

# The Trade-off between Cost and Environmental Performance in the Presence of Sustainable Supply Chain

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**Abstract** - The foremost objective of the current study is examining the trade-off between environmental performance and cost performance in the presence of the sustainable supply chain. In particular the study has examined the impact of sustainable supply chain implantations namely sustainable procurement, sustainable distribution, sustainable production and sustainable reserve logistic on the cost and environmental performance. The study has broached the argument that the financial performance and profitability of a firm can be enhanced using SSCM activities or not. Research is limited in the context of developing economies. However, extensive research is available on developed economies. It is considerable to know about the influence of SSCM initiatives on the production sustainability in the developing countries. There is need to understand the relation between performance and SSCM initiatives among the firms in developing regions including Indonesia. There is need for creating a balance between economy and environment in these economies. Employing the survey-based methodology, the PLS-SEM technique is used to test the hypothesized relationships. So, current study has used PLS-SEM as statistical tool to answer the research questions raised in this study and research objectives envisaged in the current study. The findings of the study have provided support to the theoretical foundation and proposed hypothesis of the current study. Current study will be helpful for policymakers and practitioners in understanding the issues related to sustainable supply chain implementation and supply chain performance. In author knowledge this is among very few pioneering studies on this issue.

**Keywords:** Supply Chain, Sustainability, Indonesia

## 1. Background

The concept of SCM has gained attention from social and environmental perspective over the last some years. SCM need to incorporate the environmental and social objectives in its policies rather than the ultimate focus on economic goals [1]. These initiatives of sustainability have

increased because of increase in legislations by the government for protecting environment. Further, increase in consumer awareness has led to the increase in demand of products, which are safe for the environment [2].

From academic and industrial perspective, there has been increase in the study of sustainable production and environmental sustainability for managing supply chain. SSCM has been adopted by several industries in the manufacturing sector to fulfill their responsibility towards the environment [3]. When firm is unable to show its responsiveness towards the environmental issues, the repute of the firm as well as its stakeholders comes at risk [4]. Manufacturing industries are facing increased pressures for extending their concern towards the social and environmental goals along with the economic objectives [1].

In developing economies, manufacturing companies have started working on incorporating green activities in managing their supply chain. Environmental legislations are increasing in the emerging economies because of market competition and increase in educated consumers [5]. The manufacturing companies in emerging economies for reducing externalities have adopted different initiatives related to SSCM. These initiatives include green purchasing, development of eco-friendly designs for lowering the impact of production on the environment [6]. In emerging countries, manufactures are able to fulfill the domestic needs and expand business in the international market by complying with international rules and regulations. Limited internal resources make it harder for manufacturing firms in the emerging economies to adopt initiatives for SSCM [7]. Through acquisition of green resources by collaborating with partners, manufacturing companies are overcoming the unavailability of resources. The performance of the partners in the collaborative relation is improved as well through SSCM.

Resource Dependence Theory (RDT) can be used for explaining this process. The interdependencies with the focal firm can be elaborated using this theory for the achievement of organizational objectives. RDT is crucial for expanding the research on inter-organizational collaboration in the process of implementing SSCM. The performance outcome can be evaluated using this theory. There are several advantages linked with RDT. The theory is helpful in relating to the collaborative advantage of supply chain. In the next section, this has been discussed. [8]. Research is limited in the context of developing economies. However, extensive research is available on developed economies [9]. It is considerable to know about the influence of SSCM initiatives on the production sustainability in the developing countries [10].

There is limited knowledge available on the influence of adopting SSCM on performance among the firms in the manufacturing sector of emerging economies [11]. Some of the studies have analyze the influence of SSCM initiatives on the performance in terms of economic and environmental aspects with reference to emerging economies [12]. There are contradictory statements in making conclusive arguments by these researches. There is need for empirical research on the topic related to the adoption of SSCM practices and their impact on the performance in the emerging countries. In this research study, two emerging countries have been compared related to the influence of SSCM initiatives and their impact on performance. The economies are Asean and particularly Indonesia.

The following research question has been proposed in this study.

Are there any improvement in performance through adoption of SSCM initiatives and this result in improved cost performance specifically in the emerging economies?

