IMPLEMENTATION BARRIERS FOR ACHIEVING LEAN SUPPLY – A PERSPECTIVE FROM THE ORIGINAL EQUIPMENT MANUFACTURER IN INDIA

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Abstract: *Shorter product life cycles, increased product variety, reduced lead-times and price competition are the norms of today's business. For a company to be competitive in this scenario, it needs to be more flexible and responsive, while continually lowering costs. Hence organisations are attempting to implement the lean concepts across the entire supply chain, which led to the development of a paradigm called Lean Supply Chain (LSC). Significant research in this field is happening and many case studies have been reported in the literature. However, very few papers discuss the barriers of achieving lean supply, while implementing LSC. Hence, this paper attempts to overcome this gap by presenting a case study of a Multi National Company (MNC) involved in truck production in India, to highlight the implementation of lean supply activities and some associated hurdles faced. A closer analysis of these barriers reveals that some of them are really unique to India.*

Keywords: Competitiveness, Supply Chain Management (SCM), Supply chain flexibility, Lean thinking, Lean Supply Chain (LSC), Original Equipment Manufacturer (OEM), Barriers, Case study.

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1. Introduction

The industrial world is changing rapidly. Frequent technological changes have resulted in shorter product life cycles in many sectors. Furthermore, availability of competing products on a wide scale, and increasing customer expectations, require that a company needs to deliver their product/service within shorter lead times. And as if these pressures weren't enough, price competition remains an intense battleground among the competitors. This combination of shorter product life cycles, increased product variety, reduced lead-times and price competition is the norms of today's business. For a company to be competitive in this scenario, it needs to be more flexible and responsive, while continually lowering costs. Considering such a situation in which the current businesses operate, Christopher and Towill (2001) noted that a key feature of present day business is that it is the supply chains (SCs) that compete and not the companies. Since such a thinking emerged, 'getting the right product, in right quantity and quality, at the right price, at the right time to the right customer' is the requirement for survival for most of the organisations. Hence, to fulfil the above requirement, organisations are attempting to transform their SC by applying the principles and concepts of Lean Thinking (LT), which lead to the development of a paradigm called Lean Supply Chain (LSC). Vitasek et al. (2005) defined LSC as "a set of organisations directly linked by upstream and downstream flows of products, services, information and funds that collaboratively work to reduce cost and waste by efficiently pulling what is needed to meet the needs of individual customers". In a simple term, LSC can be defined as an application of LT principles to SC for integrating the activities of all stakeholders involved in the SC network and provide 'value' to the customers by eliminating wastes (Anand and Kodali, 2008). However, this concept of LSC is not new as it has been envisioned in the year 1994 itself by the proponents of LT in the form of 'the lean enterprise' (Womack and Jones, 1994). The proponents realised that applying lean principles to achieve individual breakthroughs can be linked up and down to the value chain to form a continuous value stream that creates, sells, and serves a family of products, thereby, the performance of the whole can be raised to a dramatically higher level.

LSC can be considered as an amalgamation of different functions such as lean supply (involving supplier identification, development and procurement) + lean logistics + lean distribution + lean retailing. A taxonomy based on these functions was proposed, while reviewing the papers of LSC by one of the authors in his earlier work (Anand and Kodali, 2008). It was found that a significant amount of work has been already carried out in the

field of lean supply when compared to the areas of lean logistics, distribution and retailing. Even in a brief review of literature related to lean supply revealed that very few papers exist in the literature which attempts to discuss the barriers of achieving lean supply while implementing the LSC. In particular, there is no paper available, which enumerates the barriers from the perspective of an Original Equipment Manufacturer (OEM), which attempts to develop suppliers to procure different parts and sub assemblies. Hence, in this paper, an attempt has been made to overcome this gap. The paper is arranged as follows: Section 2 provides a brief literature review, while Section 3 presents an overview of the case study and the reasons for implementing LSC. Section 4 describes the implementation of LSC and describes the various tools and techniques implemented by the case organisation, Section 5 enumerates the barriers faced by the case organisation while implementing the LSC and Section 6 discusses the managerial implications. Finally, Section 7 ends with the conclusions.

