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An Analysis of Inventory Attributes in Leagile Supply Chain: Cause and Effect Analysis

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Abstract
In the recent era, managing a supply chain efficiency is the necessity of any business due to shorter product life cycle and market penetration order uncertainty. With the increased competition globally, organizations need to be more efficient and responsive. This situation drives attention to the concept of Leagile Supply Chain (LASC). Therefore, more attention to Lean and agile inventory attributes are advocated as the foundation to sustain competitive LASC. Trade–off between the lean and agile supply chain inventory attributes and interrelationship. Upstream lean practise based on push system and downstream agile practices based on pull system. In this paper, the cause and effect analysis is to measure the influence of integrated LASC inventory attributes on the Supply Chain Performance (SCP). From the managerial viewpoint, cause and effect diagram provides the proactive understanding to positive and negative inventory attributes affects SCP.

Keywords- Lean, Agile, Leagile Supply Chain (LASC), Supply Chain Performance (SCP).

1. Introduction

The recent decade of globalization, organizations are more intended becoming aware of gaining the strategic reputation by use of holistic perspective approach on competitiveness ingredient to maintain position sustainability in the respective field (Sangari et al., 2015). In the presence of philosophy, commodities ought to be produced and distributed of the total cost of the system-wide (Routroy and Kodali, 2005). Tannous and Yoon (2018) reveal that the quality of global supply chain management (GSCM) hinders various areas of vertical and horizontal operations from start to end of the chain. This help to create synergy among SC stakeholders and the environmental affords social, environment and economical sustainability.

Various definitions of lean can be found from literature, but the principle remains the same i.e. waste elimination and cost minimization. Wu and Wee (2009) reported that how the lean production is combined with the ‘zero inventory’ and ‘just in time’ (JIT) approach. According to Competitive Strategy (CS), Lean Supply Chain (LSC) is suggested when cost is the priority while Agile Supply Chain (ASC) is suggested when speed is the priority (Mason-Jones and Towill, 1999). The lean concept is preferred, when the demand is stable, predictable and has less variety

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of products while agile supply chain is preferred when the demand is volatile with high variety of products (Agarwal et al., 2007). There is a requirement to adopt a hybrid strategy (Christopher and Towill, 2000). According to Table A1 of Annexure-A), the migratory model and early 1980s the market winner was quality and was attained within the lean internal process scenario (Womack et al., 1990).

In a recent example, Dell has the customised LASC. Furthermore, restructuring the supply chain front end, Dell suppliers exactly decide what the individual customer selects. The lead time is maximum seven days for pulling off the essential for sub-assemblies, after finalising the PC, and additional packing and distribution to the retail customer. Agility is a key source of business capability that incorporates organization structure, information system, logistic processes and existing mind-sets (Katayama and Bennett, 1999; Power et al., 2001).

With the increased competition globally, organizations need to be more efficient and responsive. This situation drives attention to the idea of Leagile Supply Chain (LASC). The LASC enables the upstream part and downstream parts are consequently cost-effective and higher service level in the volatile marketplace. The grey theory implementation for modelling preference criteria for decision makers of two dimensions that involves flexibility and sensitivity of the market.

1.1 Objectives of the Work

- To examines the trade –off between lean and agile inventory attributes and interrelations.
- To build the connection between lean and agile supply chain attributes (SCAs)

Section 2 discusses the related literature review. Section 3 covers the trade-off between lean and agile supply chain inventory attributes and inter-relationship. Section 4 provides combined lean and agile inventory attributes practices vs. supply chain attributes. Finally, concluding remarks are given with the scope of future research.

