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Student:
Thomas Dankers
910620172020

Supervisors:
Dr. J.H. Trienekens
Dr. C. Kolympiris

# SENSE&RESPOND MANAGEMENT: CREATING AN ADAPTIVE ENTERPRISE

In today's highly competitive business environment, every enterprise faces the challenge to stay competitive. Being able to sense changes on the market and being able to respond fast to it, can give company a competitive advantages. This thesis evaluates the challenges for a company when sense and respond management is implemented by looking at three important aspects: flexibility, collaboration and information sharing.

## Contents

1. Introduction on sense and respond management....3

2. Flexibility in the supply chain....9

*2.1 Introduction....9*

*2.2 Review flexibility....9*

*2.3 Sense and respond management and flexibility....13*

3. Collaboration in the supply chain....16

*3.1 Introduction....16*

*3.2 Review collaboration....16*

*3.3 sense and respond management and collaboration....22*

4. Information sharing....24

*4.1 introduction....24*

*4.2 Review information sharing....24*

*4.3 sense and respond management and information sharing....29*

6. Case studies....31

*6.1 Introduction....31*

*6.2 Wal-Mart....31*

*6.3 Dell....35*

*6.4 Conclusion....37*

5. Discussion and Conclusions....38

*5.1 conclusion....38*

*5.2 discussion....39*

6. References....40

# 1. Introduction on sense and respond management

In today's rapidly changing business environment, fast responding on consumer demand and listening to the needs of the consumer are some important aspects of supply chain management. Theories like collaborative planning forecasting and replenishment (CPFR), Vendor managed inventory (VMI) and continuous replenishment programs are some tools developed in time to improve supply chain management and bring the focus on better serving the needs of the customer.

Better serving the customer in a supply chain leads to a chain that needs to be more responsive. According to chapter 2 of Chopra and Meindl (2007), there is a trade of in supply chain management between efficient supply chain management and responsive supply chain management. Table 1 shows a comparison of efficient and responsive supply chain. To create a better understanding of both concepts.

| Primary goal | **Supply demand at the lowest costs** | **Respond quickly to demand** |
|---|---|---|
| Product design strategy | Maximizing performance at a minimum product cost | Create modularity to allow postponement of product differentiation |
| Pricing strategy | Lower margins because price is a prime customer driver | Higher margins because price is not a prime customer driver |
| Manufacturing strategy | Lower costs through high utilization | Maintain capacity flexibility to buffer against demand/supply uncertainty |
| Inventory strategy | Minimize inventory to lower cost | Maintain buffer inventory to deal with demand/supply uncertainty |
| Lead-time strategy | Reduce, but not at the expense of costs | Reduce aggressively, even if the costs are significant |
| Supplier strategy | Select based on cost and quality | Select based on speed, flexibility, reliability and quality |

Table 1: efficient vs. responsive supply chains

*Efficient supply chain*

What stands out is that an efficient supply chain is much more costs driven, while a responsive supply chain is more focused on customer service. In general Chopra and Meindl (2007) mention that the right strategy depends on the demand of the product. With uncertain demand, a responsive supply chain fits better and with certain demand, an efficient supply

chain fits better. Of course this is very simplistic and the reality is much more complicated. The point is that companies have to find a good fit for their supply chain.
In today's business environment being responsive to the needs of the consumers becomes more and more important. However as the previous paragraph mentioned, shifting towards a responsive supply chain will decrease your efficiency and increase your costs. For example, suppliers need to have higher safety stocks in order to being able fulfilling demand when there is a shift. Manufacturers need some free capacity to increase production when there is a change in demand. In order to become more responsive but reduce the impact on efficiency a change in organizations is needed.

*Introducing sense and respond management*

In the book supply chain management on demand a theory is introduced that is called 'sense and respond supply chain management'. (An and From 2005) Sense and respond management, introduces the theory of a supply chain that can react and implement changes that occur in consumer demand at a high speed. Thanks to increasing connectivity and the integration of business processes the scope of decision making is no longer a single enterprise or multiple enterprises, bit the whole supply chain. Sense and respond management is a customer oriented approach that provides real-time responsiveness for organizations to proactively manage their supply chain (An and From 2005). In sense and respond management, it is about measuring real time consumer demand, and respond fast to fluctuation by making use of electronic infrastructures between organizations. (Buckley, Ettl et al. 2005) The brief difference between traditional supply chain management and sense and respond business performance management is as follows: traditional supply chain management focuses on planning and execution. Sense and respond does not only perform supply chain planning, it also determines business rules and policies among value partners to achieve better overall performance. Traditional approaches also respond more reactively to environmental changes. With sense and respond management, a company can make use of real time information because of the real time data that is available, this helps the company in reacting real time on environmental changes. With all the real time information available a company is also able to analyze this data and predict this environmental changes and so it has the capabilities to address issues before they occur. (Buckley, Ettl et al. 2005)
Sense and respond management is also about optimizing the supply chain. This depends on the ability of an enterprise to streamline operations along the chain, being able to process information, to respond proactively and effectively, understanding the needs of customers, the capabilities of employees and analyzing the risks and opportunities in a changing environment. Sense and respond management is there to build an open and adaptive framework. Intelligent decision making and IT technologies are used for this business optimization.
While optimizing the supply chain, sense and respond management is also able to decrease the impact on efficiency when a firm is trying to become more responsive. According to Kapoor, Gresh et al. (2004) companies can track business operations thanks to the real time information available in sense and respond management. With the real time data available, a company can track business operation and so try to improve the efficiency of this operation. Tracking all this operations can improve their business efficiency when business operations are happening (Kapoor, Gresh et al. 2004)

Kapoor, Gresh et al. (2004) also mentioned that in tactical and operational decision making, the use of information assets is increasingly important. For a long time decision making was based on the idea that up to date information was not required. So data in a data-warehouse was not required to be up to date, it can lag at least a day or a weak behind actual operational data. But Kapoor, Gresh et al. (2004) explained:
*'In today's competitive business climate, companies can't afford to wait days or weeks for information that can reduce costs and improve business processes. Companies need to track business processes'*

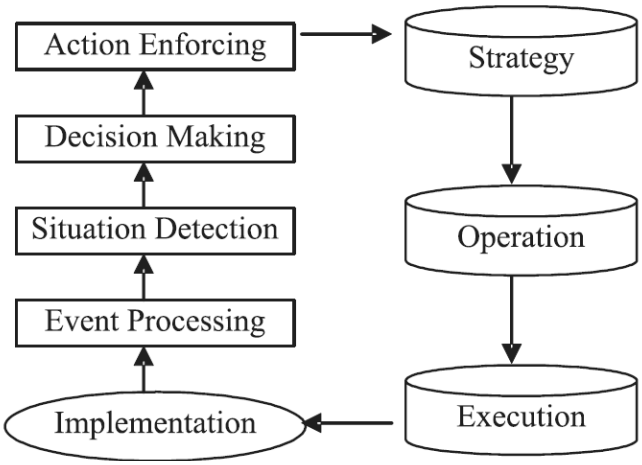


Figure 1: Sense and respond supply chains (Kumaran and Bhaskaran 2005)

*The sense and respond management framework*

Figure 1 shows a framework that defines sense and respond management. This framework actually consists of two components. The first component, from strategy to implementation is a top-down driven business integration model. The second component, from event processing to action enforcing is bottom-up model-driven business process management. The business integration model can define key performance indicators and their relationships at various levels. The business process management component can be used to define which actions have to be taken when certain business situations are detected. This can be done by attaching management policies to any key performance indicators. Together these enable a sense and respond system. (Kumaran and Bhaskaran 2005)

*The adaptive enterprise*

Like any other business, a sense and respond enterprise should be adaptive. An adaptive business will sense the changes of the environment, like need of customers, employees and business partners. So changes in the environment of the firm will be noticed and the organization responds to the change. However, for a sense and respond business, the

information that can sense changes must be real time and fast distributed throughout the supply chain, so there are some important capabilities for the handling and use of information:
-*Automation.* Collect, maintain and manage information from customers, suppliers and employees. Make use of information and databases that are available for all key members
-*Visibility.* Make data and information visible within the enterprise and also available for members of the supply chain to create more efficiency.
-*Control.* The feedback procedure that can help business units to achieve performance goals. It is also useful to determine if there is an action required because of the changing environment.
-*Adaptiveness.* This involves the use of predictive modeling and learning of historical performance with real time information, to enable enterprises to focus on core competencies and support an environment to collaborate with customers and suppliers.
(Buckley, Ettl et al. 2005)

The key points of sense and respond management:

- ✓ -respond quick and optimal to unexpected situations
- ✓ -Optimizing decision making by providing real time information about the whole supply chain and visibility for every supply chain member.
- ✓ -Optimizing the supply chain by making use of the real time information available.

*Goal of this thesis*

In the previous paragraphs the theory of sense and respond management is introduced. This theory can be used to implement sense and respond management in existing enterprises. The possibility exists that implementing this kind of management is difficult and comes with a lot of challenges. This thesis discusses and defines the challenges that occur when enterprises try to implement sense and respond management. Three important aspects of supply chain management are used to discuss challenges that occur when sense and respond management is implemented with regard to that aspect. These aspects are flexibility, collaboration and information sharing. These are all three aspects that have a high importance in supply chain management and it is interesting to look at the influence of implementing sense and respond management on this aspects.

One of the key advantages of Sense and respond management is the ability to quickly react on changes in the business environment of the firm. For that reason, flexibility is chosen as an aspect to evaluate. Fast responding requires flexibility from all members in a chain. There must be ability to quickly change the amount of supply, so contracts with suppliers have to be flexible. Also distribution must be flexible to make sure that you can fulfill changes in demand.

A firm is not able to sense and respond changes on the market only by itself. Collaboration with members of the chain is required to create the ability for sense and respond management. Sense and respond management requires a high dedication of other chain members. Also the large amounts of critical data that can be shared is a reason to have a closer look at collaboration, because with no willingness to share data, sense and respond management is not usable.

The importance of information in a sense and respond management chain is a good reason to have a closer look at information sharing. An example: It is important to identify

which kind of information has to be shared. Also with whom this information is shared is important to know.

