The Role of Supply Chain Visibility in Enhancing Supply Chain Agility

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The prime objective of this study is to examine the role of supply chain visibility enhancing its agility. For achieving the research objectives, a number of research hypotheses have been developed in this study. It is also considered whether the visibility factor improves agility or not. The research finds that the practices linked with information collection and visibility in the supply chain do not add to the agility of a supply chain. The internal and external capabilities of a firm contribute to the agility. The internal capabilities include planning of operations, forecasting and firm’s sales, while the external capabilities involve the customer response. So, this study has used the 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. This study will be helpful for policymakers and practitioners in understanding the issues related to supply chain risk, supply chain integration and supply chain performance.

Key words: supply chain, visibility, agility.
Introduction

The focus of supply chain management has been shifted over the last two centuries. The emphasis of supply chain actors was on setting clear objectives and increasing collaborations in the 19th century. However, this has shifted to the improvement of relations among the members of the supply chain and a clear understanding of association in the 20th century (Kiliç & Demirkaya, 2016). Similarly, the markets have become highly competitive with the increase in globalization. The competition has grown in the domestic as well as international markets. The performance of Zara has captured the mind because of its capability to incorporate new trends of the fashion industry through agility (Zhelyazkov, 2011). The need for speedy turnover of inventories has increased due to the pressure from retailers, ‘e’ and ‘m’-commerce sectors. It has been tried, by the supply chain members, to reduce costs while maximizing the services quality. Moreover, there is need to alter the product design, characteristics and quality according to the change in consumer taste and behaviour (Brusset, 2016).

It is required for the supply chain managers to add agility in their supply chains to deal with the environment changes and growing competition in the markets (Ngai et al, 2011). In order to increase supply chain agility, technological and consulting companies have started the provision of management and ICT tools (Hohenstein et al, 2015). Through use of improved IT tools and technologies, supply chain agility can be enhanced. In literature, the concept of agility has become a significant concern for the supply chain managers (Dubey et al, 2018).

Different perspectives exist in literature regarding the practices of management to increase the agility through improvements in organizational operational capabilities such as marketing, sharing of information, strategy formulation, operationalization, human resource management, etc. (Liu et al, 2013). This research study has its focus on supply chain practitioners. Supply chain managers are considered the main actors in management and the decision-making processes of a supply chain. Through deploying a number of managerial practices, the organizations can enhance the feature of agility at a high level. The practices involve human resources, systems, routine processes, assets, etc. These processes are required to be combined with the effective flow of goods and information across the supply chain in order to achieve agility.

The current research study is aimed at addressing the following research question:
• **What processes and practices should be implemented by supply chain managers to achieve agility?**

For answering the research question, a number of research hypotheses have been developed in this study. It is also considered whether the visibility factor improves agility or not. The research finds that the practices linked with information collection and visibility in the supply chain do not add to the agility of a supply chain.

The internal and external capabilities of a firm contribute to the agility. The internal capabilities include planning of operations, forecasting and firm’s sales, while the external capabilities involve the customer response. Combining, these factors adds to agility (Kim & Chai, 2017). The effects of two variables have been controlled, which include the economic sector and the size of the firm. With the economic sector, the results may change but these are not statistically significant because of an insufficient sample size. Firm size is not linked with any difference. It directs towards the need for amendments in the previous research works. This will open up new aspects for research in the future.

**Conceptual framework**

It is considerable to identify the techniques, which can be discussed as paradigms of manufacturing while studying the literature on agility in managing supply chains. Researchers have regarded the paradigms as practices including elements of culture, value and philosophy (Wieland & Marcus, 2013). The distinctive qualities of attributes disappear at such level of aggregation. It is not easy to differentiate among the way in which agility becomes an effective management practices and a trait.

In the present scenario, the resource based view is an effective theoretical model. This model is an extended view with the introduction of dynamic capabilities (Kamalahmadi & Parast, 2016). It has been defined as the capability to establish, integrate and reconfigure the competencies for coping with the changes in the external business environment. For explaining difference of performance among the competing firms, the concept of Dynamic Capabilities is being used in studies (Agigi et al, 2016). It has been argued that two capabilities of an organization results in the high performance of the firm. These capabilities include operational capability and dynamic capability (Roh et al, 2014).