2. Literature Review

Khalili and Alinezhad (2018) reveal that investigate green supply chain efficiency by using DEA (Data Envelopment Analysis) which is based on MPI (Maximum Productivity Index) according to input/output indicators of balanced Scorecard model and accordingly providing some rules using the decision tree. The result indicates that the proposed model had a higher degree of accuracy and interpretations in evaluating performance compared models and help managers to the better decision of automotive parts manufacturing firms. According to Qamar et al. (2018) explored that the modern manufacturing industries are endurance of transit phase in their SC strategy. The study focuses on lean, agile and leagile in the Supply Chain Strategy (SCS). The success of supply of an organization in the competitive market demands on the management and improve the SC. The performance metric of case SC has been modelled and dominant SC paradigms have been evaluated. Using the ANP and conceptual model for LASC metrics was developed and SC performance weight index score leagile has been achieved in SCS. Recent environment intense cutting edge of market competitions and sophisticated IT business tools more necessity for the organization to match specific individual customers by appropriate strive SC strategy (Weinstein, 2018).

Pavlis et al. (2018) developed a relationship b/w dimension of supply management performance and the components of the cash conversion cycle. The model proposed and hypotheses were tested using data from SMEs operating in Greece. The results will be helpful in better

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understanding the impact of supply management practices and the performance of supply management by analyzing the balance sheets and profits-loss statements.

Pakdil and Leonard (2014) explained the managing concept based on lean principle enables organization to the obtained higher level of efficiency, competitiveness based on lower cost criteria, with the more frequent level of productivity, faster speed of delivery, minimum stock levels and optimum quality. Leanness should be developed in phase in an organization develop environment be innovative and proper supportive. It should be achieve the goal of management commitment (Wyton and Payne, 2014).

According to Vinodh and Aravindraj (2013) reveals that continuous changing business environment, manufacturing firm's challenges to survive by existing to dynamic demand of modern customer desired. According to lean and agile principle has based on zero inventory and safety inventory required for volatile market conditions. The performance evaluations of the lean and agile concept as well as leagility SCs using fuzzy logic approaches.

3. The Trade-off between Lean and Agile Supply Chain inventory Attributes and Inter-Relationship

While implementation of lean and agile practices, the balance between these two must be ensured and also it should consider the SC strategy as defined. Understanding the relationship between supply chain characteristics and key performance is very important. The illustrated Table A2 (Annexure- A) clearly the relation among the lean inventory attributes and the SC performance.

The trade-off between lean –agile SCM paradigms must be compulsory to decide surplus or strategic stocking point for most of the companies as well as more sustainable and efficient supply chain. According to Azevedo and Machado (2009); Azevedo et al. (2010); Carvalho et al. (2010), the management of lean and agile practices have a good and bad impact on other. Figure 1 shows a clear view of trade off b/w lean and agile supply chain inventory attributes.

The principle difference between inventory attributes is the purpose: the lean supply chain seeks to waste minimization; the agile supply chain is covered on quick responding to Market changes". To evaluate the contribution of lean and agile inventory attributes impact on the SCP, there is a need to develop a relationship among the SC characteristics changed by the lean and agile attributes and the relation with performance indicators. For a better understanding of these relationships, the cause-effect diagram was developed.