In the next part of study, literature review has been conducted and theoretical framework has been presented. The study is related to Resource Dependence Theory and other theoretical insights have been given. The next part SSCM initiatives and their influence on performance have been highlighted in relation to the emerging economies. In the third section, research methodology has been presented ad samples have been summarized. The fourth part of the study involves results and discussion of findings [13]. The fifth part gives conclusion. The implications for managers and research limitations are given in the sixth part of the study along with areas for conducting future study.

## 2. Literature Review and Formulation of Hypotheses

### 2.1. Theoretical lens

The theoretical grounds have been presented in this section, which related SSCM to cost and environmental performance. According to [14], normative values should be presented by the studies related to the conceptual framework formulations. The normative values should be based on the theoretical aspects. A framework has been developed for SSCM performance proposed by RDT. The principles of RDT have been used in this research. It has been argued that collaborative efforts are made by manufacturing firms with the suppliers for adopting practices within the supply chain that are sustainable.

SSCM initiatives have been posed as inter-organizational dependencies in this research. There is need for coordinating with the suppliers by a firm in the development of products, which are sustainable environmentally. The implementation of SSCM initiatives is supported through internal collaboration of an organization. This offers the firm with resources, which are green. Moreover, expertise and better capabilities are attained by the firm. RDT helps in expanding the activities of an organization to its environment. Moreover, it is signified through RDT that SSCM initiatives cannot be adopted by the firm individually. Therefore, Resource Dependence Theory is related to SSCM. As firm depends on its suppliers for resources, it demands from its suppliers to adopt SSCM initiatives and fulfill the responsibilities toward environment effectively [15]. Limited research is available on the influence of SSCM practices on the performance in relation with Resource Dependent Theory [16]. This research has incorporated the use of RDT in managing organizational operations and supply chain. Moreover, it analyzes the association among the SSCM initiatives and performance with reference to the emerging economies.

There is need to make collaboration with the suppliers, when a firm aims at adopting sustainable procurement measures, design and recovery of investment as initiatives of SSCM [17]. It is crucial to increase collaboration within supply chain from the perspective of emerging economies because of lack of expertise, green resources, and capabilities [11]. The adoption of SSCM initiatives requires inter-organizational collaboration by a firm with suppliers. This creates an influence on the performance in economic and environmental terms. The performance model of SSCM has been developed on the theoretical concepts of RDT. Through inter-organizational collaboration, the implementation of SSCM initiatives can be made.

## 2.2. Sustainable Procurement (SPR)

It is ensured by environmental purchasing approach that the items, which are purchased, fulfill the attributes of ecology. This is referred as sustainable procurement. The ecological attributes include recyclability, reusability and use of materials, which are nontoxic. Raw materials are properly sourced in sustainable procurement. The emphasis is made on lowering waste and elimination of hazardous materials in the environment. There is need to work in coordination with the suppliers for developing products safer for the environment. The involvement of suppliers and coordinating with them is highly important in improving the environmental performance of a firm. Suppliers can provide green resources for complying with the environment [18]. For procurement of resources, which are sustainable environmentally, manufacturing firms need to establish relationships with their suppliers [17].

Due to increased pressure from the government regarding environmental issues, a number of leading firms operating in the manufacturing sector of Indonesia have started implementing sustainable policies. Inter-organizational collaboration is established by the manufacturing firms and use of green resources is considered essential for attaining inputs, which are environmentally friendly. Firms can attain the required resources with suppliers' collaboration. The use of expertise and green resources can be made in the development of products, which fulfill the environmental concerns of customers. The SSCM concept makes it highly crucial to make supplier collaborations for providing green resources to the firm. Further, it supports the adoption of SSCM initiatives, which influence the performance.

The environmental performance of the firms in manufacturing sector can be improved through use of SSCM initiatives including sustainable procurement [19]. It has been emphasized by [17] that the implementation of latest environmental technologies is supported by increased collaboration of firm with the suppliers. The concept of sustainable procurement and theoretical aspects of RDT make the technologies influential on the performance. The basic purpose of sustainable procurement is to ensure collaboration with suppliers for the production of products, which are environmentally friendly. It has been proposed in this research that there is relation between environmental performance and sustainable procurement to some extent. The cost performance can be influenced through sustainable procurement. This is because of the involvement of suppliers in the acquiring of green inputs. The overall economic performance of a firm is based on the role of suppliers. Suppliers, who are environmentally friendly offer different cost

structure to the firm as compared with the ones who are not environmentally friendly.

