

Evaluation on Material Structural Scarcity Resource towards Sustainable Supply Chain Performance

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Abstract

Supply Chain Performance refers to the extended supply chain's activities in meeting end-customer requirements, including product availability, on-time delivery, and all the necessary inventory and capacity in the supply chain to deliver performance responsively. The issue of inequality and extended consumption in supply and demand become crucial since the pandemic COVID-19. Plus, the increase of population enforces manufacturing to examine the sustainable effect to overcome the business impact. Therefore, anticipated with Sustainable Supply Chain Performance (SSCP) to plan an initiative of material scarcity to have a better performance in the supply chain to contribute to economic and social advantage. The objectives of this study; to investigate the level of SSCP in Material Scarcity Resources, to explore the implications of material scarcity resources for companies in structural scarcity towards sustainable supply chain performance and finally to investigate the impact of material scarcity resources in SSCP in environmental, economic and social in Malaysia. A total of 101 respondents among manager level from the southern region of Malaysia's manufacturing industry was collected. The result showed that Material Structural Scarcity Resource has a positive effect on environmental, economic, and social performance in a sustainable supply chain. Thus, sustainable supply chain performance showed consistency in the performance into the material scarcity overcomes, reducing inventory which enhances the productivity, environmental initiatives advance into product innovation and cut costs reductions. As a result of the factor analysis in the components environmental legislation demand with 89.7% showed that the sustainable supply chain performance significantly improved on the stages of manufacturing, increase diversity of products, lowering manufacturing price, increasing market share, introducing new products rapidly and be the forefront of the future legislation demands. So, it is beneficial to the manufacturing industry companies in improving their performance and stabilizing the economic condition indirectly.

Keywords: Supply Chain; Material Structural Scarcity Resource; SSCP; Sustainability

1. Introduction

Material Scarcity turn to be importantly dispersed around the world because of the shortage of material resources availability with a growing population followed by the demand and products increase make the companies recognize to restructured in supply chains. Moreover, World Bank has raised the matter of the possibility of material scarcity resource increase during the Covid-19 pandemic (The World Bank, 2020). Even though there is support in the material scarcity it may be substantial in the ability to the reduction of resources when the support is end and become a challenge to maintain the supply that affects the consumers in the future (S. Aday, 2020). Therefore, it's crucial to understand destruction on environmental, social, and economic supply chain performance effect. Moreover, WHO highlights this is not only about the public health crisis unfortunately it involved more sectors that affect the whole economy struggle especially supply and demand implications (WHO, 2020).

Furthermore, the situation in the business environment develops the strategy on sustainable supply chain performance for the competitive advantage in the marketplace. Moreover, organizations are reinforced in global community analyses through media and non-governmental organizations affecting the sustainability

part of supply and demand development (Choi, T., D. Rogers and B. Vakil, 2020). According to Fahian A.H and M. Stevenson (2020), businesses are progressively required to continue their sustainability attempts ahead of operations to include suppliers to meet customers' requirements in sustainability anticipations. Progressively industry practice to develop sustainability within supply chains performance.

According to Mani, V., & Gunasekaran, A. (2018), the supply chains need to be seriously investigated this issue of shortage material, environmentally responsive and maintain towards resources as possible. Thus, many researchers stated that the future of supply chain management is sustainability with a better understanding of development (Haffar, M., & Searcy, C., 2017). Most of the businesses are concerned to improve the environmental, social and economic standardize in utilize of the suppliers along with the supply chain improvement forward, focusing on the large outsourcing activities from the lower cost manufacturers and services provided. Thus, to develop a better environmental, social and economic on breakable material scarcity issue with improved support in long-term profitability (Cimprich A., Santillán- Saldívar J., Thiel C.L., Sonnemann G., Young S.B., 2019).