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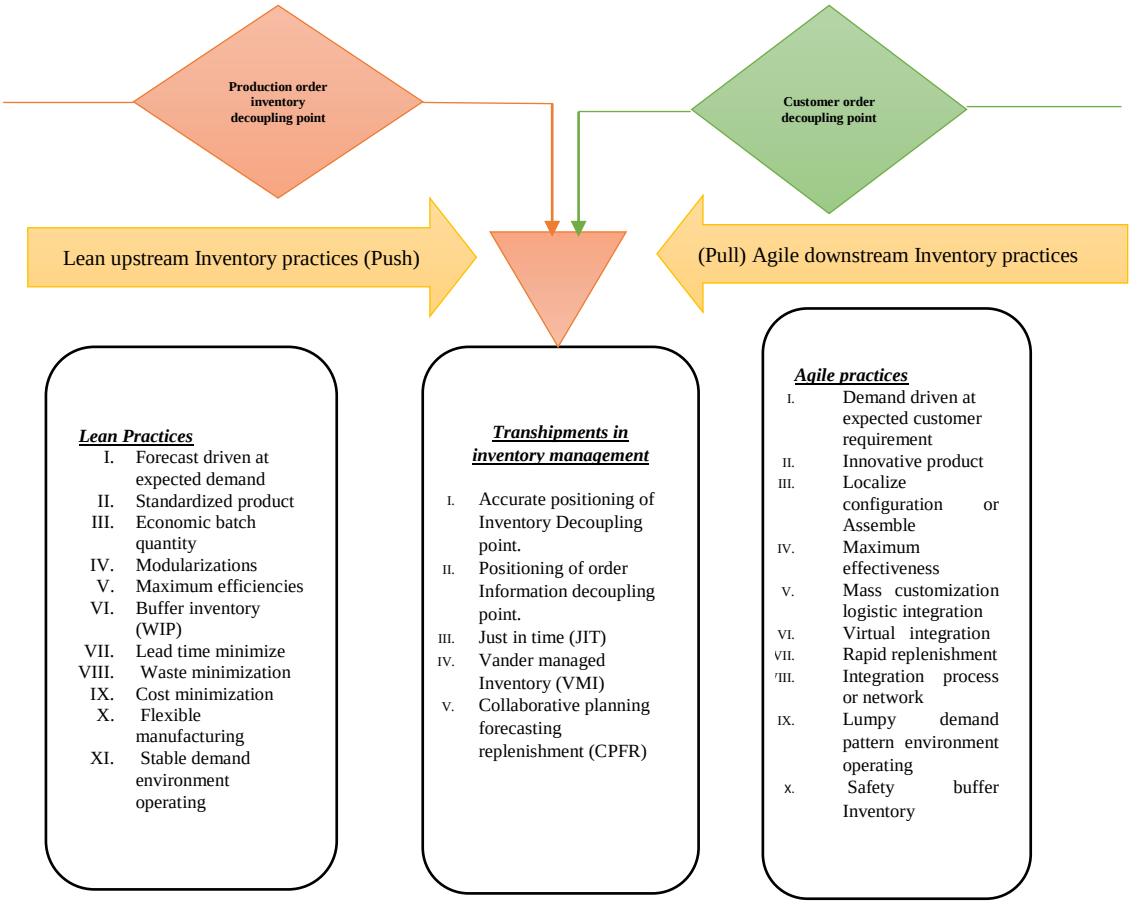

Figure 1. Trade off b/w lean and agile supply chain in inventory attributes

3.1 Lean Inventory Attributes vs Supply Chain Attributes

The linkage between lean inventory attributes and SCP have depicted in Figure 2.

The relation between the lean inventories attributes and supply chain performance will result in better understanding, with the following interpretations.

- **Inventory level Minimization**: The performance of supply chain affected by negatively in inventory level minimization. Higher inventory level minimization stimulates a lower inventory level.
- **Convention alliances** (trust, profit sharing, openness): The performance of supply chain affected by positively in relation to trust, negotiation and profit sharing of conventional alliances in the lean supply chains.
- **Information frequency**: The performance of supply chain improved by the flow of information frequency at information flow across the network.
- **JIT**: JIT implementation results in increased replenishment frequency.

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- **Resource utilization**: The implementation of lean practices is characterised by higher supply chain resource utilization, decreasing the supply chain capacity excess.
- **Lead time reduction**: The length of the lead time is an important factor of Production and transportation Lead Times (PTLT), to reduce the lead time affects negatively to the PTLT.