The basic difference between operational and dynamic capability has been discussed in literature. According to researchers, operational capability as a way to achieve new resource
conditions according to the change in markets. The dynamic capability is a way of carrying out routine strategic activities to sustain competitive advantage through configuration of resources. According to Tukamuhabwa et al (2015), there is need for research to concentrate on the internal and external factors making the firms able to identify their dynamic capabilities.

The dynamic values are based on context, which needs to be recognized rather than the way towards collective effectiveness (Hafeez et al, 2018). The dynamic values result in effective speed and better response of the organization towards external turbulence in the environment (Chiang et al, 2012). This results in improved business performance. There is need for effective information sharing and use of resources among the supply chain partners in an efficient manner for achieving a competitive advantage (Stank et al, 2015). Alternatively, a firm becomes able to survive in the given conditions through its operational capability. The way in which operational capabilities contribute to the performance of a firm is different from that of dynamic capabilities. Moreover, dynamic capabilities have higher order as compared with operational capabilities (Blome et al, 2013).

The ability of a firm to work on different activities through coordination (planning, logistics, distribution, operations, etc.) is referred as an operational capability. These activities are deeply rooted in information. Through operational capability, researchers claim that high levels of routine activities can be carried out, which can effectively respond to the changes in the market. In this competitive business environment, the need for cost effective and timely delivery of products has been recognized (Sbaouelgi, 2018). In this regard, a critical factor turns out to be supply chain agility, which enables the firm to achieve a competitive advantage. From the perspective of a supply chain of a single firm, operational capability can arise in the internal processes such as information sharing, coordination, integration and controlling suppliers and partners, etc (Zollo & Winter, 2002). A deep understanding of lower order capabilities is required for the establishment of supply chain agility. The business partners must be highly operation in strategic development and operational measures with the supply chain networks to possess effective integration (Seddighi & Yoon 2018).

The activities such as procedures, structures, managerial processes are included in the lower-order capabilities, which support every class of capability. In collective terms, collaboration and coordination is provided among the members of a supply chain that enable the chain to respond effectively towards changes in the market. Supply chain members can work on the operational skills such as processes, procedures and practices in the supply chain considering the concepts of collaboration (Helfat et al, 2009). The interest should be kept in maintain the relation between operational and lower order capabilities. The operational capabilities have
been described in the next two parts as the latent variables, which are secondary. These are developed by the supply chain members to make additions in the dynamic capabilities of the supply chain. Each capability has been characterized in the observable dimension. The lower order capabilities are factors that comprise of the micro foundations.

Agility in supply chains

Through the aspect of theory and empirical research, the concept of agility has been studied. The researchers of the Iacocca Institute firstly introduced the concept of agility. The term was refined by Stank et al (2015). It is considered by scholars that a major role in the firms’ survival is played by the agile strategies with reference to the uncertainties and market volatility. The researcher Chiang et al (2012) has recognized several supply chain characteristics for being agile in real perspective.

These characteristics have been defined as below:

- Sensitivity to the Market – this ability is related to the trends of consumers. The firm must be aware of any changes related to consumer taste and preferences.
- Virtual – this characteristic is based on information sharing across the partners of a supply chain.
- Network-based – this ability of a firm achieves flexibility through employing strengths of key players.
- Integration of Process – this refers to high level of association among the member of a network.

Through these characteristics, companies are able to redevelop products according to the tastes of customers with effective price strategy and timely approach. Several industries have a required ability of agility for survival, such as the garment or fashion industry (Wilden et al, 2013). The fashion industry cannot survive without being agile to the changes in market trends and consumer demands. Another example is of the electronic component industry, which needs technological advancements in product development according to the market changes. Some other examples include Wal-Mart, Dell and Amazon (Rajaguru & Matanda, 2013).

