Supply Chain Performance Paradigms: A Survey

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***Abstract*-- Supply chain management (SCM) is concerned with the efficient integration of suppliers, factories, distributors, warehouses, and stores so that merchandise is produced and distributed in the right quantities to the right locations at the right time in order to minimize total system cost and satisfy customer service requirements. In SCM, what is required is how to improve the performance. Supply chains, in an attempt to be more competitive, are adopting new management paradigms. Among these paradigms, there are five that deserve particular mention because of their importance to better SC performance: lean, agile, resilient, green and talentship (LARGT) paradigms. Performance measurement is crucial to better SCM. The lack of appropriate metrics for these measurements could be the main reason responsible for the following failure breakdowns in the supply chains: (1) inability to meet customer satisfaction; (2) suboptimization of firms' performance; (3) loss of opportunities to outperform the competition; and (4) creation of conflicts within the supply chain. The simultaneous integration of LARGT paradigms in SCM may help supply chains to become more efficient and streamlined, and also more sustainable. In this paper an extensive literature review was discussed and an extensive overview on supply chain practices, and competitive capability with detailed LARGT practices is discussed to improve supply chain performance. The detailed overview provides a foundation for further research directions.**

***Index Term*-- Supply chain management, lean, agile, resilient, green, talentship, and performance.**

I. INTRODUCTION

A supply chain (SC) is a network of suppliers, factories, warehouses, distribution centers, and retailers, through which raw materials are acquired, transformed, produced, and delivered to the customer. The SC consists of all the activities associated with the flow and transformation of goods from the raw material stage, through to the end user, as well as the associated information flows as shown in Fig. 1. SCM is a set of synchronized decisions and activities, utilized to effectively integrate suppliers, manufacturers, transporters, warehouses, distributors, retailers, and customers so that the right product or service is distributed at the right quantities, to the proper locations, and at the appropriate time, in order to minimize system wide costs while satisfying customer service level requirements. SCs, in an attempt to be more competitive, are adopting new management paradigms. Among these paradigms, there are five that deserve particular mention because of their importance to better SC performance: lean, agile, resilient, green, and talentship (LARGT)[1, 2].

Recently, it is accepted that competition is among SCs, not among companies anymore. SCs, which work more efficiently and create more value, will be ahead in competition. It is considered that the degree of the integration of the business functions through the SC, which is in any point in the chain that starts from the suppliers and continues till end users, affects the member companies' competitive capabilities and business performance in the SC. Companies that manage the SC as a single entity and ensure the appropriate use of tools and techniques in order to meet the needs of the market will not get left behind in the fight for survival [3].

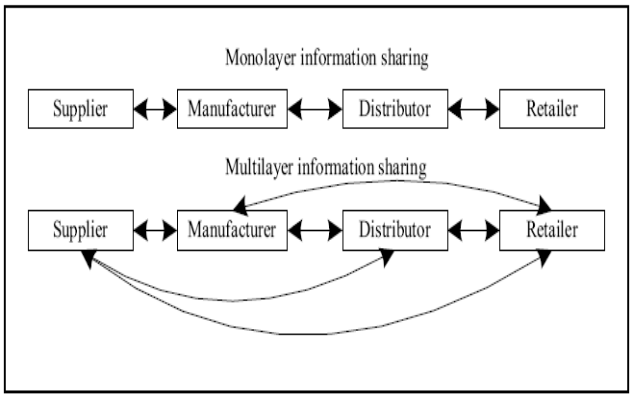

Fig.1. Span of information flow.

An SC typically extends across the multiple enterprises including suppliers, manufactures, transportation carriers, warehouses, and retailers, as well as customers, and entails sharing forecast, order, inventory, and production information to better coordinate management decisions at multiple points throughout the extended enterprise [4, 5]. An integrated SCM based on multiagent systems (MASs) technology is really a great asset. Such SCM will keep the correct information flowing over the entire SC, help supplier selection process to be easier, and provide a proper distribution system [6].

The paper is organized as follows. Section II displays a literature review. Section III classifies SC paradigms. In section IV, the performance measurement of LARGT SCM is presented. In section V, LARGT SCM practices, integration, and competition capability versus performance are studied. The conclusion and future work are outlined in section VI.

II. LITERATURE REVIEW

Some of the following literature reviews are concerned with using MASs in SC managements, and the others concentrated on the different paradigms used for improving SC performance. These paradigms are lean, agile, resilient, green and talentship (LARGT). The integration of these five

paradigms with intelligent agents will enhance the performance of the SC. We argue these literature reviews as follows.

Kumar et al. [5] argue A Multi-agent Conceptualization for Supply-Chain Management. They designed and implemented a set of agents that integrates bilateral negotiation. Order monitoring system and Production Planning and Scheduling multi agent system. Some of these agents are: Requirement/Logistic agents: These agents coordinate all activities of plant and find the various demands of various sections. Demand Agent: the main objective of this agent is to acquire orders from various vendors, compare them on the basis of quality, price, availability etc. Transportation agent: this agent is responsible for the availability of the transport, dispatching of finished goods at particular destination. It manages all the transportation routes. Financial agent: is responsible to avail the money for purchasing any material. Scheduling agent: is responsible for scheduling and rescheduling activities in the factory and generating schedules that are sent to the dispatching agent for execution.

Srinivasan et al. [7] proposed a multiagent architecture for integrated dynamic scheduling of the steel pipe industry; each agent performs a specific function of the organization and shares the information with other agents. The proposed work focus large -scale scheduling in the steel pipe industry on the significance and benefits of operating supply chains as an integral part of the modern manufacturing enterprises and also the importance of information sharing as the major requirement for the effective functioning of supply chains. The scheduling systems of these processes have different objectives and constraints, and operate in an environment where there is a substantial quantity of real-time information concerning production failures, supplier information , order processing and customer requests. Each process is assigned to an agent who independently, seeks an optimal dynamic schedule at a local level taking into account local objectives, real-time information and information received from other agents. Each agent can react to real-time events in order to fix any problems that occur.

Xu et al. [8] proposed an advancing mechanism that integrates high level architecture with multiagent distributed simulation to meet time management in SC simulation. Among the techniques supporting a multidecision context, as a supply chain is, distribution simulation can undoubtedly play an important role in a co-operative environment. The distribution simulation for supply chain has its advantages to find and solve bottleneck of supply chain. Considering the design of distribution simulation platform for supply chain, the realization of time synchronization and time advance will be the key points. This paper proposes an advancing mechanism that integrates High Level Architecture with multi-agent distributed simulation to meet time management in supply chain simulation, i.e., a 'heterogeneous' system is built during this research.

Seitz et al. [9] states that a key problem with digital product memories is their cross-domain nature, i. e. new relevant data must be added to the memory from various stakeholders during the complete product life cycle. They proposed an agent-based architecture for appending sensor data to a digital product memory in a generic way. Additionally, methods are presented how a digital product memory can be analyzed and evaluated to simplify business processes, to ease maintenance, or to bring benefit to the end-user.

Misra et al. [1] surveyed the SCM systems and stated that six characteristics define current SCM philosophy: (1) shared information, (2) organizational relationships, (3) inventory management, (4) total pipeline coordination, (5) readiness to adopt flexibility, and (6) costing issues. They considered agent-based SCM as the vision and stated that agents can help transform closed trading partner networks into open markets and extend such applications as production, distribution, and inventory management functions across entire SCs spanning diverse organizations.

Carvalho et al. [10] proposed a multiagent system for managing SC problems. They applied their systems on chemistry industry and the Hewlett-Packard. The main purpose of this paper is to assess if Multi-agent Systems technology can be used to model, study and manage Supply Chains. A second objective is to present new tools and results that they have not presented before. In this paper they present multi-agent technology as a sound alternative to classical optimization techniques that can contribute to solve hard problems. To validate this hypothesis it was modeled and implemented a MAS with the following functionalities: simulation of an almost infinite number of agents, heuristics for decision making, possibility to choose among alternative decision strategies and tactics, different evaluation criteria and evaluation functions, different message sequences, and stochastic or deterministic behavior.

Paolucci et al. [11] states that a major problem faced by manufacturing organizations is providing efficient and cost-effective responses to the unpredictable changes taking place in global markets and in supply chains. Sales and Operations Planning helps giving better customer service, lower inventory, shorten customer lead times, stabilized production rates providing top management with a handle on the business and supporting a company to get and keep demand and supply in balance over time. They proposed a multiagent-based system that would enable small- and medium-size manufacturing organizations to dynamically achieve cost-effective aggregate sales and operations plans in SC contexts. Their work presents the main features of the proposed system and it finally discusses the benefits and limitations highlighted by its application in real industrial contexts.

Uppin et al. [12] outlined that two major outcomes of the literature survey are that information sharing is the most important requirement of efficient SC and multiagent modeling is most suitable for designing SCs. On the other hand, the proposed work focus on the significance and benefits of operating supply chains as an integral part of the modern manufacturing enterprises and also the importance of information sharing as the major requirement for the effective functioning of supply chains. In order to provide the necessary information technology support for the supply chains, the basic concepts and features of agent technology has been evaluated in order to determine its suitability for the management of supply chains. An overview of multi agent model for the supply chain is presented and also the integrated functioning of certain agents resulting in information sharing is also demonstrated.

Kumar et al. [4] reviewed SCM system with short explanation and conclusion to this system. This research can demonstrate that agent technology is suitable to solve communication concerns for a distributed environment. Multi-agent systems try to solve the entire problem by collaboration with each other and result in preferable answer for complex problems. It focuses on an ongoing development and research activities of MAS for supply chain management and provides a review of the main approaches to supply chain communications as used mainly in manufacturing industries.

Abdoli et al. [13] provided a conceptual framework for implementing a sales agent at Internet-based stores (e-stores). They consider and discuss different opportunities for employing Intelligent Agents to improve the performance of an estore's operations, including sales, forecasting demand and supporting order fulfillment. They provide a framework for the application of such agents, show available sources of information, and discuss challenging issues in modeling learning and decision processes for agent.

MASCOT, which is a reconfigurable, multilevel, agent-based architecture for planning and scheduling, aimed at improving SC agility [14]. They defined their problem definition as follows: A global economy and increase in customer expectations in terms of cost and services have put a premium on effective supply chain reengineering. It is essential to perform risk-benefit analysis of reengineering alternatives before making a final decision. Simulation provides an effective pragmatic approach to detailed analysis and evaluation of supply chain design and management alternatives. However, the utility of this methodology is hampered by the time and effort required to develop models with sufficient fidelity to the actual supply chain of interest. In their work, they describe a supply chain modeling framework designed to overcome this difficulty. Using this approach, supply chain models are composed from software components that represent types of supply chain agents (like retailers, manufacturers, transporters), their constituent control elements (like inventory policy), and their interaction protocols (like message types). The underlying library of supply chain modeling components has been derived from analysis of several different supply chains. It provides a reusable base of domain-specific primitives that enables rapid development of customized decision support tools.

Chen et al. [15] analyzed the effects of negotiation-based information sharing in a distributed make-to-order manufacturing SC in a multiperiod, multiproduct-types environment, which is modeled as a multiagent system. In this work a Supply Chain Multi-agent Systems framework integrating Bilateral Negotiation, Proactive Order Monitoring Multi-Agent System , and Production Planning and Scheduling of Multi-Agent System modules on the basis of different agent platforms is presented to address the organising planning and synchronising monitoring events in a supply chain. It addresses the negotiation for suppliers' proposals trade-off and the dynamic scheduling for new orders aspects of supply chain management. Moreover, they introduce key innovative modules of the MAS frame with a special emphasis on a series of negotiation and monitoring processes through employing fuzzy logic to evaluate suppliers' proposals, and then proactive detection of events.

Federgruen et al. [16] addresses the simultaneous determination of pricing and inventory replenishment strategies in the face of demand uncertainty. More specifically, they analyze the following single item, periodic review model. Demands in consecutive periods are independent, but their distributions depend on the item's price in accordance with general stochastic demand functions. The price charged in any given period can be specified dynamically as a function of the state of the system.

Chen et al. [17] describes an ongoing effort in developing a Multi-agent System for supply chain management. In this framework, functional agents can join in, stay, or leave the system. The Supply Chain Management System functionality is implemented through agent-based negotiation. When an order arrives, a virtual supply chain may emerge from the system through automated or semi-automated negotiation processes between functional agents. They present this framework and describe a number of negotiation performatives, which can be used to construct pair-wise and third party negotiation protocols for functional agent cooperation. They also explain how to formally model the negotiation process by using Colored Petri Nets.

A mechanism to make decisions based on global information without complete access to that information is required for improved SC decision making. Cigoloni et al. [18] carried out a study of the Collaborative Planning, Forecasting, and Replenishment process for trading partners (belonging to the same SC) who are willing to collaborate in exchanging sales and order forecasts. The two major outcomes of the literature survey are that information sharing is the most

important requirement of efficient SC and multiagent modeling is most suitable for designing SCs.

Jain et al. [19] aimed at providing a broad review of the main approaches to information related issues in a dynamic supply chain, through the description of the main characteristics, techniques, ongoing developments and research activities. The literature is examined from the perspective of the existing information systems that support supply chain dynamics at operational and strategic levels, with its inherent focus on web-enabled collaboration among supply chain partners. They review the recent trends in supply chain management and analyse how diverse modelling techniques such as agent technology and Petri net can be applied to support dynamic supply chain configuration. The purpose of this article is to consolidate the existing research efforts concerning the issues related to information systems in dynamic supply chains, and to identify promising emerging issues for further study in this area.

Sadeh et al. [20] discussed their work as: The global Internet economy is expected over time to give rise to increasingly agile practices where new supply chain arrangements are dynamically set up in response to changing business conditions and demands for highly customized products and services. To implement these "supply Chain" practices, enterprises need the ability to rapidly evaluate new business opportunities and dynamically identify the best potential supply chain partners to respond to them . They also need the ability to effectively coordinate production and delivery of goods or services across the resulting value chains.

Moreover, the agent paradigm is a natural metaphor for SC organizations, because it allows for easily modeling SC member features (decisional autonomy, social ability to establish agreements with the other companies, reactivity to the market, and also proactiveness) [21]. There exists a large literature on this subject; an interesting review is exported by [22]. Agent systems can be used for SCM or design purposes.

Zhang and Tao [23] proposed a framework of agent-based supply chain management with dynamic reconfiguring ability from Autonomy Oriented Computing point of view. An agent-based SCM system with dynamic reconfiguration capability (MySCM) was implemented and tested. The experimental results show that MySCM has the advantages of robustness, flexibility and agility. The performance of agent-based SCM with dynamic reconfiguration is evaluated under a modified TAC SCM scenario. With a dynamic reconfigurable SCM system, new products and processes can be introduced with considerably less expense and rampup time.

Piramuthu [24] proposed a multiagent system which allows for a dynamic reconfiguration of the SC, managing scenarios where suppliers, prices, and customers' demands may change over time. On the other hand, the proposed framework addresses the problem of supply chain configuration. The author incorporate machine-learning techniques to develop a dynamically configurable supply chain framework, and evaluate its effectiveness with respect to comparable static supply chains. Specifically, he consider the case where several parts go into the production of a product. A single supplier or a combination of suppliers could supply these parts. The proposed framework automatically forms the supply chain dynamically as per the dictates of incoming orders and the constraints from suppliers upstream.

In [25], a machine learning algorithm based on decision tree building allows for the choice of the best node at each stage of the supply network analyzing the combination of parameters such as price, lead-time, and quantity. In particular, at each node, an agent collects information about the upstream nodes, filtering the information to extract necessary training examples for a learning module. The learning module, therefore, extracts from the training examples a set of decision rules which are used by a dispatcher to identify the best choice of a node.

In previous works [26-28], a set of agents organizes a coalition to execute a complex task based on the contract net protocol [29]. In this kind of system, a customer can specify the product he wants to buy as well as the maximum price he is willing to pay for it. The agent system finds the user willing to fulfill the customer's order at the lowest price. During the negotiation, the agents establish contracts that specify and regulate the agents' interactions allowing the required task to be distributed among a group of agents. In this sense, the task must be precise and hierarchical in nature; that is, the task can be broken down into mutually independent subtasks.

A supplier selection process involves subjective, imprecise, and uncertain information that must be translated into quantitative data for decision making [30]. In [30-31] fuzzy sets theory is used to translate this vague information into quantitative data in order to define supplier selection criteria. On the other hand, This work is aimed to present an integrated fuzzy and linear programming approach to the problem. Firstly, linguistic values expressed in trapezoidal fuzzy numbers are applied to assess weights and ratings of supplier selection criteria. Then a hierarchy multiple model based on fuzzy set theory is expressed and fuzzy positive and negative ideal solutions are used to find each supplier's closeness coefficient. Finally, a linear programming model based on the coefficients of suppliers, buyer's budgeting, suppliers' quality and capacity constraints is developed and order quantities assigned to each supplier according to the linear programming model.

Papers [32-34] focused on uncertainty issues in the organization of SCs. In [32] the authors studied the effect of uncertain customer demand, supplier capacity, and supplier's capacity utilization; they employed an agent-based simulation to evaluate two different adaptive coordination strategies. In [33] different coordination and information sharing techniques are analyzed in order to understand which combination is the

most effective in managing uncertainty. In particular, in [33], a theoretical model, based on an extension of Bayesian networks models, is used to formalize SC agents' interactions during an order fulfillment process. The direct supply-demand relationships between pairs of agents are modeled as directed causal links, because the failure of a supplier to fulfill its commitments may affect the commitment progress of his customers. Information sharing between agents is modeled as belief propagation. The extended Bayesian belief network model proposed by the authors allows the agents to perform strategic actions, such as dynamically selecting or switching the suppliers, or take decisions to cancel a commitment based on its related expected utility function.

The literature shows that most researches have been focused on the study of individual paradigms in SCM [34-37], or on the integration of only a couple of paradigms in SCM; for example, lean versus agile [38], lean versus green [39], resilience versus agile [40], or resilience versus green [41]. However, the simultaneous integration of LARGT paradigms in SCM may help SCs to become more efficient, streamlined, and sustainable.

Few literature reviews on the four paradigms are discussed such as the following: S. Azevedo et al. [2] discussed different practices and their effect on the operational, economic, and environmental performances of SCM system without any implementation and without any reference to the social performance. S. G. Azevedo et al. [42] proposed a conceptual model about the influence of LARG practices on SC operational, economic, and environmental performances without testing this proposed model. The social environment is not mentioned in this work. The concept of sustainability is not discussed. LARG paradigms should not be considered alone or in isolation within the SC, although, sometimes, they show up with opposed characteristics. Neither paradigm is better or worse than the others. Indeed, tradeoffs between these management paradigms may help organizations and their SCs to become more sustainable and competitive [43].

Hassan et al**.** [44] investigates and implements a Model for Evaluating and Improving Supply Chain Performance. They discussed the LARGT paradigms extensively and all various types of SC practices affecting the SC performance. the model is tested in a flexible manner, so it can examine the effect of one or more paradigm on the performance of the SC. The combination of the talentship paradigm to the lean, agile, resilience, and green paradigm, so we obtain the four kinds of performance namely; the operational, economic, environmental, and social performance will leads to improve the overall performance of the supply chain.

Very few researchers have worked on the selection of distributor in SCM such as the following. Zou et al. [45] deployed rough set theory to deal with the qualitative data and modified it for preferred distributor selection. They derived certain decision rules which facilitated distributor selection. They generated several rules for distributors' evaluation and selection. They showed the importance of the relationship intensity, marketing experience, and the management ability in selecting the distributors. Reddy et al. [46] deployed fuzzy goal programming approach for quota allocation to distributors of the SC. Many of the researchers have also worked on the selection of supplier in SCM.

From the literature reviews presented above, it becomes clear that the introduction of LARGT paradigms in today's organizations is made on theoretical basis only; no testing on these systems was done in order to improve and evaluate their success. Nevertheless, no study that introduced these paradigms in a multiagent implementation form with real case studies was found.

Therefore, we proposed a future work model integrating these five paradigms to overcome the limitations mentioned above in an adaptive and intelligent way. Most of the literature reviews concentrated on the supplier affairs and neglected any discussion of the distributor (except [45, 46]), which represents a main component in the SC. We will introduce a proposed model as a future work that will take this gap into consideration. The JADE platform will be used for implementing an MAS to enhance the SC performance.

III. SC PARADIGMS

This paper investigated the possibility to merge lean, agile, resilient, green, and talentship paradigms in the SC management (LARGT SCM). These five paradigms have the same global purpose: to satisfy the customer needs, at the lowest possible cost to all members in the SC. The principal difference between paradigms is the purpose: the lean SC seeks waste minimization; the agile SC is focused on rapid responding to market changes; the resilient SC has the ability to respond efficiently to disturbances; the green SC pretends to minimize environmental impacts; and talentship paradigm is focused on Labor Practices and Decent Work. A state-of-the-art literature review was performed to (i) characterize and identify the main SC practices of each paradigm and (ii) support the development of a conceptual model focused on the integration of LARGT practices and SC attributes. The main objectives were to identify SC attributes that should be managed to obtain the necessary organizational agility; to speed up the bridging between states that require more or less degree of resilience; to preserve the dynamic aspects of the lean paradigm; and to assure its harmonization with the ecologic and environmental aspects that production processes may attend. The LARGT paradigms are discussed in the following subsections.

A. Lean paradigm

The term "lean" means a series of activities or solutions to eliminate waste, reduce nonvalue-added operations, and improve the value added [47]. Lean paradigm connected to SCM is a strategy based on cost and time reduction to improve

the effectiveness. It is focused on optimizing the processes of all SCs, searching forsimplification, reducing waste, and reducing activities that do not add value. Lean thinking, extended to SC, comprises (i) identifying value; (ii) determining the best sequence for value-creating steps, eliminating wastes; (iii) performing activities without interruption when a customer requests them; and (iv) improving processes continually. A list of lean characteristics was developed: (i) supplier feedback; (ii) just-in-time (JIT) delivery by suppliers; (iii) supplier development; (iv) customer involvement; (v) pull system; (vi) continuous flow; (vii) setup time reduction; (viii) total preventive maintenance; (ix) statistical process control; and (x) employee involvement. Adopters of lean strategy may implement practices such as mass production, just in time, and long-term supplier relationships to eliminate waste and achieve a lower cost [5].

The implementation of lean manufacturing principles has led to substantial cost savings, lead time reductions, and quality improvements in many industries. Originating in the automotive industry, these principles are increasingly applied in other industries, including process manufacturing. However, traditional lean manufacturing is mainly focusing on material flows within plants, while the planning and synchronization of operations as well as the optimal management of information flows (e.g., propagation of demand signals) across the entire SC are not adequately addressed. In addition, value generation is not limited to manufacturing alone: a substantial share of the total value added is contributed by supply and distribution processes. Consequently, many companies in process industries have coined the vision of lean SCMfor the efficient planning and execution of material and information flows in an end-to-end way [6].

Investment in inventory absorbs a large portion of the working capital of a company and often it represents a large portion of the total assets of a business. Through improving return on investment by increasing the rate of inventory turnover, management often wants to ensure economic efficiency. Effective inventory management enables a firm to provide lower costs, rapid response, and flexibility for its customers. Just-in-time philosophy is most widely adopted and practiced in the recent years worldwide. It aims at reducing total production costs by producing only what is immediately needed and eliminates wastes. It is based on a radically different concept, deviating substantially from the existing manufacturing practices in many respects. It is a very effective tool to reduce the wastage of inventory and manage it effectively. It has the potential to bring substantial changes in the existing setup of a company; it can give it a new face, broaden its acceptability, and ensure a longer life. It can strategically change the atmosphere needed for longer survival. JIT happens to provide global markets. Information technology helps JIT in managing inventory effectively, as it helps in integrating the components of SC network [48, 49].

B. Agile paradigm

Agility is considered to be one of the fundamental characteristics needed for an SC to survive and thrive in an environment of turbulent and volatile markets. As these conditions become the norm due to reduced product life cycles, increased demand for customized products and services, reduced visibility of demand, and constant change, organizations have acknowledged that agility is essential for their endurance and competitiveness more than ever before. Agility has been noted as an organizational enabler of quick and effective reaction that enables the firm to establish a competitive advantage. Moreover, a firm's SC agility has been identified as a critical factor affecting its overall global competitiveness. SC agility has primarily been explored in the literature by focusing on manufacturing flexibility, SC speed, or lean manufacturing [50].

An agile SC is one which responds quickly and effectively to (unexpected) changes in market demand, with the aim to meet varied customer requirements in terms of price, specification, quality, quantity, and delivery. Agility is a business-wide capability that embraces organizational structures, information systems, logistics processes, and, in particular, mindsets. A key characteristic of an agile organization is flexibility. Indeed the origins of agility as a business concept lie in flexible manufacturing systems. Initially it was thought that the route to manufacturing flexibility was through automation to enable rapid change (i.e., reduced setup times) and thus a greater responsiveness to changes in product mix or volume. Later this idea of manufacturing flexibility was extended into the wider business context and the concept of agility as an organizational orientation was born.

On the other hand, the changing conditions of competition and increasing levels of environmental turbulence and requirement for organizations to become more responsive to the needs of customers is driving interest in the concept of *SC agility*. What it really means for an organization to be "agile," as opposed to just being efficient, effective, lean, customer focused, able to add value, quality driven, proactive rather than reactive, and so forth, has been the source of considerable debate and academic conjecture. Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace. SC agility represents the ability of an organization's SC processes to provide a strategic advantage by responding to marketplace uncertainty. SC agility can be achieved by systematically developing and acquiring capabilities that can make the SC act rapidly and diversely to environmental and competitive changes. Agile SCs are capable of rapid adaptation in response to unexpected and unpredicted changes and events, market opportunities, and customer requirements. SC agility can be founded on business processes and structures which facilitate speed, adaptation, and robustness and which are capable of achieving

competitive performance in a highly dynamic and unpredictable business environment [51].

Agility should not be confused with 'leanness.' Lean is about doing more with less. The term is often used in connection with lean manufacturing to imply a 'zero inventory,' just-in-time approach. Paradoxically, many companies that have adopted lean manufacturing as a business practice are anything but agile in their SC. The car industry in many ways illustrates this method. The origins of lean manufacturing can be traced to the Toyota Production System, with its focus on the reduction and elimination of waste [52].

C. Resilience paradigm

We define resilience as the ability of a system to return to its original state or move to a new, more desirable state after being disturbed [53]. Resilience quality enables an SC to withstand upheavals, disruptions, and unforeseen events and still be able to deliver products and services with the desired quality, price, place, and time.

In the material sciences, resilience represents the ability of a material to reacquire its original shape after a deformation, while, in the business sector, resilience refers to the ability of a company to resist a serious damaging event. The turbulent environment in which businesses operate is a main source of risk. The vulnerability of a firm increases with the volatility of demand and the globalization of the SC. Risk factors, in addition to acting individually on the vulnerabilities for companies operating in the SC, combine and influence each other (the uncertainty of such a market may be due to catastrophic events or terrorism). Basically, there is a need to include, in the decision-making models, the risks associated with traditional processes, controls, supplies, and demand, and also those related to external environments in which the SC operates. For this reason, the focus has moved from a robustness-oriented SC to a resilience-oriented SC. Robustness is the ability to remain stable with changes. The term 'resilience' means the ability to return to the desired state after a major disturbance [54].

On the other hand, the concept of resilience is related to the capacity of physical and human systems to respond to and recover from extreme events, and it has gained prominence in recent years as a topic in the field of disaster research. Resilience can be thought of as an extension of the traditional concept of resistance, defined as the measures that enhance the performance of structures, infrastructure elements, and institutions, in reducing losses from a disaster. While disaster resistance emphasizes the importance of predisaster mitigation, the concept of resilience extends those ideas in order to also include improvements in the flexibility and performance of a system both during and after a disaster. Based on those ideas, we therefore can define SC resilience to be the ability of an SC system to reduce the probabilities of a disruption, the consequences of those disruptions once they occur, and the time to recover normal performance [43].

The market environment has never been entirely stable, peaceful, and safe; there have always been problems, risks, and changes that could have adverse effects on the entrepreneurial activities. However, the extent and frequency of these events have grown rapidly in the last decade to form a complex, constantly changing, and turbulent environment. At the same time, today's society, facing extreme global competition, and which was, not so long ago, and is still affected by the global economic crisis, is now focusing on minimizing the costs. The most common example is the introduction of business philosophies based on leanness, which tries to eliminate all parts of the system which are not adding value—the sources of waste. Resilient SC has abilities that allow it to eliminate risk situations leading to its disruption [55].

Resilience refers to the ability of the SC to cope with unexpected disturbances. It is concerned with the system ability to return to its original state or to a new one, more desirable, after experiencing a disturbance, and avoiding the occurrence of failure modes. The goal of SC resilience analysis and management is to prevent the shifting to undesirable states; that is, the ones where failure modes could occur. In SC systems, the objective is to react efficiently to the negative effects of disturbances (which could be more or less severe). The aim of the resilience strategies has two manifolds: (i) to recover the desired values of the states of a system that has been disturbed, within an acceptable time period and at an acceptable cost and (ii) to reduce the effectiveness of the disturbance by changing the level of the effectiveness of a potential threat [56].

In summary, SC (re-)engineering, collaboration, agility, risk awareness, and knowledge management capabilities underpin a supply network's resilience. These formative resilience elements are based on integrating and coordinating resources which often span functional areas and thus become manifested in SC processes [57].

D. Green paradigm

Development of environmentally friendly processes, products, and services requires a unified effort by all members of the SC to avoid suboptimization at the partner level. Manufacturing organizations have begun to implement green supply chain management (GSCM) practices in response to customer demand for products and services that are environmentally sustainable and that are created through environmentally sustainable practices and in response to governmental environmental regulations. These practices require that manufacturers work in concert with suppliers and customers to enhance environmental sustainability. The implementation of GSCM practices is expected to result in improved environmental performance as measured by reductions in air emissions, effluent waste, solid waste, and the consumption of toxic materials. There is a concern, however, whether such environmental sustainability efforts will ultimately translate into improved market share and profitability. Ultimately,

manufacturing managers are responsible for the performance of the organizations for which they work. How best can they improve organizational performance within the context of their SCs? Local managers must make decisions that support the SC first and their organizations second. In short, managers must *globalize to localize*. Success at the SC level leads to success at the organizational level. Since customers and governmental entities have begun to demand processes, products, and services to be environmentally friendly, it is important that managers identify and implement environmental sustainability practices that extend throughout the SC [58].

The GSCM is a powerful way to differentiate a company from its competitors and it can greatly influence the plan success. Green supply refers to the way in which innovations in SCM and industrial purchasing may be considered in the context of the environment. Environmental SC management consists of the purchasing function's involvement in activities that include reduction, recycling, reuse, and the substitution of materials and the practice of monitoring and improving environmental performance in the SC [59].

Integrating environmental thinking into SCM includes product design, material resourcing and selection, manufacturing processes, delivery of the final product to the consumer, and end-of-life management of the product after its useful life. From these four definitions, we see that there is a range of authors focus on green SCs and their management. The lack of consensus in practice and definition of green SC is not surprising, since its foundational elements of corporate environmental management and SCM are both relatively new areas of study and practice [58, 59].

A study to describe the taxonomy of GSCM capability and firm performance identified, on the basis of a factor analysis, six GSCM dimensions: (i) green manufacturing and packaging; (ii) environmental participation; (iii) green marketing; (iv) green suppliers; (v) green stock; and (vi) green ecodesign. However, based on respondents' perceptions, top five GSCM attributes in respondents' firms are identified as follows: (1) design of products to avoid or reduce use of hazardous products and manufacturing processes; (2) substitution of polluting and hazardous materials/parts; (3) the manufacturing process capability to reduce the noise pollution; (4) production planning and control focused on reducing waste and optimizing materials exploitation; and (5) in purchasing, suppliers certification for green product conformance [60].

E. Talentship Paradigm

Talentship Paradigm is a new paradigm that can be added to the four mentioned paradigms discussed in this paper. On the other hand, to maximize the SC performance, we take into consideration that there are five paradigms affecting the SC performance; namely, lean, agile, resilience, green, and talentship paradigms. The talentship paradigm can be discussed shortly as follows:

We have proposed that the paradigm shift toward the talentship decision science requires future human resources to model itself more closely against decision-based functions like Finance and Marketing that are accountable for improving decisions throughout the organization about their respective resources. Their measurement systems are designed to direct key decision makers to focus on the relevant information. Their systems hold decision makers accountable for the quality of their decisions about financial or marketing resources. In the same way, human resources (HR) measurement needs to extend its traditional focus on the HR function, and increase its capability to support key decisions about human capital that drive organizational effectiveness. That requires a framework for connecting those investments to organizational effectiveness. To gain competitive advantage, the demand for human capital drives talent management (TM). Talent management strategies focus on five primary areas: attracting, selecting, engaging, developing and retaining employees[61,62].

It is difficult to identify the precise meaning of "talent management" because of the confusion regarding definitions and terms and the many assumptions made by authors who write about TM. The terms "talent management", "talent strategy", "succession management", and "human resource planning" are often used interchangeably[24t].In a competitive marketplace, talent management is a primary driver for organizational success. Broadly defined, talent management is the implementation of integrated strategies or systems designed to increase workplace productivity by developing improved processes for attracting, developing, retaining and utilizing people with the required skills and aptitude to meet current and future business needs[61,62].

Given the current focus on the linkage between talent and the organization's business challenges and strategies, effective strategy execution requires sufficient numbers of the right people with the right skills and knowledge, in the right roles. This has made talent management one of the most pressing issues facing senior business executives. Pressing business imperatives such as increasing turnover as the economy improves, globalization of markets and labour forces, aggressive competition heightened corporate oversight, have intensified the need to acquire, develop, deploy, motivate and retain key talent[62].

Strains of thought regarding talent management is represented in the following perspectives: The first defines talent management as a collection of typical human resource department practices, functions, activities or specialist areas such as recruiting, selection, development, and career and succession management. A second perspective on talent management focuses primarily on the concept of talent pools. A third perspective on TM focuses on talent generically; that

is, without regard for organizational boundaries or specific positions. A fourth perspective is that the organizational talent management strategy is viewed as activities and processes that involve the systematic identification of key positions which differentially contribute to the organization‘s sustainable competitive advantage[61,63].

The performance resulted from talentship paradigm is known as social performance. The measures for this performance are: 1) *labor practices and decent work* which has many indicators such as: Employment, Labor/Management Relations, Occupational Health and Safety, Training and Education, Diversity and Equal Opportunity, 2) *human rights* which has many indicators such as: Investment and Procurement Practices, Non-discrimination, Freedom of Association and Collective Bargaining, Child Labor, Forced and Compulsory Labor, Security Practices, Indigenous Rights, 3) *society* which has many indicators such as: Community, Corruption, Public Policy, Anti-competitive Behavior, Compliance. , and4) *product responsibility* which has many indicators such as: Customer Health and Safety, Product and Service Labeling, Marketing Communications, Customer Privacy, Compliance[64].

It is possible to identify differences between LARGT paradigms; for example, lean, agile, and green practices promote inventory minimization, but resilience demands the existence of strategic inventory buffers. However, there are some *overlapping* characteristics that suggest that these paradigms should be developed simultaneously for SC performance improvement. Leanness and agility should not be considered in isolation; instead, they should be integrated. The lean paradigm deployment in SCM produces significant improvements in resource productivity, reducing the amount of energy, water, raw materials, and non-product output associated with production processes, minimizing the ecological impact of industrial activity. Resilience implies flexibility and agility; therefore, for the development of a resilient SC, it is necessary to develop agility attributes[2,42].

Improvement in SC performance is one of the major issues in the current world. Lack of coordination in the SC is the main drawback of SC which many researchers have proposed different methodologies to overcome. Vendor-managed inventory is one of these methodologies whose implementation has some obstacles. Performance controlling is one way of increasing efficiency, both for processes and people handling those processes. Performance controlling is done by checking the performance indicators for the various processes. However, performance controlling, in itself being a management function, carries more meaning if only few key performance indicators can be screened out, which can best capture the performance levels of the processes [26]. Table I shows the meaning of the LARGT paradigms.

Table I
The Meaning of LARGT paradigms.

Paradigm	Meaning
L(Lean)	The term “lean” means a series of activities or solutions to eliminate waste, reduce non-value-added operations, and improve the value added. Lean paradigm connected to SCM is a strategy based on cost and time reduction to improve the effectiveness. It is focused on optimizing the processes of all SCs, searching for simplification, reducing waste, and reducing activities that do not add value. Lean thinking, extended to SC, comprises (i) identifying value; (ii) determining the best sequence for value-creating steps, eliminating wastes; (iii) performing activities without interruption when a customer requests them; and (iv) improving processes continually.
A (Agile)	Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace. SC agility can be achieved by systematically developing and acquiring capabilities that can make the SC act rapidly and diversely to environmental and competitive changes. Agile SCs are capable of rapid adaptation in response to unexpected and unpredicted changes and events, market opportunities, and customer requirements. SC agility can be founded on business processes and structures which facilitate speed, adaptation, and robustness and which are capable of achieving competitive performance in a highly dynamic and unpredictable business environment.
R(Resilience)	Resilience refers to the ability of the SC to cope with unexpected disturbances. It is concerned with the system ability to return to its original state or to a new one, more desirable, after experiencing a disturbance, and avoiding the occurrence of failure modes. The goal of SC resilience analysis and management is to prevent the shifting to undesirable states; that is, the ones where failure modes could occur. In SC systems, the objective is to react efficiently to the negative effects of disturbances. The aim of the resilience strategies has two manifolds: (i) to recover the desired values of the states of a system that has been disturbed, within an acceptable time period and at an acceptable cost and (ii) to reduce the effectiveness of the disturbance by changing the level of the effectiveness of a potential threat.
G (Green)	The implementation of GSCM practices is expected to result in improved environmental performance as measured by reductions in air emissions, waste, and the consumption of toxic materials. However, based on respondents' perceptions, top five GSCM attributes in respondents' firms are identified as follows: (1) design of products to avoid or reduce use of hazardous products and manufacturing processes; (2) substitution of polluting and hazardous materials/parts; (3) the manufacturing process capability to reduce the noise pollution; (4) production planning and control focused on reducing waste and optimizing materials exploitation; and (5) in purchasing, suppliers certification for green product conformance.
T (Talentship)	Talent management strategies focus on five primary areas: attracting, selecting, engaging, developing and retaining employees. Given the current focus on the linkage between talent and the organisation's business challenges and strategies, effective strategy execution requires sufficient numbers of the right people with the right skills and knowledge, in the right roles. This has made talent management one of the most pressing issues facing senior business executives. Pressing business imperatives such as increasing turnover as the economy improves, globalization of markets and labour forces, aggressive competition heightened corporate oversight, have intensified the need to acquire, develop, deploy, motivate and retain key talent.

IV.SCM PERFORMANCE MEASUREMENT

Organizational performance refers to how well an organization achieves its market-oriented goals as well as its financial goals. The short-term objectives of SCM are primarily to increase productivity and reduce inventory and cycle time, while long-term objectives are to increase market share and profits for all members of the SC. Financial metrics have served as a tool for comparing organizations and evaluating an organization's behavior over time. Any organizational initiative, including SCM, should ultimately lead to enhanced organizational performance. A number of prior studies have measured organizational performance using both financial and market criteria, including return on investment, market share, profit margin on sales, the growth of ROI, the growth of sales, the growth of market share, and overall competitive position [65].

Supply-chain-driven organizational performance falls into three categories: resources, output, and flexibility. *Resources performance* reflects value addition in the form of achieving efficiency. *Output performance* reflects value addition as the firm's ability to provide high levels of customer service, while *flexibility performance* reflects value addition as the firm's ability to respond. A review of the literature on SC performance measures provides the measures for value addition through the SC as on-time delivery of customer orders, back order level, percentage of stockouts, delivery lead time upon receipt of customer order, manufacturing cycle time, SC cycle time, capacity utilization, and time from concept to launch. From *the profitability* and *competitive business performance* viewpoint, return on assets, operating income, cost per sales, and sales per number of employees were suggested as SCM-related measures. Based on the above literature on the SC distribution process, organizational performance, and SC agility, this research expects a positive association between agile SC distribution practices and organizational performance [51].

The literature on performance measurements did not view the SC as a whole entity; therefore, it is difficult to evaluate performance with multiple inputs and outputs to the system. SC metrics are actually about internal logistics performance measures that have an internal focus and do not capture how the firms drive value or profitability in the SC. Regardless of their qualitative or quantitative nature, it has been suggested that SC performance indicators are measured in the form of input-output ratios. The use of such simple performance measures is limited in scope and might be inconsistent with the strategic goals of an organization. In paper [66], the authors consolidate relevant literature and suggest why it has been difficult to define and collate what SC indicators are.

Performance measurement and management require the definition of goals against which performance can be measured. The main priority of a corporate sustainability-oriented performance system is to measure, communicate, and reduce the absolute amount of negative environmental and social impacts substantially and to contribute to sustainability transformation of markets and society. This includes consideration of sustainability risks and opportunities of the existing SCs. Three general sustainability strategies have been discussed in the sustainability literature and can be applied to improve SCs—efficiency, consistency, and sufficiency [57].

Globalization has made competition more and more severe amongst the companies, and companies as a result are facing a lot of pressure on cutting costs and increasing customer satisfaction. However, it is a recognized fact that cutting costs too deeply could cut profitability and market positioning and which in turn could also whittle away the competitive advantages that a company enjoys. Even if one company just focuses on costs, it is very difficult to figure out exactly which costs best indicate the SC effectiveness. Thus as a means to increase effectiveness, the SC is more focused on three areas: profitability, performance, and partnership. Pure cost reduction and pure revenue increase are secondary objectives if they do not lead to increased profitability. Better performance of the SC increases customer satisfaction level. But unless performance is measured, it is hard to improve it. Measurement affects behavior that impacts the SC performance. As such, performance measurement provides the means by which a company can assess whether its SC has improved or degraded.

The SCM program evaluation and monitoring is dependent on the development and application of performance measures. This evaluation and the set of performance dimensions have become more complex when considering SC sustainability as environmental and social responsibility dimensions are added. Sustainable SCM performance measurement can be used for multiple purposes such as supplier selection and performance monitoring and development. Investigation of performance measurement systems is needed for advancing SCM sustainability. A critical aspect of sustainable SC performance measurement systems is the identification of key performance indicators (KPIs). Hundreds of measures for traditional business and operational SC evaluations may exist. This number of performance measures increases greatly when additional environmental and social sustainability dimensions are included in SC evaluations. Thus, the need to identify KPI becomes more critical when such a large set of sustainable SC performance measures is used. KPI may or may not provide similar amounts of information when compared to the complete performance measure indicator set. The use of information theory tools relying on information entropy measures [1] such as the rough set theory is examined to see if they are valuable for determining a usable subset of KPI for sustainable supplier evaluation with minimal information loss. Using this reduced KPI set, benchmarking tools, such as data envelopment analysis, can then be used to evaluate sustainable supplier performance [67].

Improvement in SC performance is one of the major issues in the current world. Lack of coordination in the SC is the main drawback of SC which many researchers have proposed different methodologies to overcome. Vendor-managed

inventory is one of these methodologies whose implementation has some obstacles. Performance controlling is one way of increasing efficiency, both for processes and people handling those processes. Performance controlling is done by checking the performance indicators for the various processes. However, performance controlling, in itself being a management function, carries more meaning if only few key performance indicators can be screened out, which can best capture the performance levels of the processes. Table II shows the performance measure and the indicators associated to each measure [44, 68, 69, 70].

Table II
SC performance measures

	Measure	Indicators
Operational Performance	Quality	Customer reject rate
		In-plant defect fallow rate
		Increment products quality
	Customer Satisfaction	After-sales service efficiency
		Rates of customer complaints
		Out-of-stock ratio
	Delivery	On-time delivery
		Delivery reliability
		Responsiveness to urgent deliveries
	Time	Lead time
		Cycle times
		Delivery lead time
	Inventory Levels	Finished goods equivalent units
		Level of safety stocks
		Order to ship
Economic Performance	Cost	New product flexibility
		Manufacturing cost
		Cost per operating hour
	Efficiency	Overhead expense
		Operating expenses
	Environmental Revenues	Revenues from ‘green’ products
		Recycling revenues
		Cost avoidance from environmental action
	Environmental Costs	Cost of scrap/rework
		Fines and penalties
		Costs for purchasing environmentally
		Friendly materials
		Disposal costs
		Recycling cost = transport + storage costs
		R and D expenses ratio
Environmental Performance	Green Image	Number of fairs/symposiums related to environmentally conscious manufacturing in which the organization participates
	Business Wastage	Total flow quantity of scrap
		Percentage of materials remanufactured
		Percentage of materials recycled /reused
		Hazardous and toxic material output
		Solid and liquid wastes
	Emissions	Energy consumption
		Green house gas emissions
		Air emission
Social Performance	Labor Practices and Decent Work	Employment
		Labor/Management Relations
		Occupational Health and Safety
		Training and Education
		Diversity and Equal Opportunity
		Investment and Procurement Practices
		Non-discrimination
		Freedom of Association and Collective
		Bargaining
	Human Rights	Child Labor
		Forced and Compulsory Labor
		Security Practices
		Indigenous Rights
	Society	Community
		Corruption
		Public Policy
		Anti-competitive Behavior
		Compliance
	Product Responsibility	Customer Health and Safety
		Product and Service Labeling
		Marketing Communications
		Customer Privacy
		Compliance

V. LARGT SCM PRACTICES, AND COMPETITION CAPABILITIES VERSUS PERFORMANCE

The paper proposes a set of measures to evaluate the influence of these practices on SC’s performance from the operational, economic, environmental, and talentship perspectives. Accordingly, in operational terms, the performance measures proposed are inventory levels, quality, customer satisfaction, and time. From an economic perspective, the measures recommended are cost, environmental cost, and cash-to-cash cycle. From an environmental perspective the measure suggested is business wastage. Finally, from a social perspective the measure is the Human Rights and Labor Practices and Decent Work.

A. SCM practices

SCM practices have been defined as a set of activities undertaken in an organization to promote effective management of its SC. It includes supplier partnership, outsourcing, cycle time compression, continuous process flow, and information technology sharing. Purchasing, quality, and customer relations to represent SCM practices, in their empirical study. Core competencies, elimination of excess inventory levels by postponing customization towards the end of the SC. SC integration, information sharing, SC characteristics, customer service management, geographical proximity and JIT capability. Supplier base reduction, and long-term relationship, communication, cross-functional teams, and supplier involvement to measure buyer-supplier relationships. The concept of SCM is including agreed vision and goals, information sharing, risk and award sharing, cooperation, process integration, long-term relationship, and agreed SC leadership. Thus, the literature portrays SCM practices from a variety of different perspectives with a common goal of ultimately improving organizational performance. In reviewing and consolidating the literature, five distinctive dimensions, including strategic supplier partnership, customer relationship, level of information sharing, quality of information sharing, and postponement, are selected for measuring SCM practices [65].

The SCM practices suggested are based on the literature review and respect the main characteristics and purposes associated to LARGT paradigms: all practices contribute to an SC with less waste (nonvalue-added activities), are more responsive to the customer requirements, and are able to overcome disruption conditions and also reduce environmental impacts with a qualified labors. These practices were named 'LARGT practices.' Table III shows an extensive LARGT practices listed as follows [2, 44, 60].

Table III
The SCM practices

practices in the Lean Paradigm	Outsourcing/indigenous production
	Procurement consolidation
	Profit sharing
	Single sourcing and lean purchasing
	Supplier certification
	Supplier evaluation and rating
	Supplier involvement in product development
	Supplier training and development
	Deliver materials directly to the point of use
	Use of standard or bar coded containers
	Cycle/setup time reduction
	Design for manufacturing
	Frequent quick changeovers
	High-involvement work systems
	Just-in-time
	Lot-size reduction
	Mass customization
	Parts/work standardization
	Postponement
	Production scheduling improvement
	Level production and scheduling
	Use bar coding identification
	Use production planning
	Use control technology
	Total productive maintenance
	Total quality management
	Customer relationships
	Delivery performance improvement
	Demand stabilization
	Order/shipment tracking/notice
	Use third-party logistics for transportations
practices in the Agile Paradigm	Ability to change delivery times of supplier's order
	Ability to change quantity of supplier's order
	Speed in reducing development cycle time
	Use of IT to coordinate/integrate activities
	Centralized and collaborative planning
	Facilitate rapid decision making
	Integrated supply chain corporation
	Rapidly reconfigure the production process
	Minimize setups times and product changeovers
	Produce in large or small batches
	Reduce development cycle times
	Satisfy customer delivery
	Meet customer requirement
	Capability to alter deliver schedules
	Rapid response
	Rapid confirmation of customer orders
	Rapid handling of customer complaints
	Responsiveness to urgent deliveries
	Lead time
	Cycle times
	Delivery lead time
	New product flexibility
	Time adaptability to supplier's order
	Products with substantial added value for customers
	Retain and grow customer relationships
	Speed in adjusting delivery capability
	Speed in improving customer service
	Speed in improving delivery reliability
	Speed in improving responsiveness to change market needs
practices in the Resilience Paradigm	Committing to contracts for material supply
	Flexible supply base/flexible sourcing
	Sourcing strategies to allow switching of suppliers
	Designing production systems in different conditions
	Developing collaborative working
	Excess of capacity requirements
	Lead time reductions
	Make-and-buy trade-off
	Minimal batch sizes
	Multi-skilled workforce
	Postponement
	Strategic stock
	Supply chain risk management culture
	Flexibility
	Capacity
	Efficiency
	Visibility
	Adaptability
	Anticipation
	Recovery
	Dispersion
	Collaboration
	Market position
	Security
	Financial strength
	Level of safety stocks
	Demand-based management
	Flexible transportation
	Maintaining a dedicated transit fleet
	Sielent product rollover
practices in the Green Paradigm	Use green purchasing or logistic guideline
	Use recyclable pallet to delivery materials
	Environmental collaboration with suppliers
	Green procurement/sourcing
	Prequalification of suppliers
	Energy consumption
	Reuse/recycling materials and packaging
	Reverse logistics
	Green marketing
	Green stock
	Green ecodesign
	Manufacturing noise pollution
	Waste
	Green manufacturing and packaging
	Environmental participation
	Total flow quantity of scrap
	Percentage of materials remanufactured
	Percentage of materials recycled/reused
	Energy consumption

	Green house gas emissions
	Air emission
	Hazardous/toxic material output
	Cooperation with customer for eco-design and cleaner production
	Customers return our original packaging or pallet systems
	Eco-labeling
	Environmental collaboration with the customers
	Environmental monitoring by the customer
	Environmentally friendly packaging (green packaging)
	Formal policy on green logistics/transport
practices in the TalentShip Paradigm	Labor productivity
	Employment
	Labor//Management relations
	Occupational health and safety
	Training and education
	Diversity and equal opportunity
	Supplier technical assistance
	Distributor technical assistance
	Sustainable initiatives to reduce cost
	Effective improvement proposals
	Bargaining
	Child labor
	Forced and compulsory labor
	Security practices
	Indigenous rights
	Customer health and safety
	Product and service labeling
	Marketing communications
	Customer privacy
	Compliance
	Investment and procurement practices
	Non-discrimination
	Freedom of association and collective
	Investment in research
	Employees promoted
	Welfare activities implemented
	Employee turnover
	Corruption
	Public policy
	Anti-competitive behavior

B. SCM Practices versus Performance

SC performance affected by the SC practices mentioned above are as follows. Inventory level, quality, customer satisfaction, and time represent the operational performance; cost, environmental cost, and cash-to-cash cycle represent the economic performance; and business wastage and missions represent the environmental performance. Labor Practices and Decent Work, Human Rights, Society, and Product Responsibility affects the Social Performance.

In the Lean Paradigm, for example the just in time practice decreases the inventory level, increases Customer Satisfaction ,and decreases the Time and so improves the Operational Performance. It also decreases the cost, and decreases Cash-to-Cash Cycle and accordingly increases the economic performance. With respect to the supplier relationships, the inventory level decreases, the quality increases, and the Time decreases, and so the Operational Performance increases. Supplier relationships also decreases the cost, and so increases the Economic Performance. It also decreases the Business Wastage, and so increases the Environmental Performance. Cycle/setup reduction decreases the Time, and so enhances Operational Performance. It also decreases the cost, and decreases Cash-to-Cash Cycle and so improves Economic Performance.

In the Agile Paradigm, for example, speed in improving responsiveness to changing market needs practice increases Customer Satisfaction and decreases the Time, and so increases the Operational Performance. It also decreases the Cash-to-Cash Cycle and so enhances the Economic Performance. It also decreases the Business Wastage, and so improves the Environment Performance. The production in large or small batches decreases the Inventory Level, increases Customer Satisfaction, and decreases the time, and so increases the Operational Performance. the ability to change delivery times of supplier's order practice decreases the Inventory Level and decreases the Time, and so increases the Operational Performance.

In the Resilience Paradigm, developing visibility to a clear view of upstream inventories and supply conditions decreases Inventory Level and increases Quality, so it improves Operational Performance. It increases the Cost and do increases the Economic Performance. This practice also decreases the Business Wastage, and accordingly increases the Environmental performance. Lead Time Reduction practice increases Customer Satisfaction and decreases the Time and so the Operational Performance is increases. The demand-based management practice decreases Inventory Level and increases Customer Satisfaction, and so increases the Operational Performance. It also decreases the Cash-to-Cash Cycle and so improves the Economic Performance.

For the Green paradigm, reduction in the variety of materials employed in manufacturing the products practice, the Inventory Level decreases and so increases the Operational Performance. It also decreases the Cost and decreases the Environmental Cost and so increases the Economic Performance. It also decreases the Business Wastage and so increases the Environmental Performance. Working with product designers and suppliers to reduce environment impacts practice increases the Quality and so increases the Operational Performance. It decreases the Environmental Cost and so increases the Economic Performance. It also decreases the Business Wastage and so increases the Environmental Performance.

Labor practices and decent work such as: employment, occupational health and safety, training and education, and diversity and equal opportunity,…etc., affects positively on social performance, and consequently on operational and economic performance. The human rights such as investment

and procurement practices, non-discrimination, freedom of association and collective, preventing child labor, forced and compulsory labors, preserving the security practices and giving the indigenous rights will improve the social performance which affects positively on operational, and hence the economic performance will be enhanced. Society represented in community and preventing the corruption and applying public policy, anti-competitive behavior and compliance aids in improving the social performance, and reflected positively on the operational and economic performance. Product responsibility represented in customer health and safety, product and service labeling, marketing communications, and customer privacy improves social, economic, and environmental performance.

C. Supply Chain Competition Capability versus Performance

Increasing level of competition and globalization in the world economy has major impact on looking for improvement of SC performance. Companies pay millions of dollars in order to improve their SC performance using process reengineering, implementing new systems, and training employees. As a critical result, there is a need for using raw data and measures to better understand their SC performance and improve decisions taken. On the other hand, an SC exists to support the market that it serves. To identify the performance that an SC should deliver, we need to measure different indicators and analyze them. Linking SC KPIs by the proper analysis gives better understanding of the issues and mistakes that happened in history, and recording these changes and root causes is very important, as a learning phase [54, 71].

Competitive advantage is the extent to which an organization is able to create a defensible position over its competitors. It comprises capabilities that allow an organization to differentiate itself from its competitors and is an outcome of critical management decisions. The empirical literature has been quite consistent in identifying price/cost, quality, delivery, and flexibility as important competitive capabilities. In addition, recent studies have included time-based competition as an important competitive priority. Time is the next source of competitive advantage. On the basis of prior literature, competitive capabilities defined the following five dimensions: competitive pricing, premium pricing, value-to-customer quality, dependable delivery, and production innovation. Based on the above, the dimensions of the competitive advantage constructs are price/cost, quality, delivery dependability, product innovation, and time to market [65].

D. Inventory Control versus Performance.

Inventory control is a key factor for reducing SC cost and increasing customer satisfaction and hence increasing the performance. It is one of the key topics of SCM. Usually inventory takes the form of (1) raw material, (2) work in process products, (3) semifinished products, and (4) finished products.

Inventory cost is the main cost for SCM. A drop of just several percentage points of inventory cost can greatly increase the profits of the whole SC. In addition, sound inventory level can (1) prevent shortage of material, (2) maintain the continuity of the production process, (3) avoidance of overstocking and bottlenecks,and (3) quickly satisfy customer's demand. Thereby, exploring the optimal inventory level is very necessary and valuable for SCM. This leads to the following [72]: (1) maintaining inventory levels, (2) eliminating environmental cost, (3) reducing the variety of materials employed in products manufacturing, (4) increasing custom satisfaction, and (5) reducing SC cost.

VI CONCLUSIONS AND FUTURE WORK

Performance measurement provides information for management and decision makers, enables identifying the success and potential of management strategies, and facilitates the understanding of the situation. In addition, performance measurement assists in directing management attention, revising company goals, and reengineering business processes. SC performance measurement is helpful in the continuous improvement of SCM. In this paper, we investigated the following suggestions:

- Extensive literature review was presented illustrating the role of MASs in building SCs.
- There was an extensive overview on the LARGT paradigms presenting the various directions to these paradigms.
- A set of SCM practices to make the SC more lean, agile, resilient, green and talentship, which were named 'LARGT practices,' with SC competition capability to enhance the operational, economic, environmental, and social performances, was suggested.
- The selection of right distributor for an organization should not only meet customer requirements and bring profit to the firm, but also help in fulfilling various criteria such as cost, delivery, quality objectives, and technical specifications and hence increasing the SC performance.
- Inventory control is a key factor for reducing SC cost, maintaining inventory levels, reducing the variety of materials employed in product's manufacturing, and increasing customer satisfaction which can be predicted and which resulted in increasing the SC performance.

As a future work, we will propose a model that integrates the five paradigms and tests the model in the form of an MSA on a real case study. We will design the system in an adaptive way by providing a benchmarking to the attributes and

practices that will be used. We will increase the features of intelligence through a negotiation mechanism in case of supplying and distributing in an SC.

There is also a paradigm known as talentship, which is regarded as the fifth paradigm that can be added to the four paradigms mentioned above and is regarded as a contribution. The performance resulted from this paradigm is known as the social performance. The measures for this performance are labor practices and decent work, human rights, society, and product responsibility. Therefore, we can say that there are five paradigms, namely, the lean, agile, resilient, green, and talentship affecting the SC operational, economic, environmental, and social performances.

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