CAUSE AND EFFECT ANALYSIS OF INVENTORY MANAGEMENT IN LEAGILE SUPPLY CHAIN

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ABSTRACT

In the recent era of the modern business environment, an effective and optimal SCM is a key necessity to business endurance. Supply chains replaced the traditional competition between the companies and shifted the modern business environment. Combinations of lean and agile inventory attributes are advocated as a foundation to sustain competitive Leagile Supply Chain Inventory (LASCI) attributes. The upstream part of lean inventory practices based on push system and downstream part of agile inventory practices based on a pull system. The accurate positioning of Decoupling Point (DP) stock is a key necessity for achieving surplus inventory (safety inventory), the value of quick replenishment and effective customer response by reducing delivery lead time. In such circumstances, surplus capacity (safety inventory) increases then surplus inventory may provide the agility characteristics of effective response to changes demand and overcome the market uncertainty of demand variability. Two case studies considered a namely first application of telecom network, which is based on a hybrid planning approach Kanban-type functionality with a push system. Upstream and downstream operational activities emphasized that Customer Order Decoupling Point (CODP) into strategic consideration, where designing supply operation and production based on customer requirement to fulfil the delivery responses. A second application of elevator manufacturing company purchasing of inventory items based on lean, agile and leagile supply related. The two case studies shown that inventory management in LASCI is the key role play for effective-cost reduction and more responsive to achieve the service level. Cause and effect analysis to observe that combined leagile inventory attributes have a significant impact on positive and negative indicators such as frequency, replenishment frequency and integration level, the negative indicators such as production lead time, transportation lead time and inventory level. The cause and effect analysis has identified the leagile inventory attributes on the SC Performance. The surplus inventory (safety inventory) to achieve the agility at downstream direction more customer satisfaction. The effective inventory management is a key necessity for an order to fulfil and positioning of CODP to decide for customer order production and supply chain network.

Keywords: Lean, Agile, Leagile SC, Supply Chain Management, Supply Chain Performance.

INTRODUCTION

The recent decade of globalization, organizations are more intended becoming aware of gaining the strategic reputation by adopting the holistic perspective approach on competitiveness ingredient to promote and sustain their positions in the market (Sangari et al., 2015). In presence

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of philosophy, commodities ought to be produced and distributed of the total cost of the system-wide (Routroy & Kodali, 2005). Supply Chain Management (SCM) as an emerging field has fascinated the industrial community in India. SCM is a key source to manage multiple relationships through the Supply Chain (SC) w.r.t streamlines the flow of information, materials and services to fulfil customer demand in an efficient and effective manner. This philosophy captures the continuous changes in the field of business management (Li & Wang, 2007). Kareem (2018) reveals that the essence of Global Supply Chain Management (GSCM) encumbers several different areas of vertical and horizontal operations throughout the chain. The research showed that Multinational Corporations (MNCs) are competing through SCs to increase global market share and customer satisfaction through social, environmental and economic initiatives. They try to create synergy among SC stakeholders and the environmental affords social, environment and economic sustainability. Javad (2018) reveals that investigate the efficiency of the green supply chain by using Data Envelopment Analysis (DEA) based on Malmquist Productivity Index (MPI) according to input and output indicators of Balanced Scorecard (BSC) 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. Yashar et al. (2014) reveals that multi-dimensions of work values and organizational agility, employed methodology applicable in research, some dimensions are not suitable therefore best methods that will enable managers to wisely invest in the most important issues to achieve the best results in the path to achieving the agility through the work values. The two dimensions are appropriate such as self-development and work-life balance. These two dimensions had maximum agility found which indicate a potential agility path. Doshmanli et al. (2018) examine that there was existing a significant positive correlation b/w the all four dimensions namely, economic, legal, ethical and discretionary social responsibility and development of SMEs. Finally, conclude that positive correlation of the dimensions of social responsibility and development of small businesses state that social responsibility is essential for all people in society and includes the various sizes of companies. Deshpande et al. (2014) identified that FDI implemented in Indian retail sectors requirement due to more competitive pressure of Indian retailers recognizes that the value of infrastructure should be required their own stores as brand to reinforcement of complete penetration of market positioning, IT infrastructure requirements to improve the quality of communication as value addition of money flow. Sustainable competitive opportunity will be dependent on the translating core values combining products, image and reputations into a coherent retail brand strategy. Sarjana (2015) Investigates that manufacturing dynamic capabilities can be enhanced by improvement of knowledge resources, manufacturing capability and existing environmental turbulence are intervening variable enterprise performance. The best performance in manufacturing dynamic capabilities can be sustaining the process of improving human well-being and established the relationship b/w dynamic capability and enterprise performance is always important to research in strategic management. It can be enhanced performance by promoting timelines, speed and efficiency of organizational response.

Definition of lean can formulate various ways from literature, but all they share the same principle: waste elimination and cost minimization. Fan et al. (2007) reported how the lean production is combined with the "*zero inventory"* and "*Just in Time"* (JIT) approach (Wu, 2009). According to Competitive Strategy (CS), where cost is a priority, Lean Supply Chain

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(LSC) is recommended, while for CS if speed is a priority, their Agile Supply Chain (ASC) is suitable (Mason et al., 2000). The lean concept is mostly applicable where demand is stable, predictable and has a relatively lower variety of products. If the demand is volatile and the customer variety is high, the agile supply chain is preferred (Agarwal et al., 2006). There is a requirement to adopt a hybrid strategy (Christopher & Towill, 2000). According to Table 1, Murakoshi (1994) the migratory model and early 1980s the market winner was quality and was achieved within the lean internal process scenario. The implementation of LSC has an impact on cost, but pushing the products in the marketplace would not satisfy the customer need. In the era enabled by correct positioning of the material flow, DP in the particular hybrid lean-agile supply chain is termed as LASC (Naylor et al., 1999). This chain is agile potential enough to respond to what actually selling with availability as the market winner. In a recent example, Dell has the customised LASC. Furthermore, streamlining 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 finalizing the PC and additional packaging and delivery to the individual customer. Agility is a key source of business capability that incorporates organization structure, information system, logistic processes and existing mind-sets (Power et al., 2001; Katayama & Bennett, 1999). Agility can be defined as the ability of an organization to respond rapidly changing demand and both volume and variety (Christopher, 2000). Despite the differences b/w lean and agile paradigms, but it can be used combined with successful designed and operated total SCs (Mason & Towill, 1999). The prior practices reveal that how much importance of agility and leanness depends upon the total supply chain strategy, appropriate making an allowance for the market knowledge *via* information enrichment and positioning the de-coupling point. The significant combination of agility and leanness in one SC *via* the strategic purposes of a DP has been termed le-agility (Naylor et al., 1999). The concept of leagile is a mixture of lean and agile paradigms surrounded by total SCS by proposing positioning the DP decision which has a better fit for the responded to volatile demand downstream, yet providing level scheduling upstream from the market place (Hoek et al., 2001). DP is in material flow stream to which target the customer order penetrates (Mason et al., 2000; Prince & Kay, 2003). It has depicted in Table 1; the comparison of attributes among lean, agile and LASC. The idea of the agile SC has been born in mind as means succeeding a competitive edge in a rapidly changing business environment. The important issue is supplier selection. Selecting suitable partners through qualified partners for specific purchases w.r.t the criteria which are related to the supplier's level of agility (Wu & Barnes, 2011).

According to Aravind & Jayakrishna (2018) identified that modern manufacturing industries has transit phase in an adaptation of supply chain strategy. The study focused on supply chain strategies namely lean, agile and leagile SC strategies. The success of a supply chain dependent on organization competency to compete for the competitive market demand and reduce the supply chain uncertainty. The SCP metric has evaluated using ANP methodology and develops a conceptual model of Leagile SC to examine the SC performance weight index score in Leagile SC strategy (Table 2).

Recent environment intense cutting edge of market competitions and sophisticated IT business tools more necessary for an organization to match specific individual customers by appropriate strive SC strategy (Galasso & Thierry, 2009; Rehman, 2017). Nikolaos (2018) develop a relationship b/w dimension of supply management performance and the components of the cash conversion cycle. The model proposed and the hypothesis was tested using data from

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SMEs operating in Greece. The results will support to clear understanding of balance sheet and profits and loss statements in relation to supply management performance and contribution of supply management practices to ratios derived from balance sheets and profit and loss statements.

According to Suomalainen et al. (2015) investigates that the fitness of the SC model suitable for the case organization using synergies of lean and agile concept combined for development. Enhancement of SC performance involves that SC is more strengthen to quickly responding to variations in customer demand with effective cost reduction environment (Olhager, 2010). Matawale et al. (2015) reveals that extensive view of metrics of LASC and to evaluate leagility index using scientific methods and using generic model for synergies prioritization and identification of appropriate strategies for case organization SC. Ali & Saeid (2014) reveal that leanness and agile based on SC maximization of profit margin through cost reduction procedure and customer desired to fulfil satisfactorily. 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 market and case study based on the automotive industry. Pakdil & Leonard (2014) explained the management concept based on lean principle enables an 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 to develop an environment to be innovative and proper support. It should achieve the goal of management commitment (Wyton & Payne, 2014). According to Vinodh & Aravindraj (2012) 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 legality SCs using fuzzy logic approaches. According to SCM philosophy ought to produce and distributed at the right quantity, to right time locations and the right time resulting in minimizations of the Total cost of the system-wide (Routroy & Kodali, 2005). Zhang et al. (2012) established a dynamic model of congenital SC and LASC using the system engineering concept. Through differentiates of simulation results of these two types of supply chains and explore advantages of leagile SC were explored. Most of the researchers have concentrated on the leagile SCs, some of them focused on the development of metrics for leagile SC (Soni & Kodali, 2009; Agarwal et al., 2006; Childerhouse & Towill, 2000; Gunasekaran and Kobu, 2007). The extensive view of utilized metrics in the domain of LASC are such as lead time, cost, service level, quality and customer satisfaction and market sensitiveness, process integration and flexibility (Childerhouse & Towill, 2000; Rahimnia et al., 2009; Agarwal et al., 2006). Therefore, very few methods were existing for assessing the performance of SC, which does not capture SC level identified strategy and investigate the weaker criteria further influence to improve the performance priority strategy.

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Table 1
MIGRATORY MODEL SUMMARISING THE TRANSITION IN PC SUPPLY CHAIN OPERATIONS

Supply chain evolution phase	I Phase	II Phase	III Phase	IV Phase
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,

Martin & Denis (2000).

Table 2
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. (2000a), Olhager (2003), Bruce et al. (2004).

