July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

The Moderating Role of Supply Chain Complexity on the Relationship between Reverse Logistics and Supply Chain Sustainability in Jordan

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Article Info
Volume 83
Page Number: 5007 - 5021
Publication Issue:
July - August 2020

Article History
Article Received: *25 April 2020*
Revised: *29 May 2020*
Accepted: *20 June 2020*
Publication: *10 August 2020*

Abstract

This paper presents a review of the supply chain sustainability (SCS) phenomenon, which assumes great significance in Middle Eastern countries like Jordan that are confronted with very limited resources, which makes it all the more important to pay attention to cost-saving measures in order to secure investments. In addition, the paper identifies and evaluates the current state of reverse logistics initiatives in several Jordanian organizations, such as Pepsi-Jordan company, which respects the concerns of customers and the society in general with regard to green and clean environment. It also looks into business managers' recognition of the need to ensure that their activities are cost effective and environmentally, given that reverse logistics is a green supply chain practice that allows firms to manage wastes and augment their competitiveness. Consequently, this research aims to examine the impact of reverse logistics on SCS by taking into consideration, the structural design of supply chain or supply chain complexity, with an emphasis on Pepsi-Jordan Company. The results of this study suggest that the presence of a reverse supply chain is crucial for the success and sustainability of SC, particularly for those that compete at a global level.

Keywords: *Supply Chain Sustainability, Reverse logistics, supply chain complexity, Pepsi-Jordan.*

1. Introduction

Today, the alarming surge in global warming attributed to various kinds of pollutions emitted by business has impelled organizations to find new ways of being environmentally and socially acceptable, especially against the backdrop of government regulations that mandate the presence of a green supply chain. In this context, Sarkis, Zhu, and Lai (2011) define green supply chain as integrating environmental concerns into inter-organizational practices of supply chain management (SCM), which also include logistics.

According to supply chain complexity (the moderating variable), structure and design (number of components and the relationship between these components) are the intricacies and challenges that must be taken into consideration when managing supply chain. From a sustainability standpoint for supply chains, the continuity of supply chains is not easy to maintain, particularly with of the growing

July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

trend of supply chain that needs continuous development and upgrading for all resources, such as: short product life cycle, responsiveness and agility, as well as the outsourcing of various processes to countries with lower labor cost (Bradley, 2014; Mehrjoo&Pasek, 2016). In addition, having reverse logistics has rendered sustainability more challengeable because it may lead to increased environmental costs in the short term, thereby causing financial cost. In contrast, the absence of green supply chain implies reputational loss in the form of negative publicity (Lee &Vachon, 2016).

Thus, SCM must have a full understanding on how to achieve supply chain continuity and sustainability in order to avoid disruptions or business failure (Al-Hawary et al., 2017;Caniato, Caridi, Crippa&Moretto, 2012). As a result, supply chain succession mainly depends on sustainability, which is a challenging task due to many barriers such as, complexity, resistance to making changes in processes, the paucity of detailed knowledge, information and superficial leadership commitment to sustainability and to supply chain collaboration (Orr &Jadhav, 2018).

Accordingly, this study serves as a reference for researchers who are interested in creating sustainable supply chain while taking into consideration the society and its environment. This issue assumes great importance for Jordan because Jordanian organizations face many scarcities in their local resources, which makes it important to build recycling and waste management in their supply chains. From the viewpoint of supply chain complexity, this research defines different types of supply chain complexity based on different categories. This can be a major research subject to explore in order to identify sufficient opportunities regarding supply chain.

2. Literature Review

2.1 Reverse Logistic RL (Reverse Supply Chain)

In Jordan, very limited studies have been conducted about RSC, while several research studies on this topic have been carried out in EU, North America and China. Jordan became the136th member of the World Trade Organization (WTO) in 2000, which has always expressed concerns about reducing cost to improve economy. Thus, RSC (green supply chain) is an interesting topic that is valued by all industries in Jordan.

Anysustainable supply chain with a tangible or intangible competitive advantage needs to have reverse logistic, since RL is a strategic element that organizations are increasingly taking into consideration with regard to their decision-making related to the design and development of their supply chains. This implies that it is actually difficult to find a supply chain where RL is not present, at least to some degree. Reverse logistics or ‘closed-loop supply chain’, ‘reverse supply chain’, ‘product recovery management’, and ‘circular economy’, all are similar key words that are defined as the actual process of return, after the consumer has used, reused/recycled/reclaimed materials, or else provided safe refills (Carter &Ellram, 1998).