This results in the following research question:

**What are the challenges that occur when sense and respond management is implemented?**

And for every aspect there is a sub question:
-What are the challenges of implementing sense and respond management on the field of flexibility?
-What are the challenges of implementing sense and respond management on the field of collaboration?
-What are the challenges of implementing sense and respond management on the field of information sharing?

8 thesis sense and respond manangement

# 2. Flexibility in the supply chain

## 2.1 Introduction

In a sense and respond chain, there is a focus to sense changes in the business environment and being able to quickly react on this changes. An important aspect to make a fast respond possible is flexibility. In this chapter there is an overview of views on flexibility in literature and the sub question is answered: What are the challenges of implementing sense and respond management on the field of flexibility?

## 2.2 Review flexibility

An important aspect of supply chain management is flexibility. Flexibility gives a firm the opportunity to quickly react and interfere when changes occur. With today's rapidly changing environment, flexibility in a supply chain can drive competitive advantage. In this chapter, some looks at supply chain flexibility are described.

*Types of flexibility*

Calantone and Dröge (2006) determine, based on literature, five different types of supply chain flexibilities based on a customer oriented strategy.

-*Product flexibility*. This is a flexibility that enables members of the supply chain to quickly meet special customer orders, to handle difficult, non-standard orders. Also to produce products characterized by numerous features.

-*Volume flexibility* is also a type of flexibility they determine. This means the ability to rapidly respond with more or less production when customers demand changes.

-*Launch flexibility*. Members of the chain are able to rapidly introduce large numbers of new products or improvement on existed products.

-*Access flexibility*. Members have the ability to effectively provide distribution coverage.

-*Responsiveness to target market*. The supply chain is able to rapidly respond to the need and wants of the target market.

In the research, Calantone and Dröge (2006) examined the five dimensions and their relationship with uncertainty, performance and functional interfaces in the cyclical furniture industry. Some relevant conclusions: They examined that higher levels of perceived uncertainty results in higher emphasis on flexibility. With two flexibilities there was a positive correlation, volume flexibility and launch flexibility. So with high perceived uncertainty, there is more focus on these two flexibilities. Other results where that if there was a higher emphasis on supply chain flexibilities, it leads to better performance of these flexibilities. In general, the emphasis on supply chain flexibilities leads to better performance.

*A conceptual model for supply chain flexibility*

Duclos, Vokurka et al. (2003) have determined a conceptual model of supply chain flexibility. They claimed that much research on flexibility focuses on intra-firm flexibility. For supply chain management flexibility strategies must extend beyond the boundaries of the firm. They stated: *The benefit of supply chain flexibility lies in the ability to facilitate the development*

*of meaningful organizational strategies and guidelines that improve overall performance of the firm*. (Duclos, Vokurka et al. (2003) Based on literature, supply chain flexibility is defined in six components by them:

-*Operations system flexibility*. The Ability to react to changing customer trends by configures assets and operations, at each member of the supply chain. An integral component of supply chain flexibility is the operations flexibility at each member of the chain. To meet the end needs of the customer, a member must be able to deliver the products well-timed.

-*Market flexibility*. This is the ability of members to rapidly respond to changing market conditions and changes in customer needs and wants. One of the critical aspects now at days in market flexibility is the ability to introduce new products, because customer needs, the materials and the technology are changing rapidly.

-*Logistic flexibility*. This means the ability to serve each distinct customer needs when sources of supply and customers change. Logistic flexibility is important to meet the changing channels such as the expanding electronic commerce.

-*Supply flexibility*. Members of the chain are able to reconstruct the supply chain, when the changing needs of customers requires a change in the supply of products, such as volume, product variation, or a complete new product.

-*Organizational flexibility*. The ability to align labor force skills to the needs of the supply chain to meet customer needs. Reconsider that reconfiguration and adjustment will only be as successful as the flexibility of the workforce and the organizational environment allows.

-*Information system flexibility*. Ability to align information systems and the architecture of the systems with changing information needs when the organizations are responding to the changing demand of the customer. With information system flexibility, synchronization of the information systems of all members of the chain is required.

Much is written about internal flexibility in firms, but the change from internal flexibility to cross-firm flexibility requires complete supply chains to be flexible. Duclos, Vokurka et al. (2003) mentioned in their research also the components used by Calantone and Dröge (2006). Those are diiferent because the responsibility for each flexibility lies with one functional area of a firm. For example the manufacturing area is responsible for the volume flexibility. Focusing one these area's from an internal perspective, most of the contribution for a supply chain perspective is lost.

Duclos, Vokurka et al. (2003) use the described components for a new conceptualization of supply chain flexibility. This components incorporates both within-firm and between firm flexibilities. The framework in figure 2 shows the concept.

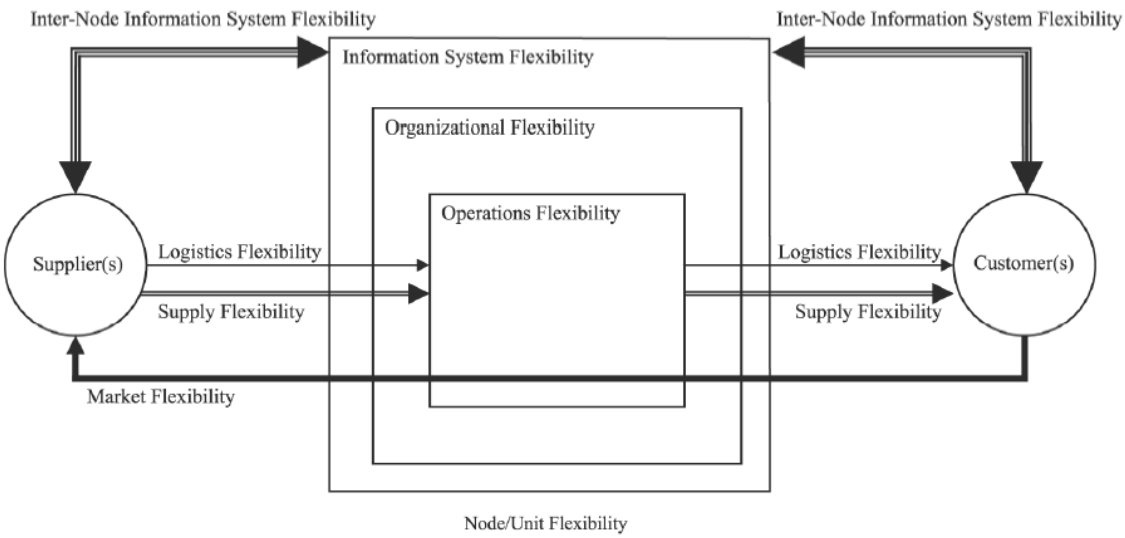



Figure 2: Components of flexibility (Duclos, Vokurka et al. (2003)

The main intention of the framework is to show that flexibility now a day crosses the boundaries of the firm. Real competition is not firm to firm but supply chain to supply chain. As figure 2 shows, the different types of flexibility in a supply chain are all somehow related to each other. This evolution, from individual organizational flexibility to a cross- firm flexibility, results in an entire supply chain that must be flexibility and make effort to achieve this.

*Flexibility and uncertainty*

One of the great drivers of flexibility is the presence of uncertainty. In their research, Candace, Ngai et al. (2011) look at the relationship between flexibility strategies and environmental uncertainties in a supply chain context. In this case study they collected data from five firms in the textile and apparel industry in mainland China. In the research they categorized three types of uncertainties. Demand uncertainty, Supply uncertainty and Competition uncertainty. They also make use of some strategic measures in four dimensions of flexibility, from the dimensions of Calantone and Dröge (2006) and Duclos, Vokurka et al. (2003). These dimensions are sourcing flexibility, operating system flexibility, distribution flexibility and organizational flexibility. With these two measurements they make a case analysis.

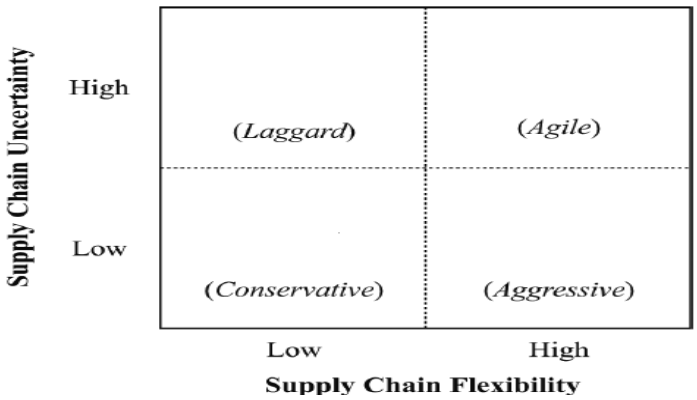



Figure 3: uncertainty and flexibility (Candace, Ngai et al. (2011)

To identify the current state of a supply chain with respect to uncertainty and flexibility, a matrix is showed. (figure 3) This matrix determines the following four quadrants:
-*Laggard*. While this strategy is characterized by a high level of uncertainty and a low level of flexibility, it is not surprising that in today's competitive markets this strategy fails to meet the demands of the market. Every chain tries to avoid this strategy.
-*Agile*. Companies in this category have a high level of uncertainty and a high level of supply chain flexibility. The high level of uncertainty is the reason that companies try to achieve a high level of flexibility. It is important for the firm that it has the opportunities to create a high flexibility strategy. For example, the firm has very extensive transportation networks so every change can be processed.
-*Conservative*. When the strategy is conservative, uncertainty and flexibility are low. Firms choose for this strategy when they operating in a market where the uncertainty is low and the competitive intensity is low. Investing in better flexibility, like flexible resources, seems to be less useful.
-*Aggressive.* When uncertainty is low and flexibility is high, the strategy of the firm is aggressive. With this strategy a firm can try to achieve competitive advantages. Another reason for this strategy is to reduce the uncertainty of any future investments.
These quadrants represent the four types of supply chain flexibility strategies.
Their research concludes that there is an importance for firms to adopt strategies for present and future development, looking at specific environments. Also a good analysis of the risks in their supply chains is required. Companies in a dynamic environment need to enhance their flexibility capabilities, while firms that have fewer uncertainties should pay more attention to cons savings and efficiency in their supply chains. For example: Companies that produce clothes are examples of firms in a dynamic environment, where demand and supply can fluctuate. Manufacturers of steal are examples of firms that have fewer uncertainties and that focus on making their production more efficient.