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Table 3
LITERATURES REVIEW OF LEAGILE SUPPLY CHAIN ORLEAGILE STRATEGY

Authors	Issues /application	Finding	Limitation and further scope
Aravind et al.(2018)	**Issue**: identified the metrics of leagile SC and evaluate leagility index using the scientific method. **Application**: Electronic switches, a manufacturing company located in Tamil Nadu, India,	**Organization**: The company unit basically manufacturing rotary switches and its SC involves certain characteristics of lean and agile paradigms. **Finding**: The SCP weight index of lean, agile and leagile paradigms 0.193, 0.301 and 0.506 respectively. The desirability index score leagile has been selected as the best supply chain strategy.	**Limitation**: The conceptual model is adapted to identify the best supply chain model suitable for the case of an organization using lean and agile concept together developed. Using ANP model and expert opinion considers. **Further:** In order to evaluate the performance of leagile SC in case organization, MGF method has been used. To study the service level, leagile SC, Leagile SC performance, generic and expert opinion considered.
Doshmanli et al. (2018)	**Issue**: development of firms, corporate social responsibility b/w SMEs and correlation b/w them. **Methodology**: develop a hypothesis tested and using factor analysis and structural equation modeling (SEM) is used to test the hypotheses. **Application**: development of Small and medium business environment and study correlation effect of dimensions such as economic, legal, ethical and discretionary social responsibility	**Finding**: The result found that there exist a significant positive correlation b/w all fours dimensions such as economic, legal, ethical and discretionary social responsibility and development of SMEs. Finally, the positive correlation of dimensions of social responsibility and the development of small businesses state that social responsibility is essential for all people in society and includes the various size of companies.	**Further extension**: Researchers are advocated to distinguish the effect of each dimension of social responsibility in small, medium and large enterprises and report their effectiveness in future strategies.it can be facilitating legislation and provide more authority to small and medium business owners for developing executives' procedures ((e.g., Nkiko (2013)). Education, culture building and injection of material resources into these enterprises and attention of governor of countries.
Masoud et al. (2016)	**Issue**: effective supply chain strategy; **Application**: Manager and practitioners to understand the framework of operational activities operates in leagile supply chain strategies based on supply chain major drivers selection criteria.	**Finding:** The proposed concept to develop a new framework to evaluate the operational activities of Leagile SCs. Operational activities of Leagile SC strategies were determined and categories with regard to SC drivers. These	**Limitation**: the operational activities of leagile supply chain strategy have not implemented in such industrial application and not examine the supply chain driver's feasibility in such a case /empirical study not considers. **Further scope**: The proposed framework study can be implemented in a real case study to check the applicability of the

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		activities were ranked based on AHP and categories based on cycle view of the supply chain.	proposed activities.
Joakimr and Eva (2015)	**Issue:** In order to retain that relevant information is a key necessity for particular decision problem to resolve and set of aggregation to focus on group of entities where same decision can be implemented. **Application**: Logistic managers need tools to simplify and automate decision-making.	**Finding:** Type of decoupling point (DP) introduced and flow is based demand or supply system. The demand and supply have combined with exogenous factor classified as independent. Endogenous factor classified as dependent. The result has classified eight types of strategic as well as tactical decoupling points identified. They identify the results has based on process framework of inventory classification can be used for flow design.	**Limitation:** The framework does not provide a novel approach of material management but it provides a structured way to better understanding the role of decoupling point i.e positioning of inventory stocking point is key role of material management. **Further scope**: The research on inventory and material management concepts implemented in positioning of DPs of real case study evidences consider.The case of evaluation of manufacturing strategies across the different delivery responsiveness. The strategy of DPs decisions mayserve as a point of reference for delineation b/w lean and agility (see, e.g. Mason-Jones et al., 2000).
Paul & Eleni (2015)	**Issues:** lean sustainable system and overproduction. **Application**: Automotive business and business manufacturing models Morgan Motor Company (MMC); **Note**: The understanding of barriers to the free movement of the material DP in the manufacturing system and ways in which this forces manufacturers to overproduction is essential for developing future environmentally sustainable supply chains.	**Finding:** The literature of leagile concept explores that a new understanding of the factors that determine the DP b/w lean and agile processes can be used in order to radical shift in economies of scale in car production such that lower volume production becomes feasible thereby reducing the need for overproduction and enabling a move towards more sustainable car production and consumption of resources. **Methodology**: a qualitative approach	**Limitation**: The sports car producer company such as Morgan was the move in material DP concept, but information DP has not involved in the supply chain by limiting their own in house activities. Modular components have outsourced of lean potential fashion from suppliers, while control of the customer-facing activities, there is being of ability to operate in agile fashion in those key value-the addition of such area they retain in-house. **Further scope**: The increased market responsiveness and agility through achieve and what is an alternative manufacturing model and one with the potential to expand into a full alternative and more sustainable business model.
Sri (2015)	**Issue**: Lack of dynamic capability enhancement to improve by Knowledge resources, Manufacture	**Finding**: to achieve the best performance in manufacturing dynamic capabilities and it can be	**Further extension**: Research on dynamic capability in manufacturing and empirical research on dynamic capability

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	capability and environmental turbulence are intervening variable enterprise performance. **Application**: Manufacturing industry using firms.	sustaining the process of improving human well-being. The established relationship b/w dynamic capability and enterprise performance is always important to research in strategic management (Tiantian (2014)). it can be enhanced performance by promoting timeliness, speed and efficiency of organizational responses	framework.
Salmzadeh et al. (2014)	**Issue**: Critical in knowledge-based organizations such as virtual universities. Research work: identified the path through organizations can achieve agility by means of work values. **Methodology**: fuzzy TOPSIS methodology using. **Application**: Knowledge-based organization and virtual organization requirement due to agility by means of work value achieve.	**Finding**: Even though multi-dimension of work values and organization agility, the employed methodology applied in the research, some of these dimensions are not considered and find the best methods that will enable managers to wisely invest in the most important issues and achieve the best results in the path to achieve agility through work values. An organization shows that a positive relationship between the work values and agility. Basically, they emphasized that considering work values and finding the agility path through work values. The considering of five dimensions of work values and found two of them are appropriate such as self-development and work-life balance. In these two dimensions had maximum agility found, which indicate a potential agility path?	**Further extension**: Managers and scholars have identified different issues such as an extension of work values and a new dimension of an organization from human resource management perspectives. Research support for managers to conduct and execution plans that enable them to achieve the agility in their organizations.
Deshpande et al. (2014)	**Issue**: Study of the transformation of the post-liberalization era by	**Findings**: Due to more competitive pressure, Indian retailers/retail	**Further extension** : Modern retail business has indirect employment support activities

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	implemented FDI and the contribution of the pillars of the Indian economy. **Methodology**: The pulls together various strains of research and databases to discuss. **Application**: FDI in Indian retail sector	industry recognizes the value of infrastructure their own stores as brands to reinforce their complete penetration of marketing positioning, IT infrastructure requirement to the quality of communication as well as value for money flow. Sustainable competitive opportunity will be dependent on translating core values combining products, image and reputation into a coherent retail brand strategy. Also, ensure that the interest of local retailers is duly protected.	through the SC, starting from procedures adapted to packaging, storage, transport and other logistic services. Modern retailers are a major source of relatively secure employment and low skilled workers. FDI have larger multinational retailers will wipe out the small Indian retails. Limitation: FDI ensures that domestic players are not unduly displaced and sufficient opportunities are available for the growth of domestic players. The government should not support and glorious opportunity offered by the largely untapped and highly promising retail sectors.
Paul et al. (2013)	**Issue**: leagile paradigms should be fit into the fisher's mode. **Application:** an electric boiler manufacturer and an elevator manufacturer.	**Finding:** Different purchasing strategies could recognise to various components according to their impact on competitive priorities. The electric boiler is a functional products and elevator manufacturing company is an innovative product, The both case studies evidences can varies across two different product types identify by Fisher model concept.	**Limitation**: The new model has not been tested based on case studies. Using AHP methodology to Lean, agile and leagile related. **Further research**: The lean and agile supply purchasing model based on fisher model concept. In the research and knowledge management and exchange activities within the industrial partners to further develop and test its efficacy.
Arnab et al. (2012)	**Issue:** Global product value chains and not just single-entity chains, **Application:** Industrial equipment manufacturing case **Methodology**: A multidimensional scaling (MDS) method is used to develop the relationship of DTDP with SSDP and PSDP using interpretations matrices and stress coefficient.	**Finding:** In the global supply chain, Product structure decoupling point (PSDP) and supply structure decoupling point (SSDP) are elemental decoupling point, which is a function of PSDP and SSDP. It is emphasized that Demand transfer decoupling point (DTDP) swings b/w the	**Limitation:** only consider the case of Industrial equipment manufacturing situation.

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		PSDP and SSDP; The swings direction is a critical piece of supply chain information that helps identify distortion.	
Arash & Jaberi (2011)	**Issue**: An integrative model of leagile production examine its influence on the quality of products based on Six Sigma approach **Application**: The automobile maker of GMG; The three main products are considered for study engine hood-model 2624(A), complete backside-model 1921(B), front bumper-model 2624(C).	**Finding**: The Six Sigma implemented that sigma level product A has been improved by 147 % considering the first indicator and 8% considering the second indicator. The product B has 65 and 47 % improved and Product C has 65 and 150 % of improvement considering the two indicators respectively.	**Limitation:** The wide range of operations and has not covered all of the products of a case study. Lack of standard criteria for evaluating leagile production, the criteria of waste has been defined using of leanness and duration of final storage has been applied to assembly line based on specific orders from the customers, which in turn might be realized as a limitation. **Further scope:** The different industries use the proposed model and its customization with respect to their particular characteristics; The proposed model distinguishes between a model of agility and leanness.
Tiwari et al. (2009)	**Issue:** Customer expectation in a more efficient manner by changing their planning and scheduling strategies. **Application:** manufacturing industries and outsourcing strategies.	**Finding:** The integration of process planning and scheduling model have an outsourcing inherently and The initiatives of leagile concept has formulated for minimize the total supply chain and improve the service level and customer order based manufacturing supply chains. The proposed algorithm provides superior and better planning tool strategies to select the outsourcing machine and better perform of the machine operations on them while considered the several technologies constraints encountered in the real shop floor situations. The efficacy of the proposed algorithm has been shown by comparing the results with GA, SA, Tabu and	**Limitation:** The integrated process planning and scheduling model inheriting outsourcing and manufacturing industries merely implemented. **Further scope**: They focused on resolve the problems of multi-objectives achievements such as Inventory cost and mean flow time simultaneously involved in the number of constraints and decisions variables. Leagile principles has shown that potential to enhancing the performance of manufacturing industries and tested in diverse field in the design of manufacturing environment.