The following research hypotheses have been developed with reference to the emerging economies.

H1: Sustainability procurement is in direct and significant relationship with the environmental performance.

H2: Sustainability procurement is in direct and significant relationship with the cost performance.

## 2.3. Sustainable Distribution (SDST)

The issues of environment related to inventory control, packaging, inventory control, transportation, etc. are involved in sustainable distribution. Sustainable Distribution aims at reduction of environmental impact. The companies need to reduce their carbon footprints. In sustainable distribution, green packaging including shape, size, and materials are valuable as they can affect the product transportation [20]. Improved packaging can benefit firms. This can lead to reduction of input used, better utilization of space and effective handling of products. Moreover, in SSCM, the design of logistics network is crucial. Different options such as single mode or intermodal, direct shipping, central warehouse, third party services, private fleet, etc are included in this [21].

Several initiatives have been taken by most of the manufacturing firms in Indonesia. The initiatives include shorter movements, effective utilization of space, direct routes, etc, which support to the environment by reduction in externalities [22, 23]. Third party logistic providers are employed by large manufacturing companies in Indonesia, which have green resources, capabilities, and expertise [12]. In this way, sustainable initiatives are carried out by the companies. The negative impact on the environment is minimized through outsourcing of logistics services by hiring green third-party logistics providers.

The focus of sustainable distribution is on the reduction of emissions linked with the transport of products within the supply chain, in this way it can improve the environmental performance [19]. According to [9], there is a direct association between cost and environmental performance and sustainable distribution. The reduction of waste and emissions of CO<sub>2</sub> are achieved through sustainable distribution. Use of green packaging can reduce the carbon footprint, which occurs through transportation of products. Green logistics and green packaging can benefit in long term to the firms. However, these initiatives are harder to implement in short term because of high cost.

The following research hypotheses have been developed:

H3: Sustainability distribution is in direct and significant relationship with the environmental performance.

H4: Sustainability distribution is in direct and significant relationship with the cost performance.

#### 2.4. Sustainable Production (SPC)

Use of input or resources, which have low impact on the environment are involved in Sustainable production. This is also referred as sustainable manufacturing [21]. The purpose of sustainable production is to reduce pollution and emissions. Moreover, efficient production processes involve the use of eco-design. In sustainable production, sustainable designing of products is included [12]. Several previous studies have suggested that sustainable design is involved in sustainable production [19, 23]. In the manufacturing process, green activities are involved in sustainable production. It has been proposed that firms should adopt sustainable designing practices as suggested by sustainable production approach. The product is designed in consideration of the environmental issues, which is referred as sustainable design. aim of sustainable design is to lower the impact on environment [20]. Inter-organizational collaboration and cross-functional cooperation is required for successful designing of product concerning the environment. Because of international environmental regulations, the governments in the countries have pressurized all the leading manufacturing companies to comply with the environmental regulations in production designing and other operations [10, 12]. To work on the initiatives related to eco-design, increased collaboration has been made by the firms in Indonesia with the suppliers. In this way, green resources, expertise, and capabilities are acquired from the suppliers [24]. A number of large manufacturers are based in Indonesia, which supply products to other countries. In the similar way, Indonesia is the home of manufacturers supplying products to the Middle East region. For complying with the environmental legislations related to exports, manufacturing firms in Indonesia are implementing initiatives of eco-design. Several issues are faced by the large manufacturers in Indonesia. These compliance issues include use of recycled and reusable materials in packaging, reduction in consumption of energy and lifecycle assessment of products, etc. [22].