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2. Literature Review

Directly the point is about the shortage that implies the basic economic crisis. Thus, the gap in the limited scarce resources and theoretically unlimited from the demand occurs. One of the major sustainable issues is the reduction of the raw material supply in the era of pandemic causes the operation in manufacturing sector operations and processes. According to Mario Schmidt (2019), regional shortages in raw material become worse in a global scarcity in supplying material sources widely, but more discussion of a global scarcity or even a drying up of raw material sources worldwide. Furthermore, these issues are still contentiously in discuss currently. Essentially, scarcity and growth reconsidered in the study highlight the raw material resources do not find a limitation growth (Sarkis et al., 2020). However, the effort

required to obtain the industry growth in their business even though the resources of the material remain tough. Thus, the raw material is the closest for the main consumption use by the industrial is most intensively (Majumdar et al., 2020; Sharma, 2020).

According to Mario Schmidt (2021), structural scarcity is regularly affected by a critical discrepancy in the distribution of capital and change resulting in certain groups of society getting extremely used to a huge of the resources. While other groups have a small capital material resources usage. Thus, inequitable structural scarcity is the main cause of scarcity contributes to the controversy of competition of discrepancy in distribution. Overall structural scarcity is caused by the mismanagement strategy and the inequality of diversifying the resource in balance.

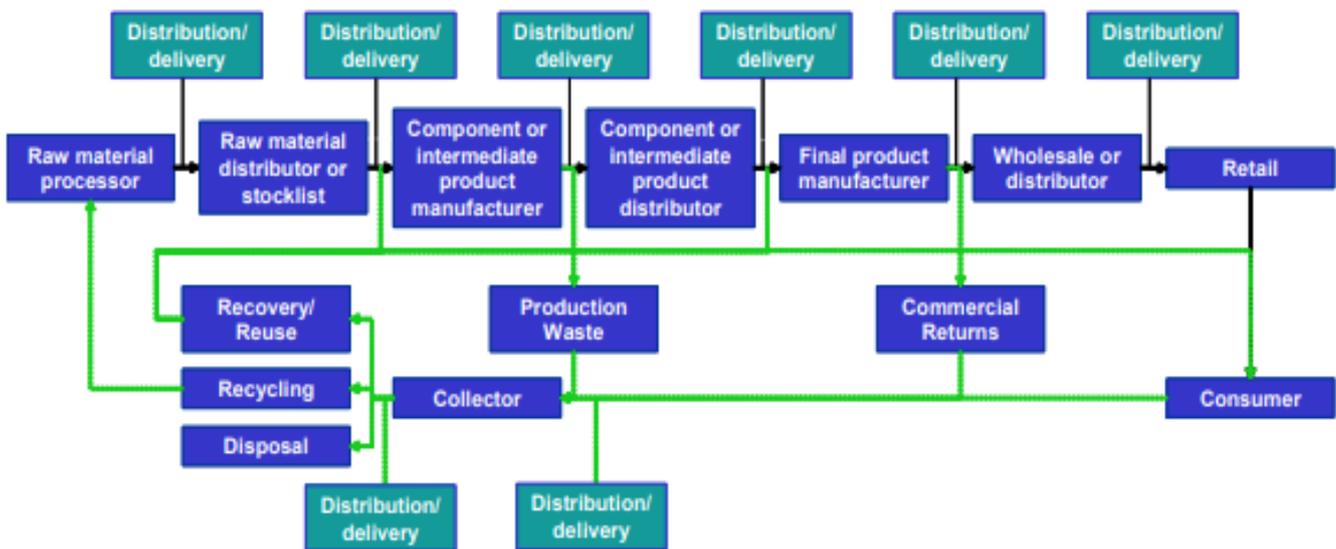


Fig. 1. SC from upstream raw material manufacturer on material supply

McKinsey (2022) define Sustainable Supply Chain (SSC) offers a chance for organizations to improve in the business field by improving performance in the supply chain area. Also, to gain customers' support, integrity and confidence with the suppliers. Moreover, it makes assessment and knowledge insight of sustainable supply chain performance (SSCP) important for theoretical and practical context. Recently, sustainable development involved more researchers, businesses and government in handling this SSCP analysis for the advantage in the operation of the business (McKinsey, 2022). Aside from the standard purpose of profitability, organizations have started contributing to environmental and social concerns which are obtained from customers' and investors' requirements (Mani, V., & Gunasekaran, A., 2018). Particularly of economic, environmental and social components of industry's processes are identified as triple bottom line (TBL).