*Flexibility and performance*

All the dimensions give a good view on supply chain flexibility, but the impact of flexibility on performance is also something useful to know. Fantazy, Kumar et al. (2009) discuss the relation between strategy, flexibility and performance. Their hypothesis on flexibility and performance is that supply chain flexibility dimensions have a direct impact on supply chain performance. Performance is measured in both financial and non-financial performance measurements. These measurements are: Net profit and sales growth for financial performance and lead time and customer satisfaction for non-financial performance. Flexibility is measured with the help of five different dimensions, based on literature. The dimensions used are*: Launch-, product-, sourcing-, logistic-, information systems- flexibility.* The reason that this types of flexibility are chosen is because they are the five types mentioned the most in literature. These five dimensions are more or less a combination of internal related supply chain flexibilities (Calantone and Dröge (2006)) and external related supply chain flexibilities (Duclos, Vokurka et al. (2003))
The relevant conclusions for financial performance are that *launch- and sourcing* flexibility has positive correlations with net profit. With sales growth *launch, product and logistic* flexibility have positive correlations. The conclusions for non-financial performance and flexibility are that

for lead time *sourcing-, product-, and logistic* flexibility have positive correlations. For customer satisfaction *product-, sourcing-, logistic- and information systems- flexibility* have positive correlations. This research shows that the dimensions of flexibility influence performance on different ways. So in supply chain management, decisions makers have to choose for the right dimensions of flexibility to pay more attention to, dependent of the goals of the organization.

## 2.3 Sense and respond management and flexibility

*Flexibility to adept*

Becoming an adaptive enterprise is not only a challenge for an enterprise itself. There have to be cooperation with other members in the supply chain.

As mentioned in the introduction there are some capabilities needed to implement a new supply chain solution. The BPIM model speaks about s capabilities that are needed. (Kumaran and Bhaskaran (2005)) An important capability in the context of flexibility is the flexibility to adept. The flexibility to adept means that new solution will not work if members of the chain are not willing to cooperate and adept the new changes. Members of the chain need the flexibility to adept the changes and help the firm to incorporate them. The firm that wants to implement the change needs to make a good evaluation of key members that are willing to adept. This flexibility to adept is also important to become an adaptive enterprise. The changes for that requires great changes, like changes in the information systems between members of the firm. Of course this kind of flexibility is different from the operational flexibilities of Calantone and Dröge (2006) and Duclos, Vokurka et al. (2003).

*Important types of flexibility*

The conceptual model of Duclos, Vokurka et al. (2003) can be used to analyze which types of flexibility are important in sense and respond management. Of course it can be said that all the components are important. To explain this, let us point out information system flexibility and market flexibility. (Figure 2) Inter node information system flexibility and information system flexibility are important. A company and its suppliers have to link and align their information systems, in order to get easy access and make use of the information they both provide. So their information systems have to be synchronized. There must be the flexibility for new information system solutions. Also important for flexibility is the ability to change the architecture of the system in order to improve it when the demand for information changes.

Market flexibility plays an important role in sense and respond management, because its aim is to make an organization and its supply chain react quickly to changes and the chain must be able to sense the changes in the market. In order to make things more clear, table 2 shows the components of Duclos, Vokurka et al. (2003) and the importance for sense and respond management.

| Component | importance | Explanation |
|---|---|---|
| ***Operations system flexibility*** | high | Sense and respond management can create more visibility about operations in the change. So operation systems have to be flexible for changes |
| ***Market flexibility*** | Very high | Sense the changes that going on at the market is one of the key points for sense and respond management. Being flexible for market changes is very important |
| ***Logistic flexibility.*** | high | The logistic flexibility is important for the respond to changes in demand. |
| ***Supply flexibility*** | high | Sense and respond management can cause big changes for a chain. Being able to change the supply is important. |
| ***Organizational flexibility*** | high | Implementing sense and respond management will ask from organization that they are willing to change, so organizational flexibility is important |
| ***Information system flexibility*** | Very high | The need for information in a sense and respond supply chain is very high. So information flexibility is very important to make sure that information is collected and visible all over the chain |

Table 2: flexibility and sense and respond

*Sense and respond and uncertainty.*

The quadrants of Candace, Ngai et al. (2011) show different strategies in different environments. In today's business environment, there will be more and more uncertainty, because of the fast changing preferences of companies. The strategy needed for a sense and respond enterprise in an agile strategy. This means that there is a high supply chain flexibility. Even if a firm operates in a market with a low uncertainty level, it can choose for a high level of supply chain flexibility, an aggressive strategy. For sense and respond management it can be useful to choose an aggressive strategy, to be able to make the operations more flexible and be able to respond quick in unexpected situations.

*Real-time information and flexibility.*

An important aspect of sense and respond management is the flow of real-time information that is needed. The information system in general is an important aspect. In the study of Kumar and Craig (2007) The relation between supplier flexibility and real time control is discussed. Different levels of supplier flexibility are measured and their relation with the information system. The relevant conclusions are that when there is a real-time information system, the delivery lead time decreases with a higher flexibility level. This delivery lead time is an important performance measure in a supply chain. This means for sense and respond management that the higher the supplier flexibility, the higher the advantages on performance, with the assumption that there is real time information available in a chain.

*Conclusion: What are the challenges on the field of flexibility?*

Becoming a sense and respond enterprise requires the flexibility for a chain to adept the changes that occur. These changes are on the field of information systems, because this helps the organization and its members to sense changes in the market and respond to it. It can be a challenge to implement such an information system. Another challenge for members of the firm can be the ability to quickly respond to changes in the chain. Therefore an organizations has to analyze is ability to be flexible. The great challenge is to create flexibility in different parts of the organization. For example a manufacturer can be very flexible and enhance the production if needed, but when the distribution network is not able to deliver the products on time, then sense and respond management becomes difficult to implement. So a big challenge for sense and respond management is to create a supply chain where all the key member have a high flexibility level.

# 3. Collaboration in the supply chain

## 3.1 Introduction

Implementing sense and respond management in an organization has as a result that there occur changes in the relationships with the suppliers. For example an organization can demand changes in the information sharing with the supplier. Therefore good collaboration is required to make changes possible and applicable. This chapter looks at the different views on collaboration and discusses the collaboration challenges that occur when there is a change to sense and respond management.

## 3.2 Review collaboration

A good supply chain needs collaboration. Without collaboration, supply chains are much less valuable. In this chapter, supply chain collaboration will be explained. Great examples of collaboration concepts are Vendor Managed Inventory (VMI) (Dong and Xu 2002) and Collaborative Planning, Forecasting and Replenishment (CPFR) (Fliedner 2003). Supply chain collaboration means that two or more companies working together to create competitive advantage through sharing information and making joint decisions. It means also that they share the benefits which result from greater profitability of satisfying the end customer needs than acting alone. (Manataki 2007)

*Collaboration dimensions*

Collaboration between organizations in a supply chain is widely adopted. Some benefits of collaboration include revenue improvement, reduction of costs and operational flexibility to cope with demand uncertainties. According to Simatupang and Sridharan (2002) the concept of collaboration can be categorized into three interrelated dimensions. These dimensions are: Information sharing, decision synchronization and incentive alignment.

Information sharing is about collecting and distributing timely and relevant information for decision makers for planning and controlling supply chain operations. This dimension is further discussed in chapter four of this thesis.

Decision synchronization refers to the joint decision making either in planning or operational context. In planning context this means decisions about long-term planning and it measures such facets like selecting a target market, customer service level and forecasting. The operational context integrates the order and delivery processes, for example in the form of shipping schedules and product replenishment.

Incentive alignment is about the level of sharing costs, risks and benefits between participating members. So are those costs, risks and benefits equally shared or have some members more benefits than others. (Simatupang and Sridharan, 2002)

*Collaboration configurations*

According to Holweg, Disney et al. (2005) the concepts of ECR, VMI and CPFR do not have the widespread adoption that was hoped for, despite of some individual successful

implementations. In their research they discuss the implementations of collaboration concepts in different industries and countries.
The benefits of collaboration in the supply chain are widely accepted. A synchronized supply chain leads to increased responsiveness and lower inventory costs. However the concept of supply chain collaboration is not as well understood as hoped. For some industries collaboration is just a case of holding stock, while for others collaboration is a complete philosophy of controlling and replenishing stock. Based on practice, Holweg, Disney et al. (2005) identified four basic supply chain configurations. In figure 4 these configurations are showed.
The model has two dimensions, inventory replenishment and forecasting. There are more collaboration dimensions, for example promotion or new product introduction, but according to Holweg, Disney et al. (2005) these two are most commonly used.

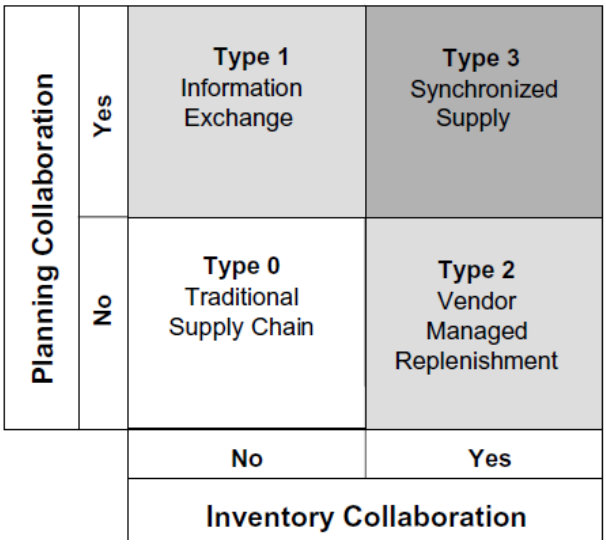


Figure 4: Supply chain collaboration configurations (Holweg et al. (2005))

*Explanation of the different configurations*
-*Type 0, traditional supply chain.* Traditional means that each member of the supply chain issues production orders in the supply chain, without considering situations in the up or down stream tiers in the supply chain. The only information available for the supplier is the purchasing order of the retailer, this causes the bullwhip effect. Despite of the presence of the bullwhip effect, it is not easy to solve. In the structure of the traditional supply chain, the bullwhip effect is integrated and therefore very difficult to avoid. Structure, determined in terms of decision tiers and delays in information and material flows, drives the dynamic behavior of a chain.
-*Type 1, information exchange.* Retailers and suppliers still order independently, but they exchange demand information and actions plans to align forecasts and long-term planning. So information sharing will create more visibility and makes it easier to predict demand. It is also much easier to implement than complete customer specific control processes.
-*Type 2, Vendor managed replenishment.* Under vendor managed replenishment, the supplier is responsible for managing the inventory of their consumer. The customer gives replenishment

orders to the supplier and the supplier get full visibility of the consumer's stock. Than the customer makes the supplier responsible for managing the inventory. In vendor managed replenishment, nothing fundamental has changed, compared with a traditional supply chain. Still the same decisions are made by every member. Despite of all the information, suppliers do not have the customer's inventory and sales information for controlling their own production and inventory process.