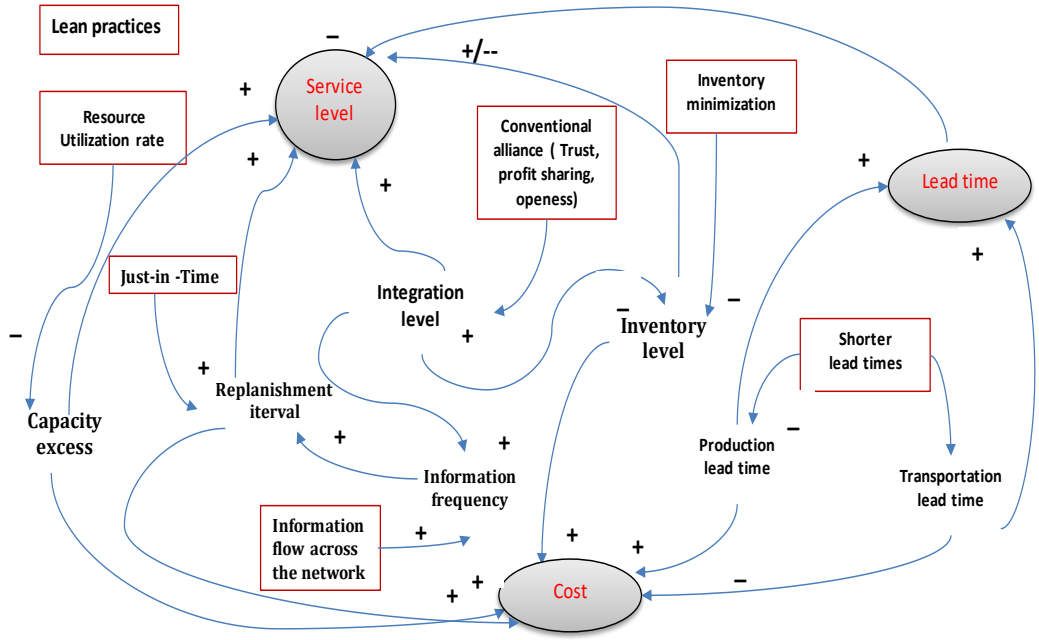

Figure 2. Lean inventory attributes and supply chain performance relationships

3.2 Agile Inventory (Safety Buffer) Attributes vs. Supply Chain Attributes

The link between agile inventories (safety buffer) attributes and SCP have depicted in Figure 3.

The relationship between inventory attributes and the SCP can be understood as under.

- **The response of inventory in customer demand**: The consequence of inventory level is affected negatively by the customer demand. Let us consider an example that the inventory is designed for better response of customer demands, then lower level of inventory is expected and the supplier readiness such as flexibility, speed and quality assurance accordingly. The readiness has a high level of speed, flexibility, and quality but the necessity of inventory is low, which gives low inventory level.
- **Information frequency**: The information frequency is positively elevated by an increase in visibility of the overall supply chain.
- **Dynamic alliances**: The magnitude of integration level is affected positively to the presence of a dynamic alliance.

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- **Respond speedily to customer demand**: The frequency of replenishment can be enhanced by adopting a strategy of responding speedily to customer needs.
- **Capacity excess:** The agile inventory attributes explain the availability of a capacity excess of resources in the supply chain gives an increase in capacity surplus.
- **Lead time reduction:** The length of the lead time is a key factor of production lead time and transportation lead time. Lead time reduction results negative PTLT. Increasing the lead time reduction level results a decrease in production lead time as well as transportation lead time.