On the other hand, Guide and Van Wassenhove (2003) viewed it as a series of activities used to retrieve used items from customer either for reusing it or disposing it (Murphy, 2012). (Rubio1 and Jiménez-Parra (2014) define it as” the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal.” Dekker, Fleischmann, Inderfurth, and Van Wassenhove (2004) pointed that the application of three driving

July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

forces are: economics, legislation and corporate citizenship; therefore, acting in RL might be an option to save costs as well as to have reputation of being environmentally- friendly and friendly relationship with customers, which leads to long term profits and sustainability of the supply chain (Lopes; Calvo 2006). Accordingly, RSC has added economic, ecological and legal value by reusing the returned materials, thus reducing different types of wastes and creating loyalty and trust in organizations products. Meanwhile LEITE (2010) pointed that conducting and implementing reverse supply chain tied with the life cycle of product (stage and length), which affects the rate of return, depends inversely on the length of the products life. This again reiterates the point that injecting RSC is essential.

According to Benjamin, Diannie and Joe (2012), reverse logistics focuses on four main recovery activities: reuse, product update, material recovery and waste management; thus, it is a series of activities as opposed to just one activity since most organizations see it, which consider as one of the barriers in RSC. Shibao, Moori and Santos (2010) stated that the difficulty of implementing reverse logistics is a result of the absence of indicators that measure the cost-benefit of implementing and operating it, which is attributed to the lack of information and real knowledge of RSC activities. Whereas Lacerda (2009) considered the difficulty of the status of returned materials' correct identification and lack of process mapping. In addition to the fact that the firms lack a standard process, there are only a few information systems that are capable of controlling the reverse flow of materials. This is also reinforced by the lack of a logistics network planning. Companies should develop infrastructure for the reverse flow of materials, which includes centralized operations for receiving and separating materials.

Likewise, the collaborative relationship between customers and their suppliers constitutes one of the barriers to the implementation of reverse logistics, given that these conflicts are related to the responsibility of each member of the chain in the reverse logistics processes, also; there are a few information systems capable of mapping reverse logistics process (Garcia, 2006; Yang, Yin, & Tan, 2008; Al-Hawary & Al-Jawazneh, 2011). Additionally, lack of effective management for RSC activities is a barrier in the form of the scarcity of professionals and lack of internal policies/knowledge about RSC processes (Aita&Ruppenthal, 2008) . Accordingly, RSC is a type of recovery management and control for items that are no longer used by customers.

2.2 Supply Chain Sustainability

According to sever competition globally, complexity in distribution channels of goods and services (Reuter et al., 2011) has raised great concerns about environment, such as focusing on safety, equity and others within supply chain (Maloni and Brown, 2006, Chin and Tat, 2015), thus implying that achieving sustainability has become challenging Sustainability is a challenging requirement for supply chain because there are no truly sustainable supply chains, and because it becomes an essential matter not only for managers, but also for all other stakeholders (Fritz & Silva, 2018). According to literature review, there are up to 16 different definitions of SCS (Dubey, Gunasekaran, Papadopoulos, Childe, Shibin, &Wamba, 2017). However, the conceptualizations of SCS largely remains inconclusive (Gold and Schleper, 2017). Many have looked at sustainability performance in SCs (Beske&Seuring, 2014; Seuring&Müller, 2008; Zhu, Sarkis, & Lai, 2007).

Sustainability in supply chain implies that several actors must be able to deliver value to

Published by: The Mattingley Publishing Co., Inc.

July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

society that can directly contribute to social, environmental, economic, safety and health aspects (Cheung &Rowlinson, 2011). However, this instrumental perspective of supply chain sustainability (SCS) must be changed (Gold &Schleper, 2017). Ansari and Kant (2017, p. 2) claim that "organizations willing to infuse sustainability practices in their SC need to satisfy various contradicting objectives such as profit maximization while reducing environmental impacts and maximizing social responsibility." Sustainable supply chain is concerned about the management of three types of flow (capital, information, material), as well as the cooperation between all elements of supply chain to achieve sustainable development accompanied by an environmental, economic and social perspective (Seuring& Mueller, 2008). In recent years; calls for environmental sustainability have increased due to the following reasons: extreme weather conditions, rising temperature, scarcity of natural resources.

