CONTROLLING INVENTORY BY IMPROVING DEMAND FORECASTING WITHIN THE ALCOHOLIC BEVERAGE INDUSTRY

A Case Study

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Xiaomu Deng

ABSTRACT

This thesis explores how combing statistical demand forecasting methods and causal forecasting methods with judgmental forecasts via a Sales and Operation Planning process can improve inventory control through improving inventory replenishment strategies within an Australian alcoholic beverage importer and distributor. The implementation of a Sales and Operation Planning process has enabled the company to involve all necessary functions of the company in the demand forecasting and requirement planning process and in this way improve the balance of inventory between demand and supply. The implementation of the improved inventory management strategies and Sales and Operation Planning process is described here-in. The constantly evolving process of the Sales and Operation Planning process and the four stages of the process development are also described. The key demand and supply performances before and after implementation of new processes are measured. The results demonstrate a significant improvement in demand forecasting accuracy as well as improved inventory efficiency and customer service levels.

Keywords: *Inventory Control, Demand Forecast, Sales and Operation Planning*

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Chapter 1 – Introduction

1.1. Introduction

This research thesis details a study of how inventory levels are controlled in the alcoholic beverage industry through improved demand forecasting accuracy and inventory planning strategies. It is based on a case study of Company ST, which is an alcoholic beverage marketer and distributor. Utilisation of multiple demand forecast methods via Sales and Operation Planning (S&OP) process will be discussed. The methods include systematic forecasts generated by a complex computer forecasting application coupled with sales and operation planning.

1.2. Background

The ultimate purpose of running a for-profit organisation is to maximise the profit for shareholders. In other words, all organisations are trying to increase their revenue and reduce costs at the same time. Inventory is the largest single investment in assets for most manufacturers, wholesalers and retailers. As such, the associated cost of carrying inventory represents a significant portion of the costs of running most businesses. Reducing inventory levels and therefore cost associated with carrying inventory contributes to increasing profits within an organisation. As an important component of the business, inventory serves the organisation in achieving economies of scale, balancing demand and supply, as protection against uncertainty, and as a buffer throughout the supply chain. As a result, it is critical to control inventory at appropriate levels in order to pursue the greatest profits for the organisation (Stock & Lambert, 2000).

Cycle stock and safety stock account for the major part of inventory. Cycle stock can be controlled by managing order frequency. However, the safety stock level varies significantly depending on a range of differing uncertainties. In reality, the uncertainties associated with demand cause management to consider the trade-offs between inventory carrying costs and stock-out costs. Considering the push / pull view of supply chain management, the first step for managers to take into account is customer demand in both scenarios. Improvements in demand forecasting can reduce uncertainties and therefore enable an organisation to control safety stock levels more proficiently (Chopra & Meindl, 2007).

Demand forecasts can be improved by different approaches, such as a simulation forecast method which combines systematic forecasts and causal forecasts. Nowadays, contemporary computer technology automates the calculation process of systematic forecast (Chopra & Meindl, 2007). However, systematic forecasts alone are not enough to determine appropriate inventory levels due to the high seasonality characteristics of the alcoholic beverage industry. It is imperative to improve demand forecast accuracy through the addition of marketing intelligence input. Introduction of a Sales and Operation Planning (S&OP) process provides a good opportunity to communicate between the functions of supply chain, finance, marketing and sales and thereby achieve the optimal demand forecast (Wallace & Stahl, 2006).

Company ST is an alcoholic beverage marketing and distribution company whose corporate mission is to 'build consumer brand equity and profitability through sustainable growth, differentiation, and consumer participation and employee innovation'. As a distribution company, Company ST sources product from Australia, Austria, the Dominican Republic, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Latvia, Mexico, Scotland and Spain. In terms of its supply chain, Company ST utilises a future demand forecast to determine the level of capacity and inventory and therefore is considered to be an organisation with a predominant push supply chain process.

Due to the high value of inventory, high seasonality of demand, and long lead time of products, it is critical for Company ST to plan and manage its inventory at optimal levels in order to achieve its company goal - maximising overall profit.

Company ST reviews its sales forecast and performance as compared to its sales target every month. Therefore its inventory level is also reviewed on a monthly basis to ensure product is available to meet projected depletion targets.

Uncertainties of both lead time and demand have been identified as being the primary causes of most of the problems in inventory management. The actual product supply lead time within the supply chain of Company ST ranges from seven to ten weeks. Although the lead time is moderately long, it can be considered as relatively certain rather than uncertain when compared with relative demand fluctuation. This is largely due to Company ST having contractual supply agreements and Service Level Agreements (SLA's) with its suppliers. Therefore, this thesis focuses on discussing controlling inventory levels more proficiently by improving demand forecast accuracy in the scenario of an 'inventory periodic review process'.

1.3. Problem Definition

Improving inventory levels is not only about reducing inventory, but also maintaining inventory of each SKU at an appropriate level in order to balance demand and supply. Thus the target inventory levels will be achieved by improving demand forecast accuracy. The following problems will therefore be explored within this research and thesis:

- How should the optimised inventory levels be determined?
- What is the relationship between inventory levels and a demand forecast?
- How can a demand forecast be improved through applying systematic computer forecasting applications?

- How can a demand forecast be improved further by enhancing communication within the organisation through implementation of a sales and operations planning (S&OP) process?
- How does the improved demand forecast translate to an optimised inventory level?

1.4. Scope and Objectives

The purpose of this study is to evaluate methods of improving inventory levels within a marketing and distribution company in the alcoholic beverage industry by improving demand forecast accuracy. The below key areas are concentrated on during this study:

- The relationship between inventory level and demand forecast with the use of mathematic tools.
- The benefit of correct implementation of systematic forecasting software tools.
- Implementation steps critical to successful use of Sales and Operations Planning within a business.
- The initial impact (6 months) on inventory level and associated financial results through the combined use of tools and market intelligence.
- The midterm impact (12 months) on inventory and finance through the combined use of systems tools and market intelligence.

1.5. Expected Outcomes and Research *S*ignificance

This research is expected to identify the relationship between inventory levels and demand forecast accuracy and the cost saving benefit as a result of the implementation of systematic forecasting software tools coupled with the use of an S&OP process. The outcome of this research will help the industry better understand improved methods with which to manage forecast accuracy and inventory and yield greater returns.

