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# A REVIEW OF ORGANIZATIONAL AGILITY: CONCEPTS, EVALUATION, AND IMPLEMENTATION

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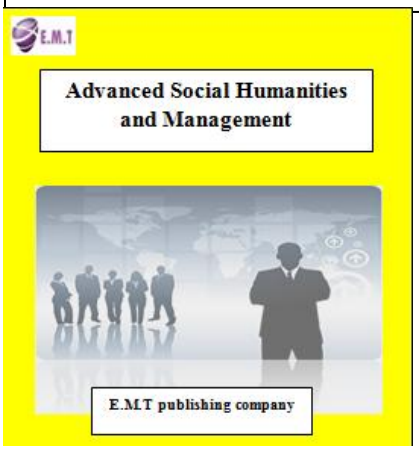


**ABSTRACT**

Today, the business enterprises must restructure and reengineer themselves to overcome the challenges of demanding customers who rapidly change their needs. The changing customer and technological requirements compel manufacturers to develop new business strategies in order to become competitive in the marketplace. As „„Change" " seems to be one of the important characteristics, the enterprises are contemplating to adopt agile manufacturing, because, it quickly adopts changing environments. Agility enables enterprises to thrive in face of competitive environment of unpredictable and continuous change. This review identified the concept of agility which can be applied to all aspects of enterprise.

Keywords: Agility, Leanness, Agility Evaluation, Agility Implementation

## INTRODUCTION

### The Concept of Agility

As we are approaching towards 21st century, success and survival of manufacturing sectors/production units are becoming very difficult to ensure (Shari and Zhang, 1999). This fact is rooted in the emergence of a new business era that has „change" as one of its major characteristics. Enterprises deal with changes in different aspects such as change in customer demand, technological advancements and unstable business environment (Shahraki et al., 2011).This critical situation has forced towards undertaking a major revision and reengineering in the contemporary business priorities, strategic vision, and examining viability of traditional models and methodologies developed so far. The emphasis is now being paid on adaptability to change in the volatile business environment and a proactive way of approaching to marketplace and customer needs through newly evolved cooperation methods such as Virtual Enterprise (VE). The emerging paradigm is denoted as Agile Manufacturing (AM), which is conceptualized as a step forward in generation of new means for better performance and success of business and in practice is a strategic approach to manufacturing considering the new market conditions as well as opportunities. Responding to unpredictable market changes and taking competitive advantage of them through systematic strategic utilization of managerial and manufacturing methods and tools, is the pivotal concepts of agile manufacturing.
Competitive advantage depends upon a dynamic capability to compete successfully in a frequent, challenging and often, unpredictable marketplace. Now-a-days, successful survival by taking competitive advantage through product price alone has no longer been a viable strategy for most of the manufacturing firms. Firms need to succeed in markets where a range of non- price advantages are frequently expected by customers. Order-winning criteria include rate of innovation, fitness for purpose, volume flexibility, variety, extreme customization and above all, rapid responsiveness (Meredith and Francis, 2000). Gradual increase of global and local competition exhibits

organizations that are unable to respond proactively to these consumer needs, they are unlikely to survive. Exploration of the principles and practices of agile enterprise seems to offer a stable candidate solution.
Agile manufacturing is a new concept that aims at improving the competitiveness of manufacturing firms. Manufacturing firms based on AM are mainly characterized by customers supplier integrated process for product design, manufacturing, marketing, and support services.
This requires prompt and efficient decision-making at functional knowledge levels, stable unit costs, flexible manufacturing system, easy access to integrated data, adaptation and exploration of information technology, and modular production facilities. Agile manufacturing requires enriching of the customer, co-operating with competitors, organizing to manage change, uncertainty and complexity, and leveraging people and information (Gunasekaran, 1999).
Manufacturing industries, even those running in relatively stable conditions with considerable market share are facing rapid and often unanticipated changes in their business environment.
Each company must respond in a specific and different way to the changing circumstances by deploying its own agile characteristics. Agility in manufacturing may be achieved through the implementation and integration of appropriate practices which provide the required abilities for a company to respond properly to changes (Sharifi and Zhang, 2001).
Tough and competitive market has led to increase attention being paid to customer satisfaction of which timely and customized products/services are the key concerns. As the product life cycle becomes shortened, high product quality becomes evident for successful survival.
Markets become highly diversified and spread over the globe and continuous and unexpected change becomes the key success factors. The need for a method of rapidly and cost-effectively developing products, production facilities and supporting software including design, process planning and shop floor control system has led to the concept of agile manufacturing (Gunasekaran, 1998).

Agile manufacturing can be defined as the capability to survive and prosper in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets driven by customer-designed products and services. Speed and responsiveness are two basic characteristics of agility. According to (Gunasekaran,1998), the key enablers of agile manufacturing include: (i) virtual enterprise formation tools/metrics; (ii) physically distributed manufacturing architecture and teams; (iii) rapid partnership formation tools/metrics; (iv) concurrent engineering; (v) integrated product/production/business information system; (vi) rapid prototyping tools; and (vii) electronic commerce.

## LITERATURE REVIEW

### Agility Evaluation

Agility is the ability of an organization to adapt to change and also to seize opportunities that become available due to change. While there has been much work and discussion of what agility is and how firms can become agile there is little work at measuring the agility of a firm. Measurement is necessary for the strategic planning of determining how much agility an organization currently posses, determining how much is needed, and then for assessing the gap and formulating a strategy for closing any perceived weaknesses (Arteta and Giachetti, 2004).
Yang and Li (2002) established an Mass-Customized (MC) product manufacturing agility evaluation index system through studying MC enterprise" s organization management agility evaluation; MC products design agility evaluation, and MC manufacture agility evaluation. The multi-grade fuzzy assessment method was used to evaluate agility of a case organization. Tsourveloudis and Valavanis (2002) proposed a knowledge-based framework as a candidate solution for the measurement and assessment of manufacturing agility. Given an enterprise, in order to calculate its overall agility, a set of quantitatively defined agility parameters was proposed and grouped into production, market, people and information infrastructures.

The measurement of agility seemed difficult to measure since it must be measured in the context of a change (Arteta and Giachetti,2004).Consequently, most current agility measurement approaches were found backward looking. A different and novel approach is to use complexity as a surrogate measure for agility.

**Agility Implementation**

Agile manufacturing enables an organization to produce a variety of products within a short period of time in a cost-effective manner. With the competition of the markets getting much more severe, it is becoming imperative to construct a highly efficient agile manufacturing system conforming to customer requirement in products" research and development, manufacture, sales and service. Besides manufacturing management, data deeply utilization, e-commerce and production optimization is also necessary for manufacturing enterprises (Liu et al., 2004).
Cho and Jung (1996) highlighted key concepts like standard for the exchange of products (STEP), concurrent engineering, virtual manufacturing, component-based hierarchical shop floor control system information and communication infrastructure etc. as enabling technologies related to implementation of agile manufacturing in Korea.

Gunasekaran (1998) presented a conceptual framework for the development and implementation of an agile manufacturing system. This framework considered customization and system integration with the help of business process redesign, legal issues, concurrent engineering, computer-integrated manufacturing, cost management, total quality management and information technology. Cheng et al. (1998) presented an approach towards implementing agile design and manufacturing concepts. The approach was based on the integration of Artificial Intelligence (AI) and Internet technologies with the conventional design and manufacturing techniques. The paper concluded on the potential benefits and the future applications of AI and Internet based agile manufacturing technology in industry. Robertson and Jones (1999) described the application of agility strategy, originally developed for manufacturing industry, in a telecommunications context. Lyu (1999) discussed the key elements of the CALS (continuous acquisition and lifecycle support) strategy and derived the necessary tactics to tackle the application of the strategy towards effective implement an agile management system. Sharp et al. (1999) proposed a conceptual model developed to identify where UK's best practice companies were in their quest to become agile. In support of this, a questionnaire was developed and completed by best practitioners of manufacturing to assess the model and establish whether they were making progress to becoming agile manufacturing organizations.
Frayret et al. (2001) presented a strategic framework for designing and operating agile networked manufacturing systems. This framework allowed collaborative planning, controlling and managing day-to-day operations and contingencies in a dynamic environment. The NetMan (Neither Market nor Hierarchy) (Powell, 1990) organizational and collaboration strategy consisted of a dynamic business method to organize and operate manufacturing activities through the configuration, activation and operation of a distributed network of inter-dependent and responsible manufacturing centers. The concepts underlying this strategic framework as well as the technical implications of such an approach were illustrated, using a detailed case study inspired by a motor coach industrial partner.
Mass customization relates to the ability to provide individually designed products and services to every customer through high process flexibility and integration. Mass customization has been identified as a competitive strategy by an increasing number of companies.

Elkinsa et al. (2004) discussed two simple decision models that provided initial insights and industry perspective into the business case for investment in agile manufacturing systems. The models were applied to study the hypothetical decision of whether to invest in a dedicated, agile, or flexible manufacturing system for engine and transmission parts machining. These decision models were a first step toward developing practical business case tools that helped industry to assess the value while implementing agile manufacturing systems.

Liu et al. (2004) analyzed the main feature of customer-driven manufacturing system and pointed out that there were four crucial subsystems viz. integrated manufacturing subsystem, data warehouse subsystem, quick

responding subsystem and e-sales subsystem, catering to the requirements of various customers in time. This paper also provided the realization case of customer-driven agile manufacturing system in Baosteel, China. Poolton et al. (2008) examined the application of the principles of agile manufacturing to marketing strategy, planning and management in the context of small and medium-sized enterprises (SMEs). The study used the case study method to test the development and deployment of agile marketing by applying the marketing techniques normally practiced only by larger companies within the „hard" and „soft" constraints imposed by one small company" s managerial attitudes, corporate resources and time horizons.

Ifandoudas and Chapman (2009) documented an action research (AR) project aimed at identifying the practical steps needed to become an agile manufacturer through a combination of the theory of constraints (TOC) and resource- based view (RBV) approaches in a small-to medium enterprise (SME) in the Australian manufacturing sector. Petersen and Wohlin (2009) conducted empirical studies for identifying a number of issues and advantages of incremental and agile methods. Xu (2009) studied the actuality analysis of the medium and small-scale manufacturing industry production mode in his country while implementing agile manufacturing strategy.

Laanti et al. (2011) reported that agile methods were rapidly replacing traditional methods by providing evidence from a large-scale agile transformation within Nokia. Garbie (2011) proposed a conceptual model to measure the agility level of the petroleum companies in Oman based on existing technologies, level of qualifying human resources, production strategies, and organization management systems. Several case studies were presented to demonstrate the proposed issues and technique through an agility questionnaire which was used for assessing the agility level of these companies. These studies provide the readers with an insight into the companies and their agility levels. Carlson and Turner (2013) reviewed selected non software agile case studies for lessons that were applicable to implementing agile methods to transform the aircraft systems integration process.

**Leanness versus Agility: Leagility**

In this era of globalization modern manufacturing enterprises are continuously facing tough market competitions. The remarkable industrial growth in past few decades has completely revolutionized their traditional manufacturing strategies giving emergence to the modern concepts of lean, agile, and nowadays, leagile manufacturing. These new strategies enable the enterprises to survive in the turbulent environment of violent competitions laid down by their competitors. The requirement of faster delivery within due date, the ability of being flexible to satisfy fluctuating market demand have been the prime motivations that has provoked manufacturing enterprises to look for the available best alternatives and implement it in their daily manufacturing practices. This led to the development of a new concept of „leagility" , which is an integration of lean and agile principles. Agile manufacturing is adopted where demand is volatile and lean manufacturing is adopted where there is a stable demand. However, in some situations it is advisable to utilize a different paradigm on either side of the material flow decoupling point to enable a total supply chain strategy. This approach is termed as leagile paradigm (Mason-Jones, 2000a, b).

Recent advancements have shown that leagile principle has immense potential to counteract the existing complexity of the market scenario. Therefore, leagile principles are, nowadays, attracting modern manufacturing enterprises; researchers as well as management practitioners are aiming to find its potential benefits almost in all industrial sectors throughout the globe.
Lean manufacturing focuses on cost reduction by eliminating non-value added activities so that several advantages can be obtained such as minimization/elimination of waste, increased business opportunities and to gain competitive advantage. Lean manufacturing is generally adopted where there is a stable demand and to ensure a level schedule. The term „lean manufacturing" , which first appeared in 1990s (Womack, 1990, Holweg, 2007) when it was used to refer to the elimination of waste in the production process, has been announced as the production system of the 21st century. Historically, the concept of lean manufacturing was originated with Toyota Production Systems (TPS); and Toyota had increasingly become known for its effectiveness in implementing Just-In-Time (JIT) manufacturing systems. Lean manufacturing is called „lean" as it uses less or the minimum, of

everything required to produce a product or perform a service. Lean operations eliminate seven tedious wastes, namely overproduction, over processing, motion, waiting, transportation, defects, and inventory.
On the contrary, agile manufacturing is the ability to respond and create new windows of opportunity in a turbulent market environment driven by the individualization of customers" requirements cost effectively, rapidly and continuously. Agile manufacturing is essentially the utilization of market knowledge and virtual corporation to exploit profitable opportunities in a volatile marketplace (Power et al., 2001; Katayama and Bennett, 1999; Christopher, 2000). Agile manufacturing is used to represent the ability of a producer of goods and services to thrive in the face of continuous change.These changes can occur in markets, in technologies, in business relationships and in all facets of the business enterprise. On the contrary, for the lean manufacturing the emphasis is on cost-cutting. The requirement for organizations to become more flexible and responsive to customers" expectations led to the concept of agile manufacturing as a differentiation from the lean organization.

Leagility is the combination of the lean and agile paradigms within a supply chain strategy by proper positioning the „decoupling point" . A leagile system has the characteristics of both lean and agile parts, acting together in order to exploit market opportunities in a cost-efficient manner. The system defined as leagile could be an entire supply chain or a single manufacturing plant with individual lean and agile sub-groups containing a decoupling point, which separates the lean and agile portions of the system. The decoupling point is the point in the material flow streams to which the customer" s order penetrates (Mason-Jones et al., 2000a,
b; Prince and Kay, 2003). It is the point where order driven and the forecast driven activities meet. A decoupling point within a factory enables lean and agile practices to complement each other at the operational level to improve overall performance and profitability of the factory. The most important reason behind combining these two concepts is to take advantages of both in a single unit; because, there is always a need for responding to volatile demand downstream and providing level scheduling upstream from the marketplace (Hoek et al., 2001). Naylor et al. (1999) believed that agile and lean manufacturing can be treated as complement to each other in the right operational conditions and should not be viewed as competitive, rather as mutually supportive. Agility is dynamic and context specific, aggressively change embracing and growth oriented (Goldman et al., 1995). Agile manufacturing promises not only improved manufacturing performance but also the support of future business strategies designed to improve the way in which an enterprise competes in the market place. On a strategic level agile manufacturing is seemed very attractive for its potential to cope up with future uncertainty and the prospect of producing a wide range of highly customized products at mass production prices. Therefore, these two concepts can be combined within successfully designed and operated supply chains where agile manufacturing concepts are applied to the part of the supply chain under the greatest pressure to operate in an environment of fluctuating demand in terms of volume and variety. Lean concepts can then be applied to the rest of the supply chain to create and encourage level demand necessary to achieve the cost benefits associated with this production strategy. The innovation being sought is the application of lean and agile concepts at different stages of the same manufacturing process route so that the benefits of both strategies can be maximized.
Naylor et al. (1999) compared lean and agile paradigm highlighting the similarities and differences as agile manufacturing is best suited to satisfy a fluctuating demand and lean manufacturing requires a level schedule. They combined both the paradigm within a total supply chain strategy particularly considering market knowledge and positioning of the decoupling point. Mason-Jones et al. (2000a) integrated lean production and agile supply in the total supply chain and supplemented by information enrichment which required evaluation of the total performance metric and development of a route map. Adopting such an approach to supply chain re-engineering ensured that customer service levels were improved at the same time lead times and costs were greatly reduced. Mason-Jones et al. (2000b) classified supply chain design and operations according to the Lean, Agile and Leagile paradigms that enabled to match the supply chain type according to marketplace necessity. Herer et al. (2002) introduced transshipments, which represented a common practice in multi-location inventory systems involving monitored movement of stock between locations at the same level of the supply chain and established a model, how transshipments could be used to enhance both agility and leanness. Stratton and Warburton (2003) explored the role of inventory and capacity in accommodating the lean as well as agile supply chain variation and identified how *Theory of Inventive Problem Solving* (TRIZ) separation principles and *Theory of Constraints* (TOC) tools might be combined in the integrated development of responsive and efficient supply chains.

Prince and Kay (2003) described the circumstances on which manufacturing organizations required an integrated agile and lean characteristic in their supply chain. They also described the development of the virtual group (VG) concept, which was the application of virtual cells to functional layouts. VGs enabled the appropriate application of lean and agile concepts to different stages of production within a factory. The identification of VGs was achieved through enhanced production flow analysis (EPFA). Bruce et al. (2000) discussed the characteristics of the textiles and apparel industry and identified the perspectives of leanness, agility and leagility within existing supply chain fiction which offered as solutions to achieving quick response and reduced lead times.

Narasimhan et al. (2006) attempted an empirical study to determine whether leanness and agility forms occurred with any degree of uniformity in manufacturing plants. The result illustrated the existence of homogeneous groups that resembled lean and agile performing plants. They identified important differences pertaining to their constituent performance and also revealed that while the pursuit of agility might presume leanness, pursuit of leanness might not presume agility. Agarwal et al. (2006) presented a framework which encapsulated the market sensitiveness, process integration, information driver as well as flexibility measures of supply chain performance. They investigated the relationship among lead-time, cost, quality and service level and presented a case study on three types of supply chain viz. lean, agile and leagile in the context of fast moving consumer goods business. Krishnamurthy and Yauch (2007) proposed a theoretical model of leagile manufacturing and analyzed the utility of leagility concept to a single corporate with multiple business units. They explained whether a decoupling point would be necessary to distinguish the lean and agile portions of the enterprise.

Rahimnia and Moghadasian (2010) presented a case study to apply the decoupling point concept in a healthcare delivery system considering the leagile concept. By grouping healthcare services into three pipelines the aforesaid study identified decoupling points for the supply chain. It also argued that while discussing leagility in a professional service organization the important role of human resources should be highlighted. Chan et al. (2009) proposed an integrated process planning and scheduling model inheriting the salient features of outsourcing; and leagile principles to compete in the existing market scenario. The authors also proposed a new hybrid Enhanced Swift Converging Simulated Annealing (ESCSA) algorithm to solve the complex real-time scheduling problems. It had an inherent feature of the Genetic Algorithm (GA), Simulated Annealing (SA) and the Fuzzy Logic Controller (FLC). Rahimnia et al. (2009) highlighted the application of leagility and its characteristics in a mass service organization.
Despite the low customization in mass services, fast food restaurants faced changing needs of the customers. To respond to these demands, the case organization could adopt new strategies so that it could be able to serve the customer with short lead times, low costs and high variety.
Huang and Li (2010) illustrated how a personal computer original equipment manufacturer (OEM) in Taiwan achieved leagility through re-engineering of its supply chain. The case study showed how the company adjusted its production processes from build-to-order (BTO) to configuration-to order (CTO) so as to achieve leagility.

Konecka (2010) emphasized the importance of the risk management in supply chains strategy such as lean, agile and leagile. These studies facilitated the choice of an appropriate supply chain strategy based on the risk analysis. Moron and Haan (2011) presented a practical case study on polish distributer in Poland. They stated that during the volatile period an agile approach provided the flexibility and competitiveness needed. However, when the market matured; the overly expensive agility caused last minute crisis; then a lean approach enabled the optimization of processes needed to supply customer in a more reliable way.
Azevedo et al. (2012) proposed an index to evaluate the extent of agility and leanness of individual companies and the corresponding supply chain. The index was obtained from a set of agile and lean supply chain practices integrated in an assessment model named Agile and Delphi technique which was used to develop a series of weighted agile and lean supply chain management practices and also the importance of the paradigms through experts in automotive. Soni and Kodali (2012) addressed the issue of lack of standard constructs in frameworks of lean, agile and leagile supply chain by evaluating reliability and validity of lean, agile and leagile supply chain constructs in Indian manufacturing industry.

Principle Component Analysis (PCA) was performed on these constructs to find out the pillars of each type of supply chain followed by evaluating reliability and validity of these pillars to establish the underlying constructs.

## CONCLUSION

An agile enterprise is a fast moving, adaptable and robust business. It is capable of rapid adaptation in response to unexpected and unpredicted changes and events, market opportunities, and customer requirements. Such a business is founded on processes and structures that facilitate speed, adaptation and robustness and that deliver a coordinated enterprise that is capable of achieving competitive performance in a highly dynamic and unpredictable business environment that is unsuited to current enterprise practices.

Change seems to be one of the enterprise‟ s important characteristics to gain competitive advantage in ever-increasing business environment. Agile Manufacturing (AM) is viewed as a winning strategy by the organizations to quickly adapt and orient themselves in changing environments. It is important to identify various agile drivers which can be deployed collectively to make the organization profit making one in the market place.

Manufacturing firms can improve agility capabilities if agility providers are identified and implemented in various areas of manufacturing such as organization, technology, people and innovation (Danuta and Swierczek, 2009). The integration of these four areas is required to provide agility capabilities in order to effective address various issues related to competition arising from market place. All the agility providers do not warrant the same focus and need the attention of the decision makers to segregate them into different classifications.

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