Winston (2014) stressed on the importance of achieving sustainability in all business aspects. Sustainability needs to be considered in every aspect of business, supply chains and executive decision-making in order to preserve natural resources for future generations. From different literature reviews, it becomes evident that a number of practices can contribute towards SCS, such as Green warehousing (Appolloni et al, 2014, Coyle et al., 2014), Strategic supplier collaboration, and up-to-date information technology systems. SCS discussed from different authors offering diverse viewpoints have been summarized in the following table.

Table 1: Different views for sustainability

Enablers of environmentally sustainable supply chain	Kumar and Shekhar (2015), Muduli et al. (2013), Shen et al. (2013), Kusi et al. (2014)
Inter organizational, and intra organizational practices for sustainability	Gimenez and Tachizawa, (2012), Lucas and Noordewier, (2016), Pagell and Gobeli (2009), Voorde et al., (2012)
Practices that lead to sustainable supply chain (leadership, regulatory pressure, supplier relationship management, employee involvement, customer relationship management, TQM, TPM, and lean)	Dubey et al. (2017), Govindan et al. (2014), Azevedo et al., (2012)
Economic sustainability performance measures	Green et al. (2012), Prajogo et al. (2016), Zhu et al. (2008)
Environmental sustainability performance measures	Green et al. (2012), Prajogo et al. (2016), Zhu et al. (2008)
Social sustainability performance measures	Gurumurthy and Kodali (2009), Martínez-Jurado and Moyano-Fuentes (2014), Aras et al. (2010)

Source: Researcher

According to the researcher's findings, SCS can be summarized in a simple equation:

SCS = Cooperative management (capital, information, and material) + Perspectives (environmental, economic, and social)

2.3 Supply Chain Complexity

Recently the management of supply chain has witnessed a major convergence in order to pursue excellence and broaden the scope of business activities. However, this management is challenging due to SC complexity or complex adaptive system that has impelled many suppliers to deal with different SCs in order to serve diverse customers (Choi, Dooley &Rungtusanatham, 2001). For example, they are required to manage information flows, physical flows, and relationships between different parties upstream and downstream supply chain (Bozarth, Warsing, Flynn & James Flynn, 2009; Al-Hawary & Al-Jawazneh, 2011).

According to Bozarth, SC complexity consists of two types: detail and dynamic complexity exhibited by processes, products and relations that make up the supply chain. Moreover, literature reviews elaborate on the complexity as a number of parts that consist of supply chain, while dynamic complexity means unpredictable response for different inputs resulting from different parts and components of supply chain ((Bozarth et.al., 2009). Therefore, complexity that results from processes and products is known as "internal manufacturing complexity", while complexity via relations and connections is known as "downstream complexity", and "upstream complexity".

Furthermore, downstream complexity is one of the major dynamic complexities that reflects the number of customers, heterogeneity of customer needs, variability in customer demands, and the average length of product life-cycle. On the other hand, upstream complexity is characterized by the number of suppliers' relationships, lead time, suppliers' reliability, and globalization of sourcing (Bozarthet.al., 2009). This is illustrated in the below figure:

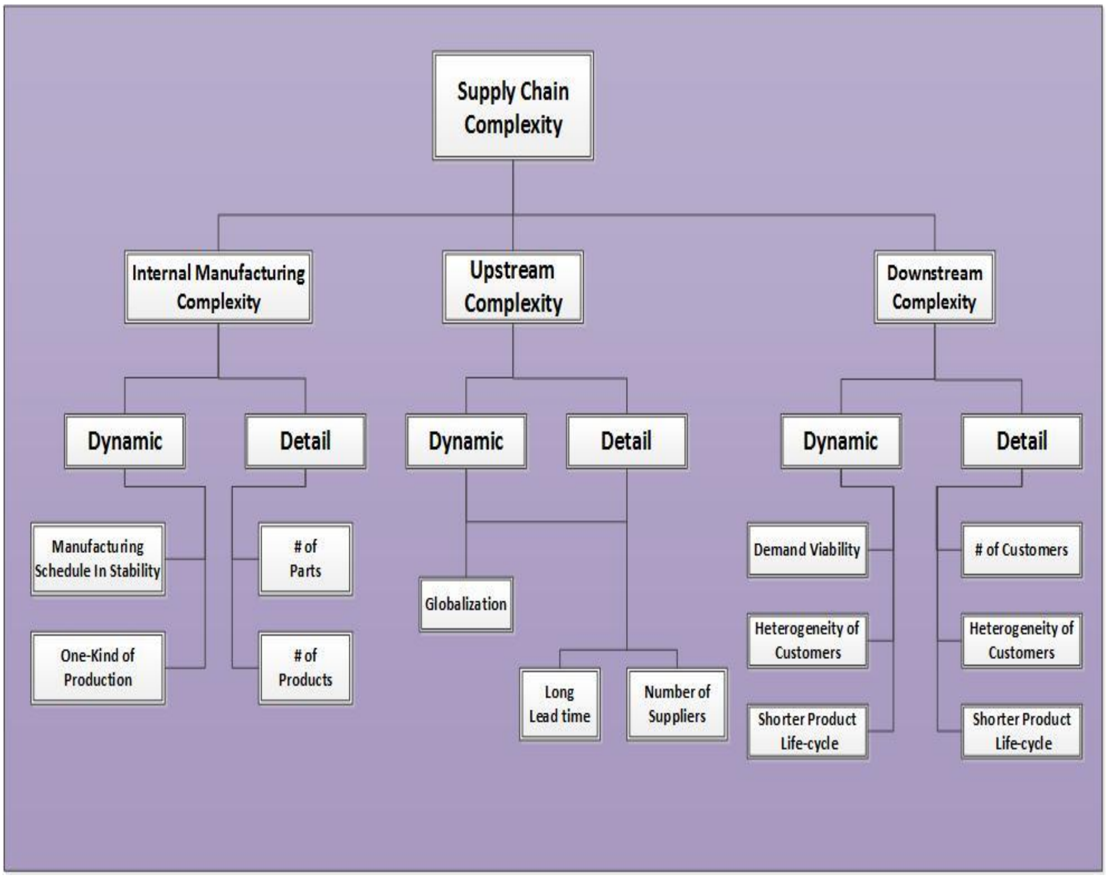

Figure 1: Supply chain complexity

Source: Researcher's contribution

July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

From another perspective, supply chain complexity can be defined by factors related to the number of suppliers (scale complexity), delivery lead time (delivery complexity), differences between suppliers (differentiation complexity) as well as their different geographic locations (geographic dispersion complexity (Choi &Krause, 2006; Caridi, Crippa, Perego, Sianesi, &Tumino, 2010; Brandon-Jonesetal, Squire, Autry & Petersen, 2014).

3. Research Model and Hypothesis:

The researcher has formulated the main hypothesis according to the following conceptual model to elucidate and analyzereverse logistics along with its impact on supply chain sustainability. The moderating role of supply chain complexity is as follows:

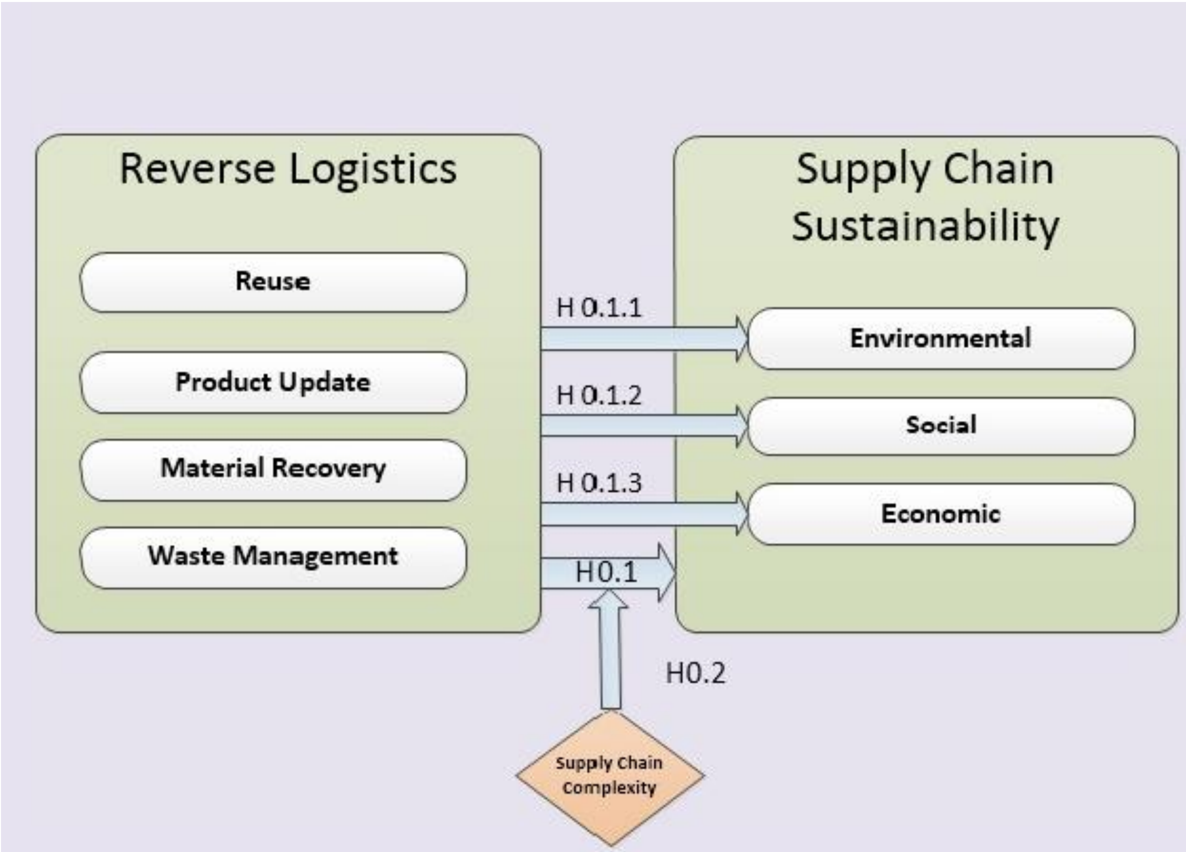

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Figure 2: Theoretical model

Based on the above literatures, this study's hypotheses can be formulated as follows:

H0.1: There is no effect of reverse logistics at a significance level (α ≤ 0.05) on achieving supply chain sustainability Pepsi-Jordan Company.

H0.1.1: There is no effect of reverse logistics *at a significance level (α ≤ 0.05) on achieving environmental supply chain environmental sustainability in Pepsi-Jordan Company*

H0.1.2: There is no effect of reverse logistics *at a significance level (α ≤ 0.05)*

July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

on achieving social supply chain sustainability in Pepsi-Jordan Company

H0.1.3: There is no effect of reverse logistics *at a significance level (α ≤ 0.05) on achieving economic supply chain sustainability in Pepsi-Jordan Company.*

H0.2: There is no effect of reverse logistics in the presence of supply chain complexity at a significance level (α ≤ 0.05) on achieving supply chain Pepsi-Jordan Company.

H0.2.1: There is no effect of reverse logistics in the presence of supply chain complexity at a significance level (α ≤ 0.05) on achieving social supply chain sustainability in Pepsi-Jordan Company

H0.2.2: There is no effect of reverse logistics in the presence of supply chain complexity at a significance level (α ≤ 0.05) on achieving economic supply chain sustainability in Pepsi-Jordan Company

H0.2.3: There is no effect of reverse logistics in the presence of supply chain complexity at a significance level (α ≤ 0.05) on supply chain sustainability.

4.Methodology

In this study, data are collected on the basis of both primary and secondary data, therefore; a case study research approach has been used. A questionnaire designed based on the proposed model is developed on literary reviews, which serve as the primary data source for research variables.

4.1 Sample of the Study

A sample of 300 has been randomly taken from the population of Pepsi-Jordan Company. In this study, the unit of analysis was employees at different levels. The reason why Pepsi-Jordan Company has been chosen because it is a leading international company in the field of manufacturing that offers a wide range of soft drinks, and has witnessed great growth globally.

The questionnaires were distributed to 300 employees with managerial and technical experience, out of which 220 were returned and only 20 were deemed suitable for statistical analysis. Subjects were asked to assess their perceptions of various items of different constructs. Assessments were based on a five-point Likert scale ranging from “strongly disagree (1) to “strongly agree (5) in order to measure the 27 items.

4.2 Constructs Measurements Analysis

The smart Partial Least Square-Structure Equation Modelling (PLS-SEM) program was implemented in this work as an approach for analysis with a view to testing and analyzing the data related to all hypotheses.

4.2.1 Path Loadings for the Suggested Model

Figure 2 shows the result of path loadings for all variables related to the proposed model in this paper. It depicts three elements (reverse logistics, supply chain complexity, and supply chain sustainability) As shown in Table 2 and Figure 3, the initial standardized factor loadings of all model items were found to be above 0.6 (Hair et al., 2014) and ranged from 0.647 to 0.881.