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		hybrid Tabu-SA optimization method.	
Fariborz & Mahdi (2009)	**Issue** : Mass services as type of service **Application**: Fast food restaurants.	**Finding**: Low cost in mass customization in the service sector and changing needs of a customer. Adopt a new strategy (leagility) to serve the customer with shorter lead times, low costs and high variety.	**Limitation:** Considers a single mass service, case study and lack of other types of services such as professional services and service shops. Leagility in professional services such as management consultancy and a hospital will face the same problem because pure services that are characterized by attributes like intangibility and each customer would be also served in a specific way.
Banomyong et al. (2008)	**Issue**: Postponement strategy adopted in the electronics industry. **Application**: An electrical appliance manufacturer company.	**Finding**: The leagile implemented in the reverse logistics process, that lead time for product repairs and returns as well as costs involved with reverse logistics, have been drastically reduced while customer satisfaction has increased significantly.	**Limitation**: The data for all costs involved with the reverse logistic channel was collected, based on two main products of the manufacturer, while the reverse logistic structure may be used for all of the manufacturer product lines. **Further research**: The leagile concept on the other aspect such as recycling or other environmental dimensions.
Yale et al. (2002)	**Issue**: Transshipments at each location, **Application**: Multi-location inventory system. **Note**: Transshipments can lead to cost reductions and improved service without increasing inventory levels in the supply chain.	**Finding**: Tactical solution to achieve leagility without postponement, we introduce transshipments, which represent common practice in multi-location inventory systems involving a monitored movement of stock between a location at the same echelon level of the supply chain. Series of models to established how transshipment can be used to enhance the leagility and leanness.	**Limitation:** How transshipments can decrease cost by reducing the overall inventory levels and improve service by both reducing the no-stock out probability and shortening the replenishment LTs. Non-identical retailers consider and how the effectiveness of the transshipment strategy can be further improved by divided the retailers into a particular subgroup.

Supply Chain Performance (SCP) Based on Hybrid (Leagile) Strategies

The SCP can be improved by quick response to variations of the customer demand and effective cost reduction strategy (Olhager, 2010). The conceptual model to identify the best

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fitness of the SC model for an organizational case study. The combined approach lean and agile both was using for development (Suomalainen et al., 2015). The critical dimensions of lean and agile attributes are recognized following such as the cost for lean and service level for agile. The cost, service and lead time were selected as a key performance indicator to identify the effect of lean and agile management in the SCP. The quality was not considered, the primary level focus on lean and agile inventory attributes to sustain the SCP. To perform efficient and effective supply chains, it must be essential to measure its performance. The performance of an organization should depend on organization competitiveness and how their organizational SCs are more sustainable and competitive (Gunasekaran, 2001). Soni & Kodali (2012) reveal that the SCM strategy has based on the competitive strategy of the firms. They consider three SC strategies such as lean, agile and leagile. Supply chain competitive strategies such as cost-effective, time responsiveness and hybrid both and firms achieve the strategic alignment b/w competitive strategy and supply chain strategies and also address the deficiency of standard construction. The objectives are achieved by evaluating reliability and validity of lean, agile and leagile supply chain constructs in Indian manufacturing industries. Principle components analysis is performed on these constructs to identify the pillars of each type of SC followed by evaluating the reliability and validity of these pillars to establish the underlying constructs. Finally, build a framework for lean, agile and leagile SC (Table 3).

Gaps identified

Paul & Eleni (2015) reveals that Leagile concept using to demining the DP b/w lean and agile processes can be used to radical shift in the economics of scales of production strategy such as lower volume production, postponement and mass customizations. Masoud et al. (2016) developed a framework to evaluate the operational activities of leagile SC. In order to leagile SC activities were identified that cross-functional team and operational activities at SC drivers. Leagile Supply Chain Inventory (SCI) practices did not consider in prior practices. According to Izunildo (2012) identified that LARG (lean, agile, resilience and green) practices not enough to enhance the SC competitiveness. Therefore, it is a key necessity to measure the influence of these practices on the SC performance as a whole. They suggest that links to the enhancement of the SC Competitiveness and fill these gaps by build an integrated model for appropriate selection of LARG SCM practices. LARG trade-offs and SC characteristics, SC managers are key role to developing the best strategies to improve their entire performance. The positive/negative indicator impacts on paradigms and balance b/w the practices to better fit the strategy by the company's. The prior study focused on leagile SC characteristics, which has associated to leagile supply, leagile demand driven and design of flexible manufacturing system. The most of the evidences has shown that DP, positioning of DP and Customer Order Decoupling Point (CODP) and evaluation trend of manufacturing industries more customer responsiveness. The past practices most of the evidence shows that lack of inventory visibility practices of upstream and downstream channel and most of the pieces of evidence of inventory management practices based on coordination and integration in Supply chains. The modern concept should be leagile Supply Chain Inventory (SCI) attributes related. Complete visibility of information & material decoupling points is a key necessity for optimal SCM.

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The objectives of the paper

1. To develop the lean and agile inventory attributes relation with Supply Chain Performance (SCP).
2. To study the case studies evidence in procurement model of lean, agile and leagile supply practices in elevator manufacturing companies and other evidence of telecom network to study the production and SC structure of importance of decoupling point role.
3. How to build a relationship with lean and agile SC Inventory attributes and SCP indicators are combined with lean and agile inventory attributes.
4. To study the leagile SC inventory attributes influence on the SCP and cause and effect analysis to leagile SCP assessment.

Novelty of this paper

The novelty of this paper to study the leagile inventory attributes relation with SCP under cause and effect analysis. The study emphasizes that rapidly changing business environment to how leagile Inventory Management (IM) practices have more competitiveness to sustain arena of modern business environment. The upstream lean attributes (physically efficient) and the downstream agile attributes (customer responsiveness or agility) to trade-off between cost-effective and more responsiveness to customer service. The two case studies evidence shown that location of positioning of decoupling points and purchasing of components has significant roles in leagile SC and effective inventory management achievements. And optimal SCM resources utilizations.

Hybrid Lean-Agile (Leagile) Supply Chain Strategies

According to Masoud et al. (2016) propose the operational activities of leagile supply chains with regard to SC drivers. The operational major key drivers such as Leagile activities of the inventory & leagile activities of information have considered in the leagile supply chain strategy to the assessment of the SC cycles view. According to Joakim & Eva (2015) reveals that continuous one-piece flow may not be achieved until the logistic manager could not improve the flow by carefully positioning inventory buffers against demand variations. The implementation of strategies such as lean, postponement, mass customization and outsourcing strategy to identified the positioning of decoupling point which better perform of customer order driven flows. Master scheduling, as well as DP, has decided on better planning and scheduling of flow strategies implementation. The DP types are decided on either demand based or supply base. Either demand or supply based the combined approaches as well as combined both with exogenous factors (independent) or endogenous factors (dependent). Results show that eight types of strategies, as well as tactical decoupling points, are investigates in a process-based framework for inventory classification that can be used for flow design.

Leagile activities of the inventory

Supply chains effectiveness and efficiency are based on demand visibility, a flow of materials and inventories throughout the supply chain (Gunasekaran, 1999; Korhonen et al., 1998). The major operational barrier of identified to supply network is inadequate management among supply and demand (Vokurka & Lummus, 2000). The following subsequent activities should be accomplished to achieve a Leagile inventory system**:**

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1. LEAI1: According to leagile IM with vendor flexibility systems considered that combine the use of agile vendors with lean sourcing practices. Their action related to inventory flexibility that can be associated to such as production, freight transportation or warehousing, with each node having its individual interiors flexibility (Purvis et al., 2014).
2. LEAI2: Leagile IM with sourcing flexibility system identified that mixture of combined use of lean vendor with agile sourcing practices. Their action related to acceptance of larger suppliers base, quick ways to reshaping and reconfiguration of supply chains. It incorporates into adoptable capability (Purvis et al., 2014).
3. LEAI3: Leagile IS could be associated with the lean principle in the upstream part and agility principle related to the downstream part (Krishnamurthy & Yauch, 2007).
4. LEAI4: There is sufficient overlap among the features of the adaptation of manufacturing systems, agility and leanness. Their concern could be examined by operating IM (Krishnamurthy & Yauch, 2007).
5. LEAI5: The involvements of sales, service group and inventory system have conventionally associated with leagile IM (Krishnamurthy & Yauch, 2007).
6. LEAI6: the strategy of leagile could be focuses to minimize the inventory magnitude at upstream and downstream channel effectively reduce by inventory minimization method (Goldsby et al., 2006).
7. LEAI7: The strategy of leagile model could be more responsive to fewer raw materials at the inventory stocking point to sufficient sub-assemblies on a reliable basis. It effective reduction of financial investment and fruitful operative advantage of the portfolio outcomes (Goldsby et al., 2006).

Leagile activities of the information

Information DP is the key necessities of upstream direction to demand data available which can play an effective role in the supply chain. The information flow is a vital role to explore the demand uncertainties (Chen et al., 2009). The following activities involved in leagile SCs.

1. LEAInf1: EDI must be the electronic movement of data exchange of business information both internal and external resources and using IT communication tool (Kisperska & De-Haan, 2011);
2. LEAInf 2: Information system could be able to perform online and more reliable to communicate with variations of operations (Kisperska & De-Haan, 2011);
3. LEAInf 3: The adaptation of IT-based process integration must be a necessity to distribution system guaranteed synchronization and sequencing (Kisperska & De-Haan, 2011);
4. LEAInf4: In appearances of autonomous control should be easy to operate and difficulties of IT mass processing related activities (Scholz-Reiter & Mehrsai, 2009);
5. LEAInf5: The complete market demand information could be significant penetrates from the downstream of the supply chain to achieve its specific customer satisfaction (Scholz-Reiter & Mehrsai, 2009);
6. LEAInf6: The outbound logistic flow in SC could be a more effective distribution if complete operative information to drives the final customer satisfaction (Scholz-Reiter & Mehrsai, 2009).

The trade-off between lean and agile supply chain inventory attributes and inter-relationship

It is shown that trade-off b/w lean and agile Supply Chain Inventory (SCI) attributes are depicted in Figure 1. According to Here et al. (2002) examine that the role of transhipment to achieve the leagility. The various obstacles were found in the cross function integration, with production and product design, logistics integration within the product design, leagility achieves it. In contrast to the mathematical model of cost, dependent could be compared with and without transhipments with the supply chain. In such a model identified that lean transhipment to achieve

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the lower inventory costs and agile transhipments to the obtained better service level. Hybrid leagile transhipments initiatives to achieve the trade-off between costs and services performances. They finally conclude that transhipment concept immediate control the low-cost way to achieve leagility while compare of supply chain reengineering programme might be required for modification in process and products. The trade-off between lean-agile SCM paradigms must be recognized to decide the surplus or strategic stocking point in the company to achieve the supply chain becomes more efficient, streamline and sustainable. The extensive view of a relationship between the lean and agile paradigms and research contribution to achieving the sustainable competitive edge of the production system in the SC. The upstream direction of lean inventory practices based on push system and downstream direction of agile inventory practices concept based on a pull system. The production order Inventory DP based on the upstream part and customer order Inventory DP based on the downstream part. The manager's decisions in supply chain significant contribution to improving entire performance.