2. Literature Review

Vonderembse et al. (2006) observed that the most promising result of an effective LSC management is long-term cost reduction via product or process reengineering by forming closer relationships with key suppliers. Taylor (2006) listed out some of the practices that are related to lean supply which include: establishment of first-tier suppliers (supplier reduction), development of supplier associations, pull systems, reduction in intermediary mechanisms, closer proximity and strategic management. Recently, Daud and Zailani (2011) too identified the practices and performance of LSC among the Malaysian companies. Cudney and Elrod (2010) addressed the effectiveness of specific lean techniques in the supply chain using a survey. They assessed the performance of organisations based on the specific techniques and implementation methods used; strategies utilised for implementing lean into the supply chain and the reasons for success and failure of lean in supply chain.

Many case studies regarding the application of LSC were reported. Fynes and Ainamo (1998) discussed about the impact of organisation learning due to lean supply relationships using the case of Apple Ireland, while Michaels (1999) enumerated the making of lean aerospace supply chain. Akel et al. (2004) described the application of lean concepts on a vertically integrated company. On the other hand, Ariff and Ahmed (2005) used a case study of a medium-sized industry in Malaysia to present the strategies to instil supplier capabilities and the support activities in creating a LSC across multiple tiers of Small- and Medium-sized

Industries (SMIs). They commented that the success of establishing lean supply is dependent on the inter-firm relationship that exists between the customer firm and the supplying firm. According to Handfield and Bechtel (2002), inter-firm relationships are important to the successful management of supply (especially lean supply) and in improving the performance of suppliers. Simpson and Power (2005) argued that developing and maintaining a supply relationship can be achieved through either collaboration or compliance. They quoted other researchers and noted that trust provides a basis for achieving collaboration, while power serves as a mechanism for achieving compliance. Although vertical collaboration is a commonly used practice in supply chain, Bahinipati et al. (2009) enumerated the role of horizontal collaboration among the competing suppliers in semi-conductor industry. Thus it can be found the success of LSC is very much dependent on the development of suppliers. Krause et al. (2000) noted that supplier development requires that the firms involved commit financial, capital and personnel resources to the development task and to share timely and sensitive information. They highlighted that many firms have increasingly used supplier development strategies to improve their manufacturing.

Although many researchers have attempted to analyse the level of implementation of LSC apart from addressing different strategies and ways to establish a lean supply, very few papers exist in the literature that throws some light on:

- Strategies of OEM in implementing lean supply
- Different hurdles that can be faced by organisations which might prevent them achieving a lean supply.

In this paper, an attempt has been made to address these issues by presenting a case study of an OEM in the automotive sector, which is starting its operation in India. One of the authors had a chance to work with the case organisation as part of his summer internship. He was involved in the project of deploying the concepts and principles of lean supply. Naturally, this provided him with adequate opportunity to interact personally with the different managers of the case organisation apart from collecting necessary data. A brief summary of the same is presented in the next section.

3. An overview of the case organisation

XYZ Limited (XYZL), a Multi-National Company (MNC), which is eyeing a potential opportunity in commercial vehicle segment in India is all set to launch its own products in India and hence has set up its manufacturing plant in southern part of India. It has operations all around the world and is one of the top players in global truck market. It is planning to launch products in the entire spectrum of truck market comprising of Light Duty Trucks (LDT), Medium Duty Trucks (MDT) and Heavy Duty Trucks (HDT) by late 2012 or early 2013 and has a vision of capturing 78% of the market share by 2021. This is only possible if it can compete with the local giants such as Ashok Leyland, TATA, Eicher, etc. in the Indian truck market. Hence the top management of the XYZL is planning to make all the parts locally adhering to the cheap labour force in India to reduce the cost considerably apart from having better control over the suppliers when compared to procuring/importing the same from abroad. A quick analysis of the upstream supply chain of the OEM revealed that most of the proprietary parts and components such as engine, transmission system are imported as Completely-Knocked-Down (CKD) units from the parent country. However, around 290 local suppliers are currently supplying different parts to the OEM. Most of the suppliers are in the Northern part of India, while the OEM is attempting to develop suppliers locally within the Southern region too. Around 6% of the suppliers are located in different countries such as Germany, Korea, etc. Although significant suppliers are supplying parts to the case organisation, various issues and problems were observed, which are described in detail in the next section. Hence, the managers were interested in re-structuring their supply chain by implementing LSC.