1.6. Limitation of Study

Because the case study is based on a specific business model, the outcome of this research has the following limitations:

1. The outcome is limited to observations from a single company in the alcoholic beverage industry which procures approximately 80% of its finished products from its overseas supplier base.
2. The outcome is only applicable to companies with relatively certain lead times in their supply chains because this study focuses on the uncertainty of demand forecasts only.
3. The outcome is only applicable to companies that utilise a periodic inventory reviewing process for planning their inventory requirements.

1.7. Structure of the Thesis

This thesis begins with an introduction of the relationship between inventory level and demand forecast and the background of the case to be studied.

The following literature review is divided into four sections. The first part reviews how to determine the optimised inventory level. The second part focuses on the relationship between inventory level and the demand forecast. The third part focuses on how to improve demand forecasts through the use of systematic forecasting and an S&OP process is reviewed. At the end of the literature review, the transition from accurate demand forecasts to improved inventory level management will be discussed.

After the literature review, there is a discussion on how the approaches of systematic forecasting and the use of an S&OP process implemented in Company ST help improve demand forecasting and the management of inventory levels. The related data will be recorded and analysed in order to track the improvements/reductions of inventory levels as a result of improvements in demand forecasting and the relationship between the two aspects.

Finally, the thesis will conclude with the outcome of this research. Recommendations will also be provided in order to assist companies in similar industries and/or operating in a similar scenario to Company ST to improve their approach to inventory management.

Chapter 2 – Literature Review

2.1 Introduction

The following five areas of literature are reviewed in this section:

1. How to determine the optimal inventory level.
2. The relationship between inventory level and ordering cycle.
3. The relationship between inventory level, demand forecast and demand uncertainty.
4. How to improve demand forecasts through the use of systematic forecasting coupled with an S&OP process.
5. The transition from accurate demand forecast to improved inventory level.

2.2 Determining Optimal Inventory Levels

2.2.1 The Role of Inventory

It is necessary to understand the role and importance of inventory in the supply chain before making any decision of what an optimised inventory level might be.

According to Bowersox, Closs and Cooper (2002), inventory plays an important role in four aspects of most businesses. First of all, inventory enables the business to achieve economies of scale. It allows economy of scale within a single facility and permits each process to operate at maximum efficiency rather than being constrained by limited resources of inventory. Secondly, inventory balances demand and supply within the firm’s value chain through accommodating elapsed time between inventory availability and consumption. Inventory also plays a very important role in buffering uncertainty in demand and order cycle. It provides protection from uncertainty related to demand in excess of forecast or unexpected delays in supply. Lastly, inventory compensates for geographical specialisation. It makes it possible for each of a firm's plants or distribution centres (DC's) to specialise in the products that it manufactures or stores.

Muzumdar and Fontanella (2006) also highlighted the importance of inventory to a business. Limited inventory availability means that the business will potentially lose customers to competitors with little hope of recapturing them in the future. Excessive inventory on the other hand can also produce lower margins as incentives are used to sell excess products or alternatively, disposal costs can be accrued for obsolete products.

Additionally, inventory also acts as a buffer between critical interfaces within the supply chain. For example these interfaces could be between the supplier and a business' procurement, between procurement and production, between production and marketing, between marketing and distribution, between distribution and intermediary, and between intermediary and final consumer (Stock & Lambert, 2000).

2.2.2 Deciding the Optimal Inventory Level

The primary objective of managing inventory is to increase business profitability. Although high levels of inventory often lead to better in-stock availability and therefore more consistent cycle service level (CSL) and increased sales, the costs associated with high levels of inventory usually exceed the benefits derived. As a consequence, the appropriate inventory level should not only increase in-stock availability but also minimise the total cost of logistics (Stock & Lambert, 2000).

Since demand uncertainty is an unavoidable issue within most businesses, it is therefore necessary to maintain appropriate levels of safety stock in order to minimise the cost of 'out of stocks'. Company ST utilises a periodic inventory review process (alternatively referred to as a fixed order interval model in some literature) to review and plan its inventory. According to Stock and

Lambert (2000), a periodic review process compares the current inventory with forecast demand, and identifies where an order needs to be placed for the necessary quantity at a regular, specific time. In other words, the interval between orders is fixed. A periodic review process has some advantages. First of all, this method facilitates combining orders for various SKU's in a vendor's line. Secondly, it enables organisations to qualify for volume purchase discounts and freight consolidation savings. Lastly a periodic review process has been found to be more adaptive, in that management is forced to consider changes in sales activity and therefore make a forecast for every order interval.

Under a periodic inventory review process, average inventory levels can be determined by average cycle stock and safety stock. The average inventory, at a stock-holding location that experiences demand or lead time variability, is equal to the total of the average cycle stock, plus the safety stock (Stock & Lambert, 2000; Chopra & Meindl, 2007)).

Equation 2.1: Total Average Inventory = Average Cycle Stock + Safety Stock

Cycle stock is inventory that results from the replenishment process and is required in order to meet demand under conditions of certainty. Average cycle stock is half of lot size of each replenishment order. The lot size of each replenishment order is decided in order to achieve economies of scale.

Equation 2.2: Average Cycle Stock = ½ × Lot Size

Equation 2.3: Lot size = $\sqrt{(2PD/CV)}$

Where:

- P = The ordering cost (dollars per order)
- D = Annual demand or usage of the product (number of units)

- C = Annual inventory carrying cost (as a percentage of product cost or value)
- V = Average cost or value of one unit of inventory

Safety stock is held in excess of cycle stock to buffer uncertainty in demand or lead time. In most businesses forecasting is rarely accurate enough to predict demand and demand is seldom constant. In addition, transportation delays along with supplier and production problems make lead-time variability a common reality (Stock & Lambert, 2000).

Since Company ST utilises a periodic review process to review its inventory, this thesis focuses on how to estimate safety stock in an inventory periodic review process scenario. According to Chopra and Meindl (2007), safety stock can be evaluated by the following equations in the periodic review process.

Equation 2.4: $SS = Fs\ (-1)\ (CSL) \times \sigma_{T+L}$

Equation 2.5: $\sigma_{T+L} = \sqrt{(T+L)}\ \sigma_D$

Where:

- D = Average demand per period
- σ_D = Standard deviation of demand per period
- L = Average lead time for replenishment
- T = Review interval
- σ_{T+L} = Standard deviation of demand during T + L periods

Equation 2.4 can be calculated by the following formula in Microsoft Excel (Chopra & Meindl, 2007)

$$\text{Equation 2.6: } SS = F_S^{-1}(CSL) \times \sigma_{T+L} = \text{NORMSINV}(CSL) \times \sigma_{T+L}$$

Thus, a linear relationship exists between safety stock and standard deviation of demand per period when CSL is certain. The safety stock level is reduced when the standard deviation is reduced.