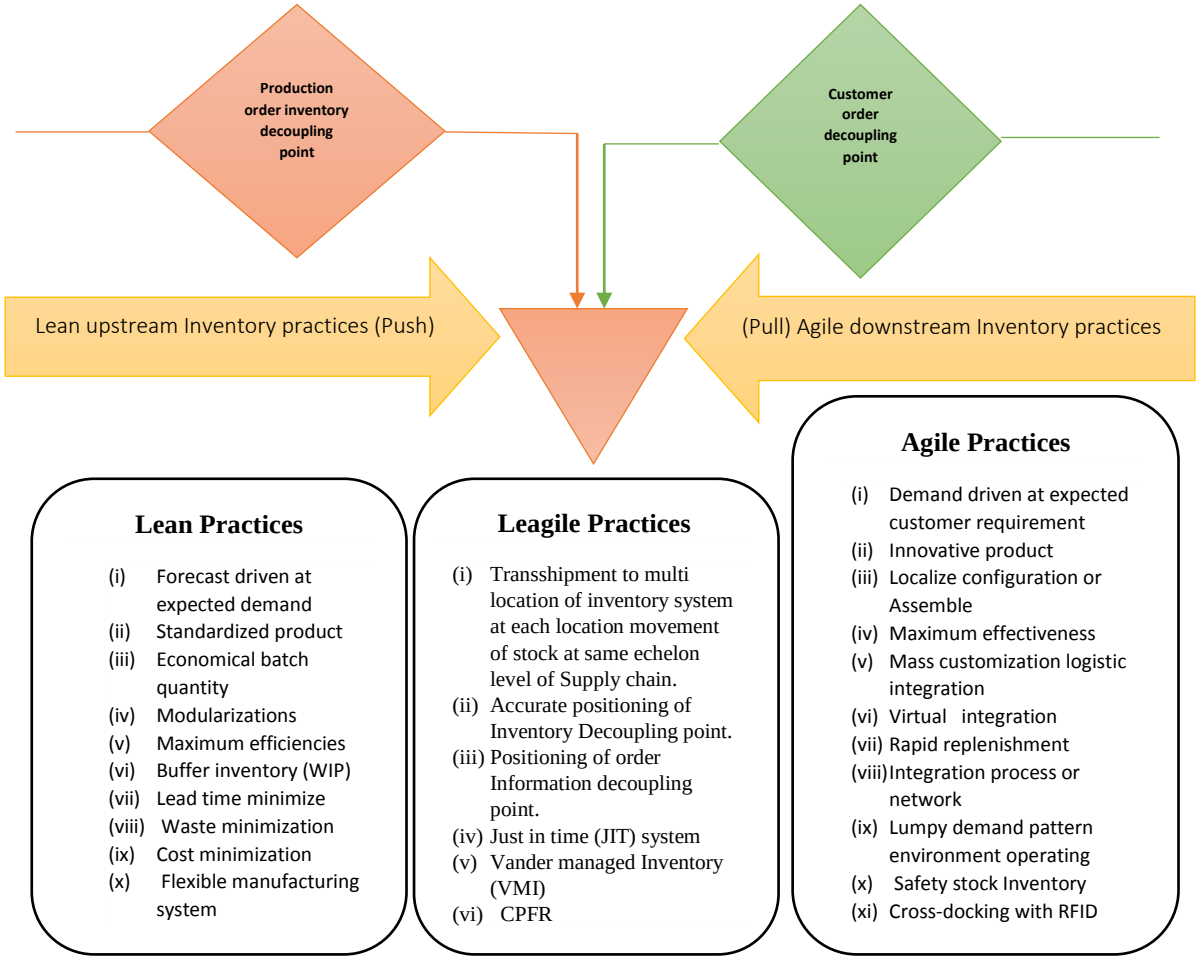

FIGURE 1
TRADE OFFS BETWEEN LEAN AND AGILE SUPPLY CHAIN INVENTORY ATTRIBUTES

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According to (Azevedo & Machado, 2009; Carvalho et al., 2010; Azevedo et al., 2010; Azevedo et al., 2011) examine that lean and agile management practices have a significant effect on the positive and negative impact of supply chain attributes. Therefore, it has necessary to balance b/w the lean and agile practices consideration and appropriate strategy selection based on supply chains. The understanding of relationship b/w the supply chain characteristics and Key Performance Indicators (KPIs). The contribution of lean and agile inventory attributes has a significant impact on the SCP. The developments of a relationship among the SC characteristics have changed within the lean and agile inventory attributes and existing performance indicators. The balance between positive and negative paradigms to better performance achieves. It has important to understand the relationship between the SC characteristics and key performance indicators. In the light of Carvalho & Machado (2009) develop a model to establish these relationships. The following IM attributes namely, Surplus capacity, replenishment frequency, Information frequency, integration level. In the cause analysis, it can seem to visualize how IM attributes effects on the performance indicators. The positive links represent that two nodes move in the same direction i.e. if the nodes are started decreasing g then other nodes also decreases. In the appearances of cause and effect diagram the supply chain attributes which has consequences to directly responsible for the SCP assessment.

The different types of decoupling point exist in production value chains

Bill of material decoupling point decision is a key necessity for Production Structure Decoupling Point (PSDP). In a multi-echelon supply network decoupling point decisions is a key requirement for supply Structure Decoupling Point (SSDP). In a multi-echelon demand, the network could be a key necessity to information sharing within demand transfer decoupling point (DTDP) to take an appropriate decision to achieve the market strategies and customer satisfaction. Decoupling point decision is a vital role in the global supply chain, where PSDP and SSDP are elemental decoupling points and DTDP can be logical decoupling, which can be functional of PSDP and SSDP. In evidence to examine that DTDP swings among the PSDP and SSDP and demand information critical role played in the supply chain network to identify the distortion causes. The material decoupling point stock acts as a buffer among the upstream and downstream direction of supply chains. The upstream direction of players to protect from consumer buying, therefore, established smooth upstream dynamics, while downstream of consumer demand meet *via* production pull by safety stock buffer. It has depicted in Figure 2, material decoupling point. The material DP may be used as a postponement strategy. Postponement basically defined as product differentiation as closer to the end consumer demand *via* strategic stock of material DP. The SC can be produced a generic product for long term possible to smoothing flow the upstream dynamics *via* reduces the product variety enable then chain to foster consumer demand and limit the effect of obsolete stock. For example, companies such as Hewlett-Packard have capitalized on moving the material stock DP closer to foster of consumer-related generic product printers and only recognize the centres to within the manufacturing plant Davies & Tom (1993). The strategic position of the material DP depends on very much on product types, consumer demands and SC approach adopted. In such situation four simplified SC strategies as defined by Pagh & Cooper (1998), they focus on alternative the positioning of material DP. According to this strategy applicable for high customized of products, which has high uncertainty of demand scenario (full postponement strategy) through

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the opportunity of providing standard products with less demand uncertainty (Full speculation strategy). Indeed, the positioning of material DP for each mentioned previously postponement strategies could be beneficial for different stages of SCs. The governing principle could be beneficial for moves the material DP positioning as closer to end consumer demand and ensuring shorten lead time for the consumer.

Depicted that material decoupling point

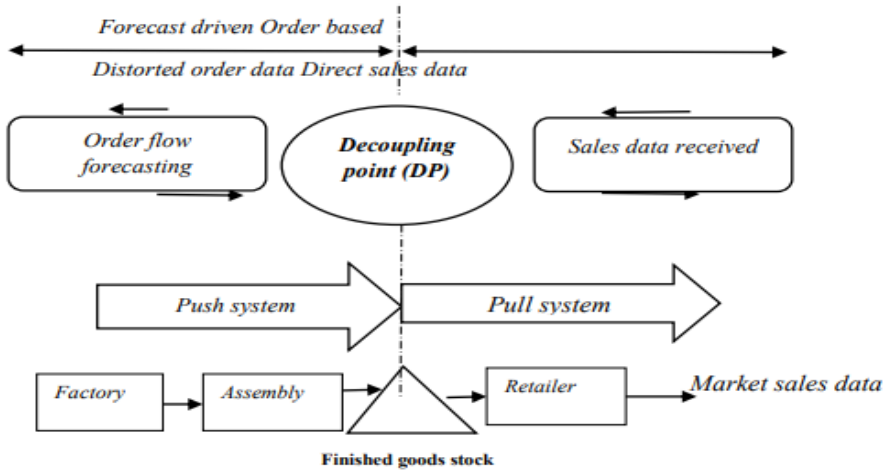

FIGURE 2
DEPICTED OF MATERIAL DECOUPLING POINT

Comparison of material and information decoupling point positioning within the supply chain

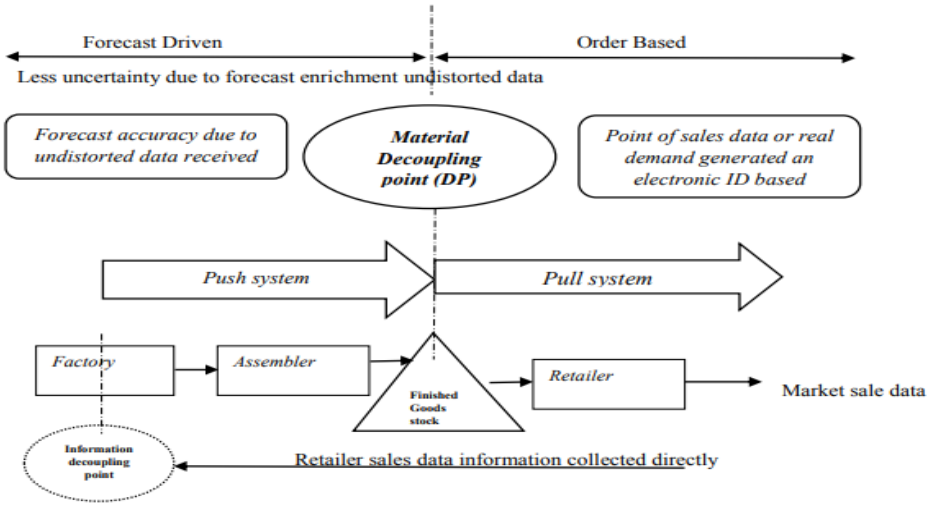

FIGURE 3
DEPICTED THAT MATERIAL AND INFORMATION DECOUPLING POINT

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According to Mason-Jones & Towill (1998) emphasized that material DP and information DP both have a separate entity in the supply chains. The strategic positioning of both DP can be beneficial for improving the performance realized. The pipeline information decoupling point can be defined as "*The point in the information pipeline to which the marketplace order data penetrates without modifications*". Where market driven and forecast driven information flow meets.

In pipeline information order decoupling point can be defined which as information turns from high actual value consumer demand data to mostly upstream distorted, high magnitudes and delay order data. The conventional supply chain concept related to material DP and it is closer to end consumer as possible. It has limited effectiveness of high-value resources undistorted order information available on the dynamics of SC. Therefore, strategic potential can be maximized if the data undistorted within the supply chain. In contrast to material decoupling point, the significant role of information decoupling point could be moved as far as possible. It enables to an upstream player to include within the ordering decisions that unbiased, undistorted, effective information that has already available downstream channel to coordinate and integrate effectively. The shifting of upstream direction to the downstream direction of order penetration capability within the supply chain closer responds to customer direct demand requirement.

The Case Study of the Telecom Network

According to (Jan, 2010) identified that complete successful operations of firms can be possible if the strategic aligned to the market requirements. Several companies have interested to incorporate the Customer Order Decoupling Point (CODP), which significantly contributes the strategic design manufacturing operations as well as SC. The CODP is a key point, where material DP and customer order specification (customer order Information DP) meets at production point within the value addition namely, Make to Stock (MTS) and make to order (MTO), Assemble to Order (ATO) and Engineering to Order (ETO). The positioning of CODP can coincide with accurate stocking point being at customer order starts. A perspective of supply chain CODP can be dominant entire supply chain flow. The Company is operating both networks namely, telecommunication industry and manufacturing microwave radio solution application in telecom networks. The major obstacles have found in the production lines. In this case study, two coordinators roles have significant supply chains. First, information of market coordinator and another coordinator is managers from operational management such as procurement process and production logistics coordination. An extensive view of cases study was provided (Selldin, 2005). An average 1000 variants were available in production line offered to the marketplace as customer requirement. The availability of auxiliary types of equipment such as antennas and power supply, the number of possible configurations of complete microwaves radio system has approximately one million. The existing upstream stages of production lines and a number of variants available in such limited. The whole supply chain focuses on the firm to respond quickly at unexpected or unpredicted demand (lumpy demand nature to match). The role of sales department managers and operational planning functional decisions to a mixture of forecasting for upstream operational activities such as supplier's capacity and customized order information to the converted final production stage. The rate based and time-based has depicted in Figure 3. The upstream direction of suppliers responsible to deliver printed circuits, components and modules. Components accessories namely, surface mounted on printed circuit boards, modules

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required into multi-chip modules, have supplied to intermediate inventory point at A. In order to an existing circuit board and multi-chip modules can assemble finally into microwaves unit. The complete microwave unit has tested before being delivered into inventory point at B. Although, finally filters necessity to provide each unit of the specified radio frequency has supplied from the outside suppliers to achieve the inventory point at B. The mechanical parts, accessories and covers have provided to the inventory at the point B. Inventory point at B has provided at CODP from non-standard products with a high fluctuation of demand at based on customer orders. The microwave unit is supplied filter with a unique frequency. However, finally complete microwave unit has produced before filter then and mounted in protective covers. The final assembly and tested operations have supplied to inventory at point C. Finally, finished products labelling, packed with other related accessories such as modern units and antennas and shipped to customers.

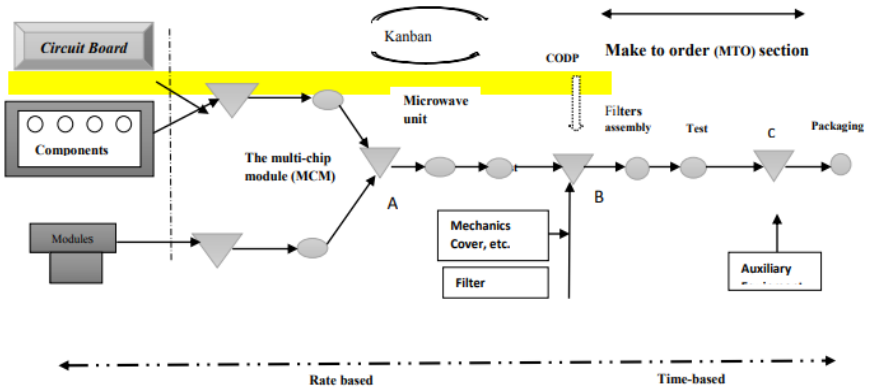

FIGURE 4
PRODUCTION AND SUPPLY CHAIN STRUCTURE OF THE CASE COMPANY (BASED ON SELLDIN, 2005)

A Kanban system: A Kanban system has an operational process to control the flow of material inventory stocking point based on CODP. The company uses three different Kanban loops such as First, the first step has employed for surface mounting in order to replenish inventory at point A. Similarly, manner has employed in multi-chip module for replenishment at inventory point at A and manufacturing product has tested and satisfied microwave unit to replenish inventory at point B. The separation point among the sections B and C have driven by Make-To-Order (MTO) system. Moreover, the utilization of the capacity at filter assembly has reduced drastically of items with relatively frequent and stable demand. The frequent and stable demand can be stocked inventory at point C. The strategic procedure adopted for CODP at inventory position B as well as focal point decisions initiative to differentiate the planning and controlling approaches. The existing of time-phased planning capabilities between the section of stocking Inventory Points B and C. Time-phased based approaches could behave like a rate based system w.r.t lot sizing, repetitive scheduling and sequences, while reverse could not possible. Most of the companie's initiatives to establish a hybrid planning approaches that involve Kanban types of functionality within a push system. The case study of company clear distinguishes between upstream and downstream operational activities emphasized the necessity

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of positioning of CODP into a strategic way, where designing and production management can be the execution of supply operations.

Case Study about Elevator Manufacturing Company and Production Line of a Supply Chain System

An elevator is structure design for specific needs in a building, under consideration of such factors certain height of the building, the number of user capacity on the floor, expected usages periods. The number of components and accessories varies with a number of stores and nature of the complexity of design of the elevator. The customer's requirement such as speed and capacity desired styles and accurate dimension of the building. The specific set of elevator components has specified and ordered from suppliers for subsequent assembly and installations in a specific building. There are existing a high-variety, low-volume and market volatility which focus on more competitiveness. The elevator manufacturer's company exercise was mapped and gathered by the questioning of each company staff members and frequently involved directly and indirectly with the company purchasing decision. Nicholas (1998) emphasized those four key functions in supplier's selection terms based such as purchasing, manufacturing operations, engineering and accounting. Under observation of the case study, the senior staff members in each department were selected based on experience and knowledge related to the business functions of the company. In order to most of staff's members in the purchasing department has selected. But, staff members from manufacturing operations were also responsible for engineering functions (Figure 4).

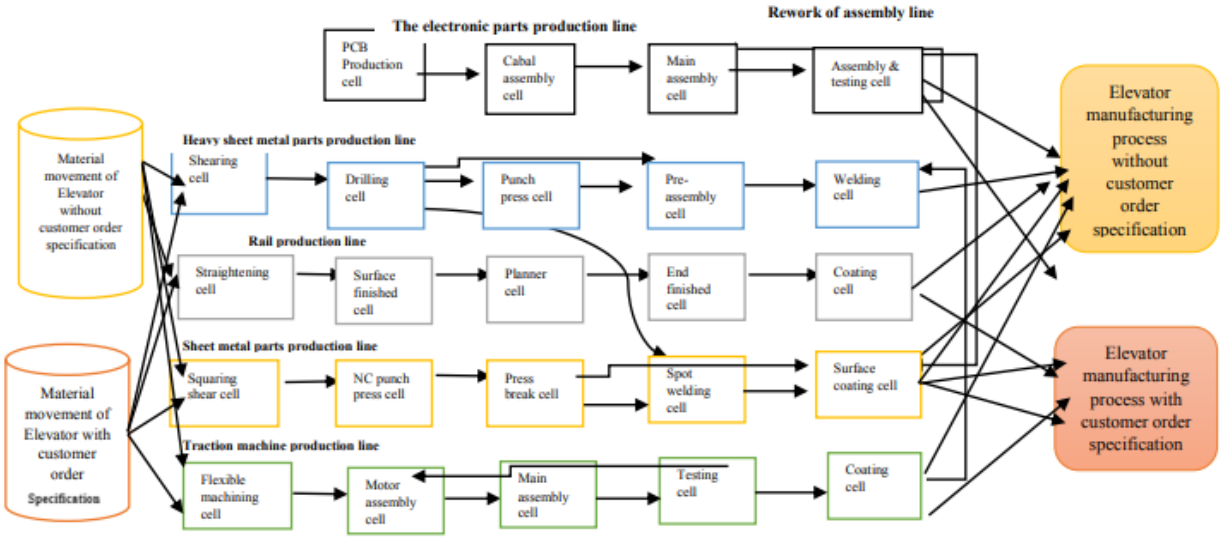

FIGURE 5
ELEVATOR PRODUCTION LINE OF SUPPLY CHAIN SYSTEM (LU, 2005)

The customer orders are generally two types one of the elevator orders, the first order is without specification of customer design elevator order and second elevator order is with the specification of customer design based subassemblies these production requirements of types may be related to a counterweight, floor door and rail or traction machine. These five-line

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process sub-assemblies in batches, while each batch consists of same subassembly types (Figure 5). The number of subassemblies in a batch can be different according to a number of stores and customer specification complexity of the design of the elevator. The operational processing times of batches and assembly types have varied accordingly. The intermediate stage supply-demand relationship exists among these fives production lines. Due to a variety of specific customer order certain-subassemblies in a line require the supply the other subassemblies from a different production line before being of assembled. Hence, all sub-assemblies can be made-to-order, intermediate stage matching all processes will be developed in the production cell are required. The final assembly of the elevator will not be performed until the elevator reaches the construction sites. The unique characteristics identified that all stages of finished sub-assemblies of an elevator must be grouped into a certain number of groups and then send to the warehouse. But, the necessity of process has grouping and matching of time of an elevator order responses becomes a crucial factor for performance enhancement of this production system. A long-time of horizon of matching results can be possible larger numbers of subassemblies in grouping buffer inventory, waiting of subassemblies that are still missing. Suppose the buffer inventory available and certain groups of sub-assemblies will have moved to warehouse storage and latterly they will decide to move back to finish the grouping process. This is a very costly and expensive procedure adopted. A short time of horizon matching can be a difficult task to achieve, while the delay of sub-assembly mostly found. Therefore, sub-assembly of elevators orders will be matching the time horizon and without delay of delivery performed.

Elevator manufacturer company operational working procedure:

According to Paul et al. (2013) emphasized that lean and agile purchasing model for examine the procurement strategies of the components level of the products support of the business strategy and addressing the weakness in the Kraljic type model. In considering a situation of agile elevator Manufacturer Company, which was adopted by Fisher's (1997) model in the business environment? The company primarily focused on agility implementation. An elevator manufacture company is incorporated both standard and specific components of design engineering products, also customized products to match the customer's requirement through a Make-To-Order (MTO) strategy. Subsequently, the implementation of flexibility is a quick effective and highest competitive priority in elevator manufacturing company. Thus, quality is the highest priority of safety reasons and flexibility is essential for customer requirement and competitive environments to sustain. Although, the elevator manufacturing company has required components characteristic such as innovative products, which involved agile supply nature and firms to focus on the lean and agile characteristics. According to Fisher principle emphasized that innovative products are suitable to fit agile supply concept and it shows significant involvement of the new model. The elevator is a relatively low priority of time (delivery lead time) to delivery responses. Elevator manufacturing approach has based on the Make-To-Order (MTO). Due to elevator manufacturing/assemble has governed by flexibility and quality aspects for essential factors of the components selection. The linkage between the manufacturer and customer based on customer order satisfaction could be an essential factor for flexibility of customer specification oriented build and quality aspects to satisfy the customer (criticality of safety requirement). The appropriate selection criteria of each pair such as lead time-flexibility and cost-quality relation to an assessment of leanness or agility respectively. For

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example, agile supply requirement can become critical competitive factors rather than flexibility, while such circumstances to satisfy the variables products requirements (Table 4).

The case study of elevator manufacturing company has demonstrated that how purchase strategy significant contribution to sustain of competitive priority of the business environment. An innovate product of elevators which varies of customer order requirement at lean and agile respectively components requirement. The situation of innovative products has strategic importance of leagile categories and another one at agile categories. The strategy of leagile supply concept can be performed cost-quality and flexibility and lead time delivery. Leagile supply could be beneficial for agility to achieve in components manufacturing company purchasing decisions and effective inventory management.

Table 4
ELEVATOR PRODUCT MANUFACTURE CHARACTERISTICS

Product life cycle	Product variety	Demand	Profit margins (%)	Average stockout rate (%)	Order winner	Level of customization	Manufacturing strategy	Supply chain
One to two years	More than 100 variants	Unpredictable	20 to 50	10 to 40	Flexibility	Tailored customization	MTO	Agile

Elevator manufacturing company number of components involved

1. Brake, 2. Buffers, 3. Car set, 4. Compensating chain, 5. Control panel, 6. Counterweights, 7. Door operator, 8. Door safety devices, 9. Governor, 10. Guide rails, 11. Guide shoes, 12. Interlock devices, 13. Limit switch, 14. Load weighing devices, 15. Motor generator, 16. Operation fixtures, 17. Rail brackets, 18. Roller guides, 19. Rope brake, 20. Ropes 21. Safety gear, 22. Traction machine, 23. Traveling cable.

The lean and agile purchasing portfolio model in elevator manufacturing company

There are four supply options such as lean, agile, leagile and non-strategic, which has adopted the purchase strategies. The procurement strategies have based on specific customer requirements of make to order strategies oriented. The components are specific and standard based on a requirement of lean or agile supply respectively. The lean supply has best for quality and cost, while agile supply has the best fit for lead time and flexibility. The manufacturing of elevator components performed into two dimension frameworks such as first dimensional components of leanness based on cost and quality and second-dimensional components agility based on flexibility and lead time (Figure 6).

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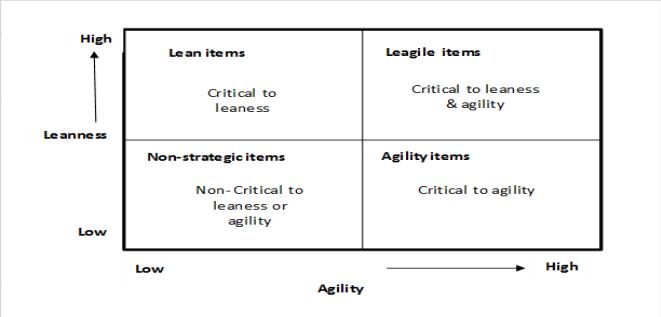

FIGURE 6
ELEVATOR MANUFACTURING ITEMS LEAN, AGILE AND LEAGILE PURCHASING ITEMS

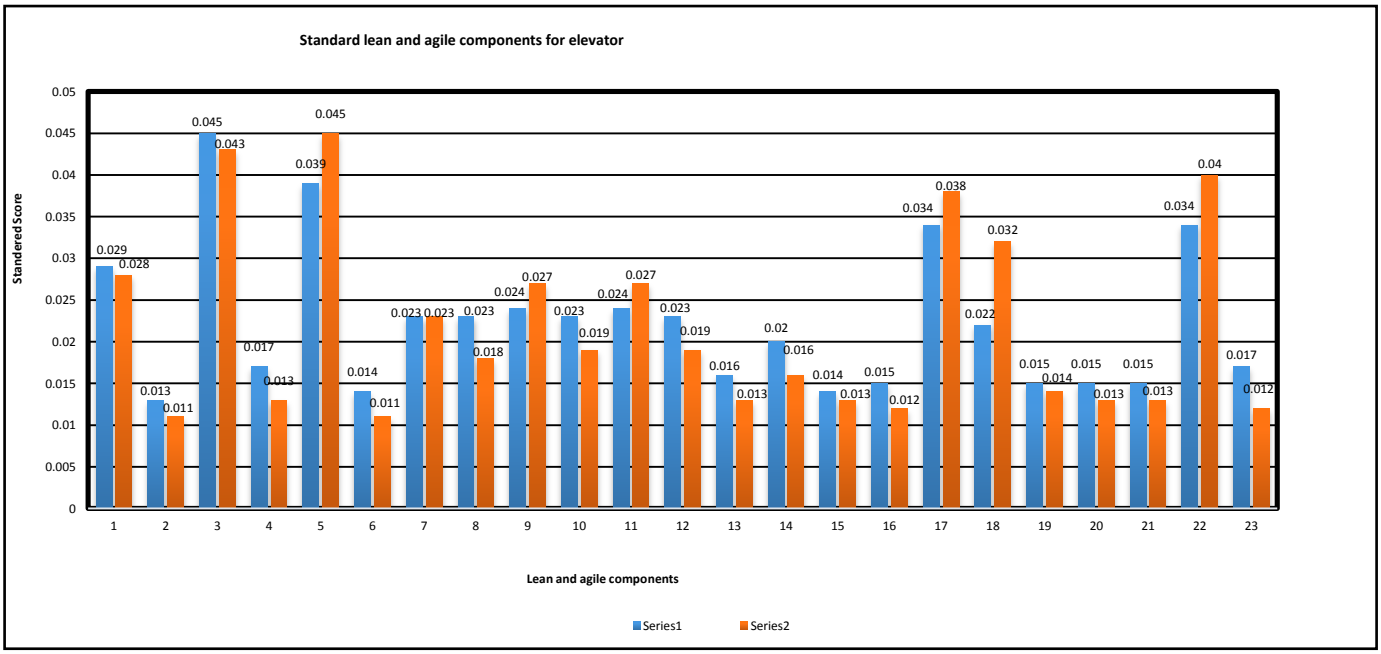

FIGURE 7
STANDARD LEAN AND AGILE SCORES OF MANUFACTURING COMPONENTS OF ELEVATOR

The composition of components selection within the lean and agile purchasing strategies has adopted in the company. It has depicted in Figure 7 and also attached appendix 1, which shown that elevator manufacturing items has agile category namely, Operation fixture sand several other components which have related to leagile category namely, Car set, control panel, Motor generator and Traction machine. Indeed, the elevator is an innovative product which fundamentally requirement to match the agile supply. According to leagile supply items concept of a combination of lean supply items to a performance of cost and quality and agile supply, items have enhanced the flexibility and delivery lead time. The non-strategic items have related to name, breaks, door operators, guides rails, door safety devices, computation chain, lower weight devices, counterweight, buffer, governor, ropes, interlock devices, rail brackets, safety gear and limit switch.

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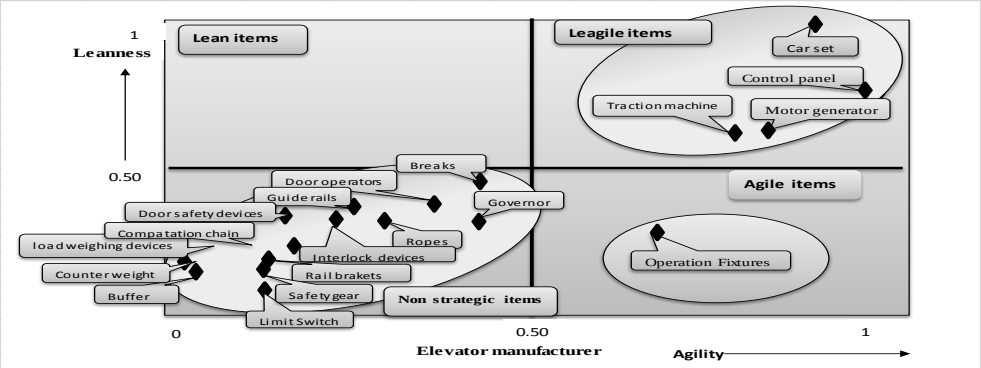

FIGURE 8
ELEVATOR MANUFACTURING ITEMS LEAN, AGILE, AND LEAGILE SUPPLY

The customer orders are generally two types one of the elevator order, the first order is without specification of customer design elevator order and second elevator order is with the specification of customer design based subassemblies these production requirements of types may be related to counter weight, floor door, and rail or traction machine.

The elevator manufacturing companies promise order are two categories, the first category has without specification of customer design elevator manufacturing and second categories have with a specification of customer design based on sub-assemblies of such components namely counter weight, floor door, rail or traction machine. The five lines of the process of sub-assemblies in batches while a batch of consists of sub-assembly's types. However, a number of sub-assemblies in batches to produced which can be a different set of subassemblies according to the number of stories and customer specification order promises of the design of the elevator. The processing times of sub-assemblies in batches production in both homogeneous for the same assembly types and heterogeneous for the different assembly types (Figure 8). Intermediate phase of supply-demand relationship exists among these existing production lines. Customer order promises of certain sub-assemblies in a line require the other-subassemblies from a different production line before final can be assembled. Since sub-assemblies are based on the Make-To Order (MTO) oriented and intermediate phase of matching assemblie's process will be performed in the production cells. The final assembly of the elevators would not perform until the elevator reaches the construction sites. The unique characteristics have identified in this system of finished sub-assemblies of an elevator. All the finished sub-assemblies of an elevator must be grouped into a certain set of numbers and then send to the warehouse. The certain set of grouping process of subassemblies to a matching of time of an elevator order becomes it may be crucial factors for the performance of production and delivery responses to match. A fruitful opportunity can be generated if the long-time duration to matching results and better forming of large numbers of sub-assemblies in grouping buffer, waiting time (queue time) sub-assemblies that are less delay time. The buffer inventory of sub-assemblies will be fulfilled in the way of warehouse storage and better performed of delivery of customer order responses. The late delivery responses and lowest warehouse expenditure cost could be minimized with the help of better components selection and procurement decision strategy adaptation in elevator manufacturing companies.

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What is lean inventory management?

According to Lean concept has a systematic concept to enhancing value addition in company's inventory by refining and eliminating waste of materials, effort and time through continuous improvement of his performance. These concept was associated on Henry (1920), who to applied the concept of continuous flow in the assembly-line process. The concept has been rectified and applicable for all the industries. The principle of lean inventory management techniques is constructed five principles namely:

1. Value addition: define the term of value that suitable fit for company to identify or investigate of lean inventory management.
2. Flow continuity: To understand how much amount of inventory stream line flows in warehouse.
3. Lean principle: 5S concept to overcome the obstacles that do not add up.
4. Pull concept based on lean principle: Customer order or request to move the inventory.
5. Responsiveness concept based on lean principle: it is being able to adopt the change.
6. Quality perfection based on lean principle (Six sigma): continuous practices to improve your inventory management process and improve the quality, cycle time, efficiency and cost.

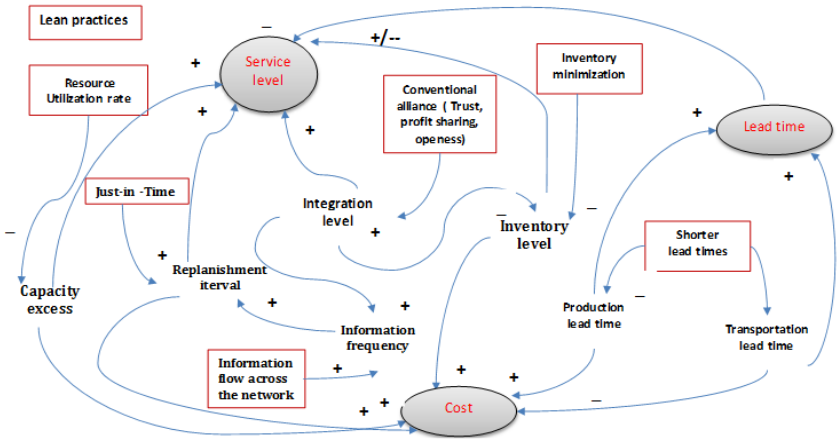

FIGURE 9
LEARN INVENTORY ATTRIBUTES WITH SUPPLY CHAIN PERFORMANCE RELATIONSHIP

Lean inventory attributes *vs.* supply chain attributes

The linkage between lean inventories attributes and Supply Chain Performance (SCP) have depicted in Figure 9. The established a relationship has positive/negative indicators significant effects on SCP. Lean inventory attributes are characterized by such as Table 5, inventory minimization, resource utilization rate and information flow across the network, JIT (just-in-time) practices, convention alliances and shorter lead times. Table 5, depicted the lean inventory attributes effects on the SCP. The illustrated Table 5, clearly the relation b/w the lean inventory attributes and the SCP.

The relation between the lean inventories attributes and supply chin performance may reveal better understanding, having in mind the following interpretations.

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Inventory level Minimization: The performance of supply chain affected by negatively in inventory level minimization. The inventory level is affected negatively by the minimization (a higher level of inventory minimization stimulates a lower level of inventory).
Convention alliances (trust, profit sharing, openness): The performance of supply chain affected by positively at related to the level of trust, negotiation and profit sharing of conventional alliances in the lean supply chains.

Information frequency: The performance of supply chain improved by a flow of information frequency at information flow across the network.
JIT (Just in Time): The implementation of just-in-time practices increases the replenishment frequency.

Resource utilization: The implementation of lean practices is characterized by a higher supply chain resource utilization causing a decrease in the supply chain capacity excess.
Lead time reduction: The length of the lead time is a key factor of production and transportation lead times, the reduction of lead time more affects negatively to the production transportation lead times (increasing the level of lead time reduction more favourable stimulates a reduction production and transportation lead times).

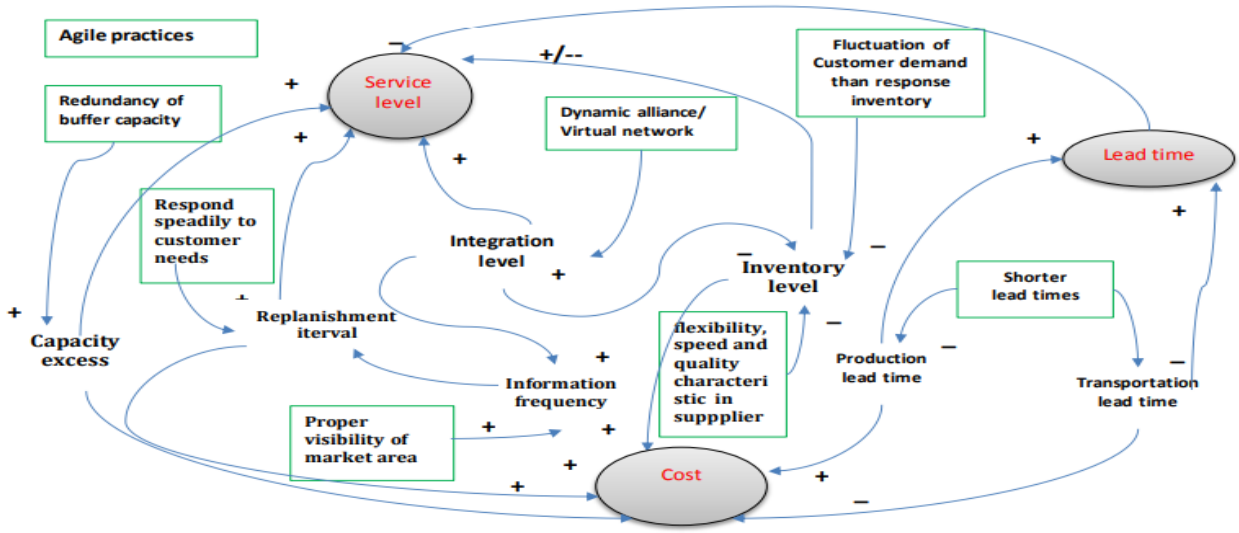

FIGURE 10
AGILE INVENTORY ATTRIBUTES WITH SUPPLY CHAIN PERFORMANCE RELATIONSHIP

Agile inventory (safety stock) attributes *vs.* supply chain attributes

The link between agile inventories (safety stock) attributes and Supply Chain Performances (SCP) have depicted in Figure 10, the established a relationship of positive/negative indicators significant effects on SCP. This is illustrated in Table 5, the main contribution of agile inventory attributes is characterized such as inventory responses to volatile customer demand, Redundancy of buffer capacity, the quick response of customer demand, proper visibility of market area, dynamics alliances, supplier readiness of speed, flexibility and

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quality and shorter lead times. It has depicted that in Table 5, the relationships established between the supply chain agile inventory attributes and the SCP.

Response of inventory in volatile customer demand: The consequence of inventory level is affected negatively by the inventory in response to customer demand. (let us consider the inventory is design to better respond to customer needs, then lower level of inventory expected in supply chain) and upstream actors by the supplier readiness such as flexibility, speed and quality assurance (let us consider, the supplier readiness have higher levels of flexibility, speed and quality but the necessity of inventory buffer is too low, which may be lead to lower inventory levels).

Information frequency: The information frequency is positively elevated by an eventual increase in overall supply chain visibility.

Dynamic alliances: The magnitude of the integration level is positively associated with the presence of a dynamic alliance in the agile supply chains.

Respond speedily to customer needs: The replenishment frequency 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 in the supply chain resources stimulating an increase in capacity surplus.

Lead time reduction**:** The length of the lead time is a key factor of production and transportation lead times, the reduction of lead time affects negatives the production and transportation lead times (increasing the level of lead time reduction stimulates a reduction production and transportation lead times).

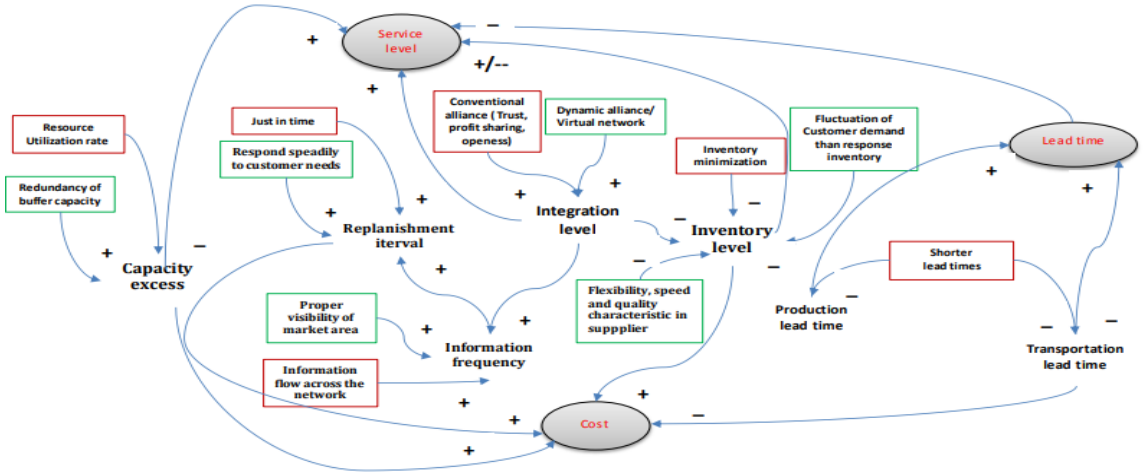

FIGURE 11
COMBINED LEAN AND AGILE INVENTORY ATTRIBUTES RELATIONSHIP WITH SUPPLY CHAIN ATTRIBUES

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

It has provided of combined lean and agile inventory attributes practices of divergences natures and overlapping of the diagrams with the relationships between the different supply chains and the lean and agile inventory attributes has developed. Figure 11, depicted it reveals that integration the lean and agile inventory attributes and SCP relationships. From the cause

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diagram, in present of diagrams to verify that mostly supply chain attributes are positively affected by all inventory attributes

(i) Information frequency increases.
(ii) Integration level increases
(iii) Productions lead time reductions.
(iv) Transportation leads time reductions.

In the supply chain attributes, lean and agile inventory attributes are implemented results in different directions. The results found divergently related to the capacity surplus are the following:

The lean inventory attributes suggest that a reduction in the supply chain buffers capacity. It can reduce the unnecessary wastes and efficiency of resources consumption. The agile inventory attributes suggest that an increase in the capacity surplus to increase the supply chain ability to respond to changes in customer's need and to possible disturbances. A similar divergence is related to the replenishment frequency. The lean inventory attributes suggest an increase in the replenishment frequency in order to respond speedily to customer needs and increase the supply chain responsiveness. Similarly, the third divergence between the lean and agile inventory is related to the inventory level. According to lean and agile strategies adoption suggests a reduction in the inventory level. The supply chain attributes should be managed, namely information frequency, integration level, production lead time and transportation lead time.

Table 5
LEAN AND AGILE SCM SYNERGIES AND DIVERGENCES OVERVIEW

Inventory attributes / **Supply chain Performance attributes**	**Lean inventory attributes**	**Agile inventory attributes**
Information 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.		

Table 5, shows an inspection of the main synergies and divergences between the lean and agile inventory attributes under study. The implementation of these lean and agile inventory

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attributes should be managed namely, information frequency, integration level, production lead time and transportation lead time. However, the impact of each inventory attributes implementation in the characteristics magnitude may be different.

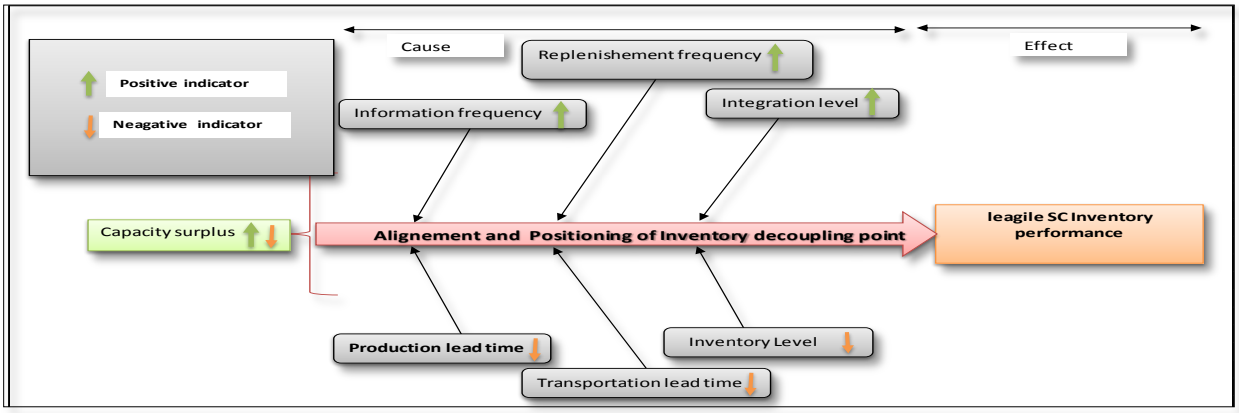

FIGURE 12
CAUSE AND EFFECT ANALYSIS OF LEAGILE SC INVENTORY PERFORMANCE

CONCLUSION

Finally, conclude that cause and effect analysis under lean and agile inventory attributes impact on Supply Chain Performance (SCP) such as cost, lead time and service level. It is depicted in Figure 12. It clearly shows positive and negative indicators are a significant impact on accurate positioning of inventory decoupling point. The positioning of DP is a key necessity for balancing of effective cost reduction and more responsive customer satisfaction to achieve by appropriate location of stocking inventory for market demand and availability of surplus inventory for quickly responding to variation in the customer demand with effective cost reduction. According to emphasized that SCP involved that SC should be quickly responding to fluctuation in customer demand with effective cost reduction. Leagile supply chain can be trade-off b/w the effective cost reduction and more responsive to achieve the service level.

The upstream direction of lean practices based on push system and the downstream direction of agile practices based on a pull system. The accurate alignment and positioning of DP is a key necessity to achieve the stocking the surplus inventory and better service level or customer satisfaction and reduces delivery lead time responses. These lean and agile inventory attributes are mainly concern to optimize surplus inventory level and replenishment frequency to optimize supply chain management achieves. In such situation of surplus capacity (buffer or safety inventory) increases then surplus inventory may provide the supply chain with added agility characteristics of effective responses to changes in customer demand and overcome the market uncertainty of demand variability. Two case studies shreds of evidence considered in this paper namely: (i) The telecommunication industry and manufacturers microwave radio solution for application of telecom network. Telecom network based on hybrid planning approach based on Kanban-types functionality with a push system. Upstream and downstream operations emphasizing the necessary action based on CODP into strategic consideration, where design of production process and supply operation executions based on customer specific order, (ii)

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Elevator manufacturing company have purchasing of items based on lean, agile and leagile supply. The two case studies evidence shown that inventory management in leagile supply chain is a key necessity for effective-cost reduction and responsive-service level to achieve customer satisfaction. Cause and effect analysis to identify that combined leagile inventory attributes have affected by positive and negative indicators such as information frequency, replenishment frequency and integration level, the negative indicators such as production lead time, transportation lead time and inventory level. The cause and effect analysis is employed to identify the influence of combined leagile inventory attributes on the SCP. The surplus inventory concept (safety inventory) to achieve the agility at downstream direction more customer satisfaction achieved. The effective inventory management is a key necessity to pull based system production (make to order) approaches and positioning of customer order decoupling point to decide for customer order oriented production and supply chain structuring. The positive indicators such as information frequency, replenishment frequency and integration level are entailed for accurate positioning of inventory decoupling point. The negative indicators are such as production lead time, Transportation lead time and inventory level are entailing for effective delivery responses for customer satisfaction. Leagile SC inventory performance is a key necessity for optimal supply chain management resources utility. The final assessment of lean and agile inventory attributes help in SCM to reduce the risk polling. The concept of lean and agile inventory attributes to overcome of global competitiveness of effective cost reduction and responsive customer satisfaction. The global purpose to satisfy the customer requirements and lowest possible costs to all the members of supply chains. The principles of lean and agile inventory strategies are distinguished such as JIT system, VMI system, VMI programme, inventory forecasting, JIT purchasing, collaborative inventory management practices. Similarly, agile inventory strategies such as Inventory replenishment frequency, VMI with RFID implementation, Cross-docking facilities with RFID, EDI, information frequency, Integration level, VMI with IOT information flow (Internet of things). The lean supply chain concept focuses on waste minimization, reducing non-value added activities, redundancy of inventory level reduces, stable customer demand. The agile supply chain concepts explore the quick response to the market changes in demand, such as VMI with consignment stock, a vendor with Source flexibility, flexible manufacturing system and supply chain visibility.

Outcomes

The Outcome of this study is trade-off (balance) between the upstream lean inventory attributes and downstream agile inventory attributes characteristics and effective positioning of surplus inventory (safety inventory) location for DP decision by managerial as well as practitioners to reduce the optimal resource utilization. Surplus capacity of inventory provides more additional agility at downwards direction to better service level perform**.** According to cause and effect analysis identified that supply chain attributes are positive and negative directly linkage to lean and agile inventory attributes adaptation. The combined approach of lean and agile inventory attributes to overcome total supply chain strategies such as effective reduction of total cost and improve the service level. The downstream direction of service level can be improved by more additional agility from safety stock inventory**.** Lean and agile inventory attributes have found significant effect such as information frequency increases, integration level increases, production lead time reduction and transportation lead time reduction and reducing

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inventory level. However, some parts are divergent of lean and agile inventory attributes namely, surplus inventory level and replenishment frequency. In such scenarios, surplus inventory capacity may provide more supply chain volume flexibility with agility and resilience capability. Due to such circumstances delay or late delivery of Inventory replenishment, longer length of the supply chain and disruption of internal and external environment impact. The Downstream direction of agility can be effective responses to change in customer demand at the shortest time horizon to fulfil the customer requirement. The number of reduction of replenishment frequency can overcome carbon emission challenges in the supply chain.

Future Extension

Develop a relationship among LARG paradigms and established the trade-off mechanisms between the lean, agile, resilience and green approaches to multi-dimensional performance achieves within supply chain strategies. The holistic perspective to establish the integration of lean, agile, resilience and green paradigms in the optimal supply chain management and optimal resources utility. From a managerial point of view, to understand the positive and negative inventory attributes effect between the different supply chain paradigms within the SCP. The upstream and downstream direction of inventory attributes based on accurate alignment and positioning of inventory DP decision based effective customer order decoupling point decision and delivery services provided. The upstream part decides the production structure decoupling point related to bill of material and Supply Structure Decoupling Point (SSDP) related to supply network decoupling point. Similarly, downstream part decides of Demand Transfer Decoupling Point (DTDP) which is associated with information sharing. DTDP is a logical decoupling point, which is basically a function of PSDP and SSDP and also swings direction is a critical piece of supply chain information that helps identify distortion level. Develop a trade-off sustainable mechanism to fit the DP among the lean and agile supply chain inventory attributes. As a senior manager's insights to how the adoption of suitable paradigms will affect their supply chain network and study the adoption of business tools impact on namely ERP and MRP in the supply chain performance.

Appendix 1

The score of Lean and agile components in the elevator manufacturing company Paul R. Drake (2013)

Normalized scores of lean and agile of all components in the elevator manufacturer (Paul R. Drake, 2013)

	Evaluator-A		**Evaluator-B**		**Evaluator-C**		**Evaluator-D**		**Evaluator-E**		**Mean score**	
Elevator component	Lean	Agile	Lean	Agile	Lean	Agile	Lean	Agile	Lean	Agile	Lean	Agile
1.Brake	0.033	0.03	0.024	0.026	0.032	0.031	0.024	0.032	0.035	0.017	0.029	0.028
2.Buffers	0.014	0.0008	0.019	0.015	0.015	0.009	0.012	0.01	0.011	0.011	0.013	0.011
3.Car set	0.046	0.037	0.039	0.039	0.047	0.047	0.047	0.041	0.052	0.049	0.045	0.043
4.Compensating chain	0.015	0.011	0.019	0.015	0.016	0.011	0.018	0.013	0.017	0.014	0.017	0.013
5.Control panel	0.039	0.043	0.029	0.046	0.053	0.045	0.033	0.043	0.037	0.046	0.039	0.045
6.Counterweights	0.015	0.009	0.019	0.015	0.015	0.009	0.013	0.01	0.011	0.011	0.014	0.011
7.Door operator	0.025	0.022	0.019	0.026	0.026	0.022	0.023	0.023	0.027	0.022	0.023	0.023
8.Door safety devices	0.025	0.021	0.019	0.026	0.023	0.013	0.023	0.02	0.023	0.015	0.023	0.018
9.Governor	0.029	0.035	0.022	0.022	0.019	0.026	0.02	0.032	0.029	0.02	0.024	0.027
10.Guide rails	0.026	0.019	0.022	0.019	0.026	0.018	0.019	0.02	0.029	0.0222	0.023	0.019
11. Guide shoes	0.013	0.012	0.019	0.015	0.014	0.013	0.018	0.013	0.015	0.015	0.024	0.027
12.Interlock devices	0.024	0.012	0.019	0.019	0.015	0.019	0.019	0.014	0.021	0.015	0.023	0.019
13.Limit switch	0.012	0.012	0.019	0.015	0.013	0.013	0.018	0.013	0.009	0.015	0.016	0.013

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14.Load weighing devices	0.012	0.011	0.019	0.013	0.013	0.011	0.018	0.013	0.014	0.014	0.02	0.016
15.Motor generator	0.035	0.043	0.029	0.026	0.037	0.045	0.031	0.033	0.037	0.041	0.014	0.013
16.Operation fixture	0.022	0.036	0.021	0.026	0.024	0.033	0.025	0.031	0.02	0.037	0.015	0.012
17.Rail brackets	0.012	0.012	0.019	0.015	0.013	0.013	0.018	0.014	0.015	0.015	0.034	0.038
18.Roller guides	0.012	0.012	0.019	0.015	0.013	0.013	0.018	0.013	0.014	0.015	0.022	0.032
19.Rope brake	0.014	0.013	0.019	0.015	0.016	0.014	0.02	0.014	0.016	0.015	0.015	0.014
20.Ropes	0.025	0.022	0.022	0.015	0.024	0.026	0.02	0.023	0.027	0.017	0.015	0.013
21.Safety gear	0.012	0.012	0.019	0.015	0.013	0.013	0.018	0.013	0.014	0.015	0.015	0.013
22.Traction machine	0.035	0.011	0.019	0.015	0.016	0.012	0.018	0.014	0.017	0.012	0.034	0.04
23. Traveling cable	0.015	0.486	0.503	0.479	0.508	0.492	0.504	0.496	0.502	0.498	0.017	0.012

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