In this research, the observation has been done from the perspective of a supply chain manager. The manager has a good position to organize activities and coordination the resources within and across the organizational network. The manager can make a difference on supply chain agility through a change in the daily activities.
The research framework in this study has been compared with some empirical studies, who worked on agility recently. Agility has been considered by Drnevich & Kriauciuinas (2011) to be an attribute, which exists among the manufacturers of Europe. This refers to the supply chain agility to be linked with dynamic characteristics. This may include several activities, which are not related to a supply chain manager. These may include reducing life cycle time, reduction in lead-time and improving customer satisfaction, etc. A measurement scale has been proposed by Ngai et al (2011) to measure agility. This involves the view of two dimensions from three horizons of time. The two dimensions are response capability and alertness of a firm and these are linked with the operational and strategic management vision. According to Braunscheidel & Suresh (2009), every supply chain member acts as a link between demand and supply.

Organizational practice, industrial flexibility and internal integration have been viewed by Ketchen & Hult (2007) to be the antecedents of agility. The strategic tools adopted by managers in supply chain practices and operational strategies are not involved in the above antecedents. Researchers do not overview the operational capabilities of the lower order that make up the ones required by the approach of dynamic capabilities. Tools have been presented by Basheert et al (2019) which can be used by the firms for internal processes such as controlling or designing activities, assembling automatically, use of internet, etc. However, these cannot be used externally. Most of the presented tools are not linked with the supply chain manager. Generic qualities, which can be applied to the flexibilities or internal processes without defining them at the level of processes and practice, have been defined by Maestrini et al (2017). Competences of a firm on the supply and demand side have been looked at by Arlbjørn & Paulraj (2013). However, this has been done without specifying the lower order capabilities as would have been done by the Dynamic Capabilities approach.

According to Sbaouelgi (2018), supply chains with agility are market oriented due to their ability to synchronise demand with supply. The internal functions of the firm must be integrated along with its suppliers and customers in order to synchronize the activities. This research study has regarded supply chain agility to be an operational capability, which arises from the management of activities along the demand and supply side processes and routines. When a supply chain aims at increasing its position for customer satisfaction, the dynamic capabilities are not provided by agility as it is based on static capabilities. The similar applies when the firm aims at increasing its profits. When this is likely to happen, the biggest manufacturer of computer and information systems (Dell) would have been considered an ideal of agility (Hafeez et al, 2018). After describing the operational capability, the lower order capabilities have been characterized. These are available to the supply chain manager.
However, if these capabilities are employed by the supply chain members, this could have resulted in operational capability.

The lower order capabilities have been defined as a combination of human, technological, physical and organizational resources resulted by the organizational routines. These are implemented within and across the organizations. The processes and routines of practical managers of supply chains have been described by a number of studies. This research study is concentrated on the processes, which are implemented by the supply chain members. Moreover, the processes that are identified as the combination of informational, organizational, relation and based on human origins in the supply chain (Seddighi & Yoon, 2018). The researchers defining these practices have not referred to the Resource Based View. However, the purpose, characteristics and resources for setting the practices clearly mark them to be lower order capabilities as identified earlier. Tangible assets such as servers, computers and networks as well as intangible assets including software along with processes and human resources are involved in Enterprise Resource Planning that is a managerial tool.

In the supply chain, the ERP system is used for exchanging information about delivery, forecasts from one firm to another through the use of specialized software. Operational capability is attained when ERP is combined with other routines and tools. Three groups of practices have been classified, which seem to have an impact on the operational capabilities.

In order to fulfill the needs of customers, partners need to coordinate with the retailers to improve their relation using the tools, such as Collaborative Planning, Forecasting and Replenishment (CPFR) variety (Roh et al, 2014). Other tools include ECR (Efficient Customer Response) and VMI (Vendor Managed Inventory). With the improved level of association among supply chain partners and retailers, inventories are aligned across the supply chain.

Using transport management systems, the flow of goods from warehouse is controlled. From the perspective of retailers, the collaborative routines are originated and implemented with the conceptual framework (Hafeez et al, 2018). The customer satisfaction is improved by combining the supply and demand information through application of ECR by the retailers as well as manufacturers. This is done by fulfilling the demands of customers regarding location, time, price and consumer choice.

The desire to establish qualification for enhancing the processes of the company is included in the CPFR collaborations (Zollo & Winter, 2002). This process of learning results in
flexible and agile supply chain. Based on the facts, the following research hypothesis is proposed by this research:

Hypothesis 1: External Capabilities has significant impact on the supply chain Agility.