July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

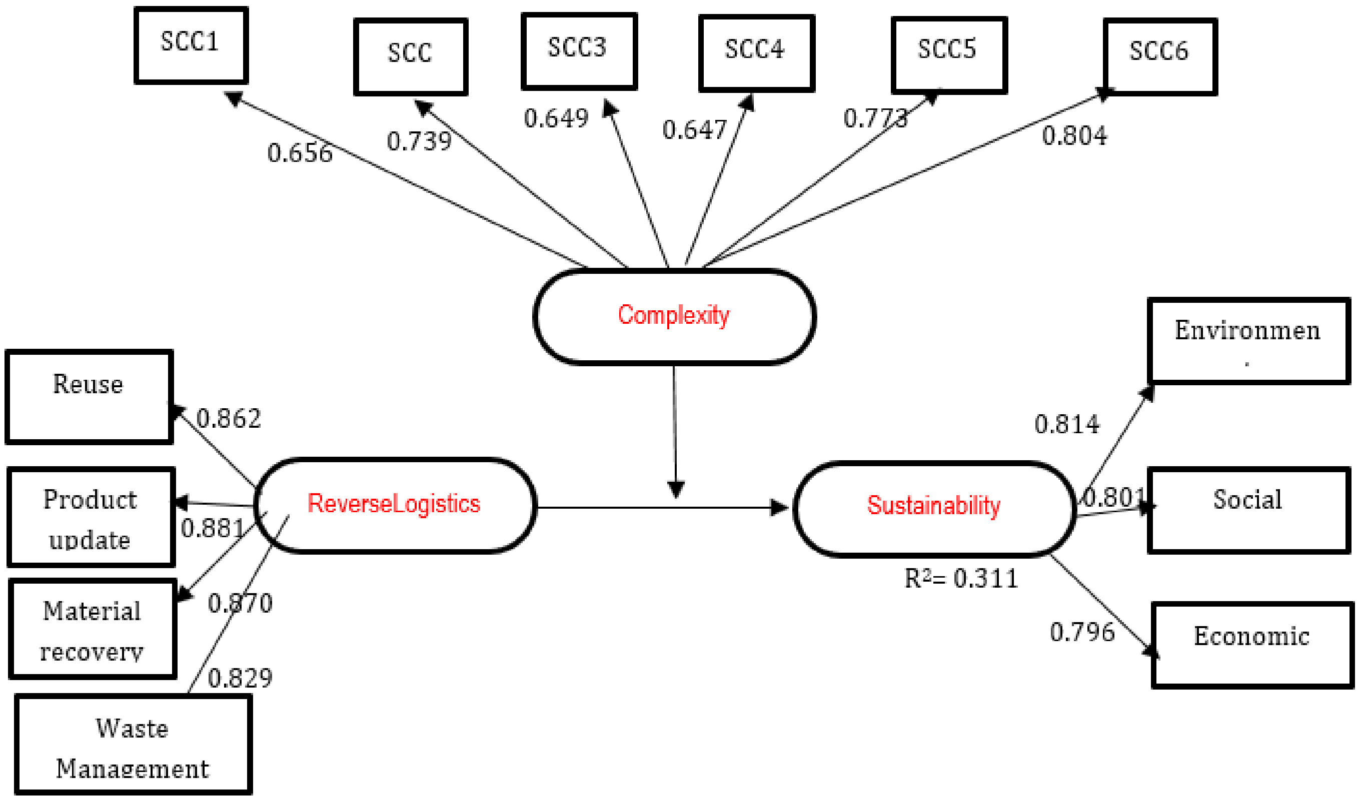

Figure 3: Path loadings for the suggested framework

Table 2: Constructs measurement

Construct	Measurement item	Loadings	Results
Reverse Logistics Practices	Reuse	0.862	Accept
	Product update	0.881	Accept
	Material recovery	0.87	Accept
	Waste management	0.829	Accept
Complexity	SCC1	0.656	Accept
	SCC2	0.739	Accept
	SCC3	0.649	Accept
	SCC4	0.647	Accept
	SCC5	0.773	Accept
	SCC6	0.804	Accept
Sustainability	Environmental	0.814	Accept
	Social	0.801	Accept
	Economic	0.796	Accept

4.2.2 Reliability and Validity Test

In order to test validity, the survey instrument was distributed to a number of universities professors and professionals to determine whether the survey was unambiguous, comprehensive, understandable, and measured appropriate content. Their feedback was taken into consideration before forming the final copy of the questionnaire. Further, convergent validity using

TEST Engineering & Management
July-August 2020
ISSN: 0193-4120 Page No. 5007 - 5021

average variance extracted (AVE) was also assessed. Each construct was found to have an AVE value exceeding 0.50, indicating very good convergent validity (Chin, 2010; Hair et al., 2014). Therefore, both tests showed adequate validity.