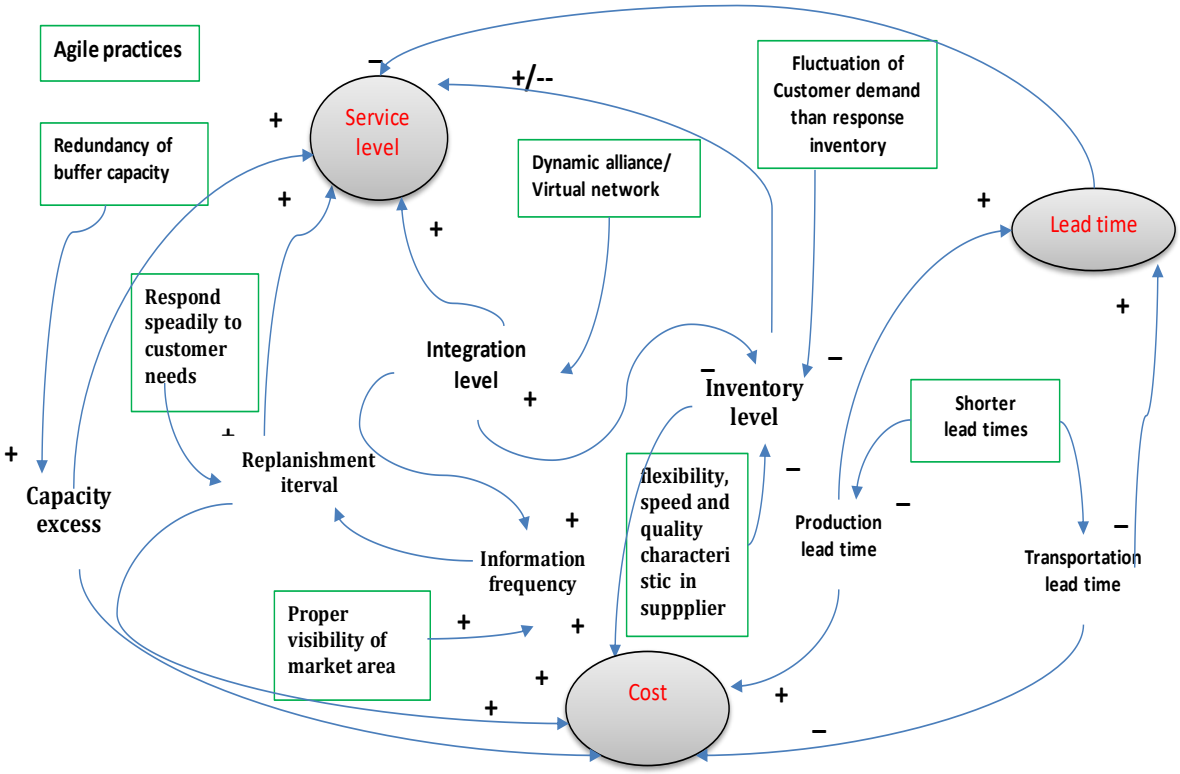

Figure 3. Agile inventory attributes and supply chain performance relationships

4. Combined Lean and Agile Inventory Attributes Practices vs. Supply Chain Attributes

From the required knowledge, the integration of the lean and agile inventory attributes and SCP relationships were developed and as shown in Figure 4.

From the cause diagram, to verify that most of the supply chain attributes have positive effects by all inventory attributes. Table 1 gives results of an inspection of important synergies and divergences among the lean and agile inventory attributes under study. For the implementation of

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these lean and agile inventories attributes like integration level, information frequency, production lead time and transportation lead time should be managed. In such a case, the impact of all inventory attributes implementation in the characteristics magnitude may be varied.