The tools of Information Technology improve the integration within the organization through the use of information systems (Rajaguru & Matanda, 2013). Through the use of information systems, supply chain collaboration is enhanced with improvements in inventories, sales and a line-up of products. A real-time exchange of information is offered through the collaborative platform provided. Better control of the supply chain operations is achieved through the tracking of goods. The survey presented by Drnevich & Kriauciunas (2011) has established the IT systems applicable to the supply chain. It is based on the capabilities of tracking such as the use of a computer, barcode, Electronic Data, etc. The use of ERP (enterprise information systems) is integrated with the other management tools of the supply chain.

The antecedents of operational capabilities with high order are visibility capabilities are antecedents including agility. The visibility skills need to be based on boundary spanning technologies and networks that connect buyers and suppliers. Distinct firms are able to work together towards a mutual goal through processes, routines and procedures (Ngai et al, 2011).

**Figure 1.** Conceptual Framework

The information can be improved through use of visibility capabilities of firms. This can creates intellectual capital making firms able to make effective decisions and take suitable actions. It has been argued that the use of collaborative platforms, tracking tools and software for supply chain management, along with ERP, will result in overcoming challenges.
Moreover, it will provide agility for responding to the increased competition and customer demands. The following research hypothesis has been developed:

**Hypothesis 2: Visibility Capabilities has significant impact on the supply chain Agility.**

The responsiveness of a supply chain is improved when customers acknowledge products. The responsiveness of a firm is its capability to respond to the market changes quickly (Ketchen & Hult, 2007). An important link is provided among the response distribution, lean manufacturing operations by the routines and processes regarded as Sales and Operations Planning (S&OP). Nowadays, consumer demands and decisions of large accounts influence supply chains. It has become an essential capability to respond at a faster rate to the changing demands and increased competition in the market.

A crucial role is played by forecasting for the working of a supply chain in lockstep. Customers’ demands are changing in terms of quality, service, pricing, variety, etc. Customer’s demand product reliability and delivery. According to Agigi et al (2016), through improvements in the internal processes of the manufacturing sector, responsiveness can be achieved. This is related to the prediction of future needs and forecasting. The following research hypothesis has been developed based on the above information.

**Hypothesis 3: Internal process capabilities have a significant impact on the supply chain agility.**

**Methodology**

This research study has made use of the quantitative method. Through the quantitative research method, the large sample size can be assessed. Based on the responses, a general conclusion can be made. The behaviour of a large number of respondents has been summarized in this research. The tool for data collection was a questionnaire survey. Using a questionnaire, the responses and opinions of respondents have been quantified. The relation between the dependent and explanatory variables has been identified through the development of the questionnaire. Keeping in consideration the research problem, objectives and hypothesis, the questionnaire for the current research study has been structured specifically. This helps in the estimation of related factors to influence the performance of employees in the manufacturing sector of Indonesia. Based on the previous research studies, the questionnaire was developed. The information collected was entered into SPSS. Afterwards it was analysed through Smart-PLS and IBM. For effective use of variables and
related constructs, the Likert scale was used. In social sciences, multiple relations can be tested simultaneously using this approach. The structure of associations among the variables can be tested as compared with multiple regression equations. In research, the use of the SEM approach enables researcher to assess the linear and additive models from theoretical perspectives. In the SEM approach, the multiple regressions and factor analysis are used collectively.

Results

The issues of supply chain performance, integration and risk management has been examined in this research study. For the analysis of data, SEM-PLS has been employed, which is a modern tool adopted in social sciences. Several researchers, such as Hameed et al. and Hair et al., have preferred the use of the SEM-PLS approach for dealing with the unconventional conceptual models.

The PLS-SEM approach is a modern approach, which has more advance features than multiple regressions. The approach involves the assessment of an inner and outer model. This approach involves a two-step equation. In the first step, the reliability and validity is measured for each construct. After measuring the validity and reliability, the hypotheses developed are tested through a structural model. The issue of co-linearity are checked in the structural model. The significance of the path coefficient, along with the R² coefficient of determination, the Q² effect size and predictive relevance has been determined. SEM-PLS can estimate multiple equations in a simultaneous way as compared with the multiple regressions. This also presents the direct and mediating relationship in the structured model.