-*Type 3, Synchronized supply.* Synchronize supply merges the replenishment decisions with the production and material planning of the supplier. The supplier is in charge of the consumer's inventory level and uses this visibility in planning his own supply operations. To make this work, it is critical that not only information is exchanged, but that there is also an adaption in the replenishment and planning structure.

On first sight the type 3 configuration seems to be the best configuration for supply chain collaboration. However from their research, Holweg, Disney et al. (2005) conclude that not every supply chain is able to achieve a synchronized supply chain, because of a mismatch between the structure of the chain, the product characteristics and the type of collaboration intended.

Table 3 shows the key factors that guide the supply chain strategy.

| Factors | Why important? |
|---|---|
| Geographical dispersion of customers and supplier plants | The closer, and more dedicated supply is, the easier it is to implement synchronized production and inventory control |
| Demand pattern of the product | The more stable the product's consumer demand, the greater the dynamic benefits of eliminating bullwhip and synchronizing demand and supply in the system |
| Product characteristics, in particular selling periods and shelf life, as well as value | The longer the shelf life or selling period of the product, the more sensible it is to consider collaborative practices. Equally, The more valuable the product, the more impact tighter inventory control yields |

Table 3: Key factors (Holweg, Disney et al. (2005))

The key factors in table 3 show why not every firm can achieve a type 3 configuration. The factors that have the influence on what type fit a firm the best are based on geographical dispersion, demand patterns and characteristics of the product. These factors explain why the type three configuration is not for every firm competent.

*Scope and depth of collaboration*

Collaboration has different dimensions, as the previous elements show. This paragraph deals with the question about the depth and scope of collaboration. The collaborative planning, forecasting and replenishment model is used as an example to evaluate this.

In the research of Skjoett-Larsen, Thernøe et al. (2003) the focus is on the collaborative planning, forecasting and replenishment (CFPR) concept. They divided the CFPR concept in

three levels: Basic CPFR, developing CPFR and advanced CPFR. The most important differences between these levels are the scope of collaboration and the depth of collaboration.

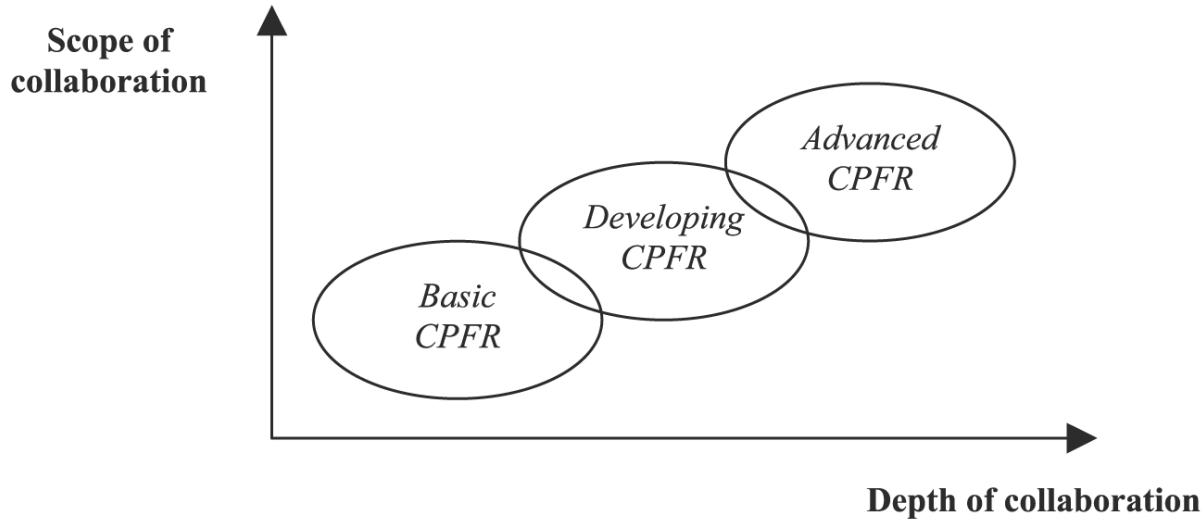



Figure 5: Different levels of CPFR

With the scope of collaboration the number of business processes involved in the collaboration is meant and the depth of collaboration shows the integration of the processes wit partners. Figure 5 shows the different levels of collaboration.

In *basic CPFR*, only a few business processes are involved. There is also a limited integration with partners. Organizations that adopt this approach will choose a few key processes relevant for their form of collaboration. Also a low integration is present. Basic CPFR collaboration gives the advantage of information exchange and minimizing the costs of transactions. Actors that participate in a basic CPFR-collaboration have a transaction theoretical approach.

*Developing CPFR*. Compared with basic CPFR in developing CPFR collaboration there is increased integration in the collaboration areas. When members of a chain start making agreements about what information to exchange and how to coordinate data, the integration increases. The focus in the developing CPFR model lies on improving client service as a way to increase trade, compared with the basic model, where focus lies on cost reduction. Supply chain actors with a developing CPFR collaboration have a network approach.

*Advanced CPFR.* The advanced CPFR model differs from the previous because collaboration is seen as more than only data exchange. Collaboration deals also with synchronizing the dialogue between the parties. A motive for entering the advanced CPFR also includes a wish to develop classifications to continue improvement of the business processes.

*The elements of collaboration*

The next part of this chapter discuss some elements that are needed for collaboration on the field of collaborative culture and a collaborative infrastructure

*The collaborative culture*

Barratt (2004) defines and discuss the elements that make up supply chain collaboration according to literature. A collaborative culture is defined as one of the major supporting elements for collaboration. Figure 6 shows the 'cultural' elements of supply chain collaboration.

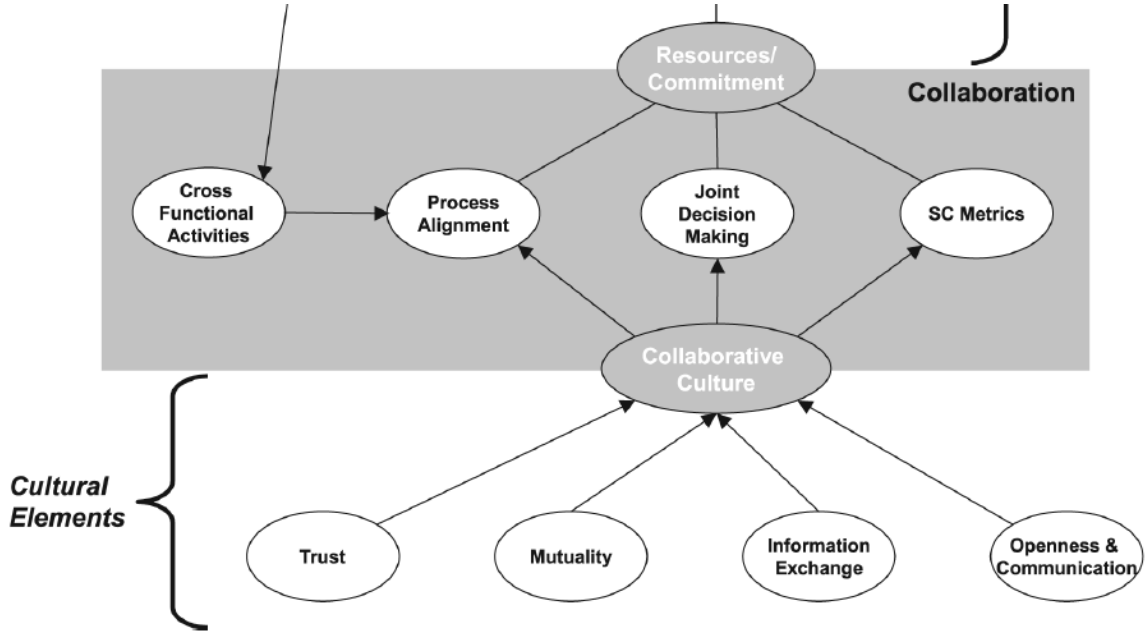



Figure 6: element of collaboration Barratt (2004)

The meaning of these elements:

-*Internal and external trust.* Trust can contribute to the long-term stability of an organization and effective co-ordination can be built on trust and commitment. Therefore a high degree of trust is needed between all players.

-*Mutuality.* Mutual benefits and risk sharing for players that collaborate is important.

-*Information exchange in a supply chain.* Transparency of data and the quality of information flows is important for a collaborative culture and the development of collaboration.

-*Openness and honesty.* This is important from both an internal and external viewpoint. Openness and honesty can develop trust, respect and commitment because of the improved certainty and reliability. For example, when a delivery is going to be late, a sender should inform the recipient as early as possible, so contingency plans can be made.

*Communication and understanding.* It is important to make open and develop clear lines of communication between partners. This leads to better information sharing and it can create a shared understanding. It is also important to create broad interfaces for communication, to overcome a lack of internal communication and to create an atmosphere that support creative thinking.

*Elements important for collaboration*

Figure 6 shows also the elements that are needed to succeed collaboration. After creating a collaborative culture, the environment is created for the start of collaboration. The elements that play a role according to Barratt (2004):

-*Cross-functional activities.* Boundaries between organizations can restrict the flow of information and the developing of trust, so it is important to lower these boundaries

-*Process alignment.* Supply chain collaboration comes with a process focus that will cross many functional boundaries, management support will be required.