Scale reliability was measured using Cronbach's alpha (α) and composite reliability (CR) values. All the values of Cronbach's α and CR for each of the constructs (reverse logistics, complexity, and sustainability) ranged from 0.711 to 0.92, thereby exceeding the suggested threshold of 0.70 (Hair et al., 2014). This, in turn, is indicative of adequate internal consistency. In addition, convergent validity using average variance extracted (AVE) was assessed as well. Each construct was found to have an AVE value exceeding 0.50, indicating very good convergent validity (Chin, 2010; Hair et al., 2014). Therefore, it can be surmised that both tests showed adequate validity. These findings have been presented in Table 3.

Table 3: Validity and reliability results

Construct	Measurement item	Cronbach's Alpha	CR	AVE
Reverse Logistics Practices	Reuse Product update Material recovery Waste management	0.916	0.92	0.741
Complexity	SCC1 SCC2 SCC3 SCC4 SCC5 SCC6	0.866	0.861	0.51
Sustainability	Environmental Social Economic	0.864	0.864	0.646

Note: CR= composite reliability; AVE=average variance extracted

4.2.3. Discriminant Validity Test

Discriminate validity was tested in accordance with the guidelines of Hair et al. (2014) and Fornell and Larcker (1981). Discriminant validity requires the square root of AVE for each latent construct to exceed the absolute correlation value between that construct and other constructs. As shown in Table 4, the findings suggest acceptable discriminant validity, where none of the correlation coefficients should be greater than 1.00 in order to ensure multi-collinearity between factors is not included.

Table 4: Discriminate

Constructs	1	2	3
(1) Reverse Logistics	**0.801**		
(2) Sustainability	0.751	**0.779**	

(3) Complexity	0.715	0.717	**0.692**

4.2.4. R2 Test

Table 5: R2 values

Path Shape	**P-value**	**R^2**
Reverse Logistics Practices → Sustainability	0.000***	0.311
Reverse Logistics Practice ×Complexity) →Sustainability	0.000***	0.443

****p>0.001; **p>0.05*

Table 4 shows that R2 significant with t-values larger than 1.96 and p < 0.05 and varies according to an effect left upon independent variable. In other words, R2 without moderator effects equal to 0.311, but R2 with the moderation effect equals to 0.443. This result shows that better prediction is made in the presence of supply chain complexity when it fluctures, which, in turn, ensures the validity of the model chosen by the reseacher on Pepsi-Jordan Company in Jordan. The value of R (Square) became 0.443, implying that it was above 25%, which defines a satisfactory prediction level based on recommended by Gaur and Gaur (2006).

4.3 Hypothesis testing

4.3.1 Direct relationships

As shown in Table 5, the supported hypotheses indicated a significant relationship with t-values larger than 1.96 and p < 0.05. More specifically, the path loading of reverse logistics practices on environmental sustainability was (β = 0.558, p < 0.01), the path loading of reverse logistics practices on social sustainability was (β = 0.495, p < 0.01), whereas the path loading of reverse logistics practices on economic sustainability was (β = 0.494, p < 0.01). All were found to have significant positive effects on sustainability. Therefore, hypotheses of H0.1.1, H0.1.2, and H0.1.3 were supported.

Table 6: Direct effects

Path Shape	**Path Coefficient**	**T-value**	**P-value**	**Support**	**F^2**
Reverse Logistics Practices → Environmental Sustainability	0.558	9.46	0.000 ***	Yes	0.339
Reverse Logistics Practices → Social Sustainability	0.495	8.026	0.000 ***	Yes	0.336
Reverse Logistics Practices → Economic Sustainability	0.494	7.998	0.000 ***	Yes	0.321
Complexity → Sustainability	0.665	12.545	0.000 ***	Yes	0.429

****p>0.001; **p>0.05*

4.3.2 Indirect relationships (moderation effects)

According to Table 6, the last hypothesis indicates a significant relationship with t-values larger than 1.96 and $p < 0.05$. More specifically, the path loading of reverse logistics practices in the presence of supply chain complexity on environmental sustainability was ($\beta = 0.207$, $p < 0.006$), the path loading of reverse logistics practices in the presence of supply chain complexity on social sustainability was ($\beta = 0.163$, $p < 0.000$), and the path loading of reverse logistics practices in the presence of supply chain complexity on economic sustainability was ($\beta = 0.162$, $p < 0.040$). All were found to have significant positive effects on sustainability. Therefore, hypotheses of H0.2.1, H0.2.2, and H0.2.3 were supported.

