



## COMPLEXITIES IN A FLEXIBLE SUPPLY CHAIN AND THE ROLE OF KNOWLEDGE TRANSFER

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### Abstract

**Purpose:** The current study is interested in exploring the nexus between product complexities, external and internal knowledge and supply chain flexibility of Indonesian manufacturing firms.

**Methodology:** The study has employed the knowledge-based view to conceptualize the relationship between product complexities, external and internal knowledge and supply chain flexibility of Indonesian manufacturing firms. The complexity of manufacturing flexibility has made this concept difficult to comprehend yet delimit. To date, agreement on how to practice this concept has not yet been resolved. Employing the survey-based methodology, the SEM-PLS technique is used to test the hypothesized relationships. So, the current study has used SEM-PLS as a statistical tool to answer the research questions raised in this study and research objectives envisaged in the current study.

**Results:** 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 supply chain risk, supply chain integration and supply chain agility. In the author's knowledge this is among very few pioneering studies on this issue.

**Key words:** *supply chain, flexibility Knowledge, complexity, Indonesia.*

### INTRODUCTION

It is important for supply chains to have the capability of adjusting according to the changes in the environment and consumer demand. The global complexities have increased with time (Blome *et al.*, 2013; Hanifah *et al.*, 2018; Hassan and Alanazi, 2018). Intense competition increases in consumer demands and expectations and short product life cycles have lead to greater complexities. The demands are put by the customers for better and less priced products. This adds to the need for supply chains to cope up with the latest trends in consumer demands and market changes. Moreover, these factors have emphasized on the need for flexibility in supply chains to deal with the disruptions and complexities of environment (Chan *et al.*, 2017). Another complexity level arises in the management because of the increase in uncertainty and risks linked with the supply chains across the globe. The focus of the current research is on analyzing the supply chain flexibility as a way to deal with the global complexity in the business environments. The focus of the research is on the supply chain capabilities such as transfer of knowledge for creating flexibility.

The ability of a supply chain to respond to changes in environment is referred as Supply chain flexibility. This is often directed towards the speed of making adjustments in the processes of production including stock turnover, life cycle of product, processes and capacities. For the current research, the supply chain flexibility is defined to be integrative (Li *et al.*, 2006). The previous concepts have been used for the development of definition stated above and are linked with the present realities. Uncertainty can be reduced through supply chain flexibility. It ensures the effective flow of products across the supply chain (Lummus *et al.*, 2005).

There are several studies, which are based on narrow concepts of flexibility. Very limited research studies have investigated on the on all sides of supply chain flexibility. The focus of this research study is on the derivation of supply chain flexibility, which is an important element in meeting with the challenges of the environment. This research makes twofold contributions. It has been suggested that a positive influence has been created by internal and external knowledge transfer on supply chain flexibility based on knowledge-based view of the firm (KBV) (Bai and Sarkis, 2018).

The firm's ability of sharing information within the organization is referred as internal knowledge transfer. The ability of a firm to use the external capabilities for products and other activities is regarded as the external knowledge transfer. The concepts of these terms are based on the integrative capabilities' literature. The definitions are consistent with the concepts given by (Hafeez *et al.*, 2018; Hassan and Azmi, 2018; Hassan *et al.*, 2018). This research study explores complexity of products and supply as mediating factors in the relation of supply chain flexibility and activities of knowledge transfer. This mediating role is played from the perspective of contingency in the today's globalized world. It has been assumed that the firm has the ability lying in the supply and product to create an impact on the supply chain flexibility through the use of internal as well as external knowledge transfer. The complexity linked with the product is defined through intricacy; product variety and customization (Yu *et al.*, 2018). However, the complexity linked with the supply is related to the changing market of supply, large number and unreliability of suppliers for conducting business.

It is important from the practical as well as theoretical aspect to resolve these issues. From the perspective of theory, the knowledge-based view of the firm is applied that is a crucial factor. The importance of knowledge has been signified in research studies. However, more research is required regarding the outcomes of supply chain (Schoenherr, 2010). This research study contributes in exploring the outcomes of supply chain. Within the field of operations management, a number of contingencies have been analyzed but there is no specific study available on the mediating impact of supply and product complexity. This aspect has been addressed through this research. Moreover, the analysis is based on supply chain from the methodological perspective. The respondents in the survey were asked to respond from the supply chain viewpoint. It is believed that supply chain has been utilized as a unit of analysis, which explores the flexibility of supply chain from this aspect.