3.1. Drivers for implementing lean supply

An informal interaction with managers of the case organisation by one of the authors revealed the various reasons for implementing lean supply. They include:

- **Nature of the product:** The truck market is a high cost market which requires heavy investment from the customers. Being an emerging player in the Indian truck market, the demand is very uncertain. Furthermore, the demand is not so high in the truck sector as in other sectors of automobiles such as motorcycles, cars, etc. as trucks are not purchased by regular people, but mostly by industrial/business customers. Hence, to increase and ensure a stable demand, the firm is planning to launch trucks in different segments such as LDT, MDT and HDT with each segment having at least 2-3 variants. Naturally, many suppliers are required to be developed to supply high

quality components. To develop such suppliers and establish close relationship and minimize lead time, the managers felt that lean supply would be an ideal strategy.

- **Type of order:** Due to high cost associated with the truck market, most of the models are sold as per order and manufacturers tend to have a build to order system. This requires a pull or a hybrid push-pull system implementation by the manufacturer, which can reduce the lead time. To accomplish the same, the lean strategies should be implemented not only in the manufacturing side, but also on the supply side.
- **Quality:** The firm is well renowned for its quality – especially in the international market. Although the prices for their international products are at higher end, the stringent quality and unique features in their products enabled the case organisation to achieve significant market share globally. With its emergence in the Indian market, it aspires to maintain the same quality standards. This requires the support of suppliers in delivering good quality raw materials, which the managers of XYZL believed that it can be achieved through LSC.
- **Cost:** As the Indian truck market is dominated by concept of low initial cost, the firm needs to have a pricing level comparable to the products offered by already established competitors. This requires reduction of different wastes and build to order strategies. The managers believed that eliminating such supply chain wastes would help them become competitive. For instance, Baum (2004) too commented that around $250 to $400 billion are wasted annually in North American industries alone due to the inefficiencies in SC. They estimated that this amount would be as big as $1 trillion worldwide.

3.2. Wastes in the supply chain of the OEM

Generally, in an automobile sector, it is a common phenomenon to have multiple tiers of suppliers - which can be as high as six to seven tiers. XYZL is not an exception in this regard. For instance, it was found that each first-tier supplier had 3-4 tiers of supplier on an average from the end product to raw material stage. As mentioned earlier, the case organisation currently has around 290 suppliers and if the tier-2 and tier-3 suppliers of these first-tier suppliers are considered, then the total number of suppliers for the production of different parts and components would be more than 1000. Having a lot of tiers in the supply chain would result in significant amount of wastes, which are briefly discussed below:

- **Motion wastes:** Sub-suppliers in India lack infrastructure as well as quality. Generally, they are family-run business with low compensation paid to the associates, who are predominantly illiterates and semi/poor skilled. This restricts such companies from having state-of-the-art machines and other facilities. Hence, tier 2 suppliers need tier 3 and tier 4 suppliers to carry out specialized tasks such as laser tool cutting, CNC machining etc. However, most of these low-rung suppliers are located nearby – typically in an industrial cluster or Special Economic Zone (SEZ). This leads to frequent movement of parts, components and sub assemblies between them resulting in motion wastes. This increases the lead time of the process significantly along with costs associated with transportation. Although, this can be considered as transportation waste, considering the small distance within the supply chain, they are classified as motion wastes.
- **Waiting:** Another problem mentioned by the supply chain manager was that the capacity of such tier 2 and tier 3 suppliers are very small. A single facility of the external supplier has around 2-3 laser cutting tool. But, there are many other industrial customers, who also outsource similar jobs to this external supplier. This creates a higher demand for this external supplier and thereby a huge waiting time is incurred for processing, which aggregately increase the lead time and the cost by many folds.
- **Transportation waste:** As mentioned earlier, XYZL is planning to produce its components and sub assembles locally. A cursory analysis of their suppliers revealed that 40% of them are located in southern parts of India, 50% in northern parts and rest are from Japan and Korea. Thus it is found that majority of the parts are obtained from suppliers from northern part of India and naturally, it results in significant transportation waste. A sample cost calculation to quantify the transportation waste is presented by considering the movement of a particular part from one of the city in northern India to the manufacturing plant. Table 1 depicts the cost calculation for moving a part to move from Ludhiana – a city in the North Western part of India to the manufacturing plant located in the Southern part of India. This cost calculation excludes the transit cost, road tax, driver salary, etc. This majorly concerns the fuel charges.