The environmental performance can be influenced through use of design, which is environmentally friendly. The intention in eco-design is to decrease the impact on environment [19]. The focus of sustainable design is on the elimination of waste related to the environment in the supply chain. Environmental improvements can be made through minimization of waste along with reduction in cost

related to discharge of waste material. This creates an influence on the cost performance [19]. It is required by the manufacturers that consumption of energy and material be reduced in sustainable design. This can result in the minimization of cost linked with the consumption of energy and other materials [25]. According to [26] here is direct association between economic performance of a firm and sustainable design. This increases the economic performance of the firm resulting in competitiveness of business.

The following research hypotheses have been developed:

**H5: Sustainable production is in direct and significant relationship with the environmental performance.**

**H6: Sustainable production is in direct and significant relationship with the cost performance.**

#### 2.5. Sustainable Reverse Logistics (SRL)

The opposite of forward or traditional logistics is referred as Reverse logistics. Reverse logistics is a process, in which used products are collected for recycling. Through use of recycled materials, remanufacturing is done. According to [25], excessive sales of the assets or products are also included in reverse logistics along with the use of recycled materials for value creation. By implementing practices for investment recovery, surplus sales can be experienced by a firm. This is important in the approach of reverse logistics. Value is recaptured through unproductive assets and reusing products in investment recovery. Logistics professionals need to pay high attention in managing reverse logistics such as practices of investment recovery, etc. Firms are not able to pay attention to such practices because of lack of internal resources [27]. Firms need to collaborate with their partners in collecting the products discarded to recycle them. There is less focus on the policies of waste management in Indonesia because of unavailability of suitable closed-loop infrastructure. The government of Indonesia pressurizes the manufacturers to focus on remanufacturing practices and recycling, as landfills reach capacity [10]. Majority of the manufacturing firms in these countries are getting involved in use of recycled products and fulfilling their responsibility to the environment (Meyer, 2018).

The focus of investment recovery is on recapturing the assets, which were not used by using them effectively. In this way, recovery can result in improved environmental performance through surplus sales [19]. The use of end of life products is made in investment recovery, which can generate surplus sales for the firm. In this way, waste and pollution can be decreases as a responsibility

towards the environment. The cost performance of a firm can be influenced by investment recovery. By working on used and scrap materials and excess capital equipment, surplus sales can be generated. According to [12], there is an association between performance and investment recovery. The economic and environmental performance can be influenced through investment recovery (Sinaga, Saudi & Roespinoedji, 2018).

The following research hypotheses have been developed:

H7: Reverse logistics is in direct and significant relationship with the environmental performance.

H8: Reverse logistics is in direct and significant relationship with the cost performance.

### 3. Methodology

This study adopts the Structural Equation Modelling (SEM) for analysis due to several reasons. SEM is considered to have equal ability with multiple and linear regression analysis which assume that variables are evaluated with no errors. Even though SEM involves multiple regression and factor analyses, it has a more effective way of estimating instrument for a number of separate multiple regression equations which it evaluates concurrently [28]. It is more potent in analyzing and modeling interactions and better in dealing with analysis associated with correlated independents, non-linearity and multiple latent independents correlated error terms and measurement errors, (measured through multiple indicators) and latent dependents with multiple indicators. Equally, when it comes to estimating multiple dependent relationships concurrently, it has better capacity to take care of measurement errors and the strength of relationship between factors can be determined more precisely [29]. Besides, a confirmatory method of data analysis is

more preferred than using exploratory factor analysis, testing hypotheses is also easier.

The scale of sustainable procurement is adapted from the studies of [30]. The sustainable distribution scale is adapted from the studies of [19, 30]. The sustainable design is adopted from the studies of [19, 30], and of investment recovery. The scales of environmental performance, and cost performance are adopted from the studies of [19, 30]. Using SEM therefore to analyses data invariably allows the researcher the use of multiple measures to denote or represent constructs and takes care of specific error which makes it easier to substantiate validity of the constructs under study [31]. Being that this study measures multiple underlying variables as predictors, indirect paths and path analysis. Additionally, with the design of questionnaire which comprised of interval and ratio scales and also measures of constructs which are highly hypothetical and conceptual in nature such as this study, the choice of SEM becomes inevitable. Furthermore, it helps to show the causal relationship between variables and further explains the complexity and the unobserved variables in the analysis [32].