2.2.3 The Relationship Between Inventory Level and Order Lot Size.

Equation 2.1 in section 2.2.2 illustrates that average inventory level is decided by average cycle stock and safety stock.

According to Stock & Lambert (2000), cycle stock is inventory that results from the replenishment process and is required in order to meet demand under conditions of certainty. In other words, when the firm can predict demand and replenishment times perfectly, when demand and lead time are constant and known, and orders are scheduled to arrive just as the last unit is sold. Thus, no inventory beyond cycle stock would be required. Cycle stock is held to take advantage of economies of scale and reduce cost within a supply chain. The costs considered include material cost, fixed ordering cost, and holding cost. A fixed cost is incurred each time an order is placed or produced. Any stage of the supply chain exploits economies of scale in its replenishment decisions in the following two typical situations. Firstly, a fixed cost is incurred each time a replenishment order is placed or produced. Secondly the supplier offers price discounts based on the quantity purchased per lot (Chopra & Meindl, 2007). Therefore, it is necessary to keep cycle stock at a certain level in order to lower the fixed ordering cost and achieve the price advantage based on purchase order lot size.

On the other hand, it is necessary to maintain inventory at an appropriate level to minimise inventory carrying costs. Based on the linear relationship between total average inventory and average cycle inventory, as illustrated in Equation 2.2 in section 2.2.2, the total inventory level can be reduced by the reduction of average cycle stock. According to Chopra & Meindl (2007), a key to reducing cycle stock is the reduction of lot size without increasing costs, (i.e. to reduce the fixed cost associated with each lot). This may be achieved by aggregating lots across multiple products or suppliers because fixed ordering and transportation costs are now spread across multiple products or suppliers.

It is therefore critical to decide an optimised lot size in order to keep the average cycle stock at an optimised level. The optimal order lot size can be decided by the following equation (Chopra & Meindl, 2007).

Equation 2.7: Optimal lot size $Q = \sqrt{(2DS/hc)}$

Where:

- D = Annual demand or usage of the product (number of units)
- S = Fixed cost incurred per order
- c = Cost per unit
- h = Holding cost per year as a fraction of product cost

In the context of the periodic order process, it is necessary to decide the optimised order frequency. Chopra and Meindl (2007) suggested that the optimised order frequency can be decided by the following equation.

Equation 2.8: $N = D/Q = \sqrt{(Dhc/2S)}$

In summary, the average cycle stock level decreases when the order lot size decreases. The overall inventory level is reduced accordingly when the cycle stock is reduced, and when the demand is certain or the safety stock is fixed. The associated inventory carrying costs are also reduced as a consequence. However, it is also necessary to keep the order lot size at a reasonable level in order to reduce the fixed order costs and achieve economies of scale. Therefore, it is necessary to decide the optimal order lot size to lower the overall supply chain costs.

2.2.4 The Relationship Between Inventory Level and Demand Forecast

Demand forecasting is a key driver of every planning decision made in both an organisation and a supply chain. This is especially applicable in a push process where a demand forecast is the key factor in determining inventory holdings. Equations 2.1, 2.2 and 2.3 in section 2.2.2 illustrate the relationship between the inventory level and a demand forecast.

Equation 2.1: Total Average Inventory = Average Cycle Stock + Safety Stock

Equation 2.2: Average Cycle Stock = $\frac{1}{2} \times$ Lot Size

Equation 2.3: Lot size = $\sqrt{(2PD/CV)}$

Where:

- P = The ordering Cost (dollars per order)
- D = Annual demand or usage of the product (number of units)
- C = Annual inventory carrying cost (as a percentage of product cost or value)
- V = Average cost or value of one unit of inventory

Equation 2.1 suggests that the total average inventory has a linear relationship with average cycle stock. Equation 2.2 and 2.3 indicate that the average cycle stock is increased when the demand of the product is increased, and the other factors are fixed. Normally the ordering costs, inventory carrying costs and inventory value are changing slowly and gradually. This therefore makes it possible to complete an analysis of the relationship between the total average inventory and demand, for a certain period of time.

Equation 2.3 suggests that when the ordering costs, annual inventory carrying costs and average cost of inventory are fixed, the average cycle stock is in a linear relationship with the square root of demand. In other words, the average cycle stock is determined by the demand forecast in a 'push process' if this is the specific scenario.

In an ideal world of certainty where the demand is always equal to the supply in each period and the supplier always delivers in full and on time, there is no need for safety stock and the average inventory equals average cycle stock. However, it is not always possible to avoid supply delays, inaccurate forecast, and inconstant demands in a real commercial business environment. Therefore, it is critical to a business to keep safety stock at optimal levels in order to improve stock availability as well as minimise their overall supply chain costs.

Equation 2.2 defines that the overall inventory level is decided by average cycle stock and safety stock. Average cycle stock has been discussed in section 2.2.2. This section discusses the key factors which decide safety stock levels, which in turn have a significant influence on the overall inventory level.

Chopra and Meindl (2007) define that safety stock is inventory carried to satisfy demand that exceeds the amount forecast for a given period. Safety stock is carried where demand is uncertain and a product shortage may result if actual demand exceeds the forecast demand. Stock and Lambert (2000) also advise that safety stock is held in excess of cycle stock because of uncertainty in demand or lead time. It is a portion of average inventory which should be devoted to cover the inventory shortage caused by short-term variations in demand and lead time.

The appropriate level of safety stock is determined by the uncertainty of both demand and supply and the desired level of product availability (Chopra & Meindl, 2007). In the context of Company ST where supply is assumed to be relatively certain and where product availability of product class A, B, C is already decided by the business, managing the demand forecast and/or any demand uncertainty is the key to ensuring safety stock is maintained at an appropriate level.

Equations 2.4 and 2.5 in section 2.2.2 suggest safety stock in the context of a 'periodic inventory review process' can be determined as follows:

$$\text{Equation 2.4: } SS = Fs\ (-1)\ (CSL) \times \sigma_{T+L}$$

$$\text{Equation 2.5: } \sigma_{T+L} = \sqrt{(T+L)}\ \sigma_D$$

Where:

- D = Average demand per period
- σ_D = Standard deviation of demand per period
- L = Average lead time for replenishment
- T= Review interval
- σ_{T+L} = Standard deviation of demand during T + L periods

Equation 2.4 suggests that the relationship between safety stock and standard deviation is linear. When CSL is fixed, the safety stock level is increased at the same rate as the increase of the standard deviation of demand during the average replenishment lead time and inventory review interval. Razi and Tarn (2003) suggested that ERP systems track functions to enable calculation of safety stock and reorder point (ROP) for each SKU contained in the database based on the SKU's demand history.