Table 1: Cost calculation for transporting components from Ludhiana to southern part of India

Ludhiana to Manufacturing Plant (Approx)	2433 Kms
Number of state borders to be crossed	7
Truck mileage (on average)	5 Kms/Litre
Total diesel used	487 Litres
Average Price of Diesel per litre	Rs 43.70
Approximate fuel cost for one way travel (excluding road tax, driver pay, daily allowances for the driver, etc.)	**Rs 21300**
Total fuel cost for entire transportation (i.e., both ways)	**Rs. 42600**
States	**Diesel prices in Rs.***
Delhi	40.91
Haryana	41.85
UP	43.25
MP	45.55
Maharashtra	45.28
Andhra Pradesh	45.08
Tamil Nadu	43.95
Average Fuel Price	**43.70**
*varies due to difference in taxes and levies between states	

The above cost is just for one trip with the assumption that only one lot of the part is supplied by a particular supplier. If different parts are supplied by the same supplier then the fuel cost can reduce slightly. However, if different parts are to be supplied by different vendors from this region or from other region, one can estimate the amount of transportation waste that will be incurred. To reduce this waste, the managers of the case organisation attempts to order as much as possible during a single trip and thereby leading to the inventory build up.

- **Wastes due to defects:** XYZL is putting a lot of stress on developing suppliers. Hence most of the first tier suppliers it has selected are either ISO or TS certified suppliers. By working together and by sharing the investment to develop resources at the supplier end, they were trying to get good quality output from the first tier supplier. But the same cannot be said about the whole supply chain as many of the lower-rung suppliers are not ISO or TS certified. Generally, it involves a huge cost for obtaining such quality system certifications and these tier 2 and 3 suppliers are hesitant to obtain the same due to their size, management style, knowledge, etc.

Naturally, even the first-tier suppliers developed by the OEM are unable to supply good quality parts.

- **Inventory Waste:** Due to all the above wastes described above, the level of inventory held at the OEM is very high. Furthermore, having multi-tier suppliers would lead to bullwhip effect due to information distortion, thereby creating huge inventory built up at different stages of supply chain.

Since the manufacturing operation has not yet commenced fully, the firm is not experiencing any waste due to oversupply and over processing currently. But as the manufacturing unit becomes functional these two wastes need to be taken care of.

4. Implementation of LSC

As seen from above discussion, it is clear that if XYZL has to be competitive, it needs to be flexible (in terms of product variety) and responsive by eliminating these supply chain wastes. Naturally, it is evident that implementing LSC is the most appropriate strategy for the case organisation. As LSC emphasizes on cost reduction, waste reduction, quality management and effective handling of variants, the top management of the case organisation envisages that implementation of LSC would be a key differentiating factor and make them highly competitive in the market. Since, it is a green field project, the plant is still under development and the production is yet to be ramped up. Hence, the managers are concentrating on establishing LSC on the supplier side initially, which would be expanded towards the downstream activities in the future once the production as well as the business is stabilized. Furthermore, they concluded that it is easier to bring in such paradigm shift during the start of the project, as it would enable them to have a control over such new and existing suppliers and thereby make them fall in line with their goals. Although many organisations in India have implemented the concepts of lean in manufacturing, the percolation of lean concepts within the supply chain is still in nascent stage among the Indian organisations (Anand and Kodali, 2008). The managers in the case organisation too have attempted to implement few elements of LSC. However, the OEM faced a lot of challenges and hurdles during the initial implementation itself, which are highlighted in the subsequent sections.

