
H4	Eco-innovation	Green supply chain management practices	0.30	<0.01	Supported
H5	Eco-innovation	Circular economy capability	0.23	<0.01	Supported
H6	Green supply chain management practices	Circular economy capability	0.76	<0.01	Supported
H7	Green supply chain management practices	Firm performance for CE supply chain	0.77	<0.01	Supported
H8	Circular economy capability	Firm performance for CE supply chain	0.19	<0.01	Supported

H9a	Big data driven supply chains	Green supply chain management practices and Firm performance for CE supply chain	0.07	0.13	Not Supported
H9b	Big data driven supply chains	CE capability and Firm performance for CE supply chain	0.05	<0.01	Supported

6. Discussion

Our study provides empirical evidence of some important relationships in the context of the CE. Firstly, that coercive, normative and mimetic pressures have a significant and positive relationship with eco-innovation. These findings extend earlier work by Zeng et al. (2017) and Prieto-Sandoval et al (2018a) by highlighting that regulations and policy, supply side and demand side factors are three eco-innovation determinants in the context of CE. In the case of Prieto-Sandoval et al (2018a) it builds on conceptual foundations. Overall, we show that institutional pressures are influencing eco-innovation – in our empirical context of SMEs in South African. Restorative eco-innovations aim to take remedial actions against damages done to the ecology. However, cyclical eco-innovations play an important role in enhancing capacity of eco-systems and close loops. Regenerative eco-innovations are also important to enhance eco-systems ability to do value addition for humans and nature (Hofstra & Huisingh, 2014).

Prieto-Sandoval et al (2018a) suggest that a transformative paradigm will be observable through eco-innovations, which are the tangible results of the CE model. They also highlight that CE adoption cases have necessitated eco-innovative solutions that ultimately support the triple bottom line approach (Elkington, 1997). Building on these observations, we provide evidence that eco-innovation has a significant and positive relationship with GSCM practices and that eco-innovation has a significant and positive relationship with CE adoption. The latter finding supports earlier work by Prieto-Sandoval et al. (2018a). Hence, our study contributes to knowledge by established a new link between eco-innovation and GSCM practices and by empirically testing and confirming the link between eco-innovation and CE adoption.

Our results support a hypothesis that GSCM practices have a significant and positive relationship with CE adoption; where such practices comprise of five main dimensions: green purchasing, eco-design or design for the environment, internal environmental management, customer cooperation for environmental concerns, and investment recovery (Liu et al., 2018). CE can be adopted at the micro, meso and macro level. Interestingly, GSCM practices happen in parallel to CE at different levels such as firm, industrial park, regional/national, and global levels. Literature has highlighted that GSCM are a key activity to transform towards CE (Govindan & Hasanagic, 2018). The linkage between GSCM practices and CE has been identified and theoretical applications suggested by Liu et al. (2018). We make a contribution to knowledge by empirically testing and validating the link.

Previous studies, for instance Costantini et al. (2015), suggest there is a positive relationship between GSCM practices and SME performance for CE supply chain and our findings support this proposition. With regards to CE adoption and firm performance for CE supply chain, we provide empirical evidence of a new and indirect link, which extends the knowledge base in relation to the drivers of the CE.

Our findings indicate that BDSCs have a moderating effect on the relationship CE adoption and firm performance for CE supply chain. Recently, Del Giudice et al. (2020) showed that BDSCs act as a moderator of the relationship between CE human resource management and firm performance for a circular economy supply chain. Our findings show that BDSCs can strengthen/weaken the relationship between CE capability and SME performance for CE supply chain.

A notable finding is that big data driven supply chains does not have any moderating effect on the relationship of GSCM practices and firm performance for CE supply chain. This contradicts some previous studies, but is consistent with others. A recent study by Wang et al (2020) revealed that big-data analytics (BDA) capability intensifies the relationship between external corporate social responsibility and green supply chain management. Also, the study of Del Giudice et al. (2020) highlighted that BDSC works as a moderator of the relationship between CE human resource management and firm performance for a CE supply chain. However, the work of Edwin Cheng et al. (2021) revealed that BDA does not have a direct effect on sustainable performance. Our findings shed light on the complex and nuanced moderating role of BDSCs. With BDSC seen having a significantly greater role when it comes to building CE capability for enhancing firm's performance for CE supply chain than it does in moderating the relationship between GSCM practices and performance.

In the next sections, we present the theoretical, practical and policy implications based on the findings of our study.