Standard deviation measures the square root of the average deviation from the mean, using squared distances to emphasise the influence of unusual data (Page & Meyer, 2003). In equation 2.5 the standard deviation σ_D measures the square root of the average demand deviation from the mean of each period when the demand is historically distributed. The more certain the demand, the less the standard deviation and therefore a lower level of safety stock is required. In other words, the level of safety stock is reduced when the demand forecast accuracy is improved.

2.2.5 Improved Demand Forecast Accuracy and Demand Certainty Through Combined Forecasting Methods

Traditional forecasting method: time series forecast

Time Series Forecast is one of the most popular forecasting methods used in business management (Wacker & Lummus, 2002). In time series forecasting, observed demand can be broken down into a systematic and a random component.

Equation 2.9: Observed Demand (O) = Systematic Component (S) + Random Component (R)

However, numerous authors also suggest that the accuracy of a time series forecast model commonly does not generate satisfactory outcomes. Time series models generally do not answer how and why sales increase and decrease. These models use the patterns in past data that were assumed to have unstated but stable causal relationships (Wacker & Lummus, 2002). Helms, Etkin and Chapman (2000) also suggested the disadvantages of time series forecasts, especially within the circumstances of the contemporary marketplace, which is constantly changing due to a constant flow of new products, promotions, and ever changing channels of distribution. The problem with using only historical data to predict future demand is that it requires the assumption that the patterns that have been created in the past will occur again in the future.

Traditional forecasting method: causal forecast

Causal forecasting methods assume that the demand forecast is highly correlated with certain factors in the environment such as the situation of the economy (Chopra & Meindl, 2007).

There is also literature suggesting that causal models are not the perfect forecasting model since causal forecasting models assume there is causality between the explanatory variables and sales (Chalmbers, 1971). Wacker and Lummus (2002) suggest that causal forecasting models have two significant disadvantages. Firstly, it is not easy to implement causal forecasting models because they often rely on leading indicators that rarely have good explanatory power. Secondly, the inaccurate forecast is not caused by poor statistical fit with the model, but rather with the prediction of the explanatory variables used in the model.

The literature, however, indicates that causal forecasts can be important, especially in the contemporary fast moving consumer goods sectors where the powerful retailers seek greater responsiveness and flexibility from suppliers in terms of reduced costs, shorter lead time, reliable delivery time, and delivery in full (Adebanjo & Mann, 2000)

The impact of forecast errors

Chopra and Meindl (2007) suggested that forecast errors contain valuable information and must be analysed carefully for two reasons. First, managers can use forecast error analysis to determine whether the current forecasting method is predicting the systematic component of demand accurately. As long as the observed errors are within historical error estimates, companies can continue to use their current forecasting method. Second, all contingency plans must account for forecast error.

There is significant research and literature suggesting the negative impact that forecast errors can have on a business. Biggs and Campion (1982) and Ritzman and King (1995) suggested that forecast inaccuracy had severe cost impacts on organisations because forecasts are a major driver for all strategic allocation plans. Research also showed that in many companies, 10% or more of net gross profit is lost because forecast errors cause overages and shortages in inventory (Ritzman & King, 1993). Wacker and Lummus (2002) indicated that an inaccurate forecast causes procurement re-planning that, in turn, creates purchasing, financing and scheduling difficulties. Wacker and Lummus (2002) also suggested that the forecasters must consider how the forecast is to be used to reduce the adverse effects of forecast errors.

Chalmers suggested in 1971 how forecast errors are caused. From an internal perspective, the marketing mix, or 4Ps (price, product, place and promotion), are the primary factors that cause forecast errors. General economic conditions (i.e. unemployment rate, income, etc.) could also cause forecast errors from the external environment. The forecasting method being used is another cause of forecast errors.

Combining forecast methods

Some literature also advises on how to measure and minimise forecast errors. Wacker and Lummus (2002) suggested that forecast errors can be quantified by a 'time series method'. Wacker and Sprague (1995 & 1998) suggested that systematically measuring forecast errors could improve forecast accuracy. Forecasters must understand the sources of forecast error to understand why the error occurred.

Markridakis (1998) suggested why combining different forecasting models could improve forecast accuracy. First of all, since forecasting errors always exist, combining them has been found to make the net effect smaller. Secondly, unstable or changing patterns or relationships cause single models to be unreliable, but combining several models has been found to improve their accuracy. Lastly, combining models usually minimises past data errors that were poor predictors of future demand. Markridakis (1998) also suggested improving forecast accuracy by using various forecasting techniques and by using empirical findings to help with formulation of the model.

Chopra and Meindl (2007) refer to this method as a simulation forecast method, where future demand can be indicated by the historical demand as well as affected by the related environment. In the simulation scenario, a business can combine time series and casual forecasting methods to predict future demand.

The systematic component measures the expected value of demand and consists of the following factors. It can be calculated by the following equation.

Equation 10: Systematic Component = (Level + Trend) x Seasonality

Where:

- *Level* is the current de-seasonalised demand; it represents the demand that would have been observed in the absence of seasonal fluctuations.
- *Trend* is the rate of growth or decline in demand for the next period.
- *Seasonality* is the predictable seasonal fluctuation in demand.

Given the large amount of data involved and the complexity of the demand and supply components in systematic demand forecasting, it is necessary to utilise an information technology (IT) system for forecasting. Gilliland and Leonard (2006) identified that forecasting software developers have made significant progress in the area of automation, scalability, and the incorporation of judgment into a forecast.

The random component is that part of the forecast that deviates from the systematic part. All a company can predict is the random component's size and variability based on their marketing intelligence.

Helms, Ettkin and Chapman (2000) suggested that the knowledge and information that exists internally and externally would, if brought together into a single more accurate forecast, have the support of the entire supply chain.

Improve forecast accuracy by combining time series and causal forecasting methods with judgmental forecast

There is also literature that illustrates that combining just 'time series forecasts' and 'causal forecasts' is not enough to generate an optimal forecast. Rather, it is more beneficial if these are taken into account with use of a 'judgmental forecast' also. Markridakis (1998) suggested combing models with judgmental inputs gives forecasters the best information on past data patterns. Remus (1995) suggested that judgmental forecasts had been shown to improve forecast accuracy because humans may be better able to detect patterns in time series data and integrate outside information.

