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IMPROVING SUPPLY CHAIN THROUGH LEANNESS AND AGILITY

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ABSTRACT

Many enterprises have pursued the lean thinking paradigm to improve the efficiency of their business processes. More recently, the agile manufacturing paradigm has been highlighted as an alternative to, and possibly an improvement on, leanness. In pursuing such arguments in isolation, the power of each paradigm may be lost, which is basically that agile manufacturing is adopted where demand is volatile, and lean manufacturing 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 de-coupling point to enable a total supply chain strategy. This approach we have termed the Leagile Paradigm. This paper therefore considers the effect of the marketplace environment on strategy selection to ensure optimal supply chain performance. Real-world case studies in the mechanical precision products, carpet making, and electronic products market sectors demonstrate the new approach to matching supply chain design to the actual needs of the marketplace.

Keywords: lean thinking, paradigm, mechanical precision, marketplace

INTRODUCTION

The success and failure of supply chains are ultimately determined in the marketplace by the end consumer. Getting the right product, at the right price, at the right time to the consumer is not only the lynchpin to competitive success but also the key to survival. Hence, customer satisfaction and marketplace understanding are crucial elements for consideration when attempting to establish a new supply chain strategy. Only when the constraints of the marketplace are understood can an enterprise attempt to develop a strategy that will meet the needs of both the supply chain and the end consumer.

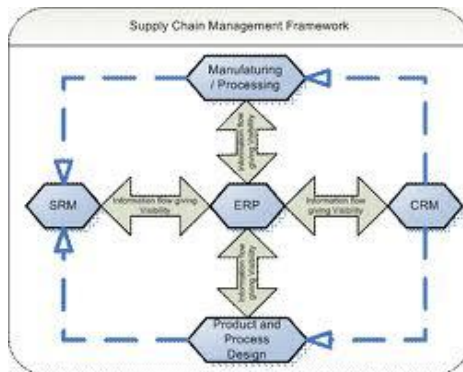
Supply chain performance improvement initiatives strive to match supply and demand, thereby driving down costs simultaneously with improving customer satisfaction. This invariably requires uncertainty within the supply chain to be reduced as much as practicable so as to facilitate a more predictable upstream demand. Sometimes, however, uncertainty is impossible to remove from the supply chain due to the type of product involved. If a product is highly fashionable then, by its very nature, its demand will be unpredictable. Hence, specie supply chains are faced with the situation where they have to accept uncertainty but need to develop a strategy that enables them still to match supply and demand. Those companies who design business strategies that acknowledge the presence of uncertainty and provide mechanisms for pro-actively tackling it are rewarded by an opportunity to enable best practice ahead of competitors whose responses are purely reactive (Mason-Jones and Towill 1999).



The message here is that supply chains need to adopt a strategy that suits both their particular product and marketplace. This paper analyses the lean, agile and 'leagile' paradigms and their roles in tackling differing marketplace uncertainty scenarios. It includes case studies illustrating the approach and representing real-world supply chains in three different market sectors.

SUPPLY CHAIN UNCERTAINTY

Much uncertainty evident in supply chains is system induced and magnified by the 'Bullwhip effect', as opposed to being present in the marketplace. The supply chain dynamics wave propagation observed by Forrester (1961) used to be called 'demand amplification'. Nowadays it is more commonly termed the 'Bullwhip effect' (Lee et al. 1997) due to the characteristic of increasingly magnified and hence worsening behaviour observed upstream from the source of the disturbance. System induced uncertainty is inherent within many supply chains due to the strategies and relationships involved and is therefore within the direct control of the companies involved. Hence, it is our experience that many of the detrimental effects of uncertainty can be alleviated by working hard to reduce the system-induced effects (Towill and McCullen 1999). Done properly, this leaves the supply chain to develop a strategy that needs only to deal with marketplace uncertainty. The combined effect of system-induced and marketplace uncertainty typically leads to the type of Bullwhip effect. This shows the resultant behaviour due to a system-imposed uncertainty resulting from a supplier discount scheme operating in a retail supply chain.

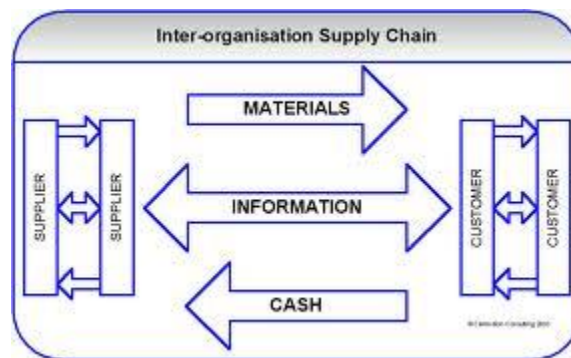


SCM framework

As can be seen, the enticement of a discount offered to the retailer caused an unpredictable change in behaviour that was magnified throughout the chain by the Bullwhip effect. This produced a typical dynamic profile with demand being amplified as it is passed upstream. The resultant on-costs are considerable for all 'players' in the chain, including overtime, shift premiums, quality variances, and additional distribution, handling and storage charges. However, the situation is made even more inexplicable by the realization that true marketplace demand could have been satisfied with a very simple order placement profile consisting of just a few ramps and plateau. In other words, by responding to true marketplace demand, a series of level schedules placed on suppliers would have sufficed, a situation ideally suited to lean supply (Suzuki 1987). Instead, the supply chain operated in the unnecessarily costly agile mode.

COPING WITH DIFFERING PRODUCT TYPES:

In his seminal paper, Fisher (1997) stated that when developing a supply chain strategy that will facilitate matching supply and demand, the relationship between product type, supply chain and sales predictability is pivotal to ensuring that the optimal approach is adopted. He classified products into two generic types, fashion and commodities. Fashion products have a short life cycle and high demand uncertainty, therefore exposing the supply chain to the risks of both stock out and obsolescence. A good example of a fashion product is trendy clothing. The challenge faced by a supply chain delivering fashion products is to develop a strategy that will improve the match between supply and demand and enable the companies to respond faster to the marketplace. Commodities that are basic products, such as tinned soups, have relatively long life cycles and have low demand uncertainty due to the fact they tend to be well-established products with a known consumption pattern. The driving force for basic product supply chains is therefore cost reduction.



Inter-Organizational supply chain

Note that in terms of Hill's (1993) manufacturing strategy metrics, there is a considerable difference between the two groups of products. Whereas the market winner for commodities is price. Quality and lead-time are market qualifiers in both cases: price and availability are market qualifiers for fashion products and commodities respectively.

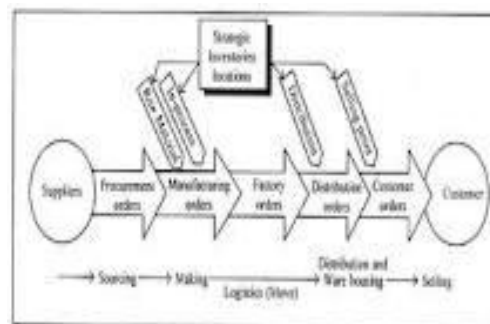
These two product types respond to distinctly different marketplace pressures and hence require a different supply chain approach to address their specific characteristics. Only through understanding the particular characteristics of the product type, marketplace requirements and management challenges can the correct supply chain strategy be

designed to ensure optimal performance and to establish competitive advantage. This can be achieved via developing strategies that will reduce the effect of the system-induced uncertainty, thereby reducing the Bullwhip effect and, at the same time, actively coping with the particular marketplace uncertainty pressures.

MATCHING SUPPLY CHAIN STRATEGIES WITH PRODUCT TYPE

Many organizations have adopted the lean thinking paradigm (Womack and Jones 1994) in their drive to optimize performance and improve competitive position. Recently, the agile manufacturing paradigm has been highlighted as an alternative to leanness (Richards 1996). It has also been suggested in some quarters that agility is the next step after leanness. This could mean that, once leanness has been achieved, an enterprise should strive for agility or even that agility should be the goal of an enterprise and leanness as a primary objective should be forgotten. These discussions oversimplify the situation as they fail to take into consideration the generic product type and hence the business environment and response requirements needed to match adequately supply chain design to the required structure.

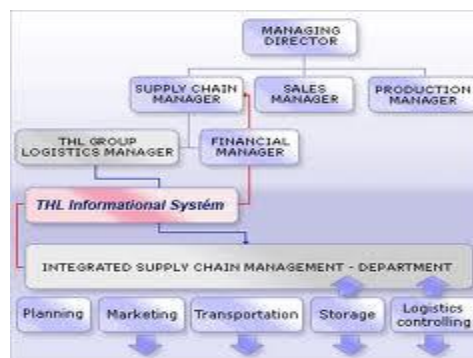
The following definitions relate the agile and lean paradigms to supply chain strategies and were developed to emphasize the distinguishing features of each (Naylor et al. 1999). Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace. Leanness means developing a value stream to eliminate all waste, including time, and to ensure a level schedule. It should be noted that what may be regarded as 'waste' in lean production may conversely be essential in agile production. As McHugh et al. (1995) have emphasized, one example is the question of capacity requirements. In lean production, the customer buys specific products, whereas in agile production the customer reserves capacity that may additionally need to be made available at very short notice.



Scope of SCM

As can be seen from the above definitions, the commodities are very well suited to the lean environment as demand is relatively predictable and therefore facilitates the level schedule requirements necessary for a lean supply chain (Suzuki 1987). Conversely the characteristics of fashion products are more suited to the agile environment where the unpredictability of the demand is accepted as a business risk and the strategy is developed to optimize performance in such an arena. A blanket approach across the whole supply chain may, however, not be appropriate.

Leanness and agility can sometimes be combined with the strategic use of a decoupling point, thereby capitalizing on the benefits of both paradigms. Thus, there are some instances where there is an economic justification for engineering a 'Leagile' supply chain, thereby getting the best of both worlds. This combined approach is known as 'Leagility' and, as a consequence, the supply chain can thereby adopt a lean manufacturing approach upstream, enabling a level schedule and opening up an opportunity to drive down costs upstream while simultaneously still ensuring that downstream of the de-coupling point there is an agile response capable of delivering to an unpredictable marketplace. The formal definitions required are as follows. 'Leagile is the combination of the lean and agile paradigms within a total supply chain strategy by positioning the decoupling point so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling upstream from the marketplace.' (Naylor et al. 1997) 'The decoupling point is the point in the material flow streams to which the customer's order penetrates. It is here where order-driven and the forecast driven activities meet. As a rule, the decoupling point coincides with an important stock point \pm in control terms a main stock point \pm from which the customer has to be supplied.' (Hoekstra and Romme 1992)

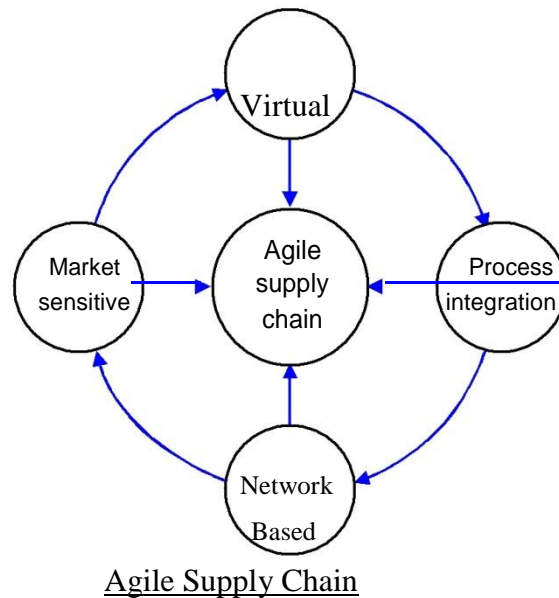


Integrated SCM

Why call it Leagile? First, because in a Leagile supply chain, Lean material flow is upstream of Agile material flow. Secondly, because to succeed as an agile process it must be fully documented, understood and engineered. This is readily enabled by initially engineering a Lean process and then adapting it by removing specific constraints and capacity limitations, thus enabling Agility. Hence, Lean precedes Agile on two counts; geographically and temporally.

EFFICIENT SUPPLY CHAIN AND RESPONSIVE SUPPLY CHAIN:

One of the causes of supply chain failure is due to the lack of understanding of the nature of demand. The lack of understanding often leads mismatched supply chain design. Fisher (1997) suggested two distinctive approaches, efficient supply chain and responsive supply chain, to design a firm's supply chain. The purpose of responsive supply chain is to react quickly to market demand. This supply chain model best suits the environment in which demand predictability is low, forecasting error is high, product life cycle is short, new product introductions are frequent, and product variety is high. The responsive supply chain design matches competitive priority emphasizing on quick reaction time, development speed, fast delivery times, customization, and volume flexibility. The design features of responsive supply chains include flexible or intermediate flows, high-capacity cushions, low inventory levels, and short cycle time.



The use of information technology to share data between buyers and suppliers is, in effect, creating a *virtual* supply chain. Virtual supply chains are information based rather than inventory based.

Conventional logistics systems are based upon a paradigm that seeks to identify the optimal quantities of inventory and its spatial location. Complex formulae and algorithms exist to support this inventory-based business model. Paradoxically, what we are now learning is that once we have visibility of demand through shared information, the premise upon which these formulae are based no longer holds. Electronic Data Interchange (EDI) and now the Internet have enabled partners in the supply chain to act upon the same data i.e. real demand, rather than be dependent upon the distorted a noisy picture that emerges when orders are transmitted from one step to another in an extended chain.

Shared information between supply chain partners can only be fully leveraged through *process integration*. By process integration is meant collaborative working between buyers and suppliers, joint product development, common systems and shared information. This form of co-operation in the supply chain is becoming ever more prevalent as companies focus on managing their core competencies and outsource all other activities.

In this new world a greater reliance on suppliers and alliance partners becomes inevitable and, hence, a new style of relationship is essential. In the 'extended enterprise' as it is often called, there can be no boundaries and an ethos of trust and commitment must prevail. Along with process integration comes joint strategy determination, buyer-supplier teams, transparency of information and even open-book accounting.

This idea of the supply chain as a confederation of partners linked together as a *network* provides the fourth

ingredient of agility. There is a growing recognition that individual businesses no longer compete as stand-alone entities but rather as supply chains. We are now entering the era of 'network competition' where the prizes will go to those organizations who can better structure, co-ordinate and manage the relationships with their partners in a network committed to better, closer and more agile relationships with their final customers. It can be argued that in today's challenging global markets, the route to sustainable advantage lies in being able to leverage the respective strengths and competencies of network partners to achieve greater responsiveness to market needs.

MINIMIZE UNCERTAINTY TO MAXIMIZE COMPETITIVE ADVANTAGE

Despite the differences in the types of market uncertainty present in the lean, agile and leagile paradigms, the Bullwhip mechanism and resultant detrimental system induced uncertainties are the same for all the approaches. Therefore, it does not matter which paradigm is adopted, the system-induced uncertainty effects can still seriously hamper the effectiveness of the strategy. Therefore, it is crucial that system-induced uncertainty is reduced to ensure that the performance opportunities available via implementing a particular strategy are fully realized.



Supply Chain: A Complex System

Fortunately, the removal of system-induced uncertainty is greatly aided by engineering streamlined material flow, and thus designing in good practice. A suitable set of tried and tested rules for simplifying and streamlining material flow is available. These rules have been derived from a wide-ranging set of simulation studies and from industrial experiments and observations, and have clearly been adopted in whole or in part in the Case Studies that appear later in this paper. It is also possible to consolidate the rules into the following powerful set of Material Flow Control Principles, which have already found widespread application in supply chain BPR Programmers of proven effectiveness.

- 1) Selection of good Decision Support Systems: if process lead times are reliable and operations information of high quality, then good, robust control systems can also be very simple.
- 2) Slashing of material flow and information flow lead times: reduction of these is within the technological and organizational remit of individual echelons, thus requiring mainly internal action.
- 3) The widespread provision and integrity of operations information: the quality and quantity of data available throughout the extended enterprise are, however, a political issue to be addressed and overcome by the supply chain product champion.

- 4) Elimination of redundant echelons: this removes a source of distortion and delay but can give rise to ownership/political problems, which again need solution by the supply chain product champion.

Note that the problem of 'wide ownership' (especially of sales data) requires an attitudinal change on the part of all supply chain 'players'. Otherwise, the rapid feedback of vital information from further along the chain will be inhibited and dynamic performance considerably worsened. For example, actual sales data at one echelon need to be identified and transmitted alongside firm orders when placed higher up the chain so that false demand signals can be discounted (Wikner et al. 1991). We now proceed to demonstrate the 'Lean', 'Agile', and 'Leagile' concepts applied to real-world supply chains.

CONCLUSION

Marketing management has not traditionally recognized the importance of logistics and supply chain management as a key element in gaining advantage in the marketplace. However, in today's more challenging business environment, where volatility and unpredictable demand becomes the norm, it is essential that the importance of agility be recognized.

Leading companies are already implementing marketing strategies which are underpinned by a supply chain strategy designed with agility in mind. These are the organizations that will be best equipped for survival in the uncertain markets of the 21st century.

We have seen that classifying supply chain design and operations according to the Lean, Agile and Leagile Paradigms enables us to match the supply chain type according to marketplace need. These results in three fundamental designs illustrated in the real world by mechanical precision products (lean); carpet manufacture (agile); and electronics products (leagile). Such a classification proves clear rules for supply chain engineering for each market segment. This enables us to apply lean principles, agile principles and leagile principles according to the real needs of the specific supply chain. However, for all three supply chain types it is essential to remove system-induced uncertainty, as typified by the 'Bullwhip' effect. This elimination is greatly assisted via the proven Material Flow Control Principles consolidated from a basic simplification checklist, and which are visibly applied in all three Case Studies. Leagile supply chains already exist in the real world. What is important is to recognize when the new paradigm is the best way forward for a particular supply chain so that it may be appropriately engineered from the outset

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