It is important for the supply chain to respond to challenges in today's world in a faster way from practical perspective. Recently, the need for supply chain flexibility was evident by the incident of the tsunami of March 2011 in Japan. The incident results in a number of companies including Ericsson, Sony and Apple along with many other manufacturers of automobiles who were not able to respond to the incident by adjusting their supply chains quickly.

The missed supplies were not compensated by the firms were unable to compensate from Japan. This resulted in huge losses for the companies. With the incorporation of flexibility in supply chains of the companies, the shortfalls could have been avoided in the supply (Craighead *et al.*, 2009). Through knowledge transfer processes, flexibility can be achieved in an effective manner. There is a need to consider the complexities in the supply and products that can hinder the transfer of knowledge activities effectively for achieving supply chain flexibility. These issues are regarded as contingencies. Moreover, these complexities offer an understanding of their influence and advice in managing supply chains for the practitioners.

## **THEORETICAL FRAMEWORK AND LITERATURE REVIEW**

### **Supply chain flexibility**

Firms can remain competitive when they adjust to the needs of consumers. For this, the ability of flexibility enables them to adapt to the changing environment and demands of consumers. In literature, flexibility of supply chain has gained wide acknowledgement. In the 1980s and 1990s, the concepts of operational as well as manufacturing flexibility were of great interest by the researchers (Basheer *et al.*, 2019). Several researchers have given their views in the aspect of supply chain management. The concept of flexibility has become broad with the increase of globalization and trend of outsourcing with regard to the high complexity of the environment. Such issues have resulted in a broader aspect of supply chain flexibility. Some researchers focused on the aspect of suppliers only and some on the information systems within the organization and marketing aspect (Blome and Schoenherr, 2011). Supply chain agility and performance of a firm is positively influenced by the initiatives of Flexibility (Malhotra and Mackelprang, 2012).

The concepts of flexibility and supply chain flexibility are complicated and multi-dimensional respectively. It is difficult to grasp these concepts completely. Research studies have tried to explain the different dimensions of supply chain flexibility particularly from the aspect of manufacturing flexibility. According to (Claycomb *et al.*, 2005), some of the aspects of supply chain management are based on the dimensions such as launch, access, volume, product and the target market. (Malhotra and Mackelprang, 2012) considered the aspects of logistics, manufacturing, development of product and boundary spanning. Some other dimensions such as product development, delivery of product, production and sourcing were included by (Claycomb *et al.*, 2005). One of the key considering research has been done by (Braunscheidel *et al.*, 2010) which is based on review of supply chain flexibility. Although there are various research studies on supply chain flexibility but there is a gap in the literature regarding the agreement on dimensions consisted by the concept. It is agreed by the researchers that supply chain flexibility being an important concept needs to be investigated further. Moreover, a gap exists in the integration of external and internal dimensions improving the supply chain flexibility. The present research study will add to the literature in these missing concepts.

### **Knowledge Transfer**

The basic unit for every organization is Knowledge. It ensures that the firm becomes able to manage the challenges of weather, complexities and develop core competencies for sustaining competitive advantage. Several researchers have worked on the concept of knowledge and its management. A key factor that has gained wide acceptance is the presence of knowledge in explicit or tacit form Learning process is another aspect, which has been analyzed by the researchers along with transfer of knowledge (Fayezi *et al.*, 2017) and its creation. The focus of this research is on the activities related to knowledge transfer. It is defined as the process by which a unit is influenced by the experience of another unit.

There is still lack of integration into the field of supply chain management even the importance of learning and knowledge management has been recognized. A relation has been found between the relationship length and the transfer of knowledge in supplier-buyer relationship. In this way, (Stevenson and Spring, 2007) has made significant contributions. New knowledge can be created by improving the collaboration among the suppliers and customers. It has been demonstrated by (Paulin and Suneson, 2015) that learning and sharing of knowledge is crucial in supply chains. Supply chain performance can be influenced positively by knowledge development. Based on the notion, this research will be extended and knowledge transfer will be explicitly used in the supply chain management's domain. Moreover, collaboration and

integration is achieved through the extended research on knowledge management. Majority of the studies have not worked on this perspective of knowledge transfer. This aspect will be incorporated in the current research.