It's important to take proactive action in order to improve resource scarcity in the future before the impacts occur. Material scarcity resources can have significant effects on essential material in the production and maintenance of the

technology in the production base on the new consequence that happens on the pandemic. Improprity, increasing the raw materials of the remaining natural resources involves environmental impacts in the form of pollution effect on destruction to the environment (Araz et al., 2020; Ivanov, 2020, p. 1; Queiroz et al., 2020). Therefore, material resources reduction may possibly have several risks that relate to the organization's performance productively on the effects of the environment and approaching the material scarcity resources sustainability in supply chain performance is a significant improvement that should be taken.

We are in a world full of demand make materials increasingly super important for the need of life from home to business for decades. However, material scarcity has a big impact on the areas of the supply chain when it comes to pandemics that cause a lot of manufacturing to create waste on the raw material expiring. Consequently, these challenges enforce the manufacturing to examine the sustainable effect to overcome their business impact. Thus, materially affects the lifestyle, transportation, medical, security, delivery of information, and technology for the

advanced operation in manufacturing sectors (Majumdar et al., 2020; Sharma, 2020).

The customer requirement to the new situation that probably has changed on the demand fulfilment even the pandemic over with the implication crisis shortage on the resource in the material has already started Sarkis et al. (2020). It's difficult for the supplier and businesses to plan their products accordingly following the customer requirement dateline. These also affect the forecast from the customer to supplier. Moreover, organizations underlining Supply Chain Sustainable to improve the financial value for suppliers and buyers in the aspects of the business objective to protect the Supply Chain in the trap of material scarcity (Sarkis et al., 2020).

Moreover, the supply chain needs to close the loop in the sustainable performance of environmental, economic, and social preserve to support material resources conceivable. Additionally, most of the organizations are serious about improving the social and environmental standards that can be applied in instant sustainability development in the Supply Chain in terms of outsourcing the material shortage at low cost follow by maximum order quantity available in the other hand support low-cost manufacturers able from the raw material resource issues (Araz et al., 2020; Ivanov, 2020, p. 1; Queiroz et al., 2020). Nevertheless, to stabilize the weakness and potentiality where it is proposed the organizations be more profitable in the long term by evaluating from supply chain sustainability performance in material scarcity resources overcome.

3. Method

Subsequently, the study integrated issues related to sustainability focusing on the environment, economic and social related to the aspects of supply chain business so the most applicable respondent will be the Supply Chain Operation, Purchasing, Production, Warehouse, Logistics and Material Packaging representative of the firm. Thus, the questionnaire will be addressed to the Supply Chain, Purchasing and Distributors who are usually from logistics operations, purchasing and the material engineering department of the manufacturing industry and examined uses statistics Statistical Package for the Social Sciences (SPSS) with quantitative research methods.

3.1. Materials

Data discovered fundamentally on mean, standard deviation, and factor analysis resulting from those categories for the outcomes (environmental, economic, and social) continues with descriptive analysis, reliability, regression analysis by Cronbach's Alpha. The primary data were gathered through a questionnaire survey. The questionnaire consists of 3 sections; the first section consists of general information required to identify the profile of the respondents. The second section consists of the question related to material scarcity resources and lastly is section includes items related to three sustainability indicators. The scales are drawn from established research and were selected to ensure reliability

and validity within the research. A 5-point Likert-type scale was used; while any number of points can be used, a 5-point scale has been commonly used from Strongly Disagree (1) to Strongly Agree (5) to measure the effectiveness of the sustainable supply chain practices on the organization supply chain performance. The questionnaire model for Sustainable Supply Chain Performance was adapted from Harmon and Cowan (2009) and Material Scarcity was adopted from Paul T Mativenga et al. (2017).