-*Joint decision making.* This is needed to prevent the chain from unnecessary and costly mistakes. Take forecasting as an example, if all members do their own demand forecasting, big variation will occur. This is unnecessary and can be costly.

-*Supply chain metrics.* They can show where the bottlenecks are in the organization and are useful to analyze and solve problems

*Collaboration and technology infrastructure*

The importance of collaboration for information sharing is mentioned by Barrat (2004), but there is more to say about the technological infrastructure elements that are needed to make a high level of information sharing possible.

Horvath (2001) concludes that collaboration is the driving force of effective supply chain management. Collaboration with every participant in the chain is needed, independent of size or function of this participant. To respond to every change in demand were ever in the chain. Good collaboration in a chain will need a new form of collaborative technology infrastructure. The fundamentals of this infrastructure are:

-*Open, low cost connectivity*. This is needed to give smaller members the change to get access without major investment. So every member can join.

-*Large, flexible, multimedia data storage capabilities*. The infrastructure must have the ability to store large amount of data from many different sources and different media. *With system and channel integration*, every member has the ability to integrate and get access to information regardless of the application used.

-*Higher-level of service capabilities*, this includes order tracking, billing information and also intelligent capabilities.

-*Intelligence gathering and analysis*, higher level self service capabilities will generate an ongoing flow of information. So better business intelligence is required to gather and analyze.

-*Supply chain collaborative exchange,* means advanced collaboration in a chain. Not only on making the product, but also on the design and development of new products.

-*Sophisticated security capabilities*, more and sensitive information is available. It has to be assured that this information is secured.

-*New electronic commerce capabilities* can help supply chain to reduce cost and a higher speed for the collaborative infrastructure.

## 3.3 sense and respond management and collaboration

*Synchronized supply*

When we look to the configurations of Holweg, Disney et al. (2005), synchronized supply is a configuration that best suith with sense and respond management. However, the research shows also that it is not suitable for every company. In a sense and respond chain it is very important to achieve this configuration to make it possible that the chain can quickly react on changes and at the same time make the chain more efficient.

*Collaborate to become adaptive*

As mentioned before, becoming a sense and respond organization requires becoming adaptive. Therefore there must be an understanding of the role that collaboration plays in becoming adaptive. The key capabilities to handle with information as mentioned before in the introduction are; *automation, visibility, control and adaptiveness.*

-*Automation.* In a chain it is important to collect and manage all the information linked to chain members and customers. This information, for example customer profiles, product information and capacity, has to be collected from all members. To help the information to be up to date and accurate, automation is required. Of course there is an important role for collaboration in it. There must be willingness to collaborate, it is important that the information systems are synchronized and that it is easy to make the information from different sources visible for everyone and in order to collect the right information, chain members have to debate about the information they make available.

-*Visibility.* For better visibility, the key for collaboration lies in transforming the collected data in standard forms to make it visible for every member. Due to the high number of different ways to store data, this is a problem that can be overcome with good collaboration. Holweg, Disney et al. (2005) about visibility: ''*Collaboration in the supply chain comes in a wide range of forms, but in general has a common goal: To create a transparent, visible demand pattern that paces the entire supply chain.''*

-*Control.* With control, processes in a chain or firm can be analyzed and it can determine if action is required in respond to changes. In a sense and respond process, control plays of course a key role. Main object of control is to analyze data and information and determine if action is required. To analyze data, information and processes, it can be important to do this with other members to create better understanding. Collaboration can be used to set up some business units with employees of different chain members that can achieve this. The BPIM model for sense and respond supply chains, that was introduced on page 4 is an example of the control. It shows the steps made in controlling and adapting the business processes.

*Elements of collaboration and sense and respond management*

The elements of Barratt (2004) are important to evaluate if a chain is ready for sense and respond management. Without members of a chain that have a collaborative culture,

implementing and make use of sense and respond management is difficult; it requires good and close collaboration.

*Information technology and sense and respond management*

Horvath (2001) describes a collaborative technology infrastructure that is needed. For sense and respond management this is very important. The high need for good information sharing, and the importance of real time information asks from chain members that there technological infrastructure is aligned so that the benefits of the information sharing are enabled

*Conclusion: challenges on the field of collaboration*

The big challenge for firms that implement sense and respond management is the ability to make good use and share of information possible. This information is the source to sense changes in the business environment and the sharing of information makes it possible to respond fast. Therefore the major challenges are the elements mentioned by Barrat (2004) and Horvath (2001). For example, good communication and understanding is needed to make the information available and usable for all members and openness and honesty are needed for good information sharing. Also the elements of the technological infrastructure mentioned by Horvath (2001) are important. For example the availability for large, flexible data storage, because the amount of data generated can be enormous and must be stored in order to make it usable.

Other challenges for an organization to overcome are on the field of close collaboration. Close collaboration is the first thing that is needed when becoming a sense and respond firm. So working on good relationships and good communication with other members of the chain are the start for sense and respond management. Having these good relations makes it easier to demand changes in the information systems and the sharing of information. The capability to handle and make use of the information that the chain provides, makes good sense and respond management possible. Sense and respond management also requires that the relations among suppliers are good and not only the relation between organization and supplier.

# 4. Information sharing

## 4.1 introduction

Duclos, Vokurka et al. (2003) discuss in their research the elements of flexibility, one of this elements is information system flexibility. This flexibility is introduced as follows: *The changing environment in which an enterprise operates, so too changes the information needs and data processing requirements of the enterprise.* This sentence tells us the importance of information sharing in sense and respond management. The changing environment is an important reason for sense and respond management and within this, information sharing plays a big role.

## 4.2 Review information sharing

Information sharing can be described as the coordination of information flows. Because of the demand uncertainty which supply chains have to deal with, the sharing of information and the coordination of orders is recommended to improve supply chain performance.

*The bullwhip effect*

In most studies related to information sharing and supply chain, the bullwhip effect is mentioned. Therefore a little explanation is required. The bullwhip effect occurs when orders to the suppliers tend to have a larger variance than sales to the buyer; this distortion propagates upstream in the supply chain. (Lee, Padmanabhan et al. 2004) According to Lee, Padmanabhan et al. (2004) one of the solutions to decrease the bullwhip effect is better demand signaling in the supply chain. So not only the retailers get the demand forecasts, but this information has to be available through the whole chain. This requires good information systems, electronic data interchange is a great example, becoming common in the industry. Other technologies such as Vendor Managed Inventory (VMI) systems or Continuous Replenishment Programs (CPR) are being used to eliminate the bullwhip effect

*Levels of information sharing*

In the research of Seidmann and Sundararajan (1998), four levels of information sharing between organizations are discussed based on the impact of information sharing.

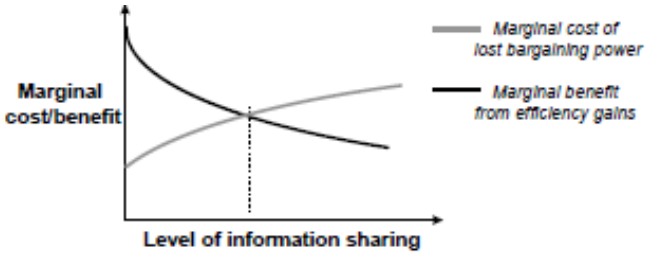



Figure 7: tradeoffs in information sharing

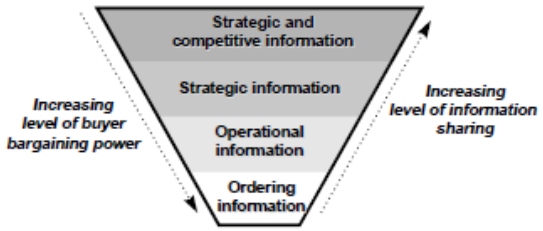



Figure 8: level of information sharing

Figure 7 shows a simple model which explains the level of information sharing between partners.

A firm that shares information will have the benefits from it, but it will also have some negative effects. When these two levels are equal, the level of information sharing is explained. Of course this model is simplified and it does not consider the technology and infrastructure costs for example. Figure 8 shows the four levels and there relation to the level of information sharing and the level of buyer bargaining power.

-*Sharing order information:* Many arrangements do not involve sharing firm specific operations information. Arrangements are used to improve logistic processes. In that case, only ordering information is exchanged.

-*Sharing operational information:* A good example of operational information that is shared is Vendor Managed Inventory (VMI). In VMI a buyer shares inventory position information with its suppliers. This enables suppliers to manage their own inventory at the buyers' site. It results in less inventory costs for the buyer. The gains for the suppliers are in the internal operating efficiency, but are minimal at best. However, the bargaining position of the suppliers with the buyer will improve, since the suppliers has superior knowledge. Suppliers can bargain for better price schedule in their favor.

-*Sharing strategic information:* The information that one organization shares can have little value on itself. Another organization can use this information to generate strategic benefits for itself, and operational benefits for the other organization. An example is the share of Points Of Sales (POS) information. This information is on itself not of much value. However, a supplier can make superior demand forecasts by analyzing this information. In efficient customer response, continuous replenishment and quick response systems models, this level of information sharing is used extensively.

-*Sharing strategic and competitive information:* The highest level of information sharing. A buyer can provide the supplier access to broad market information, which can provide strategic and competitive benefits to one of the organizations. Again, the information that is shared has little value for the organization, but the other organizations can get strategic and competitive benefits from this information. An example is category management. When one buyer deals with several competing suppliers in a category, endowing one supplier with all the inventory management responsibility for all the products in that category gives strategic benefits and competitive benefits for the supplier. The buyer's operating costs will be reduced, because management costs are eliminated and the buyer has also one supplier per category.

Note that on higher levels, the information of lower levels also is shared. (Seidmann and Sundararajan (1998))

*Questions for information sharing*

This paragraph is about the decisions that has to be made for information sharing. In the research of Kumar and Pugazhendhi (2012), there is made an overview of information sharing in supply chains. Three important questions are discussed, first the question with whom information should be shared. For this question it is good to see how far information should be shared up- and downstream the chain and which partners should be involved. The structure of the supply chain is related to these questions. This means how the companies are arranged and how activities are linked. Also a company can participate in a number of supply chains. An approach is to consider the stages to share information with, because implementation of information sharing can be expensive and can require changes in a company's business

operations. To choose the right partner, companies have to evaluate the partnering orientation. That is the pattern of shared values and beliefs between the partnering companies.