Goodwin and Wright (1993) suggested that a thorough understanding of 'how and why' judgmental forecasting improved the forecast required a better understanding of the cognitive process involved.

2.2.6 Improving Demand Forecast Accuracy and Controlling Inventory Through a S&OP Process

S&OP Process Overview

It is critical for the business to choose the proper approach to implement the forecasting method of combing a time series forecast and a causal forecast with a judgmental forecast. A wide array of literature indicates that an Executive Sales & Operation Planning process is the best way of achieving this. Wallace and Stahl (2006) believe that the S&OP process can benefit business by balancing supply against future demand. Via an S&OP process, the business is able to have visibility of any projected imbalance between demand and supply early enough so that any potential imbalance problems can be identified and eliminated or minimised before they become actual problems.

Muzumdar and Fontanella (2006) believe that an S&OP process can also help organisations reduce forecast errors by aligning supply to demand forecasts. Muzumdar and Fontanella (2006) also indicated that there is an explicit and clear relationship between the quality of an S&OP process and demand forecast accuracy. Holistically, an S&OP process introduces tools such as scenario-based modelling into the decision process so that rapid judgmental decisions can be made.

There is extensive literature providing various definitions of an Executive S&OP process. Wallace and Stahl (2006) described S&OP as a set of decision making processes with three main objectives: to balance demand and supply; to align volume and mix; and to integrate operational plans with financial plans.

Muzumdar and Fontanella (2006) also define S&OP planning as a set of business processes and techniques that enable an organisation to respond effectively to demand and supply variability with insight into the optimised market deployment and most profitable supply chains.

Dooley and Higgins (2006) defined the S&OP process as a business process adopted to manage the balance and trade-off between the conflicting preferences of the supply and demand sides of the supply chain.

S&OP Process

Both Lapide (2005) and Wallace and Stahl (2006) concluded that the S&OP process can be defined as a five step process of data gathering, demand planning, supply capacity planning, a Pre-Meeting, and the executive meeting.

The first step, gathering data, includes three elements: updating the files with data from the month just ended, generating information for sales and marketing teams to use in developing the new forecast, and disseminating this information to the appropriate people. This step is to be completed within a day or two after the end of the previous month (Wallace and Stahl, 2006).

The second step, demand planning, includes an analysis of last month's variances, the new statistical forecast, field sales input, marketing intelligence, new product plans, promotional plans, planned price changes, competitive activity, industry dynamic, economic conditions, and seasonality. Demand forecasting needs to be finalised by a short meeting of senior level sales and marketing people to get their buy-in, allow them to challenge the new forecast and make any necessary amendments (Wallace and Stahl, 2006). An unconstrained demand forecast is established in this step (Lapide, 2005).

The third step, supply capacity planning, is in order to modify the operation plans for any product families or subfamilies that require it and verufy that sufficient capacity exists. The outputs of supply capacity planning include updated operation plans, related capacity planning reports and a list of supply problems (Wallace and Stahl, 2006). The rough-cut and constrained demand plans are also developed at this step (Lapide, 2005).

The fourth step, the Pre-Meeting, generally involves five steps, which include making decisions regarding the balancing of demand and supply, resolving problems and differences by making a single set of recommendations to be presented in the executive S&OP meeting, identifying the areas where agreement cannot be reached, developing scenarios and showing an alternative course of action to solve a given problem, and setting the agenda for the executive S&OP meeting. The key participants of a Pre-Meeting should include personnel from demand planning, product development, operations, representatives from finance, and the owner of the executive S&OP process (Wallace & Stahl, 2006). Lapide (2005) suggested finalising the alignment of the demand and supply plans at this step.

The last step, the executive meeting, normally has the following objectives. The first objective is to make decisions on each product family - whether to accept the recommendation from the Pre-Meeting team or to choose a different course of action. Secondly, the executive meeting needs to authorise changes in production or procurement rates. Thirdly, it is necessary to relate the version of the executive S&OP information which contains all of the measures converted into financial terms to the business plan. The executive meeting also needs to make the decisions whereby the Pre-Meeting team was unable to reach consensus. Last but not least, the meeting reviews customer service performance, new product issues, and special productions (Wallace and Stahl, 2006). Lapide (2005) suggested running the executive meeting with a fixed agenda. A pre-specified amount of time needs to be allocated to the meeting. It is necessary to start the meeting with a review of previous plans and end with a consensus-based alignment of demand and supply plans.

S&OP Planning Process in Different Businesses

Every business is differentiated from others by size, industry, the maturity of the organisation, and business culture, etc. Therefore, there is no single S&OP process that can be applied to any business without appropriate implementation. It is therefore important to decide how to customise the S&OP process and achieve the best outcome for each specific business.

First of all, the S&OP strategy must place the emphasis on continuous improvement (Muzumdar and Fontanella, 2006). Lapide (2005) suggested that maturity models can be used as a diagnostic tool for helping a company improve its planning processes and assessing its technology needs. The maturity model includes four stages.

Stage 1: Marginal Process. Companies that have an S&OP process in stage one, have some planning processes going on but they tend to be less formal and sporadic and often display a chaotic nature. The sporadic nature and frequent cancellation are due to a belief by participants that they have more important things to do with their time. There is little attempt to develop consensus-based demand plans. In addition, supply plans might be developed with little effort given to aligning then with demand plans (Lapide, 2005).

Stage 2: Rudimentary Processes. Companies at stage two of the S&OP process have formal planning processes going on. However, they are not fully participated in and not fully integrated. At this stage meetings are scheduled and routinely held but the participants are randomly absent from the meetings. Besides, some participants do not prepare in advance of the meetings and are not interacting well with other attendees to collaboratively develop consensus-based plans.

Stage 3: Classic Stage. Companies that have a stage three S&OP process have formal planning processes that follow many of the basic elements of the “ideal” process. The planning processes are integrated so that demand and supply plans are aligned jointly by demand-side and supply-side business functions (Lapide, 2005).

Stage 4: Ideal Process. This is a process that can never fully be achieved by any company, but can be used as a benchmark for guiding the continual improvement of the process. At this stage, the S&OP processes described by Wallace and Stahl (2006) and Lapide (2005) are fully-enabled. The process is supported by systems that constantly keep track of supply and demand in real-time, and when necessary, alert everyone that is part of the S&OP process that they need to meet immediately. Meeting attendees or proxies would need to be tracked down and notified that a meeting needs to take place as soon as possible (Lapide, 2005).

Lapide (2005) also suggested that businesses should use the maturity models to diagnose what stage their companies are currently in. Each business can then begin to move to the next stage by formalising their planning processes, increasing the frequency of S&OP meetings, and continuing to increase and enhance their collaborative relationships with suppliers and customers.