3.1.1. Samples

The survey was conducted based on an individual sample unit as the survey was sent to the supply chain professionals. Contacts were gathered earlier, to survey the convenience sampling technique as the sample involved supply chain professionals at different levels, such as managers, directors, or supervisors of different industries. To have better generalizability, the mail-carrying survey descriptions and link was sent to potential respondents from industries in Johor.

3.1.2. Site

The data for this study were collected from manufacturing firms in Johor Bahru, Malaysia. This study concentrated on top-level managers of several manufacturing businesses situated in Johor Bahru. Furthermore, to engage in an efficient cluster sampling technique, a sampling frame is deemed to be essential. The selection of clusters from a sampling frame is conducted randomly, which can be time-consuming and inefficient. These provinces imply distinctive environments of manufacturing development and market economy were more suitable.

3.1.3. Procedures

The data collection was through accessibility sampling, and the sample size collected was embarrassed by the time factor, in accordance with the industry time available due to MCO because most of the employee is working virtually. Therefore, the questionnaire had answers using google form and provided via mails, Whatsapp and Telegram. The quantitative research designs were used to finalize results and prove or disprove a hypothesis by using factor analysis and reliability tests.

3.2. Measurement

A pilot test was conducted in this study and a valuable means from the testing methods for this research measurement was determined from the response rate of the respondent The survey was distributed is in Johor Bahru of 101 respondents in every state sample of manufacturing from food product, beverages, electrical and electronic products, transport equipment, machinery, engineering support, construction-related materials, textiles, chemical and pharmaceuticals.

3.3. Data analysis

Data examination toward separating information and from different resources of information gathered from the Material Structural Scarcity resource and Sustainable Supply Chain Performance area and analysed with assistance from SPSS programming.

3.3.1. Validity and reliability

Quantitative research method instrument survey had used for this study, questionnaires are utilized as a structure to aim for the quantitative survey which is to collect data and examine changes in the data gathered. The study uses statistics Statistical Package for the Social Sciences (SPSS) with the experimental design from data collection based on the instrument used for analysis and data measurements. This study is used factor analysis to validate whether the items in each section loaded into the expected categories. In addition, Cronbach’s alpha was used to assess the internal consistency or homogeneity among the items.

4. Results and Discussion

4.1. Exploratory factor analysis for material structural scarcity resources

The exploratory factor analysis with Varimax rotation was accomplished to validate the assessment and appropriateness of the measurement scale. With eigenvalues greater than 1.00 the total variance explained was 67.88%. The Kaiser-Meyer-Olkin measurement of sampling adequacy (KMO-MSA) measure of sampling adequacy was 0.764 indicating sufficient intercorrelation while Bartlett’s Test of Sphericity was significant (Chi square 1.0608, $p < 0.001$), therefore factor analysis can be considered as appropriate. Items with factor loading greater than 0.30 were retained. There were 7 questions on material structural scarcity resource, and one factor were extracted (Table 1)

Table 1
Factor analysis for material structural scarcity resources

| Items | Items no. | Factor SS |
|--|-----------|-----------|
| Structural scarcity | | |
| Material scarcity | SS1 | 0.750 |
| Cost reduction | SS2 | 0.740 |
| Environmental initiatives advance product innovation | SS3 | 0.720 |
| Customer demands | SS4 | 0.700 |

Table 2
Factor analysis for sustainable

| Items | Items No. | Component | | |
|--|-----------|-----------|-------|-------|
| | | EN | ECO | SOC |
| Environment (EN) | | | | |
| Significant improvement in compliance to environmental standards | EN1 | 0.655 | 0.282 | 0.221 |
| Significant reduction in consumption for hazardous/harmful/toxic materials | EN2 | 0.713 | 0.287 | 0.191 |
| Significant reduction in energy consumption | EN3 | 0.582 | 0.165 | 0.629 |
| Economic (ECO) | | | | |

| | | |
|--|-----|--------|
| Sustainable products give us a competitive edge | SS5 | 0.690 |
| To be at the forefront of future legislation demands | SS6 | 0.600 |
| Environmental legislation demand | SS7 | 0.897 |
| KMO | | 0.764 |
| Bartlett's Test of Sphericity | | 1.0608 |
| Eigenvalue | | 4.789 |
| Percentage variance (67.88%) | | 23.558 |
| Sig. p-value | | 0.001 |