A second question in the research of Kumar and Pugazhendhi (2012) is the type of information that should be shared. The types of information can be classified in categories like product, process, inventory, resource, order and planning information.

Which type of information will be shared depends also on the product of the company. For example, when a product has high demand variability, sharing forecast demand information can bring significant benefits. Another indicator on which type should be shared depends on the relationship between partners. With suppliers, sharing production information will help to reduce inventory and sharing and with logistic partners sharing shipment information can help to improve customer service levels.

Next to information related to the product, information about markets or consumer information also can bring benefits. Mostly, the circumstances around different partners will help to decide which information should be shared.

The last question that is addressed is about the challenges of information sharing. In the literature study of Kumar and Pugazhendhi (2012), different challenges are identified.

For example, for the use of information sharing, intranet and extranet technologies need to be implemented in supply chains. A great challenge for this aspect is the security and access privileges. Also unauthorized access and tampering of information by competitors is a problem. Next there are also the cyber-attacks that try to attack supply chain management systems.

Another challenge is the lack of IT infrastructure in supply chains. A cause for this can be the high cost for implementation and a lack of awareness and commitment of top management for IT tools.

The challenges for sharing information will be further discussed in the next paragraph.

An important conclusion of Kumar and Pugazhendhi (2012) is that the performance of a supply chain depends on what type of information is shared, how it is shared and with whom it is shared.

*Connectivity and willingness*

One great challenge in information sharing between supply chain partners is the willingness and connectivity, such as IT technologies, intranet and extranet, as mentioned before. In the research of Fawcett, Osterhaus et al. (2007) the impact of willingness and connectivity on information sharing and performance is examined.

-*The role of connectivity*. Information technologies play a central role in supply chain management. It enables firms to collect, analyze and distribute information to improve decision making. Managers getting connected across organizational boundaries and provided with more accurate information enables them to make better, collaborative decisions.

-*The role of willingness.* With connectivity creating the capability to share information, the decision to the question what will be shared and when is made by people. As a result not every chain member or individual is willing to share information, because information gives power,. For example, because of the information will give their organization a competitive disadvantage. As a result it occurred that some useful information stays unavailable for the decision maker.

The willingness of a company will determine the amount of information that is shared. When a supply chain wants the full advantages of information integration, the key players must have a high degree of willingness.

In their research, Fawcett, Osterhaus et al. (2007) study the effects of connectivity and willingness on the performance of a firm. Their study points out that connectivity and willingness on itself have indeed a positive correlation with the performance of the firm. Another hypothesis in the research is that companies with high levels of connectivity and willingness will outperform their counterparts. In figure 9 the connectivity-willingness matrix is showed. In every quadrant, the supply chain relationship, the state of connectivity, the state of willingness and the expected outcomes are showed. Companies are placed in one of the four quadrants. This matrix is used to examine that firms with high connectivity and high willingness have a better overall performance. As a result, firms with high connectivity and willingness will better perform indeed. For companies that want to distinguish themselves from competitors, both high levels of connectivity and willingness are required.

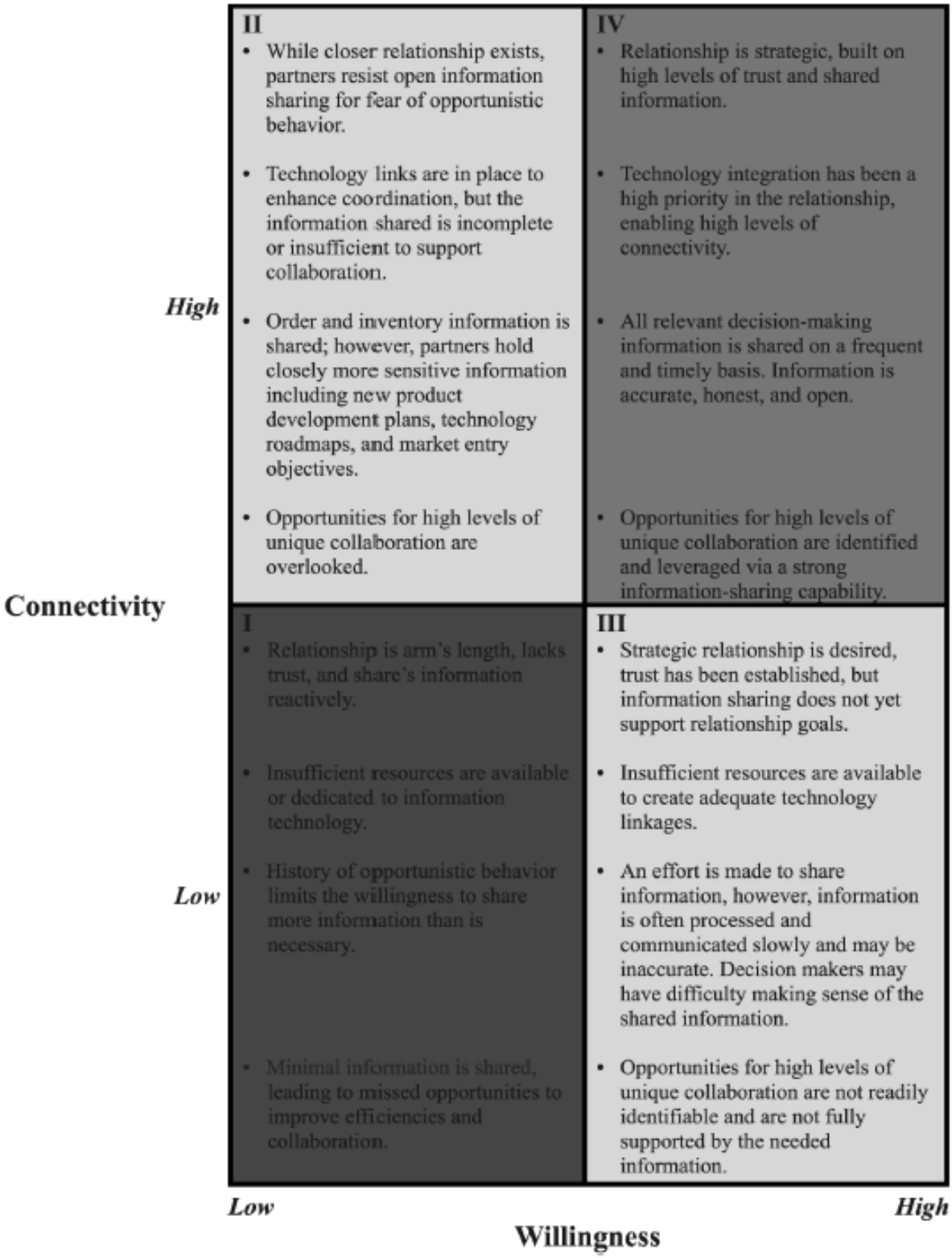



Figure 9: Connectivity-Willingness matrix (Fawcett, Osterhaus et al. (2007)

*The impact on performance*

It is clear that a supply chain needs good connectivity and the willingness to share between members to improve their performance. An interesting question is than what exactly is the impact of information sharing on performance. In the research of Zhao, Xie et al. (2002) the impact of information sharing on supply chain performance is discussed. In fact, the question is how different methods of information sharing and coordinating replenishment and production decisions among retailers and suppliers help to improve the performance of the firm. It is good to mention that this research focus on a retailer-supplier relationship. The performance of the supply chain is measured in changes in the cost and in changes in the customer service level. The research of Zhao, Xie et al. (2002) shows that information sharing and coordination indeed improve the performance of a supply chain. It also states that sharing future order information is more beneficial than only future demand information. On the other hand, not every party has advantage of good information sharing and coordination. For example, under some demand conditions or low capacity, the total cost and service level of retailers can become even worse under good information sharing and coordination.

## 4.3 sense and respond management and information sharing

Look back at the challenges of flexibility and collaboration, it stands out that those are mostly related to information systems and information sharing. Becoming a sense and respond firm requires that high level of information sharing and information sharing has a critical role in the process. Looking at the levels of information sharing according to Seidmann and Sundararajan (1998), the level of information sharing in a sense and respond supply chain is related to the highest level, sharing strategic and competitive information.

*A sense and respond enterprise*

According to Kapoor, Gresh et al. (2004): *A sense and respond enterprise is constantly evolving to keep up with the rapidly changing business environment.* They say the enterprise is data rich and on the same time information poor. This is because there are large amount of data and information available, but these data must be transformed in meaningful information for decision makers. According to Kapoor, Gresh et al. (2004) there is a critical need for:
-display a large amount of data, to share across the supply chain
-stand out complex patterns, to focus on relationships that are relevant.
-interaction with the data, to extract information when the analysis proceeds
-correlate across many variables, to identify complex relationships
-be easy to understand, to make learning quick, to make the information usable by a wide audience and facilitate communication among decision makers.

So information sharing is important in sense and respond management, but there is also a need for information management, to make information visible, understandable and useable for decision making. There in is a great challenge to make it possible for all members to implement, use and analyze all information available.

*Adeptiveness and information sharing*

Probably, Information sharing is the most important of the three aspects discussed for sense and respond management. Looking at the capabilities for an adaptive firm, it is easy to indicate the role of information sharing in it.

In automation, the role of information sharing is in the information that is collected and translated in the right format. Also there is a role for the kind of information that is shared.

Visibility. The research of Kapoor, Gresh et al. (2004) is focused on making all data visible. Visibility is a great challenge in information sharing. The collection of data and information is much easier, but to use all the data collected in the chain, that is the challenge where visibility is important.

*Conclusions: challenges on the field of information sharing*

Information sharing is important to make a chain sense and respond. There is a stream of information needed to analyze and sense changes in the market and also a stream of information that makes it possible to respond to the changes that have been sensed. Therefore information and sharing of information is critical to make it possible. The challenges that can occur are for example the different information systems that firms are using. Information systems in the chain have to be synchronized to make information visible and useful to analyze by decision makers. Another challenge is to make clear the relation with your supplier, to see to which extend information is shared. The questions mentioned by Kumar and Pugazhendhi (2012) can help to solve this problems. Analyzing with whom information should be shared and to what extent, the type of information that will be shared and the challenges that occur when trying to set up the possibility for this information sharing, can help to overcome and solve this challenges.

