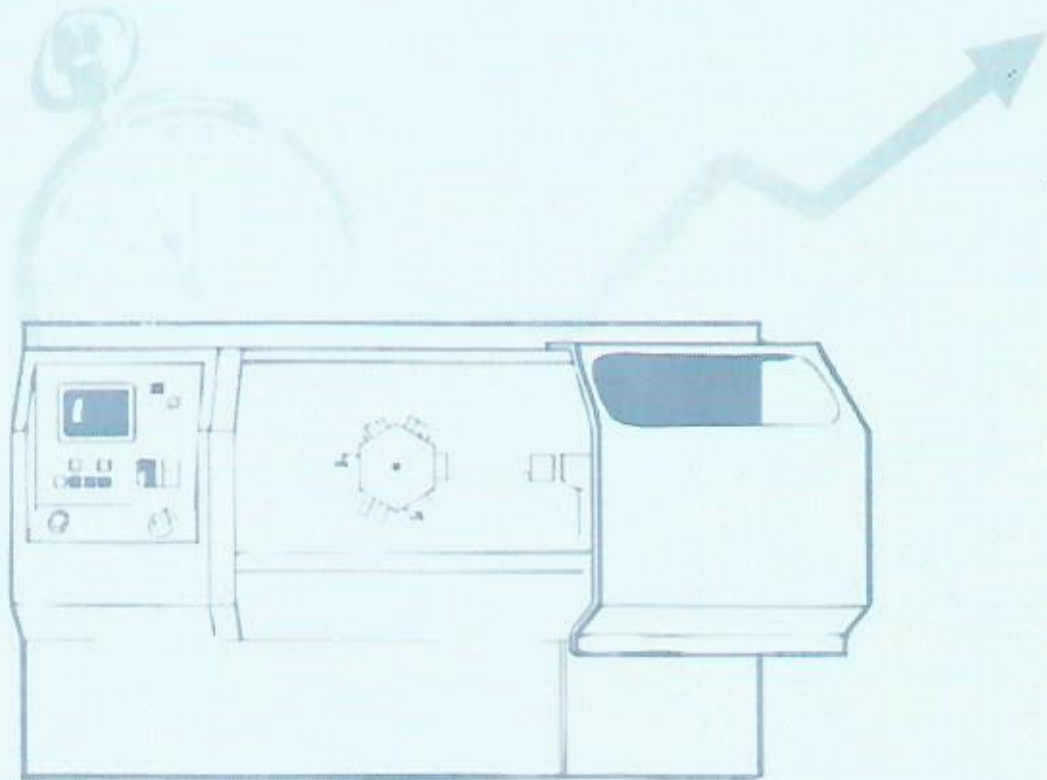




# Proceedings

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2010



editors :

Arya Wirabhuana, Muchammad Abrori, Kifayah Amar

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# Leagile Supply Chain Strategy of Indonesian Corrugated Box Manufacturer

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**Abstract** - Leagile supply chain is the combination of the lean and agile paradigms within a total supply chain strategy, for example by positioning the decoupling point to enable a level scheduling and opening up an opportunity to drive down costs upstream while simultaneously still ensuring that there is an agile response capable of delivering to an unpredictable marketplace. The purpose of this paper is to support this hybrid leagile supply chain understanding through case study in an Indonesian corrugated box manufacturer. The unpredictable customer demand of highly customized corrugated box in make to order production system is the characteristic of its demand, meanwhile difficulties in its relationship with paper suppliers that resulting long lead time and unreliable supply become its supply characteristic. In this situation, the corrugated box manufacturer can implement the combination of lean and agile supply chain or leagile supply chain using decoupling point approach.

**Keywords** - leagile supply chain, corrugated box

## I. INTRODUCTION

The term "leagile supply chain" was first being introduced by Naylor, Naim and Berry (1999). This idea has been discussed by many researchers such as Mason-Jones, Naylor, and Towill (2000), Stratton and Warburton (2001), Van der Vorst, Van Dijk, and Beulens (2001), Christopher and Towill (2002), Christopher, Peck, and Towill (2006), and Goldsby, Griffis, and Roath (2006).

Leagile supply chain is a kind of combination, hybrid, integration or fuse between lean supply chain and agile supply chain. According to Goldsby, Griffis, and Roath (2006), lean and agile must not necessarily compete and can be employed simultaneously. In some cases, the two idea of lean and agile can be brought together as a hybrid "leagile" solution (Naylor, Naim, and Berry, 1999).

While this hybrid idea still become debated topics by academics or practitioners, some case studies of leagile supply chain has been introduced such as by Naylor, Naim and Berry (1999), Mason-Jones, Naylor, and Towill (2000), Oser (2004) and Goldsby, Griffis, and Roath (2006), and Christopher, Peck, and Towill (2006). All the case studies illustrate the parallel

implementation of lean and agile supply chain in many industries such as electronics products manufacturer, car manufacturer, and apparel industry. The purpose of this paper is to support the hybrid "leagile" supply chain understanding through a case study in an Indonesian corrugated box manufacturer.

Corrugated box is a type of box made of corrugated sheets (fiberboard) for packaging and shipping container purpose. The corrugated box manufacturer in this case study is located in Banten Province, Indonesia. Located nearby the Indonesian capital, Jakarta, it supplies corrugated box and fiberboard to other manufacturers in Indonesia and sometimes to companies abroad. It is an independent corrugated box manufacturer with around 300 employees and it continuously builds their business including the supply chain.

This paper provide the result of several analysis concerning the corrugated box industry business environment including the marketplace, production system, its supply chain structure and current relationship between the company with their suppliers, customers and other business partners, and the measurement of its supply chain performance. It identifies the situation and reason for the company to implement a combination of lean and agile supply chain as their strategy.

## II. LEAGILE SUPPLY CHAIN STRATEGY

Leagile supply chain 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, Naim and Berry, 1999). Though lean and agile strategies are often pitted as opposing paradigms, they share a common objective: meeting customer demands at the least total cost. Researchers in recent years have suggested that the two approaches need not necessarily represent opposing points of view. Rather, they may be merged in a variety of ways to create so-called leagile approaches (Goldsby, Griffis, and Roath, 2006). Leagile supply chain is a hybrid of lean and agile supply chain.

Christopher and Towill (2002) conceived three distinct hybrids (Goldsby, Griffis, and Roath, 2006). The first hybrid approaches embraces the Pareto (80/20) rule, recognizing that 80% of a company's revenue is generated from 20% of products. Fast moving products that make up the dominant 20% of the product line can be produced in a lean, make to stock manner given that demand is relatively stable for these items and that efficient replenishment is the appropriate objective. Meanwhile, the remaining 80% should be produced in an agile, less anticipatory manner, perhaps even employing make to order production to generate supply for only those items ordered when they are ordered.

The second lean-agile hybrid involves having temporary capacity to meet the needs of peak demand. Most companies experience a base level of demand over the course of the year. This base level of demand can be accommodated in a lean manner, using the company's own resources to employ heijunka (smooth production) principles to maintain highly efficient operations. However, when demand spikes over the course of peak seasons or heavy production periods, outside capacity is procured to meet the heightened demand of these distinct time windows. The procurement of outside capacity for coverage in these situations is viewed as the agile component of this hybrid approach. Many companies engage in leagile supply, manufacturing, and logistics to support seasonal demands.

The third hybrid, calls for form postponement using decoupling point. Supply chain can 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 decoupling point there is an agile response capable of delivering to an unpredictable marketplace (Figure 1). This approach works best when goods can be developed from common materials into a near-finished state with final touches to the product providing for a diverse assortment that accommodates distinct customer needs.

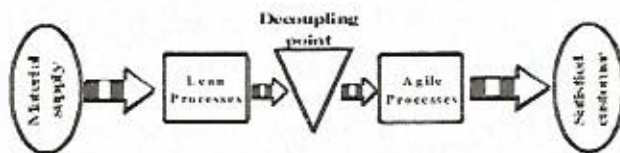


Figure 1: Block diagram representing leagile supply chain (Mason-Jones, Naylor, and Towill, 2000)

Christopher, Peck, and Towill (2006), develop taxonomy for selecting global supply chain strategies (Figure 2). In situations where demand is predictable and replenishment lead-times are short then a "lean continuous replenishment" strategy may be appropriate. If lead times are long but demand is predictable, then there is opportunity for the pursuit of lean type strategies, e.g. make or source ahead of demand in the most efficient way. When demand is unpredictable but lead times are short, then agile solutions will be required based

upon rapid response. Finally, at the other extreme (unpredictable demand and long lead times) the ideal solution is to carry strategic inventory in some generic form and assemble/configure/distribute as required when actual demand is encountered, in classic postponement concept.

Within each cell of the matrix, the tactics adopted may also be influenced by whether the product is standard or special. For example, in the postponement cell of Figure 1, for a special product we may postpone manufacturer, but for a standard product it may be better to postpone distribution (Pagh and Cooper, 1998).

Supply Characteristics	Long Lead Time	LEAN PLAN AND EXECUTE	LEAGILE POSTPONEMENT	
	Short Lead Time	LEAN CONTINUOUS REPLENISHMENT	AGILE QUICK RESPONSE	
	Predictable		Unpredictable	
	Demand Characteristics			

Figure 2: How demand /supply characteristics determine supply chain strategy (Christopher, Peck, and Towill, 2006)

### III. BUSINESS ENVIRONMENT AND SUPPLY CHAIN OF THE CORRUGATED BOX MANUFACTURER

Corrugated box is an industrial good. It tends to have a few raw materials, i.e. paper rolls, adhesive material, and ink, but produce many different designs of boxes and varied by many factors such as paper type and structure. Corrugated box is a customized product; one design is only useful for one customer, moreover for one customer's product or item. Make to order is then the common system in corrugated box manufacturing.

As corrugated manufacturer works in a make to order system, the production processes are starting after customer order arrives. This actually needs speed and flexibility to react, adjust, and executes different customer order. In fulfilling customer order, there is preliminary step called pre-order to prove the ability of manufacturer to produce the ordered product in the specified specification and design and to negotiate the price and other term and condition. This pre-order negotiation actually support company's agility to react, adjust, and executes different customer order.

The production process of corrugated box is actually a mixture of continuous and discrete manufacturing. The routing of the production is relatively fixed except in finishing processes. This fixed sequence of main production processes with short manufacturing time enable the company to have flexibility to different customer order.

For the forthcoming five years, corrugated output is expected to grow at an annual average rate of 4.0 percent (International Corrugated Case Association (ICCA), 2007). According to Ming et al (2004), corrugated box manufacturers are facing tough challenges ahead, characterized by increasingly stronger competition due to overcapacity, increasingly higher customers' expectation and increasingly higher production cost

According to the Indonesian association of corrugated cardboard industry (PICCI) the production of corrugated box in Indonesia increase in average 4% per year, but there are over capacity compared to the overall demand from consumer good manufacturers, therefore competition in this industry is tough and customer can easily move to other corrugated box manufacturer.

In general, we can say that in corrugated box industry in which this company works characterized by strong competition due to over capacity compare to the customer demand, increasingly higher customers' expectation such as higher quality, customization, and just in time delivery, and where corrugated box manufacturing is no longer simply producing of corrugated boxes but combining production and services, with services being increasingly important.

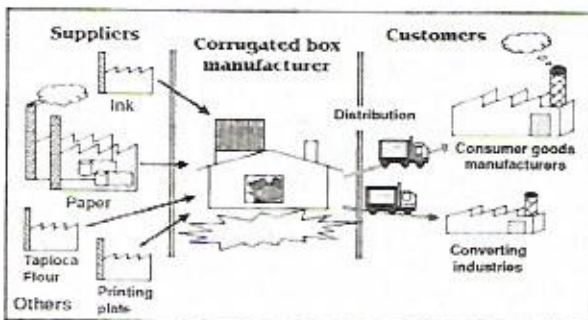


Figure 3: The corrugated box manufacturer's supply chain

The supply chain structure of the corrugated box manufacturer in this discussion is limited in 1-tier upstream (suppliers) and 1-tier downstream (customers) as shown in Figure 3. The corrugated box manufacturer has several suppliers such as paper manufacturer, ink, printing plate, and tapioca flour suppliers. Around 80% of the customers are consumer goods manufacturers and 20% are converting industries that buy corrugated sheet and then convert them into others products. There are also some transportation partners that distribute their products to the customers.

Around 75 – 90% of corrugated box production cost is for the paper; therefore strategic partnership with paper supplier is very important. Unfortunately, it is found that collaboration and coordination with paper supplier is very weak. Figure 4 shows the collaboration and coordination profile between the corrugated box manufacturer and its paper suppliers. It's a result of qualitative judgment of the company through an

interview with the company's directors, adopted from Hieber, 2002.

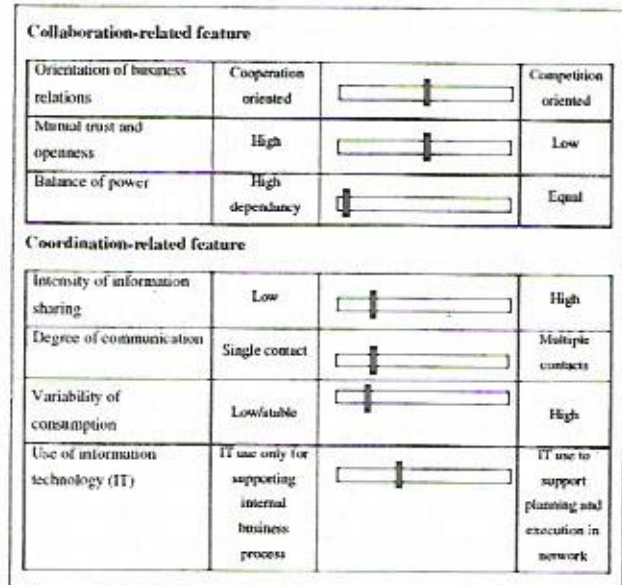


Figure 4: Collaboration and coordination profile with paper suppliers

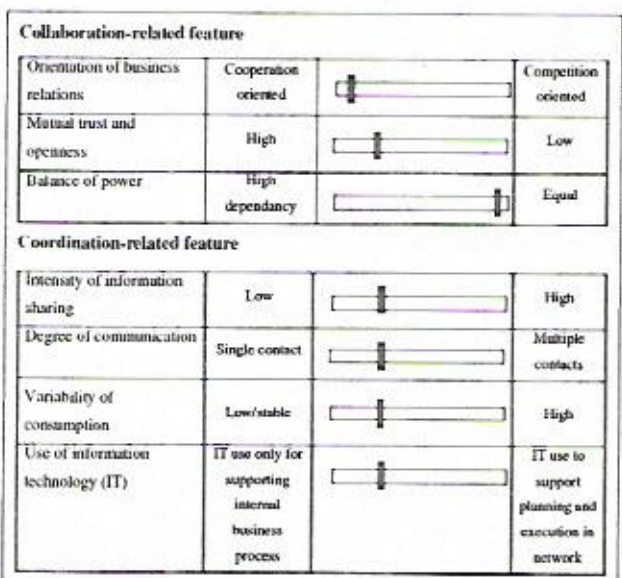


Figure 5: Collaboration and coordination profile with customers

There are limited corrugated box paper suppliers in Indonesia with varied quality level. Paper supplier is usually bigger in size and economic scale; meanwhile they prefer to sell their product to global market that has higher price than local market. Corrugated box manufacturer is too dependent to paper supplier. For all their purchase order, company can not determine the delivery date, frequency of delivery, and the number of paper roll in each delivery.

Giving the best service and relationship to the customer is the strategy of the company. One of the implementation is by selecting and maintaining only the highly beneficial customer. Figure 5 shows the collaboration and coordination profile between the corrugated box manufacturer and its customers. Pre-order process and negotiation indicate better coordination with customers, but they still have low collaboration indicate by low information sharing and limited communication contacts. In general all parties try to build mutual relationship with balance of power.

The corrugated box manufacturer outsources the ink inventory and warehousing, printing plate production, and product distribution. These practices ensure the availability of ink in economic level, fast and economic design and production of printing plate, and also flexible and quick delivery of customer order. Telephone, fax, and email are the information and communication technology used for information sharing and communication with their suppliers, customers, and other partners. Internally the company implements Corrugated Packaging System (CPS), a special Enterprise Resource Planning (ERP) system for corrugated box industry that integrates the information sharing throughout the system in the company.

According to Industry Canada (2007), the main key performance indicator for evaluating supply chain agility is inventory turns. The inventory turns of the corrugated box manufacturer have been measured and then being compared to the performance of Canadian corrugated box manufacturer. The result is shown in Table 1.

TABLE 1  
COMPARISON OF INVENTORY TURNS WITH INDUSTRY  
CANADA STANDARD

Performance Indicator	Subject of Case Study	Canadian Corrugated Box Manufacturer
Inbound inventory turns	9.56	25.7
Outbound inventory turns	79.6	32.1

TABLE 2  
CORRUGATED BOX MANUFACTURER SUPPLY CHAIN  
PERFORMANCE

Performance Indicator	Performance
Responsive planning time	1 day
Order promising time	1 day
Procurement lead time	14 days
Supplier flexibility	1 day
Upside procurement flexibility	29.18 days
New design time to order	4 days
Upside production flexibility	1 day
Order fulfillment lead time	5 days
Upside delivery flexibility	1 day
Return order lead time	3 days

It is clear that problem occurs in inbound inventory turns. The corrugated box manufacturer has lower inbound inventory turns compared to Canadian corrugated box manufacturers. Lower inbound inventory turns means raw material (paper) is stocked in longer time or they stock more raw materials in their warehouse in comparison with their production quantity. Availability of raw material and the lead time and also level of collaboration and integration with supplier may cause this difference. Table 2 provides other performance of the corrugated box manufacturer supply chain.

#### IV. LEAGILE SUPPLY CHAIN OF CORRUGATED BOX MANUFACTURER

According to Wadhawa and Rao (2003), company that works in make to order production system has a higher need for agility, because they need speed and flexibility to react, adjust, and executes different customer order. As they work in make to order system and customized products, corrugated box manufacturer surely need an agile supply chain. But, can they implement an agile strategy in their entire supply chain span? From the inventory turns performance, it can be seen that their outbound inventory turns indicating an agile supply in satisfying customer demand, but it does not supported by the inbound inventory turns. It also can be seen from the other supply chain performance.

Further analysis was done based on Christopher and Towill (2002) taxonomy. From the analyses of its demand characteristics, corrugated box manufacturer has an unpredictable demand indicating by a highly customized product with many variety and modification on its design and short term and low relationship with customer related to strong competition due to many player and overcapacity. About the supply characteristics, it can be conclude that the corrugated box manufacturer has long lead time with 14 days of average procurement lead time and 29.18 days of upside procurement flexibility. From the analysis of the relationship with paper supplier it can be seen that corrugated box manufacturer has an unequal balance power. Corrugated box manufacturer is too dependent to paper supplier. For all their purchase order, company can not determine the delivery date, frequency of delivery, and the number of paper roll in each delivery.

This unpredictable demand and long lead time is fit with the characteristic of leagile supply chain form Christopher and Towill (2002). Therefore the corrugated box manufacturer can implement a hybrid leagile supply chain. They can implement a leagile supply chain with decoupling point or postponement approach (Figure 6). As they produce special and customized product, they can postpone their manufacturing operations (Pagh and Cooper, 1998).

In supply side, the corrugated box manufacturer needs a lean supply chain. Increasing their inbound inventory turn can be the improvement measure. Better inventory management



can be an internal solution in order to increase inbound inventory turns. This company need to understand inventory characteristic from historical data such as using ABC and XYZ analysis and than define appropriate policy for optimizing their inventory such as safety stock policy and inventory controlling system.

The ABC classification is based on percent of consumption and XYZ classification is based on variation coefficient. For A-class items, higher attention by daily review is need to be given. The company also must find and keep alternative supplier for these items. For B-class items, alternative suppliers also important to be found but inventory review can be performed in weakly interval. Therefore A and B class items need to be considered in finding new supplier. In managing C-class items, efficient effort by monthly planning is required as they have less value. Based on XYZ classification, the company can set different safety stock policy for different inventory class. Because Z-class item is more difficult to forecast, it needs a higher safety stock. For CZ-class items, because they have low value but require higher attention since they more fluctuate, it would be better to accumulate and/or substitute the CZ-items by the same paper type with bigger dimension and belongs to A or B class.

In their production and distribution side, the corrugated box manufacturer needs an agile supply chain to rapidly respond any changes in customer demand. This is currently not a big problem for the company; they just have to maintain their current production and distribution capacity and flexibility supported by their ERP information system.

V. CONCLUSION

The unpredictable customer demand of highly customized corrugated box in make to order production system is the characteristic of corrugated box manufacturer's demand, meanwhile difficulties in its relationship with paper suppliers that resulting long lead time and unreliable supply become its supply characteristic. In this situation, the company can implement the combination of lean and agile supply chain or leagile supply chain using decoupling point approach. In the supply side they need a lean supply chain and better inventory

management can be their internal improvement. Their current production and distribution capacity and flexibility, supported by their ERP information system support their agility in production and distribution side.

From the case study it can be concluded that combining lean and agile supply chain in one company is possible and is necessary in this company. Other corrugated box manufacturer facing the same situation can also implement the same leagile supply chain strategy.

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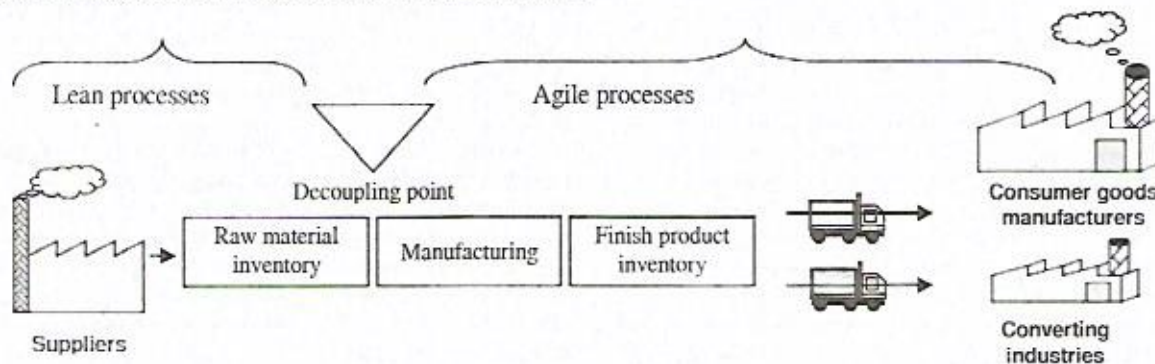


Figure 6: Leagile supply chain of corrugated box manufacturer