At the earlier level of data analysis, the reliability and Cronbach alpha values have been estimated. According to the literature, the value of Cronbach alpha needs to be similar or higher than 0.70 and the value of composite reliability should be 0.70 for acceptance. AVE is estimated for the assessment of convergent validity, internal consistency and factor loadings. It has been suggested by literature that the AVE and factors loading values should be greater than 0.50. For this research, the values for both measures are greater than 0.50. Through the use of discriminant validity, the external consistency has been estimated.
Table 1: Reliability

<table>
<thead>
<tr>
<th></th>
<th>CR</th>
<th>AVE</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCC</td>
<td>0.975</td>
<td>0.872</td>
<td>0.885</td>
</tr>
<tr>
<td>SCINS</td>
<td>0.934</td>
<td>0.843</td>
<td>0.874</td>
</tr>
<tr>
<td>SCV</td>
<td>0.702</td>
<td>0.737</td>
<td>0.924</td>
</tr>
<tr>
<td>SAG</td>
<td>0.960</td>
<td>0.871</td>
<td>0.893</td>
</tr>
<tr>
<td>AD</td>
<td>0.802</td>
<td>0.832</td>
<td>0.916</td>
</tr>
<tr>
<td>AL</td>
<td>0.840</td>
<td>0.873</td>
<td>0.943</td>
</tr>
</tbody>
</table>

The inter relation among the reflective variables and the indicators is measured through discriminant validity. It includes the variables, which are not likely to be related with each other but are related to the research study. Fornell-Larcker introduced the measurement of discriminant validity. The value of discriminant validity has been used as a base value in this research study.

The value of the outer loadings and cross loadings is similar. The relation between the constructs is analysed through cross-loadings. Concluding, the table presents the results of discriminant validity based on the Fornell-Larcker criterion and cross loadings. For hypotheses testing, a bootstrapping test has been used. The t-value is required to be higher than 1.96, which leads to the hypotheses acceptance. The hypotheses test reveals that all the t-values are higher than 1.96, which results in the acceptance of the direct hypotheses (H1, H2, H3, H4, H5, H6).

Table 2: Direct Effect

<table>
<thead>
<tr>
<th>(β)</th>
<th>SD</th>
<th>T-value</th>
<th>P-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>0.211</td>
<td>0.135</td>
<td>3.211</td>
</tr>
<tr>
<td>H2</td>
<td>0.357</td>
<td>0.152</td>
<td>3.678</td>
</tr>
<tr>
<td>H3</td>
<td>0.321</td>
<td>0.178</td>
<td>3.321</td>
</tr>
<tr>
<td>H4</td>
<td>0.342</td>
<td>0.165</td>
<td>3.234</td>
</tr>
<tr>
<td>H5</td>
<td>0.453</td>
<td>0.187</td>
<td>3.768</td>
</tr>
<tr>
<td>H6</td>
<td>0.211</td>
<td>0.135</td>
<td>3.211</td>
</tr>
</tbody>
</table>

The predictive power of the model has been explained by the coefficient of determination (Tachizawa & Wong, 2015). The degree of variation in the dependent variable, explained by the explanatory variables, is determined through the R-square value. The R-square value comes out to 0.441, reflecting the total variation of 44 percent in the dependent variable to be caused by the explanatory variables. The dependent variable is supply chain performance and the explanatory variables are supply chain risk management and supply chain integration.

Table 3: Expected Variance
Conclusion

Different perspectives exist in literature regarding the practices of management to increase the agility through improvements in organizational operational capabilities, such as marketing, sharing of information, strategy formulation, operationalization, human resource management, etc. (Liu et al, 2013). This research study has its focus on supply chain practitioners. Supply chain managers are considered to be the main actors in management and decision-making processes of the supply chain. Through deploying a number of managerial practices, the organizations can enhance the feature of agility at a high level. The practices involve human resources, systems, routine processes, assets, etc. These processes are required to be combined with effective flow of goods and information across the supply chain for achieving agility.

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supply chain, of a single firm, operational capability can arise in the internal processes such as information sharing, coordination, integration and controlling suppliers and partners.

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