# 6. Case studies

## 6.1 Introduction

In this case study part of this thesis, there will be an overview of the supply chain of two companies. One of them is the large retailer Wal-Mart and the other one is the computer manufacturer Dell. In this two cases the way flexibility, collaboration and information sharing is organized in this companies is discussed and which changes can be made to make the supply chain more sense and respond.

## 6.2 Wal-Mart

*Supply chain management in retailing*

In retail management, managing the supply chain is one of the important issues. A retailer has to deal with the chain from their distribution center to the supermarkets, but there is also a chain from the supplier to the retailer. Le Blanc, Cruijssen et al. (2006) explain in their article that a retail supply chain normally exist of two chains. The primary chain, from supplier to retailer and the secondary chain, from retailer to supermarket. Often the primary chain is supplier driven, this means that the supplier is the leader in that chain and often vendor managed inventory is used to control the supply. (Le Blanc, Cruijssen et al. 2006)

*The supply chain*

In the past, the choice of Wal-Mart to put the customer at the forefront of the chain was a radical change in retail industry. Wal-Mart has managed to change their supply chain from a pull or supply driven system into a pull or demand based supply chain. With this supply chain flow, the production quantities can be determined by accurate forecasts of customer demand. As a result, marketing and sales costs are lower because there is no need to compensate under- or overproduction. (Blanchard, Comm et al. 2008)

The supply chain of Wal-Mart is as follows. Wal-Mart uses three different ways of delivering the products to their supermarkets. These are divided based on the demand for these products, the price margins and also the shelf space is an important reason. These are the three processes used for the flow of the products through the supply chain of Wal-Mart:

-*Warehouse replenishment process* is a traditional method of distribution in retailing. Products are first stored at the distribution centers and then distributed to different retail stores. Generally, products are ordered to restock the distribution center and not the stores. This process is used for highly demanded products with high margins. That is because on-shelf availability of these products is very important for Wal-Mart; by keeping these products closer to the retail stores the availability is ensured.

-*Assembly replenishment process.* The inventory storage portion of the supply chain is skipped in this process, so products move with a higher velocity through the supply chain. Most of the products will not stay more than 24 hours in the distribution center. Products types that flow through this process are low demanded and they have low price margins. These characteristics make it unnecessary to hold a high safety stock in the distribution center.

-*Direct-to-Store* is the shipment directly from suppliers to store. This is done for various reasons, generally products supplied trough this type of process are difficult to store and highly demanded. It requires close collaboration between supplier and retailer to make this process successful. (Simatupang and Sridharan 2002)
According to (Blanchard, Comm et al. 2008) *'The distribution center do not operate as warehouses; no product inventory is stored at these facilities.'* This means that the warehouse replenishment process no longer exist at the Wal-Mart supply chain. It has only a function of a cross docking center. Like the assembly replenishment process, the items are processed when they arrive and directly loaded onto trucks to be shipped directly to stores. Also at stores, inventory level is reduced to a minimum. New deliveries are stored immediately at the store shelves. (Blanchard, Comm et al. 2008)

*Flexibility*

With a customer oriented supply chain, the focus is always on the customer. In order to satisfy the needs of the customer it means that the supply chain of Wal-Mart will try to quickly respond on changes in the consumer demand. This has as a result that suppliers and retailers must have the ability to be flexible. The amount that suppliers are producing is based on what will actually be sold and also when. This means that in case of changing demands, vendors have to adapt their production at high speed, requiring flexibility to do so. One way they do this is keeping inventory at the distribution center. This inventory consists of the highly demanded products. When demand of this product will increase, thanks to the inventory, Wal-Mart is able to fulfill this demand. According to Simatupang and Sridharan (2002) Wal-Mart is willing to operate on a continuous replenishment basis. It indicates that the inventory of stores and distribution center is minimized and that the pressure of delivering the right amount is high for suppliers. So there is an incentive to change the process of holding inventory for high demanded products.

While Wal-Mart has high demands for companies that are willing to be their supplier, so suppliers have to change their way of doing business if Wal-Mart requires it. This is not easy to do, it requires flexibility of an organization to listen to the demands of Wal-Mart

*Collaboration*

In the study of (Simatupang and Sridharan 2002) the collaboration between Wal-Mart and the suppliers is described. The first thing that is important for Wal-Mart is to ensure that the suppliers have the information they need for supply chain decisions. The suppliers get raw information that should be manipulated and analyzed to make it beneficial. Wal-Mart has a large amount of vendors, some level of collaboration is needed. The level of collaboration between supplier and Wal-Mart depends on the volume and value of products the supplier sells. It also depends on the amount of capital a vendor has to invest in building a collaborative relationship. While larger suppliers are more inclined to invest in technology and employees to exploit the information shared by Wal-Mart, and reach a high level of collaboration, smaller suppliers do not have this amount of capital available. This means that the level of collaboration with smaller suppliers is lower. Some small suppliers make use of third party for analyzing the data shared by Wal-Mart to maintain and support their relationship with Wal-Mart.

Wal-Mart is also pushing more responsibilities on to their suppliers, by vendor managed inventory, co-managed inventory and radio frequency identification initiatives to establish high levels of collaboration. Suppliers are able to implement VMI initiatives with all the data Wal-Mart provides, but it is mentioned that Wal-Mart is now shifting from VMI to CMI. CMI stands for central managed inventory. This means that it gets more control over the replenishment process, due to concerns about suppliers that ordering to their advantage. With CMI, suppliers are still able to manage their own inventory, but the retailer as a higher level of control over the replenishment. Making CMI successful requires the understanding of retailers that consistent ordering and open communication through data are necessary.

Another major collaborative effort of Wal-Mart is the implementation of RFID initiatives. RFID promises better visibility, security and cost improvements for the supply chain. Implementing RFID will improve the relation between supplier and retailer, by solving disputes about the sending and receiving of orders. With RFID it is possible to follow the products from leaving the vendor until it enters the retailer distribution center. (Simatupang and Sridharan 2002)

Blanchard, Comm et al. (2008) also discuss the collaboration between supplier and Wal-Mart. They mention the strong position of Wal-Mart in their relation with suppliers. Wal-Mart is known as a tough negotiator when it comes to pricing and delivery. Often bidding and auction are used when they negotiate with competing suppliers. Suppliers have to deal with price agreements and the costs of their products are expected to decrease on an annual basis. When terms are not met, Wal-Mart most likely will not do business. In exchange, suppliers can expect some benefits, such as large order quantities, long-term contracts, access to a large market and fast payment. Wal-Mart also makes the companies it deals with more faster and efficient by implementing its own practices.

Another benefit for suppliers is the participation in Wal-Mart's CPFR, which helps to improve in-stock position and reduce inventories. The business model provides guidelines for sharing data and collaboration and brings mutual benefits for Wal-Mart and their suppliers. With the share of data, a basis is provide for vendor and joint managed inventory (like VMI and CMI) so that the costs of moving inventory through the total supply chain can be reduced. Suppliers will be acting as partners rather than suppliers, so all companies benefit from the sharing of data like more accurate forecasting and better replenishment.

The line; *'the only thing worse than doing business with Wal-Mart may not be doing business et al'* shows the power that Wal-Mart has in collaboration with suppliers. Wal-Mart is known for forcing its suppliers to redesign products, packaging and telling suppliers what it will pay for goods. On the other hand, most companies want to do business with Wal-Mart to increase their growth. So in the end, both parties benefit. (Blanchard, Comm et al. 2008)

*Information sharing*

According to Blanchard, Comm et al. (2008); *'The success of the supply chain management of Wal-Mart is largely because its expertise in information systems and supporting technology.'*

As mentioned in the collaboration part, Wal-Mart make use of an information system, named retail link, to provide themselves and their suppliers with point of sales information for decision making. Both Blanchard, Comm et al. (2008) and Simatupang and Sridharan (2002) mentioned

this system in their research. Wal-Mart was one of the first that shared point of sales information with their retailers. Retail link is a decision support system which provides historical sales data to use for forecasting and analysis, besides point of sale this data also consist of average price, store inventory and current on order quantity. However, retail link only provides the raw data, analyzing and manipulating the data by the suppliers is required. The major functions of retail link are the storage of data, sharing the data with vendors and to aid in shipment routing. According to Simatupang and Sridharan (2002) Wal-Mart's reason for sharing this amount of data is that suppliers can make their supply chain more efficient with the data. This will result in better services to Wal-Mart and lowering Wal-Mart's costs. Retail link provides also the possibility for collaborative efforts like VMI and CMI.

Electronic data interchange is used by Wal-Mart, to share real-time information with suppliers. This has the advantages of better ordering accuracy and transparency throughout the supply chain, like better visibility. Instead of sharing this data through specialty software service providers, Wal-Mart is shifting from this value-added network EDI towards an internet applicable EDI systems.

Another information system that Wal-Mart uses is called Inforem. It is used to automate the replenishment process. Two important variables are needed for this system, the point of sale data and the amount of inventory on hand. This two are taken along with trends and demand and supply variability. The Inforem system makes decisions about when to order and the amount that is needed to order. In the end the Inforem system makes the replenishment process more accurate and with less human intervention. (Simatupang and Sridharan 2002)

Wal-Mart is working on implementing RFID tags, as mentioned in the collaboration part. These tags can provide Wal-Mart's information systems with more accurate information about the location of items. This will help to improve visibility in throughout the supply chain, and helps with more accurate replenishment and item picking. Also with product recalls, RFID tags are very useful. (Blanchard, Comm et al. 2008)

*Sense and respond*

Using sense and respond management means that an enterprise needs to be adaptive. This case study makes clear that Wal-Mart shows characteristics of an adaptive firm.

The case study of Wal-Mart shows that the retailer is an adopter of fast supply chain management, in case that is what sense and respond management can provide. Although the supply chain of Wal-Mart is adaptive and can sense and respond fast to changes in the environment of the retailer, there are things that can be improved.