Table 7: Summary of moderation effects tests

Path Shape	Path Coefficient	STDEV	T Statistics	P Values	Support
(Reverse Logistics Practice ×Complexity) → Environmental Sustainability	0.207	0.031	2.767	0.006 **	Yes
(Reverse Logistics Practice ×Complexity) → Social Sustainability	0.163	0.038	3.017	0.000 ***	Yes
(Reverse Logistics Practice ×Complexity)) → Economic Sustainability	0.162	0.067	2.015	0.040 **	Yes

****p>0.001; **p>0.05*

5. Discussion

Many studies have been conducted on RL, albeit with an emphasis on different perspectives and in a different environment. El Baz, Frei, and Laguir (2018) observed that RSC practices on Moroccan companies generate earnings from resale processes. From literature review, it was found that environmental sustainability can be achieved in two ways: proactive and reactive (Van Hoek, 1999). The reactive approach basically means going green in line with the legislations. In contrast, being proactive entails adding value to the firm's image and its products by considering environment in every practice. Dealing with each party in SC as partner and agreeing to be environmentally friendly sometimes means bypassing laws and legislations and going beyond them. In this case, Pepsi-Jordan Company cares about the environment given that it has mostly switched its products from plastic cans to metallic and glass cans.

RL processes range from basic processes like scrap and recovery processes that small firms can engage in, without having to make large investments and support from different stakeholders. Meanwhile, there are also complicated processes in place which generate revenues for their companies such as the remanufacture and repair processes; in this case, it is an international company that can afford recycling and remanufacturing processes (El Baz, Frei, &Laguir 2018). Based on research findings, it appears that Pepsi-Jordan Company has a company policy and adequate information technology that provides it with an internal incentive to have RSC practices without having to wait for legislations and economic incentives (external incentives) in order to be proactive (Erol, Velioğlu, Şerifoğlu, Büyüközkan, Aras, Çakar, &Korugan, 2010). Sustainability has emerged as a strategic issue for most organizations, because an analysis of many literature review suggests that sustainability is necessary on account of stakeholder and institutional pressures (Sancha et al., 2015, Wolf, 2014; Zhu et al., 2013).

Sustainability can be achieved through different approaches such as supply chain integration (internal and external) (Kang, Yang, Park &Huo, 2018). In this study, RSC especially in terms of remanufacture and waste management, was found to be the cause of sustainability. At the same time, environmental sustainability came across as the strongest result of RSC. With regard to supply chain complexity, there are different levels of complexity. However, in this paper, the researcher has focused on detail complexity in downstream, upstream and internal manufacturing. Supply chain complexity means the extent to which a supply is deemed flexible and adaptive.

6. Conclusion and Managerial Implications

This study yields some interesting results which may have value for practitioners and policy makers alike. First, it highlights that being environmentally friendly is essential for the continuity and sustainability of any organization, regardless of whether there are legislations and laws for it. Second, making investments in building closed loop supply chain is costly in the short term but cost effective in the long term. Thus, managers must prioritize the development of SC in order to take advantage of it. Building closed loop supply chain has become essential for all organizations because society and environmental groups have made it imperative for any company to maintain a good reputation as well as to maintain a competitive edge by convincing customers to buy their products.

In Jordan, with its limited resources and financial abilities, RSC has become mandatory and not optional for any organization seeking to focus on sustainability. From the viewpoint of supply chain complexity in terms of suppliers and customers, SCC has grown since the base of suppliers and customers is heterogeneous and has variety. In conclusion, supply chain is a non-negotiable imperative for any commercial organization that is looking to create goodwill in a global scenario by focusing on issues such as environment without neglecting profitability. Therefore, large and successful organizations imply a strong and sustainable SC.

8. Recommendations

Researches in the field of supply chain can be very vast owing to its constant growth. This implies that it can be examined deeply from diverse perspectives: mechanisms to build economic or environmentally sustainable supply chain can be studied for different organizations in various fields or environments. Finally, RSC should be studied from an information viewpoint to determine whether or not it impacts sustainability. Supply chain complexity entails many intricacies because it has many levels to examine. This paper focuses on manufacturing plant level, while complexity needs to be studied by other researchers by industry, by geographic region, or by business unit.

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July-August 2020
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