6.1 Theoretical implications

One of the significant contributions to theory of our research is the testing of a model based on eco-innovation and firm's performance for CE supply chain in the context of a developing country, South Africa, which is experiencing fast growth in technology adoption. We utilise a lens of institutional theory to extend understanding of the pressures that manufacturing organizations must deal with in order to achieve high performance levels in terms of their CE supply chains. CE necessitates innovation in the following areas: the manufacturing processes, the way customers use products, how companies formulate policies. In this manner eco-innovation has grown over time in a similar way to CE; mainly driven by environmental factors and changes in customer demands. Eco-innovations comprise of exploitative, restorative, cyclical and regenerative types. Exploitative eco-innovations focus less on ecological problems but aim to conform to legal requirements. Another unique aspect of our research model is its connection with dynamic capability view theory. Building on existing literature, we contribute to theory through the inclusion of different types of eco-innovations i.e. business model, network, organisational structure, process, product, service, market and customer engagement innovations.

6.2 Practical implications

Research on the application of institutional pressures, eco-innovation, GSCM practices and CE capabilities and firms' performance in accordance to circular economy is not new (Pagoropoulos *et al.*, 2017), yet our findings have valuable and new practical implications. Firstly, supply chain management professionals need to understand the institutional pressures that are shaping eco-innovation. The top management of organizations must implement advanced technologies, which enable managers to track eco-innovation practices on a daily basis. Secondly, managers need to support eco-innovation as it leads to GSCM practices and CE. Thirdly, managers can improve firm performance for CE supply chain through GSCM practices, by considering institutional pressures and issues relating to the resource based view of the firm. Fourthly, managers can improve firm performance for CE supply chain through CE adoption; wherein the institutional pressures and resource based view will support such improvements. Finally, managers need to understand that the more effectively CE capabilities are developed; the higher is the impact of BDSCs on firm performance for CE supply chain.

6.3 Policy implications

The policy implications of our study are threefold. Firstly, policy makers need to pay attention to the determinants of eco-innovation i.e., regulations/policies and supplier/customer practices related to eco-innovation. Focus must be on the use of innovative technologies at every level to close the industrial loops of a CE i.e., a) the micro level inside local businesses (b) the meso level at which interconnected industries operate, and (c) the macro level formed by institutions and regions. Secondly, there needs to be a strengthening of policies related to GSCM practices e.g., green purchasing, eco-design, internal environmental management and customer cooperation for environmental concerns, as they act as a catalyst in CE adoption. Thirdly, big data-related privacy and security aspects need to be considered when developing policies related to GSCM practices and CE adoption. Data driven supply chains can enhance traceability of a product and are an important enabler of environmental impact assessment. It is clear that eco-innovation and GSCM can play a critical role in CE adoption in SMEs; hence, policy makers need to consider all these aspects when developing comprehensive frameworks for CE adoption in SMEs.

There are also policy implications specific to our empirical focus on South Africa. The growing population in South Africa has put lot of stresses on waste management systems. The current waste management services operated by municipalities are under pressure to collect and dispose wastes in landfills. 75% of waste generated in this country goes to the landfill, and many valuable resources are lost through such a disposal process. To overcome this problem, the South African Government have adopted CE as part of its sustainable development program to reduce wastes and improve circularity. In the industrial waste management plan four waste stream such as tyres, paper/packaging, lighting/electrical and electronic waste have been given more attention (Tahulela & Ballard, 2020).

7. Conclusions, limitations and areas for further study

In this final section of our paper, we draw our main conclusions, highlight limitations of the study and indicate areas for further study.

To conclude, we respond to calls of previous researchers for empirically testing of the links of GSCM practices and CE in SMEs. Based on a review of the literature, we developed a theoretical model linking the antecedents of eco-innovation, GSCM, CE capabilities and SME firm performance. To test the model, we used a measurement instrument involving 240 data points, with data collected from a survey of individuals working in SMEs in South Africa. The tested model indicated that eco-innovation explains 37% of variance; while GSCM practices explained 9%; followed by CE adoption explaining 75%. Lastly, the endogenous variable i.e., firm performance for CE supply chains explained 86% of the variance.

To account for the potential differences between firms, we considered firm size as a control variable, as larger size firms have higher resource sets and enhanced ability to develop eco-innovation than smaller size firms. We also controlled for industry sector, using dummy variables to distinguish different industries (automotive parts manufacturers, light engineering, casting manufacturers and electronics parts manufacturers). Our results show that the control variables i.e., firm size and industry does not have a significant effect on the endogenous variable: firm performance for CE supply chains.