### Complexity

In research and practice, the issue of supply chain complexity has gained wide acknowledgement (Sarala *et al.*, 2016). The supply chain management becomes risky, challenging and vulnerable with the issue of supply chain complexity. [19] made the earliest contribution on the concept of supply chain complexity. (Bozarth *et al.*, 2009) explored the concept later.

It was demonstrated by the researchers that several factors such as unpredictability, complexity, numerousness are involved in complexity. These can create a negative influence on the delivery performance of products. The basic focus of research was on the benefits linked with low complexity levels. Several sub-dimensions of complexity were introduced by (Craighead *et al.*, 2007) that were classified into internal manufacturing, downstream and upstream. The difference between detail complexity and dynamic complexity was another dimension included by the scholars. This relates to the system uncertainty and distinctive components. Based on these researches, this research focuses on the proposed dimensions i.e. product and supply complexity. Through this, this research can be distinguished from previous research, which either worked on the supply complexity or product complexity. At conceptual level, complexity issue has been addressed by researchers. (Vachon and Klassen, 2002) worked on the concept of supply chain complexity a conceptual level. Tradeoffs between complexity, flexibility and uncertainty were found by (Vachon and Klassen, 2002) in their research through case studies. Researches based on the association between flexibility and complexity is limited. The present research study will be analyzing the gaps identified in literature.

### The knowledge-based view of the firm

According to the knowledge-based view of the firm, it suggested that firms' analysis should be based on the resources of knowledge. The concept of KBV is regarded to be suitable for defining the existence of firms because of the use of knowledge in an effective manner (Gimenez *et al.*, 2012). Knowledge is referred as the information. The ability of a firm to create and share this knowledge can result in competitive advantage through differentiation of services. There is a need for the development of knowledge under this viewpoint. Valuable knowledge is not obtained from every process. Inimitable resources can be provided through creation of knowledge under organized principles. According to (Turner *et al.*, 2018) this information directs towards resource-based view of the firm that can be referred to as the base for Knowledge Based View.

## HYPOTHESIS FORMULATION

### Relation between Supply Chain Flexibility and Knowledge Transfer

The world has been enriched with global complexities these days. It has become essential for the firms to incorporate the environmental and changes in consumer demand in their product development. The structures that incorporate flexibility must be implemented. The implementation of such frameworks and approaches improves the ability of firms to respond towards the changes quickly (Cabrera-Suárez *et al.*, 2018). It is suggested that the hypotheses related to the internal and external knowledge transfer processes affects the flexibility of supply chain. The research studies in the knowledge transfer field are based on the impact on innovation and business performance. There is limited research available on the impact of knowledge transfer on supply chain flexibility. The knowledge transfer was confirmed to be a factor resulting in business innovation and improved performance. This fact has been extended to result in flexibility. For improved business performance and innovation, flexibility serves as base. For innovation and business performance, flexibility can be mediating factor. (Gimenez *et al.*, 2012) confirmed the relation that can result in enhanced business performance through knowledge transfer activities.

(Wang *et al.*, 2018) have argued on the positive influences of internal and external transfer of knowledge. The researchers suggested that the internal and external learning could result in a number of capabilities that can offer great opportunities to the firms in the technological and organization field. Market opportunities are realized. In the internal and external constructs of this research study, the dimensions of internal and external learning given by (Yu *et al.*, 2018) have been incorporated. Different operational performance measures are benefited through internal and external integration. The previous research studies have a mixed view on the impact created on performance measures when the internal and external integration is analyzed in literature. The expected impact of internal and external integration on the flexibility of supply chain is not confirmed particular to the aspect of supply chain flexibility (Paulin and Suneson, 2015). Through offering clarity to the previous research findings, the research will contribute in this regard. The knowledge-based view of the firm provides theoretical support for the positive impact of knowledge transfer on supply chain flexibility. A valuable resource is represented through knowledge that supports in the differentiation of firm with respect to market competition. The knowledge application is based on its transfer effectively. When the knowledge transfer is supported, the performance can be improved greatly. The two mechanisms of knowledge transfer have been deal that is related to the internal and external ability of the firm. High level of supply chain flexibility can be expected through higher proficiency in the transfer of knowledge. A flexible supply chain is resulted when right knowledge is processed through right channel to the right recipient. In the processing of information, these notions are evident in the corresponding theoretical domain. An infrastructure is presented by knowledge transfer process (internal and external) for conversion of knowledge into specific

actions. Based on the arguments of information processing theory and Knowledge based View, the following research hypotheses has been developed:

**H1:** *Supply chain flexibility (SCFL) is in significant relationship with internal knowledge transfer (IKT)*

**H2:** *Supply chain flexibility (SCFL) is in significant relationship with by external knowledge transfer (EKT)*

### **The Role of Complexity as A Moderator**

It has been hypothesized based on the contingency theory that supply and product complexity mediate the impact of knowledge transfer on supply chain flexibility. It has become crucial to investigate such contingencies with the clarity of direct relations among the variables and refined theories. The initiative effectiveness is influenced by the basic principle of contingency theory. The structures of organization should be fit effectively in the given context. (Craighead *et al.*, 2007) worked on this aspect earlier. This created an influence on the operations management and production theory (Braunscheidel and Suresh, 2018). No research has been found, which is based on the mediating role of supply and product complexity irrespective of the fact that there is an increasing need for analysis of such contingencies. This gap in research makes this study valuable from the practical aspect as well as theoretical.

By focusing on the role of product complexity as a mediator, the previous research studies have suggested that it can result in low performance because of the multifariousness of the products. The complexity in manufacturing and product variety has the power to destroy the supply chain performance. This suggests mitigation of the complexity of models. Low performance benefits are achieved when different products are purchased in a bundle as well as product complexity exits. Product complexity creates an influence on the purchasing structure as stated by (Sumelius and Sarala, 2008). It has been identified that greater product complexity results in high level of inventory, low service, less reliability and poor delivery system (Sousa and Voss, 2008). A direct impact of product complexity has been suggested on the performance in previous research studies through the mediating effect. There is simple direct relation. This research study focuses on the mediating and direct effect in line with the contingency theory. A negative moderation is suggested.

The current research is focused on moderating effect of supply complexity on determining the relation between supply chain flexibility and knowledge transfer activities rather than direct relationships involved in previous research. The previous researches have not incorporated this before. It has been suggested that supply complexity negatively moderates the association between knowledge transfer (internal and external) and supply chain flexibility. This association is in line with the contingency theory in line with the direct relationship investigated before.

The inherent supply complexity can become vulnerable by the impact of effective knowledge transfer on supply chain flexibility. From the perspective of cognitive psychology and processing of task, the mediating impact of product and supply complexity can be explained further. Difficult time can come across individuals because of the challenges of the environment in terms of supply and product complexity. This can reduce the impact of knowledge transfer on flexibility of supply chain. Sense making may be hindered due to overwhelmed response by an individual because of transfer of information and knowledge. Effective use of knowledge can be reduced for positive influence on supply chain flexibility. The amount of knowledge processed can be limited through high level of processing. The following research hypotheses have been developed:

**H3:** *Product complexity (PC) moderates the relationship between supply chain flexibility (SCFL) and internal transfer of knowledge (IKT).*

**H4:** *Product complexity (PC) moderates the relationship between supply chain flexibility (SCFL) and external transfer of knowledge (EKT).*

**H5:** *Supply complexity (SC) moderates the relationship between supply chain flexibility (SCFL) and internal transfer of knowledge (IKT).*