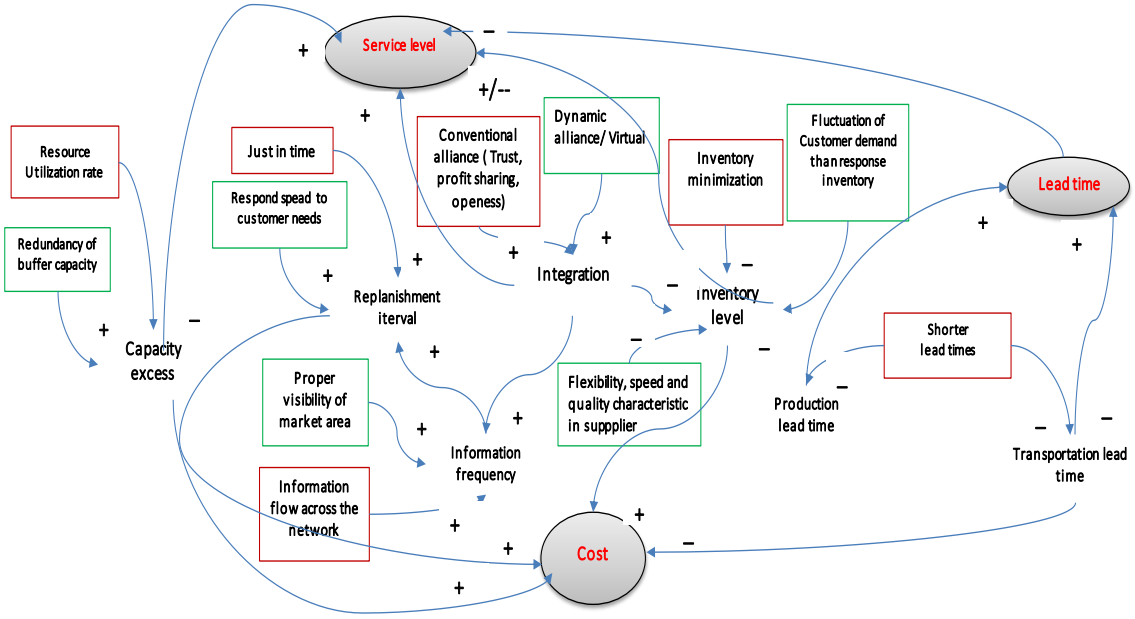

Figure 4. Conceptual model with lean and Agile inventory attributes relationship

Table 1. Lean and agile SCM synergies and divergences overview

Inventory Attributes Performance / Supply Chain Attributes	Lean Inventory Attributes	Agile Inventory Attributes
Information sharing frequency	Increase (↑)	Increase (↑)
Integration level	Increase (↑)	Increase (↑)
Production lead time	Decreases (↓)	Decreases (↓)
Transportation lead time	Decreases (↓)	Decreases (↓)
Capacity surplus	Decreases (↓)	Increase (↑)
Inventory level Replenishment frequency	Decreases (↓) Increase (↑)	Decreases (↓) Increase (↑)
Legend: ↑ increase; ↓ decrease		

Finally, conclude that cause and effect analysis under lean and agile inventory attributes impact on SCP in terms of lead time, cost and service. It has illustrated in Figure 5.

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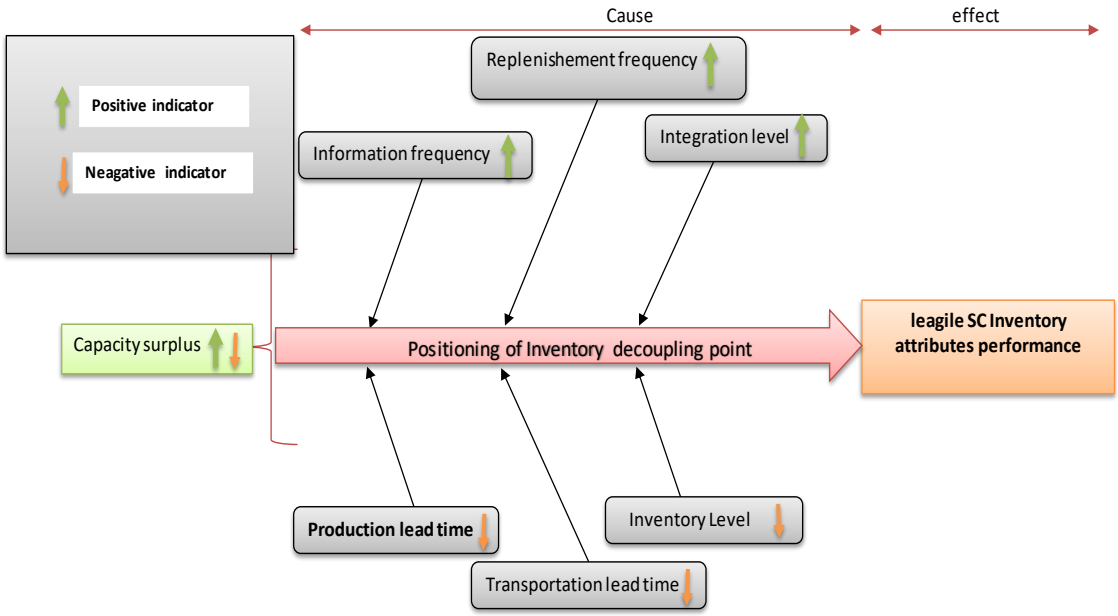

Figure 5. Leagile SC inventory attribute cause and effect analysis

It reveals that positive and negative indicators are directly impacted of integrated LASC inventory attributes performance. The accurate positioning of the decoupling point is necessary for stocking the inventory for market nature and better service for the customer. The positive indicators are such as information frequency, replenishment frequency, and integration level. The negative indicators are such as lead time (production and Transportation) and inventory level. Hence, it is necessary to balance between the lean and agile practices implementation, considering the strategy defined by the supply chain.