4.2 Exploratory factor analysis for sustainable supply chain performance

The factor analysis outcomes for the sustainable supply chain performance shown in Table 2. The primary theoretical framework identified that material structural scarcity resources have an edge towards the effect of sustainable supply chain performance. However, the results from factor analysis show three different factors for the effects of the consequences. A review of the literature on material scarcity issues in the supply risk by McKinsey (2022) indicated that the possible outcomes of material scarcity issue in supply chain sustainability management can be categorized as the economic, environmental, and social effect. Moreover, these categories of outcome were compared with the sustainable supply chain management outcome proposed by Majumdar et al., (2020) categorized outcomes of sustainable supply chain as environmental, economic and social outcome which are directly aligned with sustainable supply chain performance. Referring to the question items derived from the sustainability supply chain performance constructs by Harmon and Cowan (2009).

The results of the Varimax rotation were used to validate that there are constructs distinctive in sustainable supply chain performance. Results showed three clarifications with eigenvalues greater than 1.0 and the total variance explained was 69.98%. The measurement KMO of sampling adequacy is 0.718 indicating sufficient intercorrelation, while Bartlett’s Test of Sphericity was significant (Chi square 1.1173, $p < 0.001$). This result confirms that the construct is unidimensional and particularize distinctively and that all the items used to measure a particular construct are loaded on three factors (Table 2).

| | | | | |
|---|------|--------|--------|--------|
| Significant improvement in terms of sales and market share | ECO1 | 0.292 | 0.685 | 0.237 |
| Significant reduction in terms of waste and disposal cost | ECO2 | 0.181 | 0.712 | 0.138 |
| Significant improvement in terms of resources management efficiency | ECO3 | 0.290 | 0.705 | 0.204 |
| Social (SOC) | | | | |
| Significant improvement in image of customers | SOC1 | 0.071 | 0.090 | 0.657 |
| Significant improvement in relations with stakeholders, e.g: (NGO) | SOC2 | 0.109 | 0.077 | 0.530 |
| Significant improvement in product image | SOC3 | 0.085 | 0.175 | 0.612 |
| KMO | | 0.718 | | |
| Bartlett's Test of Sphericity | | 1.1173 | | |
| Eigenvalue | | 3.731 | 2.635 | 2.102 |
| Percentage variance (69.98%) | | 23.731 | 20.001 | 19.088 |
| Sig. p-value | | 0.001 | | |

4.3. Modified research framework and hypotheses

Anticipated of the variations in the theoretical framework, the original hypotheses related to the relationships between sustainable supply chain performance and outcomes were reaffirmed. Thus, reaffirmed hypotheses reflect the addition of environmental, economic, and social as the new list of variables for the measurement. Accordingly, new hypotheses were added to reflect the hypothesized relationships between material structural scarcity resource and environmental, economic, and social outcomes.

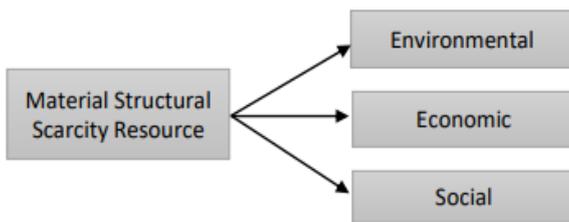


Fig. 2. Modified theoretical framework

4.4. Reliability

The inter-item consistency measure of Cronbach’s alpha was used to assess the reliability of all major variables. Cronbach’s alpha (α) is considered as the most popular indicator of internal consistency, the α -values of variables used in this study. The α -values of all variables were considered as preferable and reliable with $\alpha > 0.70$. The Highest Cronbach’s alpha was observed for economic performance in sustainable at 0.932 and the lowest for social performance (0.795). The high value of Cronbach’s alpha for all the variables under study indicates that the question items are reliable and consistent. This can be attributed to the fact that all the questionnaire items were either adopted or adapted from published journals or articles that have been empirically tested or conceptualized.