Based on available CE literature we anticipated that eco-innovation has a stronger impact on CE adoption than on GSCM practices. However, our findings indicate that the effect of eco-innovation on GSCM practices is stronger than its impact on CE adoption for South African SMEs. Another noteworthy finding is the identification of the moderating effect of big data driven supply chains on circular economy capability and SMEs firm performance.

The uniqueness in our study is that we have empirically tested conceptual models proposed by previous researchers, for instance the antecedents of eco-innovation and the link between GSCM and CE. We have identified hereto-unspecified relationships between eco-innovation and GSCM in SMEs and developed a model of CE and its antecedents.

Like every research project, our study suffers from some limitations, such as the use of cross-sectional data and data collection from a developing country. A longitudinal study would address this first limitation, by testing of the relationships shown in our theoretical model for causality, which will increase its validity. In terms of the second limitation, testing our model in different country contexts and, indeed, different industry sectors, would enhance the generalisability of the findings. Finally, further work could help explain some of the nuances we found, such as the moderating role of BDSC, which, in our model, is significant in some relationships and not in others

References

Adams, K.T., Osmani, M., Thorpe, T. and Thornback, J. (2017), "Circular economy in construction: current awareness, challenges and enablers", "Circular economy in construction: current awareness, challenges and enablers", *Proceedings of the Institution of Civil Engineers-Waste and Resource Management*, Thomas Telford Ltd, pp. 15.

Afshari, H., Searcy, C. and Jaber, M. Y. (2020), "The role of eco-innovation drivers in promoting additive manufacturing in supply chains", *International Journal of Production Economics*, Vol. 223, 107538.

Armstrong, J. S. and Overton, T. S. (1977). "Estimating nonresponse bias in mail surveys", *Journal of Marketing Research*, Vol. 14, No. 3, pp. 396-402.

Bag, S., Gupta, S., Kumar, A., & Sivarajah, U. (2021a), "An integrated artificial intelligence framework for knowledge creation and B2B marketing rational decision making for improving firm performance", *Industrial Marketing Management*, Vol. *92*, pp. 178-189.

Bag, S., Pretorius, J. H. C., Gupta, S., & Dwivedi, Y. K. (2021b), "Role of institutional pressures and resources in the adoption of big data analytics powered artificial intelligence, sustainable manufacturing practices and circular economy capabilities", *Technological Forecasting and Social Change*, Vol. *163*, 120420.

Barbieri, R. and Santos, D.F.L. (2020), "Sustainable business models and eco-innovation: A life cycle assessment", *Journal of Cleaner Production,* Vol. 266, pp. 121954.

Cai, W. and Zhou, X. (2014), "On the drivers of eco-innovation: empirical evidence from China", *Journal of Cleaner Production,* Vol. 79, pp. 239-248.

Chiarini, A. (2014), "Strategies for developing an environmentally sustainable supply chain: differences between manufacturing and service sectors", *Business Strategy and the Environment*, Vol. 23, No. 7, pp. 493-504.

Chiarini, A. (2017), "Environmental policies for evaluating suppliers' performance based on GRI indicators", Business Strategy and the Environment, Vol. 26, No. 1, pp. 98-111.

Chappin, M.M., van den Oever, Maurice VD and Negro, S.O. (2020), "An overview of factors for the adoption of energy efficient eco-innovation: The cases of the Dutch brewing and paper industry", *Journal of Cleaner Production,* Vol. 275, pp. 124122.

Chin, T.A., Tat, H.H. and Sulaiman, Z. (2015), "Green supply chain management, environmental collaboration and sustainability performance", *Procedia CIRP,* Vol. 26, pp. 695-699.

Confente, I., Scarpi, D., and Russo, I. (2020), “Marketing a new generation of bio-plastics products for a circular economy: The role of green self-identity, self-congruity, and perceived value”, *Journal of Business Research*, Vol. 112, pp. 431-439.

Costantini, V., Crespi, F., Marin, G. and Paglialunga, E. (2017), "Eco-innovation, sustainable supply chains and environmental performance in European industries", *Journal of Cleaner Production,* Vol. 155, pp. 141-154.

Costantini, V., Crespi, F., Martini, C. and Pennacchio, L. (2015), "Demand-pull and technology-push public support for eco-innovation: The case of the biofuels sector", *Research Policy,* Vol. 44, No. 3, pp. 577-595.

Del Giudice, M., Chierici, R., Mazzucchelli, A. and Fiano, F. (2020), "Supply chain management in the era of circular economy: the moderating effect of big data", *The International Journal of Logistics Management,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/IJLM-03-2020-0119.