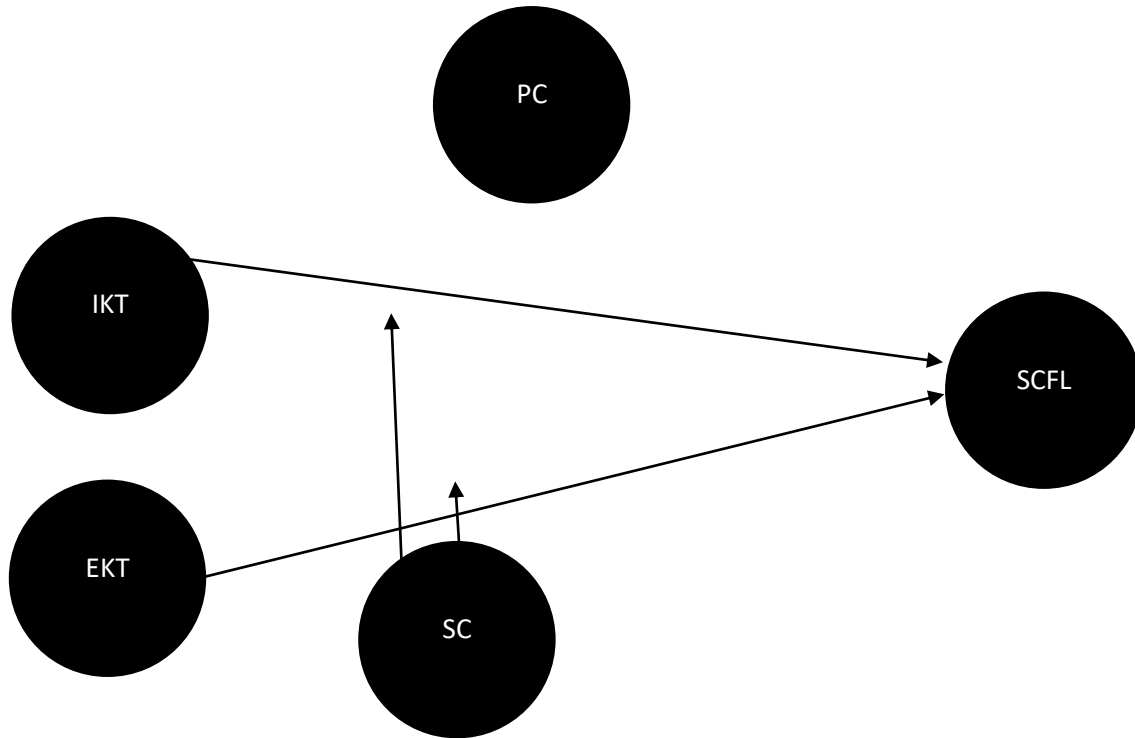
**H6:** *Supply complexity (SC) moderates the relationship between supply chain flexibility (SCFL) and external transfer of knowledge (EKT)*

### **METHODOLOGY**

The current research is based on determining the relation among the identified variables. The research has adopted a quantitative approach with survey for data collection. A detailed examination of the large sample size is involved in the quantitative research approach. Inferences can be made from these responses. Questionnaire survey has been used for collection of data. The relation among the dependent, explanatory and intervening variables is determined through questionnaire. The questionnaire was formulated keeping in consideration the research problem, objectives and hypotheses. Based on the literature review, the questionnaire has been developed. The significant variables affecting the employee performance working the Indonesian manufacturing industry have been assessed. The data collected was put into the SPSS software and analyzed further. For scaling the respondents' responses, Likert scale was used.

**RESEARCH ANALYSIS AND DISCUSSION**

The statistical tool adopted for research analysis is PLS-SEM method. The objectives of research have been analyzed through this technique. This technique is latest, extended version of structural equation modelling, and can estimate multiple models at a time. The association among the direct and intervening variables is reflected through the results of structural model. In contrast to the conventional multiple regression, SEM-PLS technique is better (Hair Jr *et al.*, 2014). The technique has the ability to work on conceptual models that are not known and estimate the current aspects Moreover, the approach can handle different set of equations simultaneously as compared with multiple regressions in which different steps are involved.



**Figure 1: Conceptual framework**

There are two steps involved in PLS-SEM Approach. It is the latest approach than the multiple regression analysis. It includes the assessment of inner and outer models in the research study. In the first phase, the reliability and validity of the variables is estimated. For hypothesis testing, it is important to assess the structural model. A five-step process is involved in the analysis. The first step involves the structural model analysis for collinearity. The second step is related to testing of significance level of the path coefficients. The third step estimates coefficient of determination ( $R_2$ ). The fourth step assesses the effect size ( $f_2$ ). The fifth step relates to the predictive relevance and effect size ( $Q_2$  and  $q_2$ ).