4.5. Regression analysis

Table 3 showed the results from multiple regression analysis. Thus, were used to determine the influence of a set of independent variables on a dependent variable. For example, how much of the variance in the dependent variable is explained by the set of predictors or independent variables.

Table 3 Reliability analysis of overall construct

| Variable | No of Items | Cronbach's Alpha(α) |
|--|-------------|------------------------------|
| Overall | 13 | 0.915 |
| Material Structural Scarcity Resource (IV) | 7 | 0.880 |
| Environmental Performance (SSCP-DV) | 3 | 0.857 |
| Economic Performance (SSCP-DV) | 3 | 0.932 |
| Social Performance (SSCP-DV) | 3 | 0.795 |

Table 4 presents the results of the regression analysis for material structural scarcity resource and sustainable supply chain performance. The first model is between material structural scarcity resource and environmental performance in SSCP and it was significant ($F=23.797$; $p<0.001$) with $R^2=0.337$ and adjusted $R^2=.320$. Moreover, structural scarcity was significantly related to environmental performance in SSCP ($\beta=.571$, $p<0.001$). The next model is between material structural scarcity resources with economic performance in SSCP. This model can explain 41.4% ($R^2=0.414$) of variance on economic performance and was significant ($F=39.753$, $p < 0.001$). The 58.6% due to error or explained by other factors are not included in this study. Structural Scarcity ($\beta=.481$, $p<0.001$) was found to be statistically related to economic performance in SSCP.

The third model is the results of the regression analysis undertaken to test the material structural scarcity resource on social performance (SSCP). The model is significant ($F =23.345$; $p\text{-value} <0.001$). The coefficient of determination (R^2) was found to be 0.309 indicating that 30.9% of social performance in SSCP is explained by the material structural scarcity resource. From the regression analysis, it can be observed that Structural Scarcity ($\beta=0.411$; $p<0.01$) and did have a significant influence on social performance in SSCP. Therefore, from the result, it shows that the significant value is less than 0.05 which is between the Structural Scarcity component and sustainable supply chain performance with a $p\text{-value}<0.001$ makes the variable in a significant unique contribution to the prediction of the variable. Thus, the result for H1, H1a, H1b and H1c material structural scarcity resource will be significant in improving sustainable supply chain performance is supported for this study.

Table 4

Regression of material structural scarcity resource on sustainable supply chain performance

| Material Structural Scarcity Resource | Environmental Performance β | Economic Performance β | Social Performance β |
|---------------------------------------|-----------------------------------|------------------------------|----------------------------|
| Structural Scarcity | 0.571 | 0.481 | 0.411 |
| R^2 | 0.337 | 0.414 | 0.325 |
| Adjusted R^2 | 0.320 | 0.431 | 0.309 |
| F | 23.797 | 39.753*** | 23.345*** |

Significant Level: ** $p < 0.01$. *** $p < 0.001$.

Material Structural Scarcity Resource has a positive effect on environmental, economic and social performance in a sustainable supply chain based on the results. Moreover, the primary theoretical framework defined that material structural scarcity resource conducted to the results measurement outcomes of sustainable supply chain performance. Thus, sustainable supply chain performance showed consistency in the performance into the material scarcity overcomes, reducing inventory which enhances the productivity, environmental initiatives advance into product innovation and cut costs reductions. Therefore, in delivering the product to customers on time to fulfil the customer demand resulted in shows that consistent performance is frequently attributed in sustainable supply chain performance into products competitive edge have been implemented in Malaysian manufacturing industry in Johor Bahru. As a result of the factor analysis in the components environmental legislation demand with 0.897 which were shown that the sustainable supply chain performance significantly improved on the stages of manufacturing, increase diversity of products, lowering manufacturing price, increasing market share, introducing new products rapidly and to be the forefront of the future legislation demands.