### 4. Results

The first step of PLS analysis is to determine the measurement model which is referred as outer model. It includes the reliability of individual item, reliability of internal consistency along with discriminant, convergent and content validity [32, 33]. The estimation of measures goodness is involved in the measurement model. For assessing the outer model in this research, two basis rules were adopted, which include reliability and validity. The consistency of measurement tools are involved in the reliability test, which determine the expected functioning of the tool. The measurement of the concept in an exact manner that is meant to measure is assessed in validity tests [33].

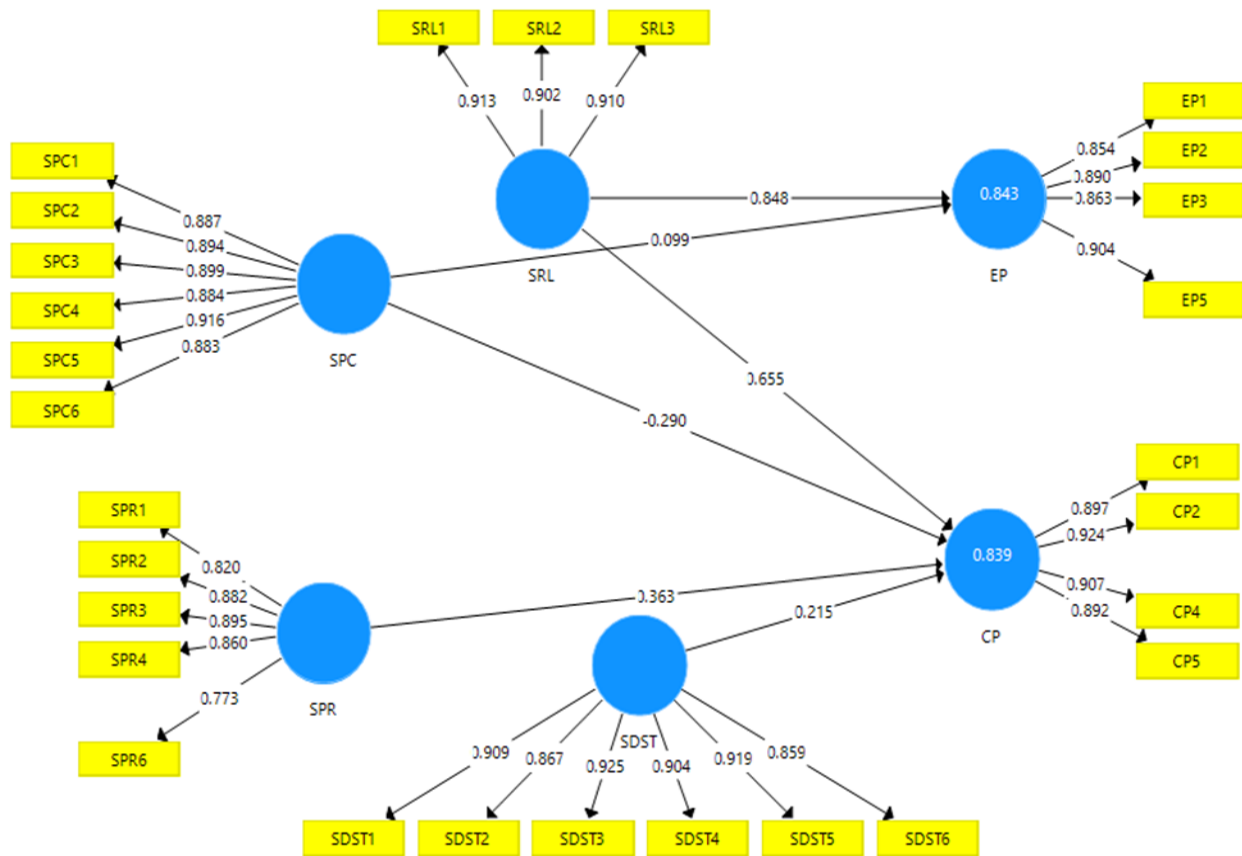


Figure 1. Measurement Model

Evaluation of the indicator item reliability is done through the measure of individual concept at the out loadings [32, 33]. According to [32], it is suggested to hold the items with values of item loading in the range of 0.40-0.70. The results of

this research suggest that 12 values out of 40 were eliminated because of values below 0.40. Only 28 out of 40 items were kept in the model as their value lied in the range of 0.501 and 0.951.