Secondly, the application of S&OP technology can improve the efficiency and effectiveness of S&OP planning process. Lapide (2005) suggested that S&OP technology included integrating Enterprise Resource Planning (ERP) systems and an S&OP workbench.

ERP systems are integrated with both demand-side planning systems and supply-side planning systems. The demand-side planning systems can be used to develop the unconstrained demand forecast. The supply-side systems help to generate the inventory, production and procurement plans that will be followed to best meet the unconstrained baseline demand forecasts. The demand-side and supply-side systems need to be integrated and synchronised so that a change in either the demand or the supply plans can be quickly reflected in the overall supply chain (Lapide, 2005). Dooley and Higgins (2006) also suggested that integration of the systems is required to enable the consequences of changes to the forecast on the supply plans to be interpreted and communicated back into the business in real-time.

Multiple literatures suggested that the S&OP process should include the functions of self-audit and constant self-development (Wallace & Stahl, 2008; Lapide, 2005). The S&OP workbench includes dashboards that benchmark the planned supply versus unconstrained demand situation, what-if analysis of potential changes to the supply or demand plans, and the Key Performance Indicators (KPI) that reflect how well the S&OP process has been working (Lapide, 2005).

Finally, it is necessary to measure the outcome of the S&OP planning process in order to find out whether the implemented S&OP is working. Lapide (2005) suggested that the measurement should include three components: typical forecast errors, variance to baseline forecast and budget, and the adherence to prior sales, marketing and operational plans.

2.3 Outcome of Literature Review

Based on the above literature review, it can be determined that a constantly self-developed process can be implemented for Company ST to improve their demand forecast and therefore improve the control of their inventory level for the benefit of the entire business.

The objective of managing inventory is to increase business profitability. In order to achieve this, inventory needs to be maintained at an appropriate level to avoid either 'out-of-stock' or 'excessive stock' situations. The average inventory level is decided by average cycle stock and safety stock. Average cycle stock is decided by purchase order lot size which is decided by annual demand, ordering costs, inventory carrying costs and the average cost of inventory. In the case of Company ST, their ordering costs, inventory carrying costs and the average cost of inventory are relatively stable or only fluctuate slightly based on changes in the macro-economic environment (i.e. foreign exchange rate) and therefore these factors can be assumed unchanged and do not have any substantial influence on the cycle stock level in this case study. On the other hand, their annual demand is difficult to predict because its demands are highly seasonal and significantly activity driven. Therefore, their average cycle stock level is changed according to the changes in demand.

In the periodic inventory review process, safety stock is decided by customer service level (CSL) and standard deviation of demand in certain periods. Equation 2.4 and 2.5 show that there is linear relationship between the safety stock level, customer service level, and standard deviation of demand. Since CLS is normally pre-decided and can be considered as coefficient of the equation. Standard deviation is the only variable in the equation and therefore has influence on the safety stock level. The higher the standard deviation, the higher the safety stock level needs to be. In other words, the more accurate the demand forecast, the lower the safety stock level.

Thus, the key to inventory control is the accuracy of demand forecast because it has significant influence on both average cycle stock and safety stock. In the competitive business environment, it is difficult to forecast demand by only one forecasting method especially in a fast moving sector like the alcoholic beverage industry. The literature therefore suggested combining multiple forecasting methods including a time series forecast (or systematic forecast), a causal forecast, and a judgemental forecast to predict the level, trend and seasonality of future demand.

An S&OP process is considered to be the best approach to combining time series, causal and judgemental forecasts. The business can achieve a consensus forecast across different functions within the business via its S&OP process and therefore minimise forecast error and generate as accurate a demand forecast as possible. However, every business has its distinctive way of handling its business. In order to get the best result from an S&OP process, it is necessary to customise the process to fit the specific requirements of the business. At the same time, different businesses have different maturity levels of its S&OP process. It is also important for the S&OP process driver to constantly improve the maturity of the process in order to achieve the best fit with the business.

The calculation of demand forecast and inventory level is complicated in the contemporary business world and therefore it is easy to make mistakes and mislead the decision making process.

The progress of technology makes it possible to utilise the integration of ERP systems and planning software to calculate a demand forecast and inventory projection.

In conclusion, a constantly self-developed S&OP process can help the business to combine time series and causal forecasts with judgemental forecasting methods to improve demand forecast accuracy. The improved inventory level is the consequence of improved demand forecast when assuming that the supply uncertainty is minor. The information technology, including ERP systems and demand and requirement planning software packaging, can be used to improve the efficiency of determining the demand forecast and appropriate inventory levels, therefore minimising any forecast errors.

Chapter 3 – Methodology

3.1. Introduction

The purpose of this research is to describe how the appropriate utilisation of a periodic inventory review process, combined with systematic and causal forecasting methods, can significantly improve inventory management within a business such as Company ST which operates in the alcoholic beverage industry in Australia while its supply is considered as less flexible but relatively certain.

The research falls within the framework of a Social Constructivism worldview. The research follows an embedded case study approach. The first known actual implementation of the new inventory strategies and S&OP processes are documented. It is also documented how the S&OP process was customised step by step to fit the specific requirements of the company. The resulting impact on the case company's demand and supply chain performance is measured.

3.2. Research Strategy

According to Crotty (1998), designing a research strategy involves the consideration of four distinct but closely related elements of the research process: methods to be utilised in the study, the methodology governing the choice of methods, the theoretical perspectives embedded in the methodology, and the epistemology that supports the theoretical perspective. Creswell (2007), also discusses research design and whilst the primary focus of Creswell is on five different approaches to research (Narrative, Phenomenology, Grounded Theory, Ethnography, and Case Study), Creswell also discusses the importance of the researchers epistemological perspective in relation to the development of the research strategy which he incorporates within the context of the researchers philosophical assumptions. An additional important aspect discussed by Creswell in relation to the overall research strategy is the researchers 'basic set of beliefs that guide action' referred to as a paradigm or world view. The research strategy proposed by Creswell will form the basis of the decision making process for the methodology for this research.

The four paradigms that Creswell (2007) discusses are Postpositivism, Social Constructivism, Advocacy/ Participatory and Pragmatism. The underlying world view in the context of this research is considered to that of a 'Social Constructivism'. Social constructivism, which is often combined with interpretivism, is a worldview whereby individuals seek understanding of the world in which they live and work. Within this paradigm, researchers recognise that their own background shapes their interpretation and they position themselves within the study more closely than in the other three paradigms and in many ways, become a key part of the study. Whilst all four paradigms were reviewed in relation to this aspect of the research, the interpretivist nature of the social constructivism world view aligns more closely with the values of the researcher and the overall objectives of the research.