Tools and techniques used by the OEM to achieve lean supply

Since significant amount of wastes in the supply chain are incurred by the case organisation, the managers in the OEM attempted to reduce some of the wastes by implementing some of the elements of LSC:

- **Sole sourcing:** Since 290 suppliers are currently available for supplying different parts, it is becoming increasing difficult to manage, develop and communicate with these suppliers. Furthermore, it also results in significant wastes. Hence, the company is trying to implement the concept of sole sourcing, by which they are trying to reduce the number of suppliers. As the first step, they eliminated few redundant and poor quality suppliers in the supply chain and attempted to develop suppliers within a small geographical location to have a better control over them.
- **Establishing supplier relationships:** To implement sole supply, it is necessary to build relationship to ensure long term commitment from the suppliers. XYZL is sharing different process mapping with the first-tier supplier and has developed Key Performance Indicators (KPIs) and quality gates after adequate discussions with them. The purchasing managers are also involved in motivating the first-tier suppliers to share the process maps with their lower rung suppliers.
- **Supplier involvement in design:** The purchasing managers of the OEM have ensured that most of the first-tier suppliers are involved in the design activities. Although the designs for different models of the trucks are obtained from the parent country, the first-tier suppliers are involved in designing and developing the process, tools, fixtures, etc. apart from customising the part/component design to meet the Indian conditions.
- **Hub and spoke arrangement:** The OEM is also attempting to implement hub and spoke model for those suppliers located at a distance from the manufacturing plant. Plan is underway to create a hub in the form of a supply warehouse at Delhi, as most of the suppliers are located in the National Capital Region (NCR) of India. In addition to the other modes of transport such as rail and air, they are currently focusing on employing road transportation by trucks as the most common mode of transport. The reason being that the road infrastructure in India is being strengthened by developing express highways such as Golden Quadrilateral, which connects all the 4 metros (Chennai, Mumbai, Delhi and Calcutta). Secondly, it will certainly reduce the transportation cost apart from the lead time when compared to other modes.

- **Milk run system:** For local suppliers (located in southern/northern parts of India), XYZL is planning to implement milk run system which will enable the trucks to be loaded fully.
- **Standard containers:** Though the firm has standardized many of the assemblies, the firm is yet to standardize the packaging system in Indian subsidiary. Packaging and its design is currently left with the suppliers and hence maintenance of a standard packaging system across the supply chain is missing. A standardized packaging system will help the firm to reduce the unnecessary packaging costs apart from enabling them to implement Point Of Use Storage (POUS) in the manufacturing.
- **POUS:** The firm is planning to have a POUS, where the parts from the supplier are directly sent and stored in the shop floor at the point, where it will be used without any inspection. However, the purchasing executives are treading a cautious approach based on their confidence in the supplier development process and the suppliers. The inspection of the parts and the quality are in the hands of few first tier suppliers. Thus, the inspection of the parts at the internal level of the firm is minimized and hence reduces the cost significantly. However, they have established periodic reviews of the parts with a gap of 6 months. They are also making these few first tier suppliers to develop their sub-suppliers to establish such system to reduce the cost across supply chain.
- **Supplier assessment and evaluation:** The OEM developed a list of critical components based on the concept of ABC analysis and thereby identified the critical suppliers. The critical component assessment was done internally, whereas the critical supplier assessment was done by on site visit. Currently, the on-site assessment and supplier risk assessment were mostly done for the first-tier suppliers only, while the managers of XYZL are planning to expand the same to tier 2 and 3 suppliers also.
- **Vendor managed inventory:** The case organisation has attempted to implement the concept of Vendor Managed Inventory (VMI) with few of its first-tier suppliers. In this case, the OEM has requested their supplier to have a resident engineer in the production plant to monitor the inventory level and also to order different components as and when necessary. They have included this condition as part of their contract, while attempting to establish a long term relationship between these suppliers. As part of this concept, the supplier shares a substantial part of its proprietary information on costs and production. According to Womack et al. (1990), the concept of VMI goes

beyond just managing the inventory level, but focuses on working together over every detail of the supplier's production process - to cut costs and improve quality.