Using composite reliability and measures of Cronbach alpha, the validity and data reliability have been estimated. The acceptance value is 0.70 for both Cronbach’s alpha and composite reliability. For the internal model consistency and convergent validity, the average variance extracted, and factor loadings have been observed. The resultant value is greater than 0.50, which is acceptable. The discriminant validity test is taken for external consistency of the model. It is determined through discriminant validity that variables are not related to each other. In this research, the variables are not inter-linked (Sarstedt *et al.*, 2014). The cross and outer loadings values are similar for this research. The correlation among the constructs is compared in cross-loadings. Table 2 presents the results.

**Table 1. Reliability**

	CR	AVE	Cronbach Alpha
PC	0.925	0.872	0.985
SC	0.702	0.777	0.924
SCFL	0.920	0.821	0.873
IKT	0.812	0.832	0.926
EKT	0.861	0.831	0.923

Hypothesis testing is the final step of data analysis. PLS bootstrapping has been used for hypothesis testing. The t-value must be greater than 1.96 and p-value should be lesser than 0.05 as a standard value. The analysis shows that all the hypotheses have values within the range, which leads to the acceptance of hypotheses

**Table 2. Direct Effect**

	(β)	SD	T-value	P-Values
<b>H1</b>	0.211	0.135	3.211	0.000
<b>H2</b>	0.357	0.152	3.678	0.000

The moderation effect is shown in table 3

**Table 3. Indirect Effect**

	(β)	SD	T-value	P-Values
<b>H3</b>	0.211	0.135	3.211	0.000
<b>H4</b>	0.357	0.152	3.678	0.000
<b>H5</b>	0.453	0.187	3.768	0.000
<b>H6</b>	0.408	0.132	3.968	0.000

The (R<sup>2</sup>) R-squared is another important criterion for assessing the PLS SEM structural model, which is referred to as the coefficient of (Sarstedt *et al.*, 2014) equally, referred to R<sup>2</sup> value to represent in the independent variable the proportion of variation that can be explained by one or more predictor variable (s). Although the research context determined the acceptable level of R<sup>2</sup> value (Hair Jr *et al.*, 2014; Hye and Lau, 2018) recommended a minimum acceptable level of an R-squared value of 0.10. In the meantime, it was suggested by (Closs *et al.*, 2010; Hassan and Kommers, 2018; Horzum and Izci, 2018) that it can be considered when R<sup>2</sup>, value is 0.19 ,0.33 and 0.67, categorized respectively as weak, moderate and substantial in the PLS-SEM table 4 presents the R-squared values of the endogenous latent variable.

**Table 4. Expected Variance**

	R <sup>2</sup>
<b>SCFL</b>	19.0 %

## CONCLUSION

There are several studies, which are based narrow concepts of flexibility. Very limited research studies have investigated on the on all sides of supply chain flexibility. The focus of this research study is on the derivation of supply chain flexibility, which is an important element in meeting with the challenges of environment. This research makes twofold contributions. It has been suggested that a positive influence has been created by internal and external knowledge transfer on supply chain flexibility based on knowledge-based view of the firm (KBV). The current study is interested in exploring the nexus between product complexities, external and internal knowledge and supply chain flexibility of Indonesian manufacturing firms. The study has employed the knowledge-based view to conceptualize the relationship between product complexities, external and internal knowledge and supply chain flexibility of Indonesian manufacturing firms. The complexity of manufacturing flexibility has made this concept difficult to comprehend yet delimit. To date, agreement on how to practice this concept has not yet been resolved. Employing the survey-based methodology, the SEM-PLS technique is used to test the hypothesized relationships. So, the current study has used SEM-PLS as a 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 supply chain risk, supply chain integration and supply chain agility. In author knowledge this is among very few pioneering studies on this issue. This research study contributes in exploring the outcomes of supply chain. Within the field of operations management, a number of contingencies have been analyzed but there is no specific study available on the mediating impact of supply and product complexity. This aspect has been addressed through this research. Moreover, the analysis is based on supply chain from the methodological perspective. The respondents in the survey were asked to respond from the supply chain viewpoint. It is believed that supply chain has been utilized as a unit of analysis, which explores the flexibility of supply chain from this aspect. Flexibility can be achieved in an effective manner. There is a need to consider the complexities in the supply and products that can hinder the transfer of knowledge activities effectively for achieving supply chain flexibility.

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