The research strategy used is classified as a descriptive study. According to Page and Meyer (2000), a descriptive study is a study that sets out to describe a phenomenon or event as it exists, without manipulation or control of any elements involved in the phenomenon or event under study. A common descriptive research method in a management context is the 'case study'. A case study is an in-depth description of an individual, group or organisation, either for the purpose of testing whether the case fits a particular theory or fits one theory better than another or, to simply determine what makes the particular case superior, inferior, or different to other otherwise similar cases (Yin, 1994). A case study strategy is considered to be an appropriate choice of methodology for research adopting an interpretivist perspective (Walsham 1995). Whilst other research strategies such as action research are also possible methodological choices from an interpretivist perspective, these are not closely aligned with the aims of this study. For instance, this study did not aim to change practice as would have been the case with action research (Berg 2007). Instead, the aim was to design a study that would help address the research question in the best possible way.

Adopting a case study methodology also requires making decisions in relation to the unit(s) of analysis and whether a multiple or single case design would be the most appropriate. Patton (2002) indicates that that when selecting and making decisions about the appropriate unit of analysis, a key consideration is to determine what unit it is that the researcher wants to be able to say something about at the end of the research. He argues that ‘each unit of analysis implies a different kind of data collection, a different focus of analysis of data, and a different level at which statements about findings and conclusions would be made. In the context of this research, a multiple case design is deemed the most appropriate to meet the objectives of the study. The unit of analysis is also closely linked to the primary research question of the study.

Since the research question in this study relates to understanding the relationship between inventory levels and demand forecasting and communication within a specific supply chain, the units of analysis adopted for this study are:

(i) the relationship between inventory levels and demand forecasting in achieving optimal inventory levels.
(ii) the interaction between the different functions within the supply chain and decision makers in achieving optimal inventory levels.

According to Yin (2003), case research that involves more than one unit of analysis is classified as an embedded case study. The primary advantage of an embedded case study approach is that it forces the researcher to consider a specific phenomenon in operational detail. As the setting for this research is focused at the operational level within the context of a specific business environment and incorporates two units of analysis, the embedded case study is deemed the most suitable methodology for this research. As discussed, as this research involves two units of analysis, different data collection methods need to be incorporated into the research to support an in-depth study of each phenomena of interest. The primary units of observation in this research are the products (SKU's) and the managers within the business from which the data will be collected in relation to the two units of analysis and the research question. The data collection methods adopted for this research are discussed in the following section.

3.3. Data Collection

In most cases, the final theoretical framework for a research project will rest on two types of data, namely secondary data and primary data. Secondary data is defined as existing data, which has been collected in the past for various purposes. Primary data is defined as new data collected as part of the research project (Page & Meyer, 2003).

In this case study, the use of primary data is preferred to existing data. The problem with existing data is that it has not been generated specifically to address the research, and may therefore contain potential biases or be unrepresentative of the population in which the researcher is interested in (Page & Meyer, 2003). This research, however, focuses on some specific problems of a certain business within a specific business environment. Thus, it is necessary to utilise primary data collected as part of the case study.

The research focus of any study defines the population of interest. In other words, at some stage the researcher must clearly define the circumstances under which the current research may be generalised outside the study situation. In most cases, a population is too large for individual exploration and only a small portion of the population, or sample, can be studied (Page & Meyer, 2000).

Judgemental sampling is a method for obtaining non-probability samples. It consists of respondents who, in the judgement of the researcher, will best supply the necessary information. Such samples can be useful for the pre-testing of studies, but there is no secure basis for assuming that they are representative of the research population. By definition, a judgemental sample never allows for randomisation, but may exhibit some stratification (Page & Meyer, 2000). In this case study, the selected samples meet three criteria. First of all, the selected SKU's must be A Class SKU's. This is because the A Class SKU's represent more than 80% of either total inventory value or annual sales revenue of the company. Second, the supply of the selected SKU's is nearly certain because one of the focus areas of this research is the impact of demand uncertainty on inventory. Finally, the selected SKU's must have sufficient demand history to generate a systematic demand forecast based on historical data.

In this case study, the following data collection methods are utilised to obtain the data: interviews, observation, and re-collecting existing data. Interviews are common in exploratory and descriptive studies as they provide the ability to identify the issues of relevance in circumstances where little is known about the topic under investigation. Interviews are more flexible than a set of structured questions in a questionnaire.

The three main types of interview techniques discussed in the literature are structured interviews, semi structured interviews, and unstructured interviews. In a structured interview, the same questions, with the same wording, and in the same sequence are asked of all participants involved in the research. In semi-structured interviews, which are frequently used in qualitative analysis, the researcher has a list of key themes, issues, and questions to be covered although the order of the questions can be changed depending on the direction of the interview. In a completely unstructured interview however, each interview tends to follow a completely different pattern with participants encouraged to speak openly, frankly and give as much detail as possible. For the purpose of this research, the semi-structured interview technique will be utilised as this best fits the requirements of the research.

Observational techniques are also common in exploratory and descriptive research, where the observation condition can be either naturalistic or contrived, and where the researcher has the option simply to observe, or to participate and observe at the same time. According to Ghauri and Gronhaug (2005), observation as data collection technique entails both listening to and watching other people's behaviour in way that allows some type of learning and analytical interpretation. The main advantage of this technique is that researchers can collect first-hand information in a natural setting. In participant or field observation, the observer is considered a natural part of the situation or event. The researcher is often part of a company or organisation and decides to study a particular phenomenon within that organisation. It is also an important aspect of observation that the process should be planned systematically in direct relation to the research question or the relevant unit of analysis. In the context of this research, participant observation was deemed to be an appropriate data collection technique in relation to providing information in relation to the unit of analysis that focuses on the interaction between the different functions within the supply chain and decision makers in achieving optimal inventory levels.

When we collect data that already exists we are usually gathering archival data, or data found in the published literature. Both archival data and published literature must be scrutinised for their relevance and their validity as secondary data for the study in question (Page & Meyer, 2000).

3.4. Data Analysis

The measurement scale determines what type of descriptive measure should be used. Descriptive measures are particularly useful for comparing the response pattern for different groups or different questions (Page & Meyer, 2000).