Table 1. Outer Loading

	CP	EP	SDST	SPC	SPR	SRL
CP1	0.897					
CP2	0.924					
CP4	0.907					
CP5	0.891					
EP1		0.854				
EP2		0.889				
EP3		0.864				
EP5		0.904				
SDST1			0.909			
SDST2			0.867			
SDST3			0.925			
SDST4			0.904			
SDST5			0.919			
SDST6			0.859			
SPC1				0.887		
SPC2				0.894		

SPC3				<b>0.899</b>		
SPC4				<b>0.884</b>		
SPC5				<b>0.916</b>		
SPC6				<b>0.883</b>		
SPR1					<b>0.817</b>	
SPR2					<b>0.883</b>	
SPR3					<b>0.896</b>	
SPR4					<b>0.856</b>	
SPR6					<b>0.777</b>	
SRL1						<b>0.913</b>
SRL2						<b>0.902</b>
SRL3						<b>0.910</b>

The level to which the same concept is evaluated by the indicators is referred as internal consistency reliability. In an organizational research, the reliability of internal consistency is measured through the estimates such as coefficient of composite reliability and coefficient of Cronbach's alpha [34]. It is under discussion about the most

suitable approach for estimation of reliability. The coefficient of Cronbach's alpha is used across the globe for the estimate, but it can underestimate the value of reliability. In addition to the SEM-PLS models, composite reliability is used as it is advanced than the Cronbach's alpha.

**Table 2. Reliability**

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
CP	<b>0.926</b>	<b>0.929</b>	<b>0.948</b>	<b>0.819</b>
EP	<b>0.901</b>	<b>0.903</b>	<b>0.931</b>	<b>0.771</b>
SDST	<b>0.952</b>	<b>0.954</b>	<b>0.961</b>	<b>0.805</b>
SPC	<b>0.950</b>	<b>0.952</b>	<b>0.960</b>	<b>0.799</b>
SPR	<b>0.901</b>	<b>0.905</b>	<b>0.927</b>	<b>0.718</b>

To ensure the internal consistency, the coefficient of composite reliability has been used in this research. The reason for selecting composite reliability is the assumption in the Cronbach's alpha that equal contribution is made by all the items to the construct and individual role of loadings is not considered [35]. [35] gave a traditional rule for the interpretation of internal consistency reliability along with the composite reliability coefficient and [33] suggested that the value of composite reliability should be above 0.70. The coefficients of composite reliability of the constructs are shown in the Table 4.10. The value of coefficient of composite reliability for each construct as shown in the table lies in the range of 0.774 to 0.894. All the values lie above the

minimum acceptance value, which shows that there is satisfactory reliability of internal consistency of the constructs [33]

The level to which the items are associated with the measures of the similar construct is regarded as convergent validity (Hair et al., 2014). When the items loading indicators in relation to the constructs are greater than 0.5, the validity is referred to be convergent [29]. According to [32], three principles are used for assessment. These principles include that all the indicators of factor loadings have significance level. The second principle include that the value of composite reliability is greater than 0.7 and the value of Average Variance Extracted is greater than 0.5.

**Table 3. Discriminant Validity**

	CP	EP	IR	SDS	SDST	SP
CP	<b>0.945</b>					
EP	0.913	<b>0.928</b>				
SDST	0.891	0.915	<b>0.908</b>			
SPC	0.819	0.804	0.802	<b>0.947</b>		
SPR	0.719	0.671	0.668	0.901	<b>0.917</b>	
CP	0.680	0.677	0.682	0.908	0.899	<b>0.894</b>

Another criterion for determining the level of differentiation of a variable from the other variables is regarded as discriminant validity [29]. Discriminant validity is regarded as the extent with which the constructs differ from each other. It has been suggested by the high level of discriminant validity that the variables are unique and differ greatly from one another. The square root value of

AVE was used for measuring discriminant validity. This value needs to be higher than the value of correlation among the variables. Comparison of the association between the constructs with AVE square value was made. Moreover, the standard given by [35] was used in discriminant validity, which involves the comparison of items in cross loadings as depicted in the table.

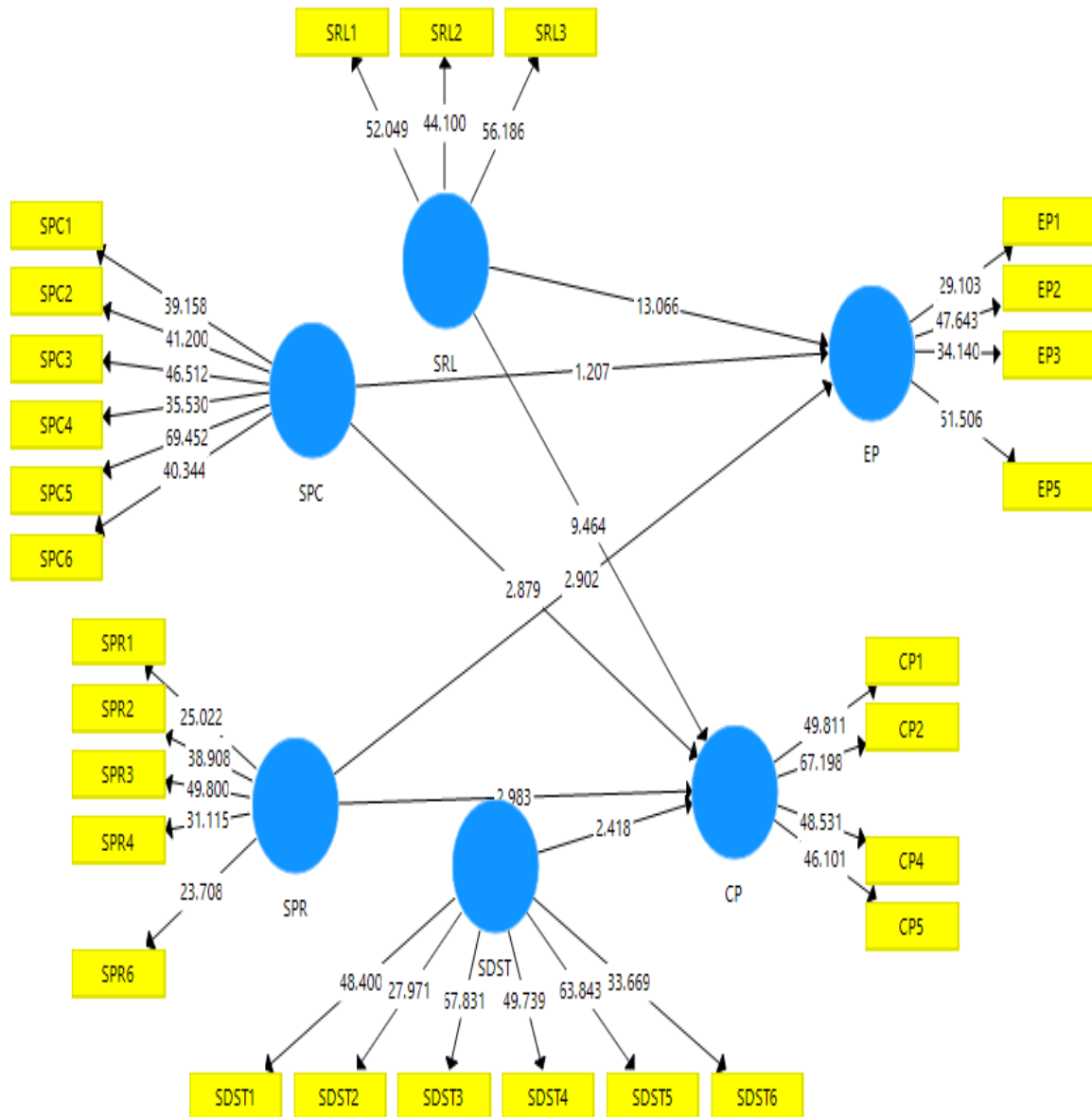


Figure 2. Structural Model

With the establishment of a measurement model, the next step is to estimate the structural model for developing an overall relation with a model. Moreover, in a recent study, [36] stated that model validation can be sufficiently assessed through the goodness-of-fit criteria. For instance, while employing PLS path models having reproduced data, it has been argued that goodness-of-fit criteria is unsuitable, as it fails to distinguish among the invalid and valid models.

In this section, the structural model was developed after the establishment of the measurement model. The basic aim was to develop a relation of the model as a whole. It is important to note that for the validation of model, goodness of fit is not regarded to be suitable [32, 36]. For model validation, use of PLS path model along with data simulation, goodness of fit is not appropriate due to the inability of separating valid and invalid models [32]. This research study has adopted a process



based on two steps in line with the current developments for the evaluation of PLS-SEM path. The structural model has been determined in this research study. The method of bootstrapping

involving 5000 bootstrap has been used to determine the path coefficients significance [32, 33]. The third hypothesis is the only hypothesis which is rejected.

**Table 4.** Direct results

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ((O/STDEV))	P Values
<b>SDST -&gt; CP</b>	0.218	0.225	0.090	2.418	<b>0.016</b>
<b>SPC -&gt; CP</b>	-0.289	-0.284	0.100	2.879	<b>0.004</b>
<b>SPC -&gt; EP</b>	-0.101	-0.094	0.084	1.207	<b>0.227</b>
<b>SPR -&gt; CP</b>	0.360	0.358	0.121	2.983	<b>0.003</b>
<b>SPR -&gt; EP</b>	0.298	0.299	0.103	2.902	<b>0.004</b>
<b>SRL -&gt; CP</b>	0.654	0.645	0.069	9.464	<b>0.000</b>
<b>SRL -&gt; EP</b>	0.746	0.737	0.057	13.066	<b>0.000</b>

The ability of endogenous variables to predict is reflected through the value of R2 in the structural model. The accuracy of the forecasted model is measured through it. The combined effect of independent variables on the dependent variables is measured through R2 [28]. The variation in the dependent variable because of the independent variable is explained through coefficient of

determination. The value of R2 should be high within the range of 0-1. When the value is 1, it reflects complete predictive accuracy. The value of R2 to be 0.26 is substantial, 0.13 to be moderate and 0.02 to be weak. According to [28], the value of R2 to be 0.75, 0.50, or 0.25 for independent variable is considered good, moderate and poor respectively.

**Table 5.** R-Square

	R Square
<b>CP</b>	0.838
<b>EP</b>	0.853

## 5. Conclusion

This research has generalized the findings by classifying Indonesia as a higher emerging economy and Iran as middle. This makes the two economies suitable for representing emerging markets. The adoption of SSCM in the two emerging countries will be empirically studied through cross-country comparison for giving findings. This approach has been used by some previous researchers in differentiating the contradicting directions [8]. This study will demonstrate a general comparison of adoption of SSCM by studying the similarities and differences in Indonesia. From environmental perspective, it is important to implement SSCM initiatives in the emerging markets considering that there is no empirical evidence available. Moreover, doing a good business requires the adoption of SSCM practices in the emerging economies. A comprehensive model of SSCM performance has been developed in which SSCM practices have been related to the performance of an organization. By including the constructs, which have been developed recently, this research adds to literature of SSCM. The research is based on an integrated

performance model of SSCM, which has been proposed by RDT. In relation to RDT, there is limited empirical research on SSCM. This research study narrows the gap found in literature by working on the adoption of SSCM in the emerging economies. The study has argued that the cost performance can be influenced through sustainable procurement. This is because of the involvement of suppliers in the acquiring of green inputs. The overall economic performance of a firm is based on the role of suppliers. Suppliers, who are environmentally friendly offer different cost structure to the firm as compared with the ones who are not environmentally friendly. The study is also of the view that the reduction of waste and emissions of CO2 are achieved through sustainable distribution. Use of green packaging can reduce the carbon footprint, which occurs through transportation of products. Green logistics and green packaging can benefit in long term to the firms. The focus of sustainable design is on the elimination of waste related to the environment in the supply chain. Environmental improvements can be made through minimization of waste along with reduction in cost related to discharge of waste

material. This creates an influence on the cost performance.

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