First on the part of flexibility, Wal-Mart has small and big suppliers. As mentioned in the literature, not all suppliers have the capability to make full use of the information that Wal-Mart provides, like the point of sale data. If small suppliers of Wal-Mart do not have the same information as the bigger suppliers, it can be difficult for them to have the flexibility based on real-time information. Small suppliers then are depended of keeping a higher inventory level to be flexible for changes in demand. To avoid this problem, Wal-Mart has to provide, together with the raw data, also the tools to manipulate and analyze the data. This means that they have to improve their information system. Also for good collaboration, improving the information system can help. It is also mentioned that big suppliers have a much higher level of collaboration with Wal-Mart than small suppliers. This is possible because the big suppliers have

the opportunity to make better use of the data than small suppliers, they often do not have the funds to invest for tools to make information visible. For good sense and respond management, it can be necessary to have also a high level of collaboration with smaller suppliers. This can be achieving by providing them with tools that make it easy to process and analyse the data that Wal-Mart provides. Now, the ability to make use of this data is what distinguishes bigger suppliers from smaller. Looking at the characteristics of an adaptive firm, two important characteristics are visibility and automation.

What stands out on the collaboration in the Wal-Mart supply chain is the power of the retailer. Although both retailer and supplier have benefits from the collaboration, Wal-Mart is not focusing on good relationships. If a firm tries to be a sense and respond enterprise, a good relationship may be essential. This is because it requires that suppliers be adaptive, change their way of thinking and have to implement new information systems. However, being as big as Wal-Mart gives opportunities to make partners doing what you require of them. It seems that Wal-Mart knows this very well.

## 6.3 Dell

*Introduction*

The first case was about a retailer, this case is about the large computer manufacturer Dell. Dell pioneered the build to order business when no one thought that consumers would be willing to wait for the arrival of a computer that he or she has not even seen. It was the start of a success. In order to build this success, the constant attention Dell pays to its supply chain and the developed innovations to maximize the value of the chain where important. As result, the main competitive advantage of Dell is their supply chain. (Kumar and Craig 2007)

*Dell's supply chain*

The supply chain model of Dell eliminates the retailers by selling the computers directly to customers. This has as an advantage that Dell can distribute the computers much faster. In their chain, Dell makes use of a direct sales model, this means a demand driven supply chain. In this chain, they make use of a build to order approach. With this model and approach, dell is able to decrease inventory, cut cost and reduce production cycles compared with a build to stock approach. In order to reach this, Dell makes use of it's just in times practices (JIT) expanded from there company to the entire supply chain to integrate suppliers in their operations. (Chou, Tan et al. 2004)

When a consumer has placed an order at dell.com or by telephone, there is a financial evaluation and a configuration evaluation, to look if a customer is able to pay and to look if the demanded technical configuration is possible. Than the order go to one of its manufacturer plans. There it is built in about eight hour. Suppliers bring the right components to the manufacturer in order to build the demanded computer. Dell's supply chain consist of the suppliers of computer components, these components are shipped to the manufacturer plans of Dell and then shipped to the consumer.

*Flexibility*

Within a company with a build to order approach, flexibility plays a critical role. This is because the build to order approach of dell has the result that good forecasting is difficult and Dell and its suppliers have to be prepared for great changes in demand. According to Kapuscinski, Zhang et al. (2004), many of the suppliers of Dell are located in Southeast Asia and their transportation times range from 7 to 30 days. To compensate for this long lead time and buffer against demand variability, one demand from Dell for its suppliers is that they keep inventory on hand in small warehouse close to Dell's assembly plans. These warehouses are not owned by Dell, they are owned by the suppliers. This is also mentioned by (Kumar and Craig 2007) and they mentioned, related to the warehouses, the help of Dell to negotiate transportation costs and arrange dedicated shipping space. This helps to decrease the costs and also increase flexibility of products being delivered to the warehouses.
Another thing that increases flexibility is modularity. This means the organization of complex products by composing it into smaller portions that can be managed independently. Components from different suppliers can fit in the modular form of the computer. This makes Dell less dependable of a few suppliers and so increases the flexibility. The entire computer can be put together in very little time after the order. (Kumar and Craig 2007)

*Collaboration*

Manataki (2007) stated that Dell has a strong relationship with its suppliers. '*Dell fully adopts the approach of the extended enterprise by viewing its suppliers as an integral part of doing business and a key factor for its success.'* As a result, Dell select suppliers with expertise, experience and the ability to deliver value and their performance is well measured. Dell meets every quarter with its suppliers and provides feedback on performance and future expectations. Performance is evaluated by comparing the suppliers with its competitors and well-performing suppliers are provided with training and support to further improve their process. (Manataki 2007)

Kumar and Craig (2007) mention that Dell views its supply chain as being in competition with its competitors' supply chain. So Dell works hard to help improve the value and reduce the costs of the entire chain. Dell has a number of partnerships with suppliers, service providers, shipping companies and customers. For example, closely working with suppliers is needed to ensure that inventory needed for the assembly plant is available.

In the collaboration process with its suppliers, Dell makes use of vendor managed inventory. So suppliers individually manage their inventory with information about the demand of Dell. However, Dell demands from its suppliers to decrease the inventory levels in the warehouses, to cut costs and also to increase product quality. This is because quality problems can be detected and solved much easier when the inventory is low.
According to Dell is constantly improving the collaboration with its global suppliers. The internet portal valuechain.dell.com is an important tool. It provides real-time information between suppliers and Dell. So the suppliers know the forecasts and can respond about their ability to fulfill the demands. All the collaboration practices of Dell require close collaboration between Dell and its suppliers, mutual trust and data exchange are the keys to achieve it.

*Information sharing*

As mentioned in the part about collaboration in the Dell chain, valuechain.dell.com is an important tool within the company and an important source for information sharing. According to Manataki (2007), it is the most important facility for information sharing. Dell's suppliers can get informed about the level of inventory in the chain, component quality metrics and supply and demand data.
Dell also has a similar extranet set up for service providers. This allows Dell to alert them when failures occur at the customer site. Also information about current and past issues with a computer is recorded. This can help to track if there is an issue with a component, to alert suppliers about this quality problem. All the information helps to improve quality for consumers and suppliers. Even Dell's competitors can benefit from the increased quality of components from a supplier.
The practice of sharing all this information was first questioned because Dell's suppliers also supply its competition, but sharing the information was important enough for a more streamlined supply chain and more efficient suppliers.

*Sense and respond*

The build to order approach of Dell makes it an adaptive company on itself. Thanks to this approach, the company always knows the 'market' because changes in demands are directly influence the strategy of the firm. Of course there is still a need to distribute this knowledge trough the chain to gain the advantages.

The case study of Dell shows that their strategy is much related to sense and respond management. The reason for this is obviously their build-to-order approach. For this approach, their supply chain has to be flexible. As the case study shows, Dell is aware of this and requires actions of its suppliers. For example the near to assembly plant warehouse they need. On the subject of collaboration, Dell is aware that only close collaboration can help to maintain and make a success of their build to order approach. This is also seen about the information dell shares. It is important information that can also be useful for competitors, but Dell knows that the information has to be shared with their suppliers.

## 6.4 Conclusion

The two case studies that are done are about two entirely different companies. The question that rises than if sense and respond management is applicable for both companies. The case of Dell shows that it has already a kind of sense and respond management. The Wal-Mart case is quite different. Sense and respond management can be seen as more applicable in the case of Dell, with a build to order approach. However, this does not mean it is not useable in a retail supply chain like Wal-Mart's. In order to serve the customer needs, a retailer always wants to know the demand and 'sense' the changes in the market in order to react on it. For this part of their chain, sense and respond management is useful for being adaptive.

# 5. Discussion and Conclusions

## 5.1 conclusion

The concept of sense and respond management is an interesting opportunity in today's highly competitive environment. It provides firms with an opportunity to distinguish themselves from competitors by focusing on processing real-time information and respond if any change in the business environment is sensed. The first step to this new supply chain solution is to become an adaptive enterprise. Looking at three capabilities, automation, visibility and control, the key for an adaptive firm lies in the process of data and information sharing. With good information sharing, the right information is shared, the data is visible for every member and every member can give meaning to the data, to make it easy for decision makers. Information sharing is an important aspect, but flexibility and collaboration play also an important role. First of all flexibility is needed to start with a change towards a sense and respond chain. Members have to be flexible to accept the changes and implement them in their own companies, for example implement new information systems. Another aspect of sense and respond management that requires flexibility is the respond part. Being able to respond fast on any change in the business environment will require suppliers and manufacturers that can quickly react if a change is needed. The collaboration aspect of the change towards an adaptive enterprise is the fact that sense and respond management requires very close collaboration. For example, the information that will be shared is not only simple order information, but also strategic information and competitive information. To share this kind of information, a high level of trust is needed.

*Challenges*

Becoming a sense and respond organizations is a step that will take some challenges with it. On the aspect of flexibility, sense and respond management requires a chain to be flexible on multiple aspects. Being for example only market flexible, so sense changes on the market and try to respond to it, is not enough to be really able to respond fast and in a good way. Also collaboration plays a very big role. A great challenge on this aspect is the collaboration culture. This means that it is important that every important chain member has a high willingness to collaborate in order to achieve a higher level of collaboration. This higher level or closer collaboration is important for sense and respond management. For the last aspect, information sharing, the challenge is mainly on making information sharing possible by synchronize the different information systems that members of a chain are using. Also identifying what kind of information, with whom and to what extend information should be shared is an important challenge.

## 5.2 discussion

The idea for a sense and respond management is introduced by IBM. IBM is a large enabler of ICT solutions. Because IBM is an enterprise that can provide the information technology needed for a sense and respond enterprise, it is interesting that the idea of sense and respond management is introduced by them. Thinking about it, is it possible that the theory is introduced to support the products that IBM sells.

Furthermore, sense and respond management is in the end maybe a management form that especially is focused on information systems and better data management. In the thesis, three aspects are discussed. The question for sense and respond management is, is information sharing the only aspects that is really important. The changes that have to be made to implement the sense and respond management theory are all on the field of information sharing, or also on the field of the other aspects. That is a question

A thing that makes it difficult to research the sense and respond management system is the limited scientific reviews or studies about the subject. Sometimes it is mentioned, but mostly the research department of IBM mentions the subject.

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