The key assessment of the paper to acknowledge the tools of supply chain management can be analysed. The result of assessing the lean and agile supply chain management concepts shows that the tools used in these systems can help in reducing the risk level. The concept of lean and agile inventory attributes to overcome global competitive cost reduction opportunity.

5. Conclusions

The conceptual model constructs and primary level knowledge of outlook of the trade-off between upstream lean inventory attributes and downstream agile inventory attributes characteristics and positioning of stocking point or surplus inventory location for decoupling point decides by managerial as good practitioners.

Cause-effect analysis demonstrated that supply chain attributes are positive or negative linkage to all lean and agile inventory attributes creates synergies among them. Lean and agile inventory attributes were found to significant effect on inventory attributes like increase in information frequency, increase in integration level, reduction in production lead time as well as in transportation lead time. In managerial point of view, cause and effect diagram provides a proactive understanding to positive and negative inventory attributes affects the SCP.

This study raises propositions of relationships between variables involving the supply chain, though only in theoretical terms, however, does not provide any empirical results. In future research, these relationships can be empirically validated. Figures 2 and 3 attempts to present the "positive" and "negative" aspects, however, there is no in-depth discussion about said aspects in light of the literature. In future research, detailed analysis with the depth discussion in light of the literature can be made.

Further, how the LASC will affect inventory attributes as well as SCP may be tested empirically. Finally, it will be interesting to know that how different business tools such as ERP and MRP-I, MRP-II can enhance the performance of SCP.

Conflict of Interest
There is no conflict of interest among the authors.

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Annexure-A

Table A1. Migratory model summarising the transition in PC supply chain operations

Supply chain evolution phase	**Phase I**	**Phase II**	**Phase III**	**Phase IV**
Supply chain time decade	Early 1980s	Late 1980s	Early 1990s	Late 1990s
Market supply chain philosophy	Product driven	Market orientated	Market driven	Customer driven
Supply Chain type	Lean functional silos	Lean supply chain	Leagile supply chain	Customised leagile supply chain
Market winner	Quality	Cost	Availability	Lead time
Market qualifiers	Cost , Availability ,lead time	Availability ,lead time , quality	Lead time, quality, cost	Quality, cost, Availability
Performance metrics	Stock turns, production cost	Throughput time , physical cost	Market share, Total cost	Customer satisfaction, Value added

Source: Christopher and Towill (2000)

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Table A2. Difference between lean, agile and leagile supply chain

Distinguishing attributes	**Lean supply chain**	**Agile supply chain**	**Leagile supply chain**
Market demand	Predictable	Volatile	Volatile and unpredictable
Product variety	Low	High	Medium
Product life cycle	Long	Short	Short
Customer drivers	Cost	Lead-time and availability	Service level
Profit margin	Low	High	Moderate
Dominant costs	Physical costs	Marketability costs	Both
Stock out penalties	Long term contractual	Immediate and volatile	No place for stock out
Purchasing policy	Buy goods	Assign capacity	Vendor managed inventory
Information enrichment	Highly desirable	Obligatory	Essential
Forecast mechanism	Algorithmic	Consultative	Both/either
Typical products	Commodities	Fashion goods	Product as per customer demand
Lead time compression	Essential	Essential	Desirable
Eliminate muda	Essential	Desirable	Arbitrary
Rapid reconfiguration	Desirable	Essential	Essential
Robustness	Arbitrary	Essential	Desirable
Quality	Market qualifier	Market qualifier	Market qualifier
Cost	Market winner	Market qualifier	Market winner
Lead-time	Market qualifier	Market qualifier	Market qualifier
Service level	Market qualifier	Market winner	Market winner

Sources: Naylor et al. (1999), Mason-Jones et al. (2000), Olhager (2003), Bruce et al. (2004)