Since, the case organisation is in the process of establishing a full-fledged manufacturing system from the scratch; the supply chain is also not yet developed fully. Hence, all the elements of lean supply are not implemented. For instance, elements such as kanban, pull system, information sharing through Information Technology (IT) systems, etc. are not yet implemented. However, these practices and procedures will be implemented once the OEM is fully operational.

5. Barriers in achieving lean supply

Although the case organisation was successful in initiating a change towards lean supply by implementing various elements, significant hurdles were faced during the course of implementation. A relationship diagram was constructed to understand the barriers that prevent the OEM from lean supply. This was carried out by one of the authors' who solicited information from a team of purchasing and logistics managers by allowing them to discuss freely on the barriers/hurdles faced by them in implementing lean supply elements. Clear instructions were given to the participants that no discussion should happen among them and none of the ideas should be criticised or discarded. Once the different barriers were identified, a relationship diagram was constructed as shown in Figure 1. Brief explanations about the different barriers faced by the OEM are listed below:

- **Non availability of high quality suppliers:** A major issue with the OEM has been that it has not been able to find quality suppliers. The reason being that the existing high quality suppliers in the Indian automobile industry are already committed to other Indian automobile giants such as Tata, Ashok Leyland, etc. Due to contractual agreements with these auto giants, these suppliers are not able to supply to the new entrants, even though they have adequate capability and capacity. This has led the OEM to develop supplier on its own by considering those sub-optimal and new suppliers, who are not well-developed with respect to their tier-2 and 3 suppliers.