The mean is the average of the data. It is the most important measure for the data that are symmetric or near symmetric because it utilises all the information that is available. The standard deviation is the most important of the measures of variability when the mean is used as the measure of centre. In other words, the standard deviation is the best measure of variability only for variables with a symmetric or near-symmetric distribution. The standard deviation measures the square root of the average deviation from the mean, using squared distances to emphasise the influence of unusual data (Page & Meyer, 2000).

Chapter 4 – Case Study and Analysis

4.1 Introduction

This chapter is included to outline the analysis of the thesis and discuss the problems identified.

4.2 The Market Circumstances and Company Background

Company ST imports, markets and distributes alcoholic beverage in Australia. As a distribution company, Company ST sources products of more than twenty brands from Australia, Austria, the Dominican Republic, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Latvia, Mexico, Scotland and Spain. Around forty per cent of the brands are owned by Company ST and the other sixty per cent are distributed by Company ST via third party contracts. The comprehensive portfolio helps Company ST achieve the necessary economies of scale and increase its competitiveness in the market.

Its corporate mission is to ‘build consumer brand equity and profitability through sustainable growth, differentiation, consumer participation, and employee innovation’. In terms of its supply chain, Company ST utilises future demand forecasts to determine the level of capacity and inventory availability and therefore can be described as an organisation with a ‘push’ processes within its supply chain. Some distinct characteristics of the demand of Company ST has a significant influence on its demand forecasts

4.2.1 Factors Impacting Demand

First of all, the sales pattern of Company ST is highly seasonal. Summer and holiday periods are the key seasons of alcoholic beverage consumption. As a western country in the southern hemisphere, the major holidays in Australia fall in the summer. As a consequence, approximately 60 per cent of the sales of Company ST occur in the last quarter of each year. It is therefore critical for the company to seize the opportunity in this quarter and maximize the profit for the business.

Secondly, to some extent, the demand of most brands can be predicted by the statistical demand forecast based on historical demand data, especially the mature brands. The mature brands are normally iconic in the industry. They have been distributed by Company ST in the market for years and cannot readily be substituted by different brands. The level and trend of demand for these brands changes gradually from year to year. However, the seasonality of the demand of each year is very similar. Therefore, it is possible for the company to generate a statistical demand forecast based on the historical demand data. Even for those brands which are not so mature in the market, the forecaster can also predict the seasonality of the demand for each year.

Thirdly, the demand is easily driven by promotional incentives. The Australian alcoholic beverage industry is dramatically competitive, especially for the brands where the consumer can easily find a substitute product. Sales incentives like discounted prices, promotions and 'gift with purchase' (GWP) have a remarkable influence on the demand of these brands. Beside, this industry in Australia is dominated by two major national retail chains - Woolworths and Coles, who are also the most important customers of Company ST without exception. Any activities conducted by these two groups have a huge impact on the value chain of Company ST because they represent more than 40 per cent of its business. The consumers normally choose the alcoholic products with the best price or some other kind of incentive where any brand loyalty is absent. It is therefore difficult to predict the demand driven by promotional incentives based on historical demand because the retailers, especially the national chains, do not always decide the timing of promotions based on logic or statistical basis. The forecast errors are therefore more significant in this situation.

Finally, changes in the macroeconomic environment have a substantial impact on the demand of alcoholic beverage. Around 80 per cent of Company ST products are imported from overseas via sea freight. Due to this foreign currency exchange rates and fuel costs have a considerable impact on inventory cost and therefore on the final price. As a consequence, the demand of alcoholic beverage is also influenced. At the same time, alcoholic beverages are classified as ‘excisable goods’ in Australia. The excise paid to the government forms a significant part of the cost of the goods. The sales price will therefore increase in line with any increases in excise rates. In addition to these factors, both the unemployment rate and interest rate can also have a considerable influence on the demand of alcoholic beverage drinks in the Australian market.

4.2.2 Forecasting and Planning Process of Company ST

Due to the high value of inventory, high seasonality of demand, and long lead time for its supplier to deliver the goods, it is vital for Company ST to plan and manage its inventory at optimal levels in order to achieve its overall goal - maximising company profit. Company ST reviews its sales forecast and achieves its sales target every month and therefore its requirement planning also needs to be reviewed on the same periodic basis in order to facilitate achieving their depletion targets for all SKU’s each month. As a consequence, its inventory is also replenished on a monthly basis.

The products of Company ST are sourced via two different methods: imported from overseas suppliers and produced locally from contracted manufacturers. The suppliers of the imported goods usually need on average two months lead time from receiving the purchase order to delivering the order; due to long production lead times and sea freight transit times. In relation to the products produced in Australia, it is also necessary to provide the purchase order to the manufacturer at least two months prior to the required delivery date due to the long lead times of some ingredients.

Uncertainty in demand usually causes most of the problems in inventory management. The actual lead time of the supply chain of Company ST varies from seven to ten weeks. Although the lead time is moderately long, it can be considered as 'a certainty' rather than 'an uncertainty' compared with demand fluctuation. This is due to contractual agreements and Service Level Agreements (SLA's) between Company ST and its suppliers. As previously discussed, Company ST uses a periodic review process to review its inventory requirements. When the reviewing period and lead time for each product family are considered fixed the average cycle stock changes according to the change of demand of each period. Besides, safety stock is decided by the accuracy of the demand forecast. Therefore, demand forecast accuracy is the key to managing the inventory efficiency of Company ST.

Company ST operates only one distribution centre in Sydney and distributes goods to all areas in Australia. Five sales teams are located in five different states and territories and responsible for the sales to their respective customers. There is also an individual sales team focusing on sales to the two major national chain groups due to the importance of these two groups to Company ST. The six different sales teams are also responsible for reviewing the sales forecasts for their respective market segments on a monthly basis. A forecast and planning system called 'Cognos' is utilised to consolidate the forecasts from all the sales teams into a single forecast, with the consolidated forecast becoming the sales target Company ST is trying to achieve every month.

At the same time, the supply chain team utilise a forecasting and planning system called MerciaLinc to generate a systematic demand forecast based on historical demand data. The inventory level is also reviewed by MerciaLinc, based on the systematic forecast generated by the same system. The inventory is also reviewed on a monthly basis in order to facilitate the sales forecast reviewing system. As a consequence, the inbound shipments of each brand are also scheduled to arrive once per month. A 'certain weeks' worth' of safety stock is carried on top of the average cycle stock for different brands.

4.3 The Problems Faced by Company ST

Company ST has been operating in Australia for 26 years and became more successful in recent years. Its sales revenue was expected to increase from $150 million to $250 million per annum in 2009. In order to achieve the significant increased sales projection, Company ