A Supply Chain Paradox

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Abstract

Supply chain collaboration is the key to success in business. A major challenge in such collaborations is the dilemma between locally optimized quick solutions and the more systemic, long-term but 'slow-acting' approaches. Such dilemma in business collaborations has been contemplated in supply chain management research, illustrating their respective benefits and disadvantages. In light of the findings from literature, this study investigates the dynamics of this dilemma using an integrated perspective, utilizing both theories and case studies in supply chain relationships and collaborations. The archetypical dynamics and behavior of relationships over time are modeled, proposing an ever-evolving framework of supply chain collaborations. Along with the model, a prototype of a supply chain collaboration simulation model is also presented, as a customizable environment for policy testing and demonstration of different supply chain collaboration approaches. This model may also be used for training purposes as Microworlds.

Keywords: Supply Chain Management, Collaboration, Relationship, Cooperation, Archetype, Simulation.

Introduction

Supply Chain Management promotes efficiency in production and delivery of products to consumers through business collaborations. These businesses transform raw material into final products at different stages, where each individual business may focus on their core competencies, and all contribute to a more efficient and effective production process

(Mentzer et al. 2000, Balakrishnan et al. 2004, Power 2005, Cousins et al. 2006, Fabbe-Costes 2007, Glock 2012).

Collaboration in supply chain is essentially the interactions among partner companies towards achieving "mutually acceptable outcomes" (Pagell, 2004). Individual companies, while being engaged in their autonomous operations, are often working jointly with its partners as well in planning and execution (Simatupang et al. 2002). Collaborative relationships emerge while on one hand the individual companies strive to maximize their own gains, and on the other hand, they perform jointly to support one another along the supply chain.

Supply chain collaboration conforms to systems theory in terms of the local versus global optimization paradox (Ackoff, 1993), as in whether to aim to benefit the entire supply chain, or an individual company (Glock 2012). This study aims to explore different ideals and approaches in supply chain collaboration under such a dilemma. Should supply chain partners optimize their own operations so that they reap maximum benefits? Or should they focus on optimizing the supply chain as a whole to ensure the well-being and sustainability of the chain?

Supply Chain Collaboration

The process of supply chain collaboration and integration is not a simple one. Partners in supply chains may collaborate in different ways, for different objectives, through different means, and operate with different levels of relationships (Cousins et al. 2006). In general, close collaborations feature supply chain partners working together with blurred organizational distinctions (Stock et al., 2000), and thus the supply chain as a whole tends to resemble one big business organization.

A wide range of collaboration initiatives facilitate the bond between supply chain partners. While most of such relationships are contract-based (Gan et al. 2004), other "hidden" efforts and information beyond contractual relationships also contribute to supply chain collaboration (Narayanan et al. 2005, Nair 2011). Examples of collaboration initiatives include joint product development (Balakrishnan et al. 2004), price negotiations and agreements (Nair, 2011), risk sharing (Kogut 1988; Cao et al. 2010), access to complementary resources (Park et al. 2004), information sharing (Malhotra et al. 2005; Croson et al. 2005; Vachon et al. 2008; Bailey et al. 2008; Ding et al. 2010), inventory coordination (Glock, 2012), and supplier development (Asanuma 1989; Dyer et al. 1998; Nair 2011). All such initiatives facilitate the collaborative operations across companies along the supply chain.

Supply Chains as Systems

Supply chains consist of a sequence or network of interdependent relationships fostered through strategic alliances and collaboration (Chen et al., 2004). The idea of supply chain management is to apply a *total systems approach* to manage the entire flow of information, materials, and services from raw-materials suppliers through factories and warehouses to the

end customer (Chase, 1998). With such ideas in mind, managers must appreciate the way which supply chains behave like systems.

According to Maani et al. (2007), systems are:

> "a collection of parts that interact with one another to function as a whole. However, a system is not the sum of its parts – it is the product of their interactions (Ackoff, 1993). [That means] when a system is taken apart it loses its essential properties and so do the parts. When an engine is separated from a car it loses its function and so does the car (ie. motion). A system subsumes its parts and can itself be part of a larger system."

This definition, in the supply chain context, shows that a supply chain behaves as a system that consists of a number of business entities (partners), which take the roles of the "parts" that interact with one another so that the "system" of supply chain functions as a "whole". Moreover, a supply chain is not merely the sum of all its partners. Instead, the proper functioning of a supply chain depends on its partners' interactions. If the supply chain is "taken apart" (the collaborations among partners ceases to exist), the whole chain loses its original properties, and so do the individual partners.

A simple analogy that outlines the total systems approach in this context is that of a basketball team. The team consists of individual players who strive at their best level of performance. However, while performing as a team, the overall performance is not solely determined by the capabilities of each individual team member. The coordination and interactions among the members play an even more important role. While the individual performance (points scored by individuals) may be compromised for certain members in a "support" role, the overall team performance may be optimized with good support and defense. Instead, if each individual team member is focused on optimizing their individual performance, all team members will be competing against each other in order to score the maximum points. The overall performance of the team is most likely hindered by such intra-team competition. As suggested by Ackoff (1992), one cannot possibly construct the best automobile by simply fitting together the best performing parts from different makes and models. Instead, the parts must be designed to work with each other. Under a systemic environment, local optimization at the individual level will sometimes have to be compromised in order to facilitate global optimization at the systems level.

The systemic properties of supply chains result in collaborative advantages that resides not within an individual company, but "across the boundaries" among supply chain partners. Such benefits are gained through cooperation rather than competition (Ferratt et al. 1996, Dyer 1996, Dyer et al. 1998, Kanter 1994, Jap 2001). All in all, a well-coordinated supply chain offers joint benefits and shares of greater gains that could not be achieved by the individual partners on their own (Jap 1999, Cao et al. 2010).

Approaches of Supply Chain Collaboration

Under the specific circumstances in supply chains, a unique mix of collaboration initiatives may be employed, which potentially results in benefits and improvements for the supply chain as a

whole. One major factor that influences these collaborative relationships, is the asymmetrical distribution of power among supply chain partners (Belaya et al. 2009). This argument is based upon the observations by Ogbonna et al. (1996) that the natural states of supply chain relationships are seldom in symmetry and equilibrium. Instead, the power distribution among partners are asymmetrical, and thus a "chain captain" with the most significant power (for example, in size, or bargaining power) emerges, while the other partners are dependent and therefore directly or indirectly influenced by the "captain"'s approach towards collaboration (Wildemann, 1997). Such approaches towards supply chain collaboration is described as dyadic (Jap, 2001; Krajewski et al., 2007), which may take the form of either "cooperative" or "competitive".

A cooperative approach is characterized as supply chain partners (buyers and suppliers) that "help the other as much as possible", with long-term commitments, joint work on quality, and where the buyers support the suppliers' managerial know-how, technological capabilities, and developments in capacity (Krajewski et al. 2007). Under such collaborative environment, the number of suppliers for a particular item is usually limited, which results in increases in each supplier's order volumes. This in turn allows the suppliers to "gain repeatability", and thus move towards high-volume operations at low costs. It is also crucial for cooperative supply chain partners to share information in order to facilitate better forecasts of the buyer's future demands.

Among such collaborative initiatives, Nair (2011) highlighted the importance of "synergistic investments" that create collaborative advantage which in turn enhances one's own resource or competence based competitive advantage. For example, manufacturers that outsource their supplies desire that their suppliers are brought to global standards so that the manufacturers are better supported. As outlined in Li et al. (2012), such investments are considered as a form of supplier development (Krause et al., 1997), where a buyer attempts to increase the "performance and/or capabilities of the supplier and to meet the buyer's short and/or long term supply needs." Developments in this regard include training (Galt et al. 1991, Carr et al. 2007), equipment and technical support (Monczka et al. 1993), and exchanging personnel (Neuman et al. 1996). All in all, such collaborations share a common goal of achieving mutually acceptable outcomes for the supply chain as a whole (Pagell 2004, He et al. 2012), which often involve compromises for some of the supply chain partners. This is further discussed in the up-coming sections.

On the other hand, a competitive approach involves negotiations between buyers and suppliers that resemble a "zero-sum game", where "whatever one side loses, the other side gains" (Krajewski et al. 2007). The buyer, especially when in a more powerful position, may force the suppliers' prices down in return for business opportunities, while the suppliers may press for higher prices for better levels of quality and flexibility. In such a relationship, "[power] determines the clout that a firm has" to bargain a better deal (Belaya et al. 2009).

"Competitive" dealings across partners are often aimed at "selfish enhancement of one's own competence, which usually leads to a detrimental effect on the relationship." (Nair, 2011). For example, buyers may enforce requirements upon suppliers to increase performance goals

(Monczka et al. 1993, Prahinski et al. 2004, Li et al. 2012), and evaluate suppliers' performance to determine further business (Guinipero 1990, Watts et al. 1993, Prahinski et al. 2004). In general, such collaborations are based on the local optimized performance of the powerful supply chain partner(s), at the cost of the other businesses.

Research Objectives

Based on the literature surveyed, it is established that collaboration is a central theme in supply chain management, and that there exists a multitude of approaches and strategies to collaborations. Among the collaborative initiatives observed, however, most are portrayed and presented in linear contexts. For example, that long-term buyer-supplier relationships lead to higher reliability, quality, and flexibility. While these may be credible claims, details in their implementation and the generation of the claimed benefits are somehow lacking in literature. This study aims to explore the underlying dynamics of such implementations and how these dynamics progress through time, using system dynamics techniques.

This paper proposes a supply chain collaboration continuum based on the literature surveyed. Based on this continuum model, two business cases are discussed and evaluated to address the different dynamics in supply chain collaboration. The insights gained from the cases are integrated into a collaboration framework that models different collaboration approaches over time. Based on such dynamics, prototypes of simulation models are discussed and demonstrated to show collaborative dynamics over time under different business environments. Outcomes of this study should contribute to a better understanding of supply chain collaboration dynamics over time, with a Microworld simulation model for scenario testing of different collaboration approaches under unique supply chain environments.

The Cooperative and Competitive Continuum

Based on the concepts discussed in the literature survey, approaches towards supply chain collaboration range between two extremes – "cooperative" and "competitive". While each of these approaches may be favored under different circumstances, the preferred mode of collaboration may evolve throughout the life of a supply chain relationship, where the circumstances may be constantly changing, as shown in the up-coming mini cases. This study proposes a continuum framework between these extremes, as presented in Figure 1.

Figure 1 Supply Chain Collaboration Continuum

These approaches are defined for this study as follows.

Cooperative Collaboration

This form of supply chain collaboration takes a systemic perspective in its approach. Central to this idea is that supply chain activities happen among separate and very independent organizations. As a result, "serious inefficiencies" (Heizer et al. 2006) may happen in its collaboration. Any partner's actions should be mutually beneficial, and that assistance between each other, such as information exchange, must be reciprocal (Stevenson 2005).

The primary objective of the cooperative collaboration approach is to facilitate an integrated supply chain. The issue of local cost and profit optimization should be minimized with a good systemic perspective on the supply chain as a whole. Among the examples of cooperative initiatives discussed in the previous sections, this study focuses on supplier development in terms of investments between companies on quality and capacity enhancements.

Competitive Collaboration

This extreme focuses on the performance of one particular business entity in a supply chain, and contemplates from its point-of-view on how its suppliers and customers should collaborate with it. The primary objective for this approach is to maximize customer value through local optimization. Suppliers may compete for orders, usually with pricing incentives. Innovations of suppliers may also be exploited, with minimum loyalty (Slack et al. 2009). Suppliers are also expected to "help their customers lower product cost by lowering the price of its own goods and services." Other responsibilities of suppliers include supplying information, contributing in design, fast response, meeting demands for quality, lowering inventory, and prompt delivery. In short, suppliers in the chain are responsible to support the end retailer to maximize customer value, and any supplier that failed to provide such support are to be replaced by alternative suppliers. These arguments, along with Belaya et al. (2009), suggests that the ultimate power in the supply chain often lies with the downstream operations towards to buyers' end. However, such power differential is often dynamic. Roles played by different partners in negotiations and bargains may change over time. Among the examples of competitive initiatives discussed in the previous sections, this study focuses on price negotiations and bargaining power between buyers and suppliers.

Examples of initiatives along the supply chain collaboration continuum are discussed below, based on two case studies: Toyota Motor Corporation, a Japanese car manufacturer, and Wal-Mart, a US based retail chain.

Toyota and Wal-Mart's Supply Chain Collaboration Philosophies

Toyota and Wal-Mart, while different in their backgrounds, product specialties, and operating philosophies, are both renowned as pioneers in supply chain management, in terms of their supply chain innovations, strategies, and practices (Ireland et al. 2005, Iyer et al. 2009). Both companies have a common objective to maximize customer value and satisfaction through effective and efficient supply chain management.

There are certain commonalities and differences between the two companies' supply chain management approaches. To start with, both companies aim to collaborate with its suppliers, and thus limit the number of suppliers they purchase from. Both companies aim to reduce costs along the supply chain in order to create better value for customers, and in order to support that, both companies promote efficient information sharing with its suppliers. Looking deeper into these common aspects, however, the approaches to achieve these goals are rather different. The following section outlines examples of Toyota's and Wal-Mart's supply chain management approaches, based on case studies of these two companies.

Toyota Motor Corporation

The key to success in the well-renowned Toyota Production System is the careful management of relationships along the supply chain. This is reflected in Iyer et al.'s (2009) description of Toyota's operating philosophy, where customer value and the stability of its supply chain go hand-in-hand. While Toyota aims to maintain stability in its supply chain through limiting the number of variants in its product range, a reasonable level of product value must be offered to customers in order to compensate for the lack of choice. Given the large role played by suppliers in Toyota's supply chain, such value creation must begin at the suppliers.

Toyota's supplier collaboration targets value in both vehicle pre-launch and post-launch phases (Teresko 2006). Prior to the launch of a particular model (about two or three years ahead), supplier collaboration focuses on identifying and solving potential problems to the mutual benefit of both parties. Key issues at this stage are usually focused on product design. For example, the packaging of new parts. Even though a minor issue, getting the packaging design right in a collaborative manner saves a lot of future costs throughout the supply chain. Considerations in this aspect include how the packaging "interfaces with the supplier's process, product shipment and finally with how the part moves into production at a Toyota plant… the packaging of a purchased part can produce winning results in every venue – not only on Toyota's assembly lines." Such positive results encourage Toyota and its suppliers to further offer visibility about their operations (Iyer et al. 2009). With higher visibility and clearer information such as Toyota's annual volume goals, both have a better idea about whether plans and targets are feasible, and adjustments can thus be made accordingly.

A whole different lot of issues in collaborative work surfaces once the product is launched (Teresko, 2006). The focus at this stage is on making it easier and less costly for the supplier to "maintain and even improve that low defect rate for delivered parts." Teresko stressed that "there's more value to be gained by collaborating with a supplier than by merely harassing them on cost."

Bearing such an important role in Toyota's operations, Toyota's suppliers are carefully chosen with a long-term perspective. Chosen suppliers are met with active support and other collaborative efforts from the car manufacturer. For instance, Toyota's objective in supplier management is to "minimize the number of suppliers and create long-term partnerships by nurturing existing suppliers to expand and grow with Toyota instead of growing the number of suppliers to induce competitive price bidding." (Iyer et al. 2009). Supplier evaluation criteria

include assessment of management attitudes, production facilities, quality levels, and their research and development capabilities. During the selection process, it is not uncommon for Toyota to visit the candidates' site, make observations, and comment on improvements. A suppler must meet extremely tough conditions to qualify. While some of the prospective suppliers are driven away by the stringent requirements imposed by Toyota, others consider that requirement was to their advantage and held that the advice on improving quality and competitive factors provided by the technicians saved the cost of employing outside consultants. Iyer et al. illustrated this idea with an example of Toyota's prospective supplier that resulted in a win-win outcome:

> "Toyota asked its potential suppliers [in the UK] to provide evidence that they could cut costs immediately with improved designs. One supplier came up with a design that was not only cheaper but simpler and better than that of Toyota's own Japanese supplier. The component was a simple gear stick knob costing pennies, but the British found a way of making it in two plastic parts instead of four, as in Japan."

Given the strict selection criteria and supportive advice from Toyota, the suppliers understand that they are entering into a long-term and loyal relationship with the car manufacturer once they are chosen. Suppliers are offered stable order commitments by Toyota, and in return the suppliers are expected "to use this opportunity to develop superior quality products and achieve productivity improvements." Such quality and cost improvements are then "reflected in improved customer value." (Iyer et al. 2009).

Toyota manage its suppliers and maintain their relationships with certain policies that provide support, while at the same time ensuring that the suppliers' performance are up to standard. A key strategy is to establish policies that "prevent unilateral actions to change volumes or commitments. The use of a consensus approach, fostered by visibility across the supply chain, minimizes actions that result in additional costs at different parts of the supply chain." (Iyer et al. 2009). In managing some of the more important suppliers, Toyota would absorb a part of the business risks or even invest in equity positions in them. An example of this is Denso, a key electronics supplier of Toyota (Teresko, 2006).

In return for Toyota's support, suppliers bear responsibilities other than the basic requirements in terms of costs and quality performance and customer value. These include recapitalizing on order stability to maintain delivery performance and productivity improvements. All suppliers to Toyota are expected to share their innovations with other suppliers that supply similar products. (Thus, being a supplier brings along with it an opportunity to receive ideas generated across the supply network) (Iyer et al. 2009). Amongst the committed suppliers of Toyota, many of them carry specialties including wide ranges of patents for specific processes and the flexibility to adjust for demand changes in a timely and efficient manner. At the occasions of problem solving support, whether from Toyota or from the suppliers, personnel from both parties may dedicate substantial periods of time (up to months) working closely together. Such approaches tap into the knowledge base of the supplier network effectively.

In terms of contracts and price commitments, Toyota usually review prices with its suppliers every six months, “but the contract award is kept in place over the model life.” (Iyer et al. 2009). While a long-term contract is offered, suppliers are kept under pressure to perform. Cost minimization is a key objective. This is usually achieved by practicing efficiency enhancing initiatives outlined by the Toyota Production System, including quality improvements, waste minimization, and just-in-time delivery.

In the case of major problems in the supply chain, Toyota and its suppliers make short and long term measures in order to reduce immediate damages, and to maintain the sustainability of the solutions’ impact. For example, with an immediate supplier problem such as sharp drop in profits, experts from Toyota visits the supplier, observe, and suggest improvements. Such improvements get quick results but do not ensure that the supplier has imbibed the underlying principles. On the other hand, less urgent or long-term issues call for fundamental solutions. For example (Iyer et al. 2009),

> “during the recession in Japan, only three of [Toyota’s] main suppliers saw profit increases, while 57 saw profit and revenue decreases. Toyota responded by creating a kaizen promotion section within its purchasing department. The group worked with suppliers to decrease pay and cut investments and thus enable recovery of loss. In addition, suppliers were able to enhance their long-term capability. All of this works on an informal, personal level … the supplier is permitted to keep the gains from improvement due to Toyota’s assistance.”

Given the dedication in the way that Toyota nurtures its supply chain partners to develop long term relationships, there comes times when the luxury of time is not readily available and “short-cuts” may have to be taken. As Toyota expanded and developed with exceptional growth rates, it became increasingly dependent on suppliers outside Japan with whom it did not have decades of working experience (Anonymous 2010). Nor did Toyota have enough of the senior engineers, known as sensei, to keep an eye on how new suppliers were shaping up. Yet Toyota not only continued to trust in its sole-sourcing approach, it went even further, gaining unprecedented economies of scale by using single suppliers for entire ranges of its cars across multiple markets. Such changes are perceived as one of the main causes of the quality problems at Toyota during 2009-2010, where the cooperative initiatives could no longer be properly managed, resulting in Toyota being ill-supported. Such failure created a “wake-up-call” for Toyota and other car manufacturers (including the US manufacturers troubled by financial constraints) to revisit their supply chain strategies (Sedgwick, 2011; Bunkley, 2011; Ramsey, 2011; Hookway et al. 2011)

On the whole, Toyota’s supplier management approach shows key themes of mutual support, long-term perspectives, and the sustainability of results. Yet such approach is not a one-size-fits-all solution as circumstances evolve through time.

Wal-Mart

Another featured supply chain management pioneer is Wal-Mart, a major retail chain in the USA. Wal-Mart became the "best supply chain operation of all time" by following two fundamental strategies (Ehring 2006):

1. It leverages its scale in multiple ways to create operational efficiencies that drive significant competitive advantage.
2. It uses its scale to create additional competitive advantage through best execution and supply chain investments.

Wal-Mart has always focused its operating philosophy on customer satisfaction (Ireland et al. 2005). The chain's executives understood, as early as in the mid-1980s, that effective supply chain management and collaboration would "enable the company to be more customer centric. Benefits for customers such as lower prices and reliable delivery can result from an effective supply chain. Further benefits for the business such as customer loyalty would thus be within reach. Wal-Mart understands that "if it does not take care of the consumer, then a competitor will."

Wal-Mart managed its operations as an "extended enterprise" (Ireland et al. 2005), an idea similar to supply chain management that was novel in the 1980s. One particular focus of Wal-Mart's collaboration approach is on information visibility. According to Ireland et al., Wal-Mart challenged the "prevailing mind-set" about the mistrust and the adversary relationship between buyers and their suppliers. The retail chain understood that if information such as point-of-sale consumption and future customer demand are shared with suppliers, both parties can effectively reduce inventory and other wasted activities, and thus costs could be minimized, and the savings can be passed along to the consumers.

Information sharing, of course, is not uncommon among trading partners in business in general. However, most retailers (such as Kmart), offered operational information for a price (Ireland et al. 2005). Such information is typically used by suppliers as market intelligence that "aided decisions about marketing programs and promotions." Wal-Mart, on the other hand, provides such information free of charge to its suppliers. For some major suppliers, such as Procter and Gamble, the extent of information sharing went as far as both parties' investment of proprietary knowledge and processes into each other to improve quality and drive costs out of the business (Ehring, 2006). As quoted by Fishman (2003), a Wal-Mart spokesperson claimed that "the fact is Wal-Mart aims to improve its suppliers' performance. The chain makes its suppliers more efficient and focused, leaner and faster. Wal-Mart itself is known for continuous improvement in its ability to handle, move, and track merchandise. Less experienced suppliers are encouraged and urged to coordinate such improvements, with the help of a supplier development team, a free resource designed to enhance their capabilities to forge enduring relationships with Wal-Mart's managers and buyers. One example of Wal-Mart's collaborative initiative for coordination and efficiency is its announcement in 2003 that its top 100 suppliers must tag their product cases and pallets with RFID tags. It was envisioned

that all of the mega retailer's suppliers will fall under this directive by the end of 2006 (Boland, 2005).

Given the advancements and novelty in Wal-Mart's supply chain management philosophies, some of its tactics and approaches, however, have met major criticisms, especially in terms of supplier relationship management.

For instance, Ehring (2006) pointed out that Wal-Mart is "notorious for leaning on its suppliers to drive down prices." Fishman (2003) also claimed that Wal-Mart has the "power to squeeze profit-killing concessions from vendors."

In order to achieve its objective to maximize customer satisfaction, Wal-Mart adhered to its promise to offer "everyday low prices." As a result, especially on basic products, "the price Wal-Mart will pay, and will charge shoppers, must drop year after year." (Fishman, 2003). Part of such reduction is of course achieved by the continuous improvement in its supply chain operations that drive down costs. However, the pressure from Wal-Mart towards its suppliers to simply reduce prices plays an important part, and it is not uncommonly heard. Fishmen (2003), in an investigative report, outlined some of the negotiations between Wal-Mart and its suppliers. Strategies such as "threats" to lower prices or to lose Wal-Mart's business, and the strict 30 second delivery window for some suppliers were discussed. It generally commented that Wal-Mart, in its collaboration with its suppliers, is legendary for quite straightforwardly telling suppliers to redesign everything from their packaging to their computer systems, in order to be compatible with Wal-Mart's operations. When particular suppliers cannot perform to Wal-Mart's requirements, the retail chain will source from some other companies, or they will produce the product themselves. Some suppliers are eventually forced to source off-shore where resources are cheaper, or simply forced into bankruptcy, which negatively impacts the US local jobs and economy. The sheer size of Wal-Mart's operations and business volume has given it tremendous power in negotiations, as Mufson reported in 2010 that Wal-Mart's guidelines to its Chinese suppliers could be more important than the orders from the Chinese government.

Through such stringent collaboration approaches, Wal-Mart is successful in maintaining low prices while keeping close to suppliers who are up to the challenge. Fishman (2003) quoted one of the suppliers that "Wal-Mart does not cheat suppliers, it keeps its word, it pays its bills briskly … they are tough people but very honest; they treat you honestly." And thus, in order to do business with Wal-Mart, vendors have to be "as relentless as and as microscopic as Wal-Mart is at managing their own costs. A particularly successful example of collaboration and the resulting improvements is Levi's, the apparel company (Fishman 2003):

> "Levi couldn't have qualified to sell to Wal-Mart. Its computer systems were antiquated, and it was notorious for delivering clothes late to retailers. Levi admitted its on-time delivery rate was 65% … Getting ready for Wal-Mart has been like putting Levi on the Atkins diet. It has helped everything – customer focus, inventory management, speed to market. It has even helped other retailers that buy Levi's,

because Wal-Mart has forced the company to replenish stores within two days instead of Levi's previous five-day cycle."

The examples of Toyota and Wal-Mart, two pioneers in supply chain management, illustrated a wide spectrum in approaches and tactics in effective supply chain collaborations, both within and across companies and industries.

Clear extremes of supply chain collaboration tactics were seen in the Toyota and Wal-Mart cases. According to Iyer et al. (2009), the "Japanese model" of supply chain collaboration encourages close relationships, competition over quality, delivery, engineering capability, high levels of information exchange, high levels of commitment, long-term relationships, and working with existing suppliers to resolve problems. The US model, in contrast, involves competitive relationships, easy switching among suppliers, low commitment, and price based supplier selection criteria. This is consistent with Teresko's claim in 2006 that the Japanese model focuses on "building and maintaining collaborative supplier strategies", while the US approach in general showed supplier relationships "hinging on cost-cutting demands." Similar to Sedgwick et al.'s (2011) claim that "a healthy win-win relationship with suppliers is a key factor that … separated top-level automakers (Toyota, Honda and Nissan) from also-rans (the Detroit 3) in North America."

There are of course exceptions to such generalizations. As seen in the discussion above, Wal-Mart's close collaboration with Procter & Gamble shows dedication and commitment between the two companies, while Toyota admits that its relationships with some of the recent suppliers outside Japan are no longer as close as before due to the rapid expansion by the manufacturer (Anonymous, 2010). As suggested by Ehring (2006), "no company can invest in an unlimited set of relationships." Sedgwick et al. (2011) observed that the lead Toyota used to have over other manufacturers in supplier relationships (according to a recent survey) has diminished over a five-year period, while other American companies are starting to catch up. American companies similar to Wal-Mart (such as Ford, Chrysler and General Motors) are starting to communicate more frequently with their suppliers, pay them faster, and invest more actively in their relationships. It is seen that these companies are starting to become more willing to compensate suppliers for rising raw material costs. The survey has also shown that companies with the "Japanese model" (Teresko, 2006) such as Honda had their relationships with suppliers eroding slowly since 2007 due to their rapid growth. Responses of the survey suggest that the automaker has "taken a more adversarial approach to cost cutting in recent years." More suppliers of Honda have commented that they had to cut prices because they feared a loss of business (Sedgwick et al. 2011).

All in all, both Toyota and Wal-Mart's approaches and tactics towards supply chain collaboration falls along the collaboration continuum as follows, while Toyota leans towards the "cooperative" end, Wal-Mart's position is closer to the "competitive" side (Figure 2). Both companies have achieved phenomenal success in supply chain management in their own ways.

Figure 2 Positions of the cases along the collaboration continuum

Dynamics of the Supply Chain Collaboration Strategies

Both "cooperative" and "competitive" collaborations discussed in the previous section have shown their outstanding effectiveness in promoting success in supply chain operations. According to Iyer et al. (2009), Toyota's supplier performance is consistently superior compared to its counterparts[1] in the automotive industry, and Wal-Mart still reigns as the world's largest retailer and employer (Anonymous, 2011).

The basic dynamics of the cooperative and competitive approaches in light of systems theory are defined and portrayed for this study in the following causal loop models (Figure 3):

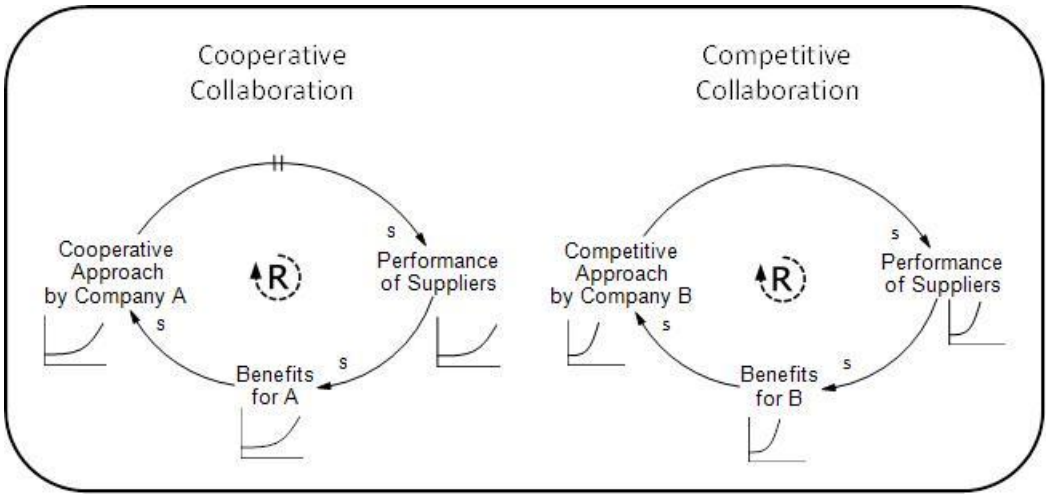


Figure 3 Dynamics of the supply chain collaboration strategies

In the models presented in Figure 3, Company A collaborates with its supplier in a cooperative manner. The suppliers are carefully selected based on their potential capabilities such as quality, delivery, and continuous improvement. Once the suppliers are chosen, Company A commits funds, investments, time, and effort into these suppliers, by the means of

[1] This claim is based on a Working Relations Index which ranks businesses over 17 criteria, including supplier trust of the OEM, open and honest communication, timely information, degree of help to decrease costs, extent of late engineering changes, early involvement in the product development process, flexibility to recover from cancelled or delayed engineering programs. "In 2005, the working index value for Toyota, Honda, and Nissan was between 298 and 415. The index for Chrysler, Ford, and General Motors (GM) was between 114 and 196. Eighty-five percent of the suppliers to the Big 3 OEMs characterize their relationship as 'poor,' with around half the suppliers claiming they would prefer not to do business with the OEM." (Iyer et al. 2009).

collaborative design, assistance in problem solving, and investments for improvements, with the vision of product and process quality improvement, cost reduction through coordination and elimination of wastes, and customer value enhancement. Such effort results in improvements in the suppliers' performance after a delay (time taken for nurturing the suppliers). These improvements provide benefits for Company A, which may reinforce further practice of similar approaches towards supplier collaboration.

On the other hand, Company B, collaborates with its supplier in a competitive manner, aiming to improve customer value by direct strategies such as imposing pressure on suppliers to cut costs, often through demands for improvements in efficiency, production cost cutting, and even sourcing off-shore for cheaper alternatives. Company B also require its suppliers to conform and align their products and processes with Company B's operations (for example, material packaging) to further leverage efficiency for Company B. A key example of this is Wal-Mart's 30 second delivery window for certain suppliers, and its design requirements for suppliers' packaging to conform to Wal-Mart's operational configurations (Fishman, 2003).

The outcome of such approach (with stringent performance policies) is an increase in suppliers' performance. Suppliers endeavor to perform up to the required standards in order to continue supplying Company B. As a result of the cost-cutting and performance improvements from the suppliers, the benefits for Company B increases, thus further encouraging the successful competitive approach. This is similar to the initiatives of Wal-Mart where suppliers are required to further conform to its policies in RFID implementations (Boland, 2005) and environmental/sustainability compliances (Turner 2010, Mufson 2010).

The reinforcing dynamics shown in the causal loop models are the basis of both the cooperative and competitive approaches of collaboration, towards the objectives of improvements in efficiencies and customer value.

Dynamics Over Time

In the cooperative collaborations case, the basic model shows a reinforcing long-term supportive relationship, with objectives similar to the competitive approach (continuously improving efficiency and minimizing costs, improving customer value). Even though the basic dynamics show also reinforcing benefits for the company and the suppliers, a main disadvantage of such an approach is the delay in reaping such benefits. While Company A in the model collaborate with its supplier in a cooperative manner, such as investing and assisting in improving its suppliers' performance, the improvements may not be realized until after a significant period of time. Iyer et al. (2009) pointed out that a typical improvement project for Toyota and its supplier can take at least one and a half years. In one particular case, Toyota committed two to four consulting personnel to the supplier on a regular basis after the initial improvement project for the next five years. Therefore, along with the cooperative collaboration approach, the initial investment into new relationships should be included. This results in a hindrance in the company's own performance before improvements are seen at the suppliers' end. An example of this is the recent chain of product failure and the recalls in Toyota automobiles. Anonymous (2010) quoted the chairman of Toyota Motor Corp., Akio

Toyoda, that “in its pursuit of growth [Toyota] stretched its lean philosophy close to breaking point.” As a result, Toyota became “increasingly dependent on suppliers outside Japan with whom it did not have decades of working experience.” Initial “grooming” of suppliers in committed relationships requires commitment of resources which may be diverted from normal operations. This is a major risk for this approach, especially in times of rapid growth.

In light this additional dynamic, the basic model is extended to incorporate the delay in improvements (Figure 4):

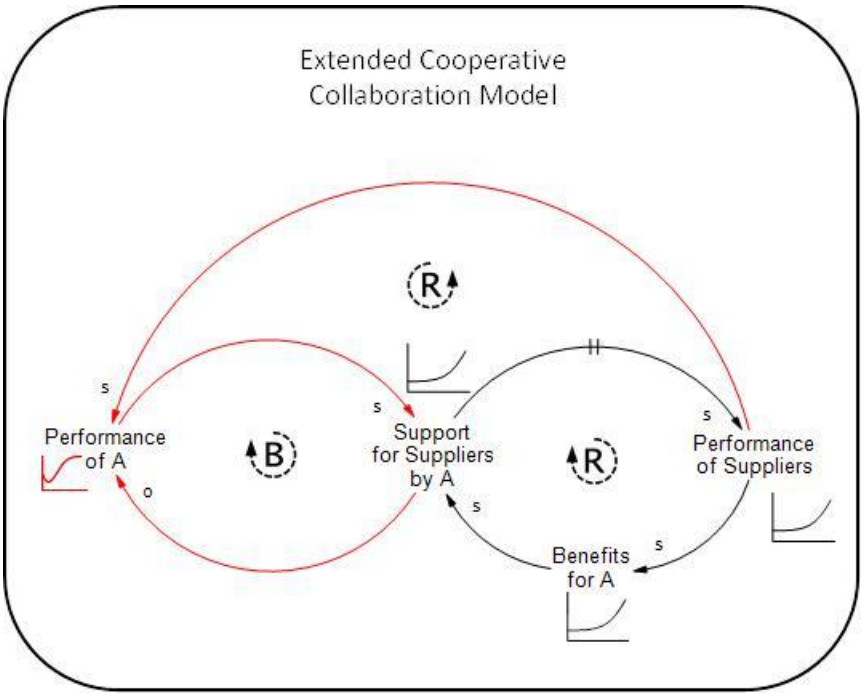


Figure 4 Extended cooperative collaboration model

The cooperative support for suppliers by Company A has a direct negative impact on its own performance, due to the time, money, and effort invested in its suppliers (as discussed in Toyota’s case). Such impact may in turn discourage further support for suppliers. However, the cooperative collaboration approach assumes that the supply chain partners are willing to compromise or to even sacrifice its own temporal optimality to pursue optimization across the supply chain, and therefore such discouragement is negligible.

Eventually, the suppliers’ performance starts to increase (after the delay). Once this effect kicks in, the resulting increase in Company A’s performance can further reinforce the cooperative support towards its suppliers, and thus promotes sustainable improvements. Notice that two new loops are introduced in this extended model. The behavior over time dynamics remain unchanged from the basic model, and the “Performance of A” (new variable) shows a “worse before better” behavior over time.

Looking at the supply chain environment of a competitively collaborated buyer-supplier relationship on the other hand, the partners (especially the buyer) may follow its collaboration philosophy all along, with reinforced actions such as continued focus on price reductions from

suppliers, imposing new and more stringent policies on suppliers in terms of packaging, stock keeping, and environmental/sustainability initiatives. While such improvement initiatives are, according to Fishman (2003), effective encouragements for some suppliers to continuously improve. For the smaller suppliers however, the on-going demand from the buyer to cut costs and improve has proved to be a burden. For example, with Wal-Mart's new directive towards environmental concerns, suppliers were forced to "get serious" about pollution. "Wal-Mart says if you're over the compliance level, you're out of business." (Mufson, 2010). In terms of forced cost cutting, some smaller suppliers had to "lay off employees and close US plants in favor of outsourcing products from overseas." (Fishman, 2003). There are claims that many American jobs were lost, due to this effect, to low-wage countries such as China. Wal-Mart has doubled its imports from China between 1998 and 2003. All in all, as summarized by Fishman (2003), "doing business with Wal-Mart can give a supplier a fast, heady jolt of sales and market share, but that fix can come with long-term consequences for the health of a brand and a business."

The longer term competitive collaboration approach dynamics discussed above is portrayed in the extended model in Figure 5.

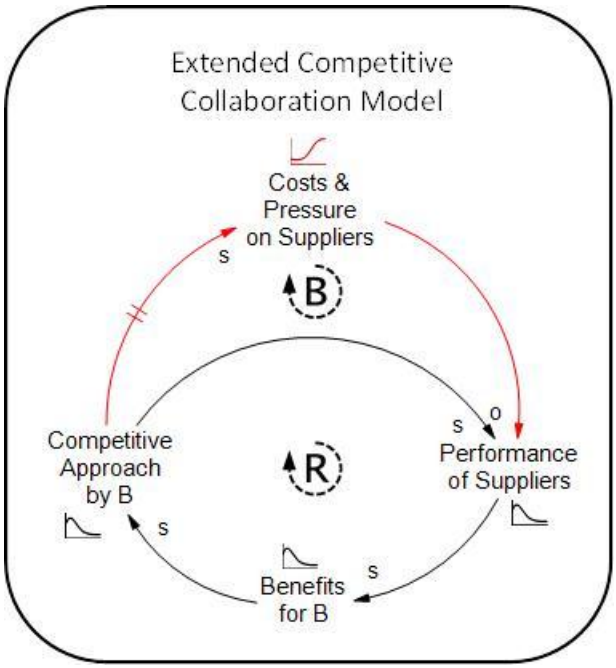


Figure 5 Extended competitive collaboration model

The extended model in Figure 5 is based on the basic competitive collaboration model, which showed all three variables (Competitive Approach by B, Performance of Suppliers, and Benefits for B) with exponential increase patterns over time.

In this extended model, however, a new variable with two links are introduced. Competitive approach by Company B (while focusing on costs and price reductions) has a side effect of imposing costs and pressure on suppliers. This effect becomes significant after a delay. With the increased costs and pressure on suppliers, their performance in quality and even the

capability to supply is reduced. Company B may opt to switch suppliers, but the capabilities of new suppliers are also questionable, since they would not have been Company B's first choice in the earlier selection process. With the deterioration of the suppliers' performance, the benefit for Company B is jeopardized, and hopefully this negative impact will result in milder competitive approaches by Company B (for example, less pressure on price reductions). Notice that the additional balancing dynamic has changed the original behavior over time. The benefits for Company B are no longer reinforced, and thus, the incentive for further pressure is discouraged. The costs and pressure on suppliers will eventually level off, while remaining at a high level.

Key Dynamics in the Cooperative and Competitive Approaches

The dynamics discussed above imply that the two approaches in collaboration, while being able to provide good outcomes (as seen in the case studies), result in distinctive behavior over time. For Company A, its cooperative approach results in a "worse-before-better" behavior, while for Company B, its competitive approach results in a "better-before-worse" dynamic. Both approaches showed their benefits and disadvantages. Based on these ideas, a general portrayal of the dilemma along the collaboration continuum can be described using a model based on the systems archetype of "Shifting the Burden" (Maani et al. 2007) (Figure 6)

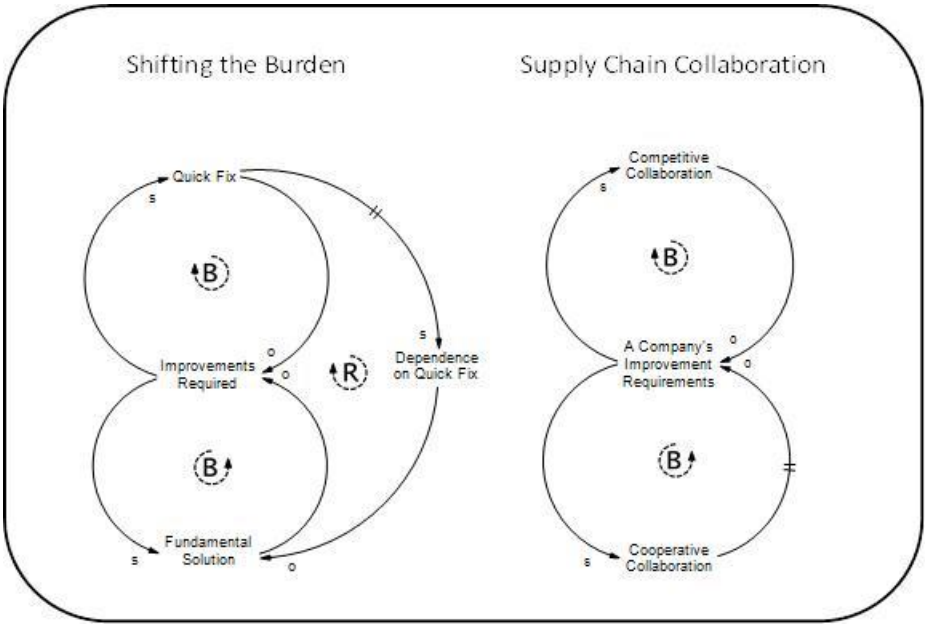


Figure 6 Archetypical dynamics of supply chain collaboration

In general, both collaboration approaches share the same objective, to maximize customer value through better supply chain management. Both approaches are effective in enhancing the company's performance. With a competitive approach (the top loop), the company can quickly and effectively reduce costs and impose other requirements on its suppliers to work for its own needs. This results in immediate benefits, thus reducing the requirements for further improvements. This is based on the assumption that the company has significant influence over its suppliers, such as its size, market share, and brand image.

The main disadvantage of this approach, as discussed above, is that the benefits are not sustainable.

On the other hand, the company can also take a cooperative approach, where improvements in performance are achieved through long-term, dedicated, and supportive relationships with its suppliers. The customer value is eventually increased through the betterment of all operations along the supply chain, thus reducing once again the requirements for further improvements.

The main disadvantage of this approach, as discussed above, is that the benefits takes a long time to realize (there is a delay in the bottom loop's dynamics). That is, it does not provide a quick solution, and it usually involves significant initial investments.

The two extreme approaches, "competitive" and "cooperative" collaboration, correspond to the "quick fix" and "fundamental solution" respectively in the "shifting the burden" archetype. Thus, according to systems theory, there is a tendency for the company to rely on the quick fix (that is, the competitive approach) for quick solutions. This is consistent to the theme of capitalistic business modes, which is to locally optimize operations to ensure that the company's benefits are maximized. In Wal-Mart's case, they can continually enforce their stringent policies upon their suppliers to work in Wal-Mart's best interest. For Toyota, in the process of achieving rapid expansion, they have teamed up with unfamiliar suppliers with its usual partnership requirements which resulted in initial quick benefits. Eventually, a dependency is formed for the company to utilize the competitive approach, instead of the other option. This is portrayed in the model in Figure 7.

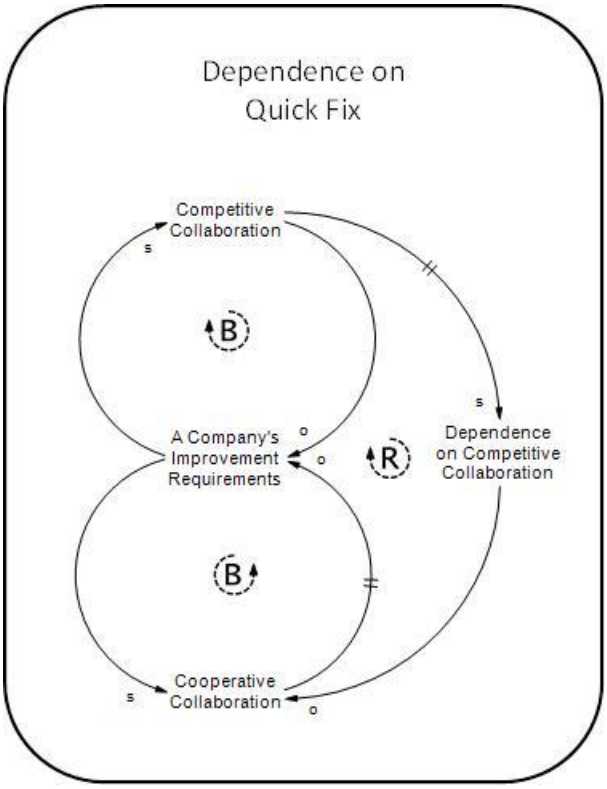


Figure 7 Dependence of quick fix

With a higher dependence on the quick fix option, the fundamental solution becomes even less appealing.

According to the case studies of Toyota and Wal-Mart, however, the above model does not seem to capture all of the major dynamics. As seen in the case where Toyota regrets the quick fix approaches, and how Wal-Mart starts to develop closer relationships with major suppliers such as Procter & Gamble, some of the negative impacts of the competitive approach seem to have an impact in promoting the fundamental solution, which is cooperative collaboration. In order to reflect this, the paradox model is further extended by another loop that outlines the eventual tendency towards collaborative collaboration in Figure 8.

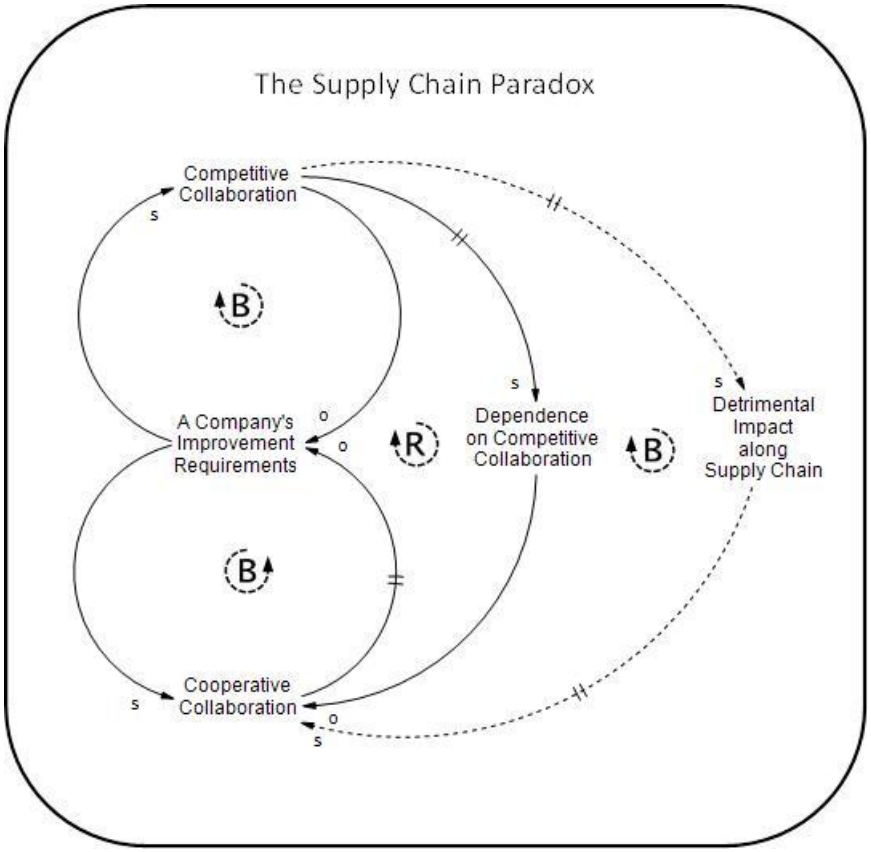


Figure 8 The supply chain paradox

The extended loop in Figure 8 suggests that the detrimental impact resulted by competitive collaborations can eventually result in an encouraging effect on the pursuance of the "fundamental solution" of cooperative collaboration.

Evidence in this extension of the model, however, is not commonly seen in existing research. The supply chain dynamic model discussed in this paper proposes a new research interest area in supply chain collaboration strategies and tactics, as discussed in the following section.

Supply Chain Collaboration Dynamics in Action

The dynamics outlined in the previous section propose a theoretical construct of different approaches over time. Outcomes of collaboration approaches, however, as in other types of interventions in complex systems suggested by Maani et al. (2010) are significantly impacted by implementation related factors such as the current circumstances of the system and the style, frequency, and timing of the interventions. In order to further explore the theoretical dynamics of supply chain collaborations, this study proposes a dynamic modeling approach for scenario testing to address the following issues:

i. The impact of different supply chain collaboration approaches;
ii. Such impact under different business circumstances; and
iii. Such impact under different timing of approaches.

Note that the proposed model outlines an approach to test the validity of different approaches under different circumstances. No empirical data has been involved. The construction of the model is based on fictitious scenarios to demonstrate the purpose and the functionality of the model which can be easily developed with empirical data for future studies.

In short, the purpose of this model in the scope of this study is to demonstrate business dynamics as a result of different approaches in supply chain collaborations. The proposed model forms a prototype for further studies and/or practical use for actual business cases.

The Model

The basic construct of the supply chain collaboration dynamic model consists of two companies. The "buyer" and the "supplier". The buyer produces and sells a product with a constant demand from consumers. Each unit of the buyer's product requires one unit of material from the supplier. For example, a food packaging company as the buyer requires one glass jar from the supplier for each jar of jam it produces. There is a two week lead time in the production process, and the quality output rate of the operations is based on two factors. (1) the quality capability and (2) the level of burnout of the workforce.

Quality capability is based on the skills of the workforce and the standard of the equipment. Initially, the two companies have their quality capability conforming to their industry standards. This capability, however, deteriorates through time. In order to maintain its quality performance, the company has to reinvest (from their profits) into quality maintenance and training. In this model, the buyer (who runs a bigger business) may also invest into their supplier's quality capabilities.

The level of burnout is determined by two factors. The current work backlog and the normal production capacity. Burnout is intensified when backlog exceeds normal production capacity, and relieved when capacity exceeds backlog. Reinvestments from the company on pressure relieving activities (for example, company outings, Friday night drinks) may directly reduce burnout. another avenue for relieving burnout is the reinvestments in production capacity (for example, hiring, new equipment acquisition). Similar to quality capabilities, reinvestments come from the company's own profits, and also from the buyer to the supplier.

Consumer demand is assumed to be constant. The buyer's revenue depends on its quality production (not exceeding the quantity demanded). The supplier's revenue is dependent on the buyer's demand, which may fluctuate over time. Costs of the companies are dependent on inventory holding costs for both the raw material and finished products, plus its production costs. Note that faulty products due to quality issues or burnout of workforce may be reworked or discarded, with the same production costs incurred.

A causal loop model of the companies is presented in Figure 9.

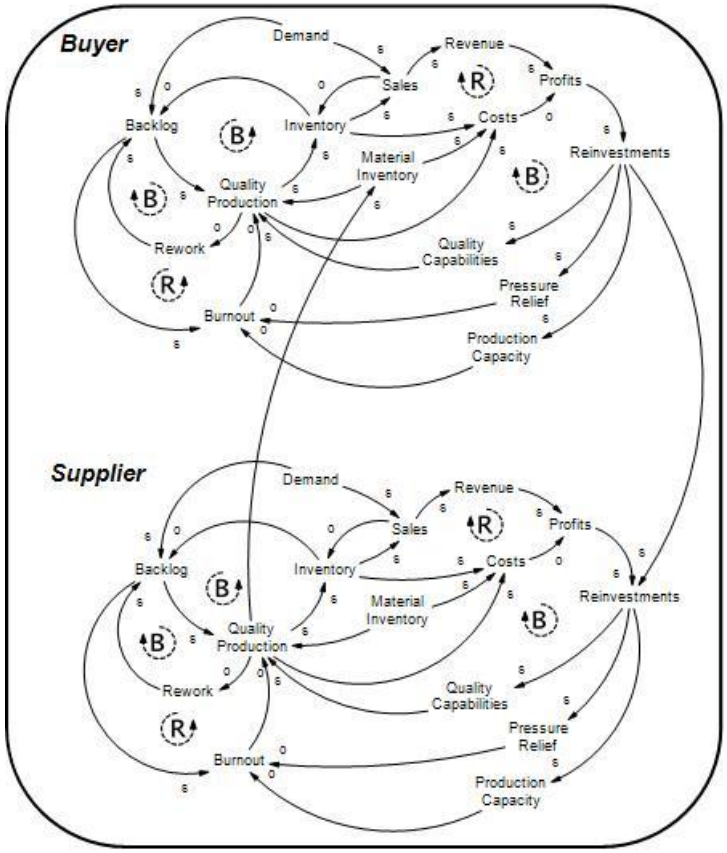
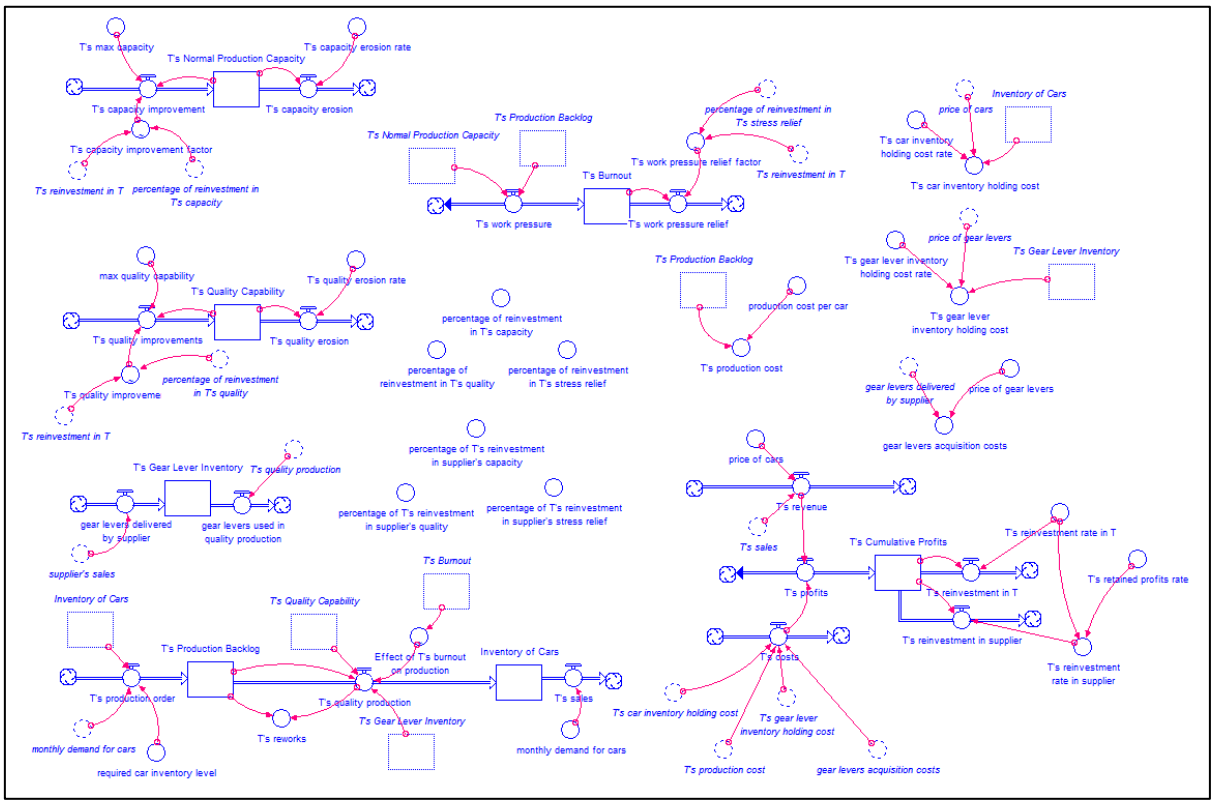


Figure 9 Operational dynamics of the two model companies

The dynamics outlined in Figure 9 is modeled using iThink with different business scenarios. Figure 10 presents the stock and flow diagram of the simulation model featuring Company T as the buyer, with one of its product's parts sourced from a single supplier.

The Buyer:



The Supplier:

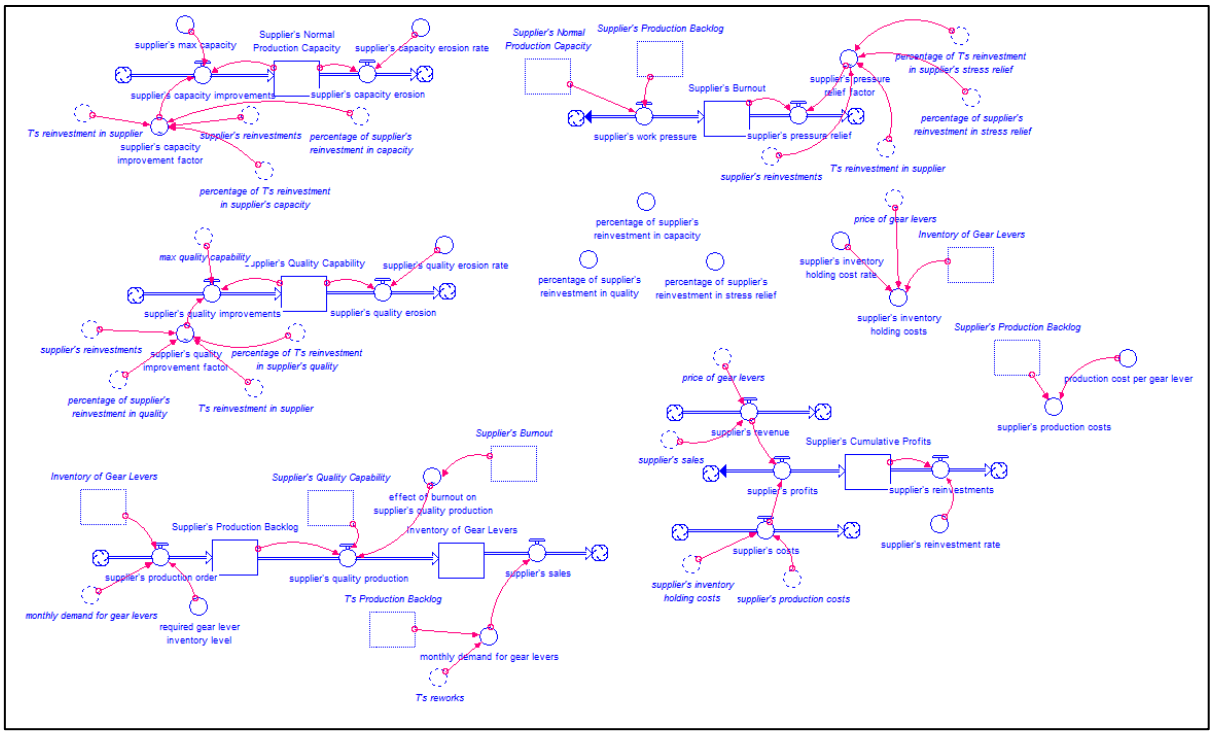


Figure 10 Stock and flow diagram of the two model companies

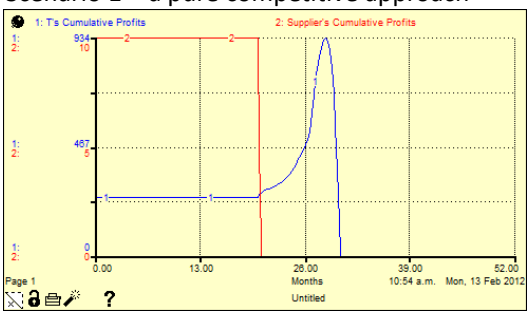
The simulation begins at a steady state, with the supplier selling 50 units of gear levers to Company T every month at $6,000 each.

Two scenarios are tested initially under this steady state environment with respect to the approaches along the supply chain collaboration continuum. The objective to improve the buyer's profit margin:

1. A competitive approach - The unit price of gear levers are to be reduced by 10% (to $5,400 each) from month twenty onwards.
2. A collaborative approach – The buyer invests 5% of its monthly profits into the supplier's operations (quality, capacity, and burnout relief) from month twenty onwards.

The simulation results are presented in Figure 11.

Scenario 1 – a pure competitive approach



Scenario 2 – a pure collaborative approach

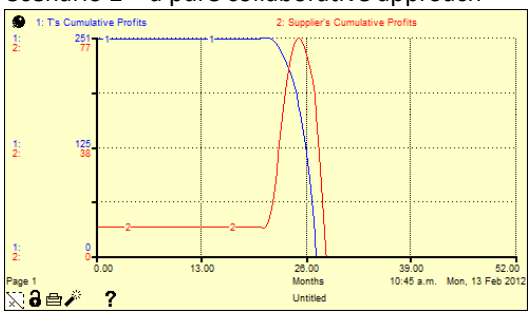


Figure 11 Simulation results I

As shown in Figure 11, both approaches did not result in sustainable benefits for this pair of companies. In scenario one, where the competitive collaboration approach is favored, price is reduced by 10% from month twenty onwards. This immediately resulted in significant improvements in the buyer's profits, at the supplier's costs. Eventually, the supplier's operations ran into losses, and it failed to support the buyer's needs (with reduced profits, the supplier failed to maintain its quality performance, production capacity, and its production team's burnout). The initial gains for the buyer could not be sustained. Note that in this simulation, the option of sourcing from a different supplier is not available.

In scenario two, the companies attempted a cooperative collaboration through the buyer's investment into the supplier on its quality capabilities, production capacity, and burnout maintenance. Initially, the output shows that the supplier's performance improved significantly, through lowered costs driven by improved quality performance, higher production capacity, and better maintained burnout. The buyer's performance, on the other hand, experienced a major 'dip' as a result of the reduced re-investment on itself. According to the collaboration model, the buyer's performance is expected to 'bounce-back' once the supplier's performance is improved, thus providing the buyer better support. However, under the current model's circumstances, the recovery did not happen in time, and both companies ended up in failure.

Further investigations on this result combined with varied approaches in collaboration shows that an evolution of collaboration approaches through time is more in-line with the archetypical dynamics, as proposed in the collaboration model (outlined in Figure 8). Here, a new set of scenarios with different approaches are tested as follows:

1a. The buyer enforced a 10% price reduction at month 20, followed by a 5% investment into the supplier's operations 3 months later.

2a. The buyer started investing into the supplier at month 20 with 5% of its profits. The price of the material is reduced by 10% 3 months later.

The results are shown in Figure 12.

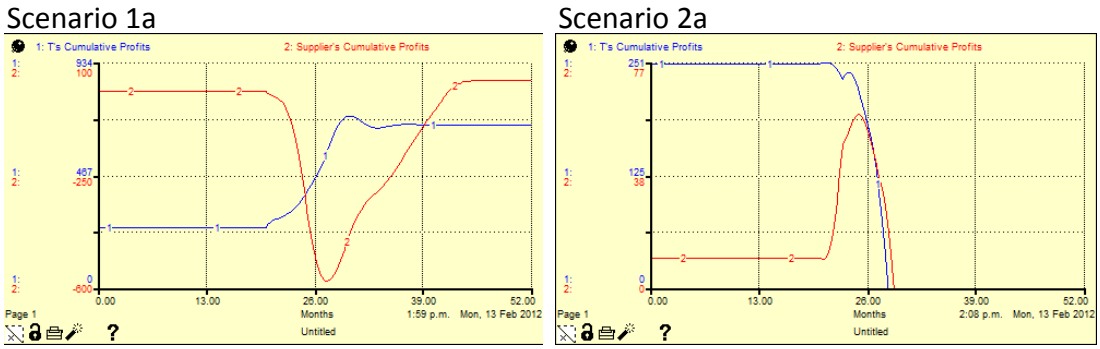


Figure 12 Simulation results II

As shown in Figure 12, the alternative approach for scenario 1 successfully rectified the problem. As the buyer sees the detrimental effect on the supplier due to its price reduction, the buyer starts investing into the supplier's operations. The supplier could therefore slowly recover, while attaining a performance lever better than before. The performance of the buyer is leveled off and sustained at the end.

The alternative for scenario 2, however, did not rectify the problem. As the buyer sees its detrimental effect on itself through its investment into the supplier, it enforced a price reduction of 10% in an attempt to recover. Such intervention resulted in a temporal improvement in its performance, which was not sustainable. Overall, the behavior over time is similar to the original scenario 2.

With a further modification to scenario 2 (scenario 2b), the initial investment rate is adjusted to 2% instead of 5%. The following output is generated in Figure 13.

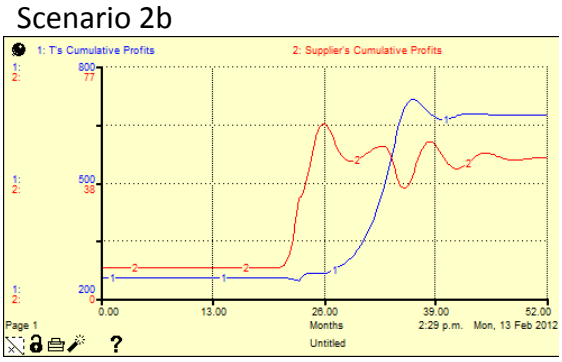


Figure 13 Simulation results III

With this alternative investment rate, the improvements for both companies are sustained. The resulting performance levels are similar to those of scenario 1a.

Note that the model presented is not a generic model of supply chain collaboration, and that the outcomes of these scenarios are specific to the circumstances of the initial state of the companies. For instance, the particular cooperative collaboration approach in scenario 2 ended up in failure, due to the inadequate profit margin of the buyer to invest into its supplier. This approach may work in a different situation where the buyer's investments can be sustained. The purpose of this model is to demonstrate the dynamics proposed in the collaboration model, in terms of the pros and cons of the extreme approaches, and how collaboration approaches may evolve over time due to the changes in the collaborative dynamics.

Conclusions

Successful supply chain collaborations can be realized by a variety of approaches, ranging from a totally cooperative relationship to a highly competitive environment. While evidence from cases and models have shown the effectiveness of typical collaboration approaches, the findings of this study highlight the dynamics of these approaches' over time. The benefits and downsides of the cooperative and competitive modes of collaboration are distinctive, and the environment of collaborations is constantly evolving under such dynamics. The archetypical modeling of the dynamics suggests that such evolution in relationships calls for appropriate management and update of collaborative approaches through time in order to sustain the benefits and relationship.

This study proposes a computer simulation approach for scenario testing and planning as an aid to managing collaboration approaches. The maintenance of sustainable improvements and benefits are demonstrated in the examples, showing combinations of cooperative and competitive approaches. Different strategies and approaches may be further tested for different business environment to explore case specific situations.

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