However, the results from the factor analysis show four different factors for the outcomes. Thus, categories of the constructs were compared with the sustainable supply chain performance as environmental, economic and social constructs on analysis which directly aligned with the supply chain performance. The results showed the environmental performance in SSCP defined as positive consequences with material scarcity on the compliance of environmental standards, reduction of material hazardous and reduction of energy consumption. Additionally, economic performance in SSCP defined as financial returns significantly improving the sale, market, reduction of disposal the waste cost and improving the resources management efficiency. Furthermore, social performance in SSCP is defined as conceptual outcomes that in the image of customers' view of the scarcity, the improvement of the product image and the relation with the stakeholder. However, for the above result from the response by the firms they believe the benefits of this initiative may reflect on internal and external parties on the firm which is supplier and customer that related to the supply-demand. Although, material structural scarcity resource focuses on improving the sustainable performance in the supply chain of its supply of material requirement have a shortage problem because of less stock of the raw materials by implementing the SSCP it can benefit the supplier and customers indirectly on managing the sustainable on

supply chain performance. Moreover, this study contributed to the factor that finding the lack of availability of the systematic monitoring of the KPI derived the environmental, economic and social performance for the organization to plan accordingly on material scarcity overcome. Moreover, this study indicated the effect of Material Scarcity Resource builds on the execution of the Malaysian manufacturing industry which demonstrates that there is a positive connection between Material Structural Scarcity variables and sustainable supply chain performance in organization performance.

5. Implication of the Study

From the analysis results perspective, there is empirical evidence of strong vertical integration between material structural scarcity resource with the three types of outcomes (environment, economic and social) concerning sustainable supply chain performance in the managerial implications, the results indicate that material structural scarcity has a positive effect on sustainable supply chain performance. Specifically, from the economic and social perspective that supports with the information that anticipated business benefits have a significant effect on sustainable supply chain performance. Thus, the organizations need to work together to share the benefits of achievement of sustainable supply chain performance with other organizations to implement and delivered the SSCP concepts through the industry in Malaysia commercial success.

Future research could utilize the concepts and results to develop a detailed conceptualization of material structural scarcity resources and their impact on sustainable supply chain performance, especially in the context of Malaysia. Furthermore, even the result is significantly improved future research need to more focus on the demand-induced scarcity and supply-induced scarcity in the effect of sustainability towards the operation performance on the organization implementation in longitudinal analysis study to improve and determine the capacity on the material scarcity in inventory management with Sustainable Warehouse that can contribute for social, economic, academia and industry.

6. Conclusion

Recently, sustainability is obtaining an increasing level of awareness in the global levels, which ultimately conducts to questions on how to incorporate sustainability with business operations and strategy on the material shortage related to supply and demand. Moreover, material scarcity resource could be good to extend in the business responsibility in reducing the material scarcity, advance

product innovations, cost reduction that related to the efforts from the scarcity exists to fulfil the demand of the product's achievement of the raw materials in sustainable environmental, economic and social performance from the limited resources. This study examines the material structural scarcity resources practices in manufacturing firms in Malaysia affect sustainable supply chain performance. Thus, determined the direct impact on the sustainable performance in manufacturing in Malaysia practices especially in environmental, economic and social performance outcomes that bring value to the organization and for the researcher on the solution of the scarcity.

The SSCP as a guide on improvement to a reduction in resources, material scarcity, enabling the resource utilization limitation with significant environmental, economic and social performance development on the industry and globalization. Overall, this study indicates that material structural scarcity resources represent the current issue of the industry that required further research to understand the adoption into SSCP in the organization practices for the solid solution on the scarcity resources. Therefore, future research is encouraged on SSCP related to operation performance towards the supply-induced and demand-induced for the sufficient and productively improvement that relate goods and services.

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