Demirel, P. and Kesidou, E. (2019), "Sustainability-oriented capabilities for eco-innovation: Meeting the regulatory, technology, and market demands", *Business Strategy and the Environment,* Vol. 28, No. 5, pp. 847-857.

Dewick, P. and Foster, C. (2018), "Focal organisations and eco–innovation in consumption and production systems", *Ecological Economics,* Vol. 143, pp. 161-169.

Dey, P. K., Malesios, C., De, D., Chowdhury, S. and Abdelaziz, F. B. (2019), “Could lean practices and process innovation enhance supply chain sustainability of small and medium-sized enterprises?”, *Business Strategy and the Environment*, Vol. 28, No. 4, pp. 582-598.

Dey, P. K., Malesios, C., De, D., Budhwar, P. S., Chowdhury, S. and Cheffi, W. (2020), “Circular economy to enhance sustainability of small and medium-sized enterprises. *Business Strategy and the Environment (In Press).*

Deza, X.V. and Sánchez, ÁP. (2019), "Eco-innovation and Circular Business Models as drivers for a circular economy", *Contaduría y Administración,* Vol. 64, No. 1, pp. 1.

DiMaggio, P., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 48, 147–160.

Duan, Y. and Aloysius, J.A. (2019), "Supply chain transparency and willingness-to-pay for refurbished products", *The International Journal of Logistics Management*, Vol. 48 No. 1, pp. 57-62.

Dubey, R., Gunasekaran, A., Childe, S. J., Blome, C., Papadopoulos, T. (2019a), “Big data and predictive analytics and manufacturing performance: integrating institutional theory, resource-based view and big data culture”, *British Journal of Management*, Vol. 30 No. 2, pp. 341-361.

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., Luo, Z., Wamba, S. F., & Roubaud, D. (2019b), “Can big data and predictive analytics improve social and environmental sustainability?”, *Technological Forecasting and Social Change*, Vol. 144, pp. 534-545.

Dubey, R., Gunasekaran, A., Childe, S. J., Luo, Z., Wamba, S. F., Roubaud, D., & Foropon, C. (2018), “Examining the role of big data and predictive analytics on collaborative performance in context to sustainable consumption and production behaviour”, *Journal of Cleaner Production*, Vol. 196, pp. 1508-1521.

Edwin Cheng, T. C., Kamble, S. S., Belhadi, A., Ndubisi, N. O., Lai, K. H., & Kharat, M. G. (2021), “Linkages between big data analytics, circular economy, sustainable supply chain flexibility, and sustainable performance in manufacturing firms”, *International Journal of Production Research*, 1-15.

Elkington, J. (1997), “Cannibals with Forks: The Triple Bottom Line of 21st Century Business”. Capstone, Oxford.

EMT (Ellen Macarthur Foundation) (2013). https://www.ellenmacarthurfoundation.org/assets/downloads/government/EMF_TFPM_FullReportEnhanced_11-9-15.pdf. Accessed December 19, 2020.

Farooque, M., Zhang, A., Thurer, M., Qu, T., and Huisingh, D. (2019), “Circular supply chain management: A definition and structured literature review. *Journal of Cleaner Production*, Vol. 228, pp. 882-900.

Fehrer, J. A., & Wieland, H. (2021), “A systemic logic for circular business models”, *Journal of Business Research*, Vol. 125 No. March, 609-620.

Figge, F., Thorpe, A.S. and Good, J. (2020), "Us before me: A group level approach to the circular economy", *Ecological Economics*, Vol. 179, pp. 106838.

Fornell, C. and Larcker, D. F. (1981), “Evaluating structural equation models with unobservable variables and measurement error”, *Journal of Marketing Research*, Vol. 18 No. 1, pp. 39-50.

Foster, J.B. (2012), "The planetary rift and the new human exemptionalism: A political-economic critique of ecological modernization theory", *Organization & Environment,* Vol. 25, No. 3, pp. 211-237.

Frigon, A., Doloreux, D. and Shearmur, R. (2020), "Drivers of eco-innovation and conventional innovation in the Canadian wine industry", *Journal of Cleaner Production,* Vol. 275, pp. 124115.

García-Sánchez, I., Aibar-Guzmán, C. and Aibar-Guzmán, B. (2020), "The effect of institutional ownership and ownership dispersion on eco-innovation", *Technological Forecasting and Social Change,* Vol. 158, pp. 120173.

Geissdoerfer, M., Savaget, P., Bocken, N. M., and Hultink, E. J. (2017), "The circular economy–A new sustainability paradigm?.", *Journal of Cleaner Production,* Vol. *143,* pp. 757-768.

Gelhard, C., and von Delft, S. (2016), "The role of organizational capabilities in achieving superior sustainability performance", *Journal of Business Research,* Vol. 69, No. 10, pp. 4632-4642.

Genovese, A., Acquaye, A.A., Figueroa, A. and Koh, S.C.L. (2017), "Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications", *Omega,* Vol. 66, pp. 344-357.

Gente, V. and Pattanaro, G. (2019), "The place of eco-innovation in the current sustainability debate", *Waste Management,* Vol. 88, pp. 96-101.

Gligor, D., Gligor, N., Holcomb, M. and Bozkurt, S. (2019), "Distinguishing between the concepts of supply chain agility and resilience", *The International Journal of Logistics Management,* Vol. 30 No. 2, pp. 467-487.

Govindan, K. and Hasanagic, M. (2018), "A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective", *International Journal of Production Research,* Vol. 56, No. 1-2, pp. 278-311.

Greco, M., Germani, F., Grimaldi, M. and Radicic, D. (2020), "Policy mix or policy mess? Effects of cross-instrumental policy mix on eco-innovation in German firms", *Technovation,* pp. 102194.

Hellström, T. (2007), "Dimensions of environmentally sustainable innovation: the structure of eco-innovation concepts", *Sustainable Development,* Vol. 15, No. 3, pp. 148-159.

Hofstra, N. and Huisingh, D. (2014), "Eco-innovations characterized: a taxonomic classification of relationships between humans and nature", *Journal of Cleaner Production,* Vol. 66, pp. 459-468.

Hojnik, J. and Ruzzier, M. (2016), "What drives eco-innovation? A review of an emerging literature", *Environmental Innovation and Societal Transitions,* Vol. 19, pp. 31-41.

Hopkinson, P., Zils, M., Hawkins, P. and Roper, S. (2018), “Managing a complex global circular economy business model: Opportunities and challenges”, *California Management Review,* Vol. 60 No. 3, pp. 71-94.

Jain, N.K., Panda, A. and Choudhary, P. (2020a), "Institutional pressures and circular economy performance: The role of environmental management system and organizational flexibility in oil and gas sector", *Business Strategy and the Environment,* https://doi.org/10.1002/bse.2593.

Jia, F., Yin, S., Chen, L., and Chen, X. (2020), “Circular economy in textile and apparel industry: A systematic literature review”, *Journal of Cleaner Production,* Vol. 120, pp. 7-28.

Katz-Gerro, T., and López Sintas, J. (2019), “Mapping circular economy activities in the European Union: Patterns of implementation and their correlates in small and medium-sized enterprises”, *Business Strategy and the Environment*, Vol. *28, No.* 4, pp. 485-496.

Kock, N. (2017), "WarpPLS user manual: Version 6.0", *ScriptWarp Systems: Laredo, TX, USA.*

Kristensen, H.S., and Mosgaard, M.A. (2020), “A review of micro level indicators for a circular economy – moving away from the three dimensions of sustainability?”, *Journal of Cleaner Production, Vol.* 243, pp. 118531.

Kristoffersen, E., Blomsma, F., Mikalef, P., and Li, J. (2020), “The smart circular economy: A digital-enabled circular strategies framework for manufacturing companies”, *Journal of Business Research,* Vol. *120*, pp. 241-261.

Lahane, S., Kant, R., and Shankar, R. (2020), “Circular supply chain management: A state-of-art review and future opportunities”, *Journal of Cleaner Production,* Vol. 120, pp. 85-9.

Lee, Y., Hu, J. and Lim, M. K. (2021), “Maximising the circular economy and sustainability outcomes: An end-of-life tyre recycling outlets selection model”, *International Journal of Production Economics,* Vol. 232, 107965.

Lee, H., Shin, K. and Lee, J. (2020), "Demand-side policy for emergence and diffusion of eco-innovation: The mediating role of production", *Journal of Cleaner Production,* pp. 120839.

Li, G., Wu, H., Sethi, S. P. and Zhang, X. (2021), “Contracting green product supply chains considering marketing efforts in the circular economy era”, *International Journal of Production Economics*, Vol. 234, 108041.

Li, J., Zhang, X., Ali, S. and Khan, Z. (2020), "Eco-innovation and energy productivity: New determinants of renewable energy consumption", *Journal of Environmental Management,* Vol. 271, pp. 111028.

Lieder, M., and Rashid, A. (2016), “Towards circular economy implementation: a comprehensive review in context of manufacturing industry”, *Journal of Cleaner Production*, Vol. 115, pp. 36-51.

Lim, W.M. (2017), “Inside the sustainable consumption theoretical toolbox: Critical concepts for sustainability, consumption, and marketing”, *Journal of Business Research,* Vol. 78, pp. 69-80.

Liu, J., Feng, Y., Zhu, Q. and Sarkis, J. (2018), "Green supply chain management and the circular economy", *International Journal of Physical Distribution & Logistics Management*, Vol. 48 No. 8, pp. 794-817.

Liu, Z., Adams, M., Cote, R. P., Geng, Y., and Li, Y. (2018), “Comparative study on the pathways of industrial parks towards sustainable development between China and Canada”, *Resources, Conservation and Recycling*, Vol. *128,* No. 417-425.

Lloret, A. (2016), “Modeling corporate sustainability strategy”, *Journal of Business Research, Vol.* 69, No. 2, pp. 418-425.

Lu, Q., Wu, J., Goh, M. and De Souza, R. (2019), "Agility and resource dependency in ramp-up process of humanitarian organizations", *The International Journal of Logistics Management,* Vol. 30 No. 3, pp. 845-862.

Maroufkhani, P., Tseng, M. L., Iranmanesh, M., Ismail, W. K. W. and Khalid, H. (2020), Big data analytics adoption: Determinants and performances among small to medium-sized enterprises. *International Journal of Information Management*, Vol. 54, 102190.

Mazzoni, F. (2020), "Circular economy and eco-innovation in Italian industrial clusters. Best practices from Prato textile cluster", *Insights into Regional Development,* Vol. 2, No. 3, pp. 661-676.

Milios, L., Beqiri, B., Whalen, K. A., and Jelonek, S. H. (2019), “Sailing towards a circular economy: Conditions for increased reuse and remanufacturing in the Scandinavian maritime sector”, *Journal of Cleaner Production,* Vol. 225, pp. 227-235.

Nascimento, D. L. M., Alencastro, V., Quelhas, O. L. G., Caiado, R. G. G., Garza-Reyes, J. A., Rocha-Lona, L. and Tortorella, G. (2019), “Exploring Industry 4.0 technologies to enable circular economy practices in a manufacturing context." *Journal of Manufacturing Technology Management,* Vol. 30 No. 3, 607-627.

Parida, V., Burstrom, T., Visnjic, I., and Wincent, J. (2019), "Orchestrating industrial ecosystem in circular economy: A two-stage transformation model for large manufacturing companies", *Journal of Business Research,* Vol. 101, pp. 715-725.

Pan, X., Dresner, M. and Xie, Y. (2019), "Logistics IS resources, organizational factors, and operational performance", *The International Journal of Logistics Management,* Vol. 30 No. 2, pp. 569-594.

Patwa, N., Sivarajah, U., Seetharaman, A., Sarkar, S., Maiti, K., and Hingorani, K. (2020), "Towards a circular economy: An emerging economies context", *Journal of Business Research*.

Peeri, N. C., Shrestha, N., Rahman, M. S., Zaki, R., Tan, Z., Bibi, S. and Haque, U. 2020, "The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned?." *International Journal of Epidemiology* 10.1093/ije/dyaa033

Pagoropoulos, A., Pigosso, D. C. and McAloone, T. C. 2017, "The emergent role of digital technologies in the Circular Economy: A review." *Procedia CIRP* 64: 19-24.

Pizzi, S., Caputo, A., Corvino, A. and Venturelli, A. (2020), "Management research and the UN Sustainable Development Goals (SDGs): a bibliometric investigation and systematic review", *Journal of Cleaner Production,* pp. 124033.

Prieto-Sandoval, V., Jaca, C., and Ormazabal, M. (2018a), "Towards a consensus on the circular economy", *Journal of Cleaner Production,* Vol. *179,* pp. 605-615.

Prieto-Sandoval, V., Ormazabal, M., Jaca, C., and Viles, E. (2018b), "Key elements in assessing circular economy implementation in small and medium-sized enterprises", *Business Strategy and the Environment,* Vol. *27, No.* 8, pp. 1525-1534.

Ripanti, E.F. and Tjahjono, B. (2019), "Unveiling the potentials of circular economy values in logistics and supply chain management", *The International Journal of Logistics Management,* Vol. 30 No. 3, pp. 723-742.

Roos Lindgreen, E., Salomone, R. and Reyes, T. (2020), "A Critical Review of Academic Approaches, Methods and Tools to Assess Circular Economy at the Micro Level", *Sustainability,* Vol. 12, No. 12, pp. 4973.

Rosa, P., Sassanelli, C., and Terzi, S. (2019), "Circular business models versus circular benefits: An assessment in the waste from electrical and electronic equipments sector", *Journal of Cleaner Production,* Vol. 231, pp. 940-952.

RSA (Republic of South Africa). (2018). https://www.gov.za/speeches/minister-lindiwe-zulu-launch-revised-definition-small-enterprises-south-africa-and-release. Accessed December 19, 2020.

Saavedra, Y. M., Iritani, D. R., Pavan, A. L., and Ometto, A. R. (2018), "Theoretical contribution of industrial ecology to circular economy", *Journal of Cleaner Production*, Vol. *170*, pp. 1514-1522.

Sezen, B. and Cankaya, S.Y. (2013), "Effects of green manufacturing and eco-innovation on sustainability performance", *Procedia-Social and Behavioral Sciences*, Vol. 99, pp. 154-163.

Smol, M., Kulczycka, J. and Avdiushchenko, A. (2017), "Circular economy indicators in relation to eco-innovation in European regions", *Clean Technologies and Environmental Policy*, Vol. 19, No. 3, pp. 669-678.

Su, C., Umar, M. and Khan, Z. (2020), "Does fiscal decentralization and eco-innovation promote renewable energy consumption? Analyzing the role of political risk", *Science of The Total Environment*, Vol. 751, pp. 142220.

Tahulela A.C. and Ballard H.H. (2020), "Developing the Circular Economy in South Africa: Challenges and Opportunities. In: Ghosh S. (eds.) Sustainable Waste Management: Policies and Case Studies". Springer, Singapore. https://doi.org/10.1007/978-981-13-7071-7_11

Türkeli, S., Kemp, R., Huang, B., Bleischwitz, R., and McDowall, W. (2018), "Circular economy scientific knowledge in the European Union and China: A bibliometric, network and survey analysis (2006–2016). *Journal of Cleaner Production*, Vol. *197*, pp. 1244-1261.

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S.D., Tegmark, M. and Nerini, F.F. (2020), "The role of artificial intelligence in achieving the Sustainable Development Goals", *Nature communications*, Vol. 11, No. 1, pp. 1-10.

Wang, C., Zhang, Q., & Zhang, W. (2020), "Corporate social responsibility, Green supply chain management and firm performance: The moderating role of big-data analytics capability", *Research in Transportation Business & Management*, 37 (December), 100557.

Wu, G. C., Ding, J. H. and Chen, P. S. (2012), “The effects of GSCM drivers and institutional pressures on GSCM practices in Taiwan’s textile and apparel industry”, *International Journal of Production Economics*, Vol. 135 No. 2, pp. 618-636.

York, R. and Rosa, E.A. (2003), "Key challenges to ecological modernization theory: Institutional efficacy, case study evidence, units of analysis, and the pace of eco-efficiency", *Organization & Environment*, Vol. 16, No. 3, pp. 273-288.

York, R., Rosa, E.A. and Dietz, T. (2010), "Ecological modernization theory: Theoretical and empirical challenges", *The International Handbook of Environmental Sociology*, pp. 77-90.

Zeng, H., Chen, X., Xiao, X., Zhou, Z. (2017), “Institutional pressures, sustainable supply chain management, and circular economy capability: Empirical evidence from Chinese eco-industrial park firms”, *Journal of Cleaner Production*, Vol. 155, pp. 54-65.

Zhang, J., Yalcin, M. G. and Hales, D. N. (2020), “Elements of paradoxes in supply chain management literature: A systematic literature review”, *International Journal of Production Economics*, 107928.

Zhu, Q., Geng, Y., Sarkis, J. and Lai, K. (2011), "Evaluating green supply chain management among Chinese manufacturers from the ecological modernization perspective", *Transportation Research Part E: Logistics and Transportation Review*, Vol. 47, No. 6, pp. 808-821.

Zhu, Q., Sarkis, J. and Geng, Y. (2005), “Green supply chain management in China: pressures, practices and performance”, *International Journal of Operations & Production Management*. Vol. 25 No. 5, pp. 449-468.

Appendix

Operationalization of constructs

Constructs	**Code**	**Measurement Items**	**Adapted from**
Coercive Pressures (CP)	CP1	Regulation and policy determinants influence and motivate consumers' and suppliers' environmental practices	Zeng *et al*. (2017); Prieto-Sandoval *et al*. (2018a)
	CP2	Policy makers propose instruments to decrease resource demand, such as repairing or renovating products (including electronics) instead of purchasing new ones, and encouraging a sharing economy	
	CP3	Regulation and policy determents support the development of innovative solutions for waste collection	
	CP4	Regulation and policy determents support economic incentives for cleaner production	
	CP5	Policy makers tend to promote economic aspects	
	CP6	Successful economic incentives may drive environmental and public health improvements	
Normative Pressures (NP)	NP1	The extent to which your firm's suppliers are involved in eco-innovation	Prieto-Sandoval et al. (2018a); Dubey *et al*. (2019a)
	NP2	The extent to which your firm's customers are involved in eco-innovation	
	NP3	The extent to which industry associations' (such as CII or FICCI) promotion of environmental management influences your firm to consider eco-innovation	
	NP4	Emerging environmental education programs in schools and universities in your country are increasing people's interest in the value of nature	
Mimetic Pressures (MP)	MP1	Our competitors who have adopted eco-innovation have greatly benefitted	Zeng et al. (2017); Dubey et al. (2019a)
	MP2	Our competitors who have adopted eco-innovation are favourably perceived by the others in the same industry	
	MP3	Our competitors who have adopted eco-innovation are favourably perceived by their suppliers and customers	

Eco-Innovation (ECOI)	ECOI1	Business model innovations, which are related to the way that companies create and capture value	Prieto-Sandoval *et al*. (2018a)
	ECOI2	Network innovations, which are created by working in symbiosis with other companies	
	ECOI3	Organizational structure innovations in the development of new organizational and management practices to support environmental strategy	
	ECOI4	Process innovations, which are associated with the way that companies make their products or offer services	
	ECOI5	Product innovations, which are related to the quality and functionality of the products	
	ECOI6	Service innovations in the CE context tend to be developed to increase the use of a product by decreasing its ownership; this means that a product can be used many times by different people, rather than being used by a single owner for a brief period	
	ECOI7	Market innovations, which are created through communication channels with the customer, brand values and the positioning of the product	
	ECOI8	Customer engagement innovations, which focus on customer experiences, and meeting their needs or desires	
Green Supply Chain Management Practices (GSCM)	GSCM1	We focus on green purchasing	Liu *et al*. (2018)
	GSCM2	We practice eco-design or design for the environment	
	GSCM3	We focus on internal environmental management	
	GSCM4	We consider customer cooperation for environmental concerns	
	GSCM5	We emphasis on investment recovery	
Circular Economy Capability (CEC)	CEC1	This country facilitates sustainable development through its implementation at the implementation at the micro (enterprises and consumers)	Zeng *et al*. (2017)
	CEC2	Company is dedicated to reducing the consumption of raw materials and energy	
	CEC3	Company initiatively enhances the energy efficiency of production equipment	

	CEC4	Product packaging materials are used repeatedly	
	CEC5	Waste produced in the manufacturing process is recycled	
	CEC6	Waste products from consumers is recycled	
	CEC7	Waste and garbage are used after reprocessing to manufacture new products	
Firm Performance (FIP)	FIP1	Improvement in customer retention	Maroufkhani *et al*. (2020)
	FIP2	Improvement in sale growths	
	FIP3	Improvement in profitability	
	FIP4	Introducing new products or services to the market quickly	
	FIP5	Improvement in success rate of new products and services	
	FIP6	Our organization has decreased of cost for materials purchasing	Jain *et al.* (2020)
	FIP7	Our organization has decreased cost for energy consumption	
	FIP8	Our organization has not decreased fee for waste treatment	
	FIP9	Our organization has decreased fee for waste discharge	
	FIP10	Our organization has decreased fine for environmental accidents	
	FIP11	Our organization has reduced air emission in the last 3 years	
	FIP12	Our organization has reduced waste water in the last 3 years	
	FIP13	Our organization has reduced solid waste in the last 3 years	
	FIP14	Our organization has reduced consumption of hazardous/harmful/toxic materials in the last 3 years	
Big Data Driven Supply Chains (BDSC)	BDSC1	The firm builds consistent, interoperable, cross functional department database to enable concurrent engineering, rapid experimentation and simulation and co-creation	Del Giudice *et al*. (2020)
	BDSC2	The firm aggregates customer data and makes them widely available to enhance service level, capture cross and up-selling opportunities and enable design to value	
	BDSC3	The firm implements advanced demand forecasting and supply chain planning across suppliers	

	BDSC4	The firm model production virtuality to create process transparency, develop dashboards and visualise bottlenecks	