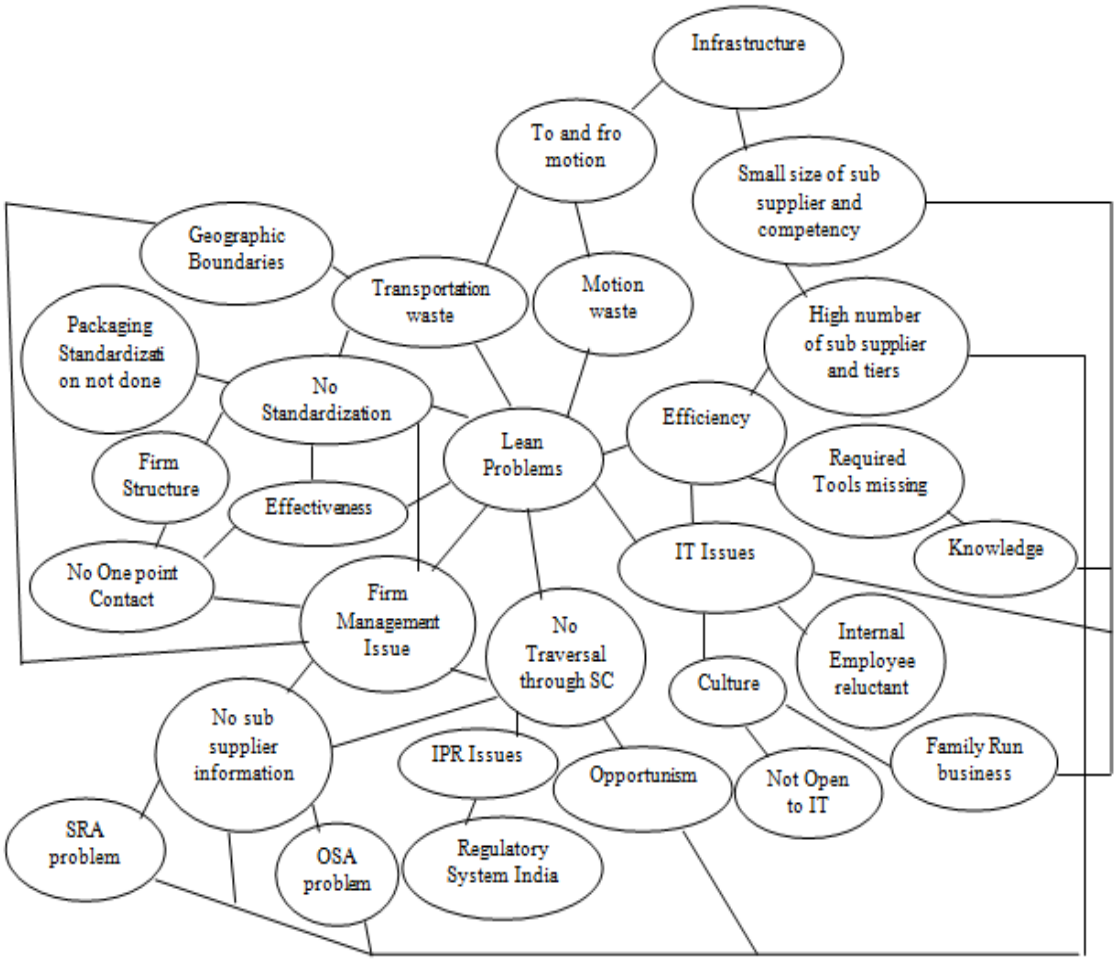

Figure 1: Relationship diagram depicting the hurdles and barriers of implementing lean supply for the OEM

- **Issue of Intellectual Property**: Most of the automotive and auto-component companies are very particular about the Intellectual Property Rights (IPR) as a result of cut-throat competition in the market. Many of the suppliers have proprietary parts whose design is individually created by them. The production of such parts and the development of sub- and sub-sub-suppliers are also the responsibility of the suppliers. Hence, for this kind of products, the suppliers are reluctant to share the sub-supplier information with the OEM, and this result in lack of information flow and mismanagement of the suppliers. The reluctance behaviour of the supplier is justified due to the poor implementation and security of proprietary rights in India.
- **Governmental regulations:** One of the unique barriers in implementing LSC among companies in India is that the country is differentiated by state boundaries which have

implemented their own transit taxes and checkpoints. Generally, the LSC requires a logistics system which is not highly variable in nature with respect to time otherwise it may eventually result in inventory build up. However, such an irregular transit barriers at different boundaries of state makes it difficult to speculate the time and involves unusual cost in supervision and tracking.

- **Lack of IT systems**: The success of a supply chain is highly dependent on the implementation of IT Systems to ensure a smooth flow of information across the whole supply chain. Although, it is available with the first-tier suppliers, the implementation across the whole supply chain is currently lacking. Currently, the usage of IT such as Virtual Private Network (VPN), Intranet has been deployed with most of the first-tier suppliers. But the problem starts with the lower rung suppliers, as the size of the companies are small and implementation of IT system requires extra cost and change in the way of working. Thus, many small sub-suppliers become reluctant to implement the IT system within their organisation itself. This disrupts the effort of the OEM to have a sound and continuous information flow system.
- **Resistance to change**: Currently, the records are maintained in paper format in registers which makes it quite difficult to track each of the consignment. The communication between these suppliers is through phone/fax with manual data recording. Most of the sub-suppliers are not ready to accept the change proposed by their first-tier suppliers – especially with respect to the implementation of IT to smoothen and streamline the information storing and sharing process. Since, they are habituated to this "age-old system", many of the lower rung suppliers are finding it difficult to change. Second, the size, type of management and quality of human resources too contribute to this resistance to change.
- **Size and type of businesses:** A majority of the second- and third-tier suppliers are family run businesses headed by one person. Hence all the strategic and critical decisions are taken by this person who in many cases may not even have a formal degree or management education. This leads to reluctance in implementing IT or even share information with their customers. Furthermore, the cost involved in deploying the IT systems and the subsequent expenses in hiring a tech-savvy person to operate and maintain the same are to be borne by them, which makes these small businesses to shy away from these practices.

- **Human resources in the suppliers:** The major problem in the implementation of IT solution is the reluctant behaviour of the current employees with the suppliers. Most of the employees and managers in the tier 2 and tier 3 suppliers do not have adequate knowledge and qualification to work with the IT systems. Hence, employees are used to work in a traditional manner involving pen and paper. Furthermore, a casual talk with such employees revealed that they are of the belief that "implementing of IT may rob off their job". Such a belief becomes a major barrier in not only using the IT but also affects the successful implementation of LSC.
- **Varied exposure of suppliers:** The implementation of lean elements such as sole sourcing, VMI and other tools are mostly limited with the first-tier suppliers. This hinders the implementation of lean concept across the supply chain. As different tiers of the supply chain are working with different ideologies and concepts, the procurement executives of the OEM are finding it hard to organize and standardize processes across the supply chain. Many of the sub-and sub-sub-suppliers do not even follow basic practices such as Statistical Process Control (SPC), calibration of equipments, housekeeping (5S), etc. due to their lack of knowledge. This leads to increase in the transaction costs and decrease in the overall efficiency of the supply chain.

6. Managerial implications

Figure 1 provided a pictorial view of the causes or the hurdles in implementing lean supply apart from listing out the reasons behind such causes. It is evident that the major causes/barriers to LSC is due to the various hurdles such as non-implementation of IT, poor sharing of information, etc. These hurdles are predominantly caused by other hurdles such as small size, qualification, skill level of work force, culture within these organisations, which are naturally the direct outcomes of the businesses being family run. However any change in this would be gradual in nature, which can be brought about through continuous efforts of the OEM. Furthermore, there are many other issues such as geographical distance, regulatory systems, etc. which were beyond the control of the OEM.

However, to overcome these hurdles to some extent, the OEM must invest heavily in development of these small tier 2 and 3 suppliers to make them achieve economies of scale and provide them knowledge about 'good manufacturing and supply chain practices' through

effective training, which can help in successful implementation of LSC. The OEM should also share the investment in implementing IT system across the whole supply chain and develop trust to negate the effect of opportunistic behaviour in the supply chain. However, before they embark on this huge investment, the purchasing and logistics executives should also invest in standardizing different process across the supply chain apart from reducing the number of suppliers by successful development and assessment of supplier and sub suppliers.

7. Conclusions

The paper started with the claim that although significant case studies demonstrating the implementation of lean supply to achieve a LSC are available in the literature, very few of them have highlighted the barriers in implementing LSC. None of the papers have highlighted the barriers in the upstream activities of the supply chain while implementing LSC especially from the perspective of an OEM in the automotive sector, which is setting up a green field plant in a new market. This paper attempted to resolve these issues by presenting a case study of a truck manufacturer in India, which attempted to implement LSC to remain competitive by being flexible and responsive. Detailed description about the reasons for implementing lean supply, the wastes that are happening in the supply chain, different tools and techniques of lean supply apart from the barriers and hurdles faced by the OEM was enumerated. It was found that one of the significant barriers was the non-availability of good quality suppliers at second- and third- tier of the supply chain. In addition, it was found that the size, business type, work culture, lack of knowledge and the capability of existing suppliers in second- and third-tier of the supply chain are also contributing to significant supply chain wastes. Apart from this, the geographical boundaries and the Government and regulatory issues that are beyond the control of XYZL and unique to India also act as certain barriers from achieving lean supply. However, considering the level of implementation happening at XYZL, it can be concluded that the case organisation is in the right track to achieve the objective of lean supply. Furthermore, it is believed that this paper would help the practitioners in attacking these barriers or at least give adequate consideration during the implementation of lean supply. It can also be inferred that if the Indian manufacturing sector need to become a manufacturing hub as envisaged by the policy makers, it is necessary to develop the Small- and Medium-sized Enterprises (SMEs), which can happen only with the support of both the Government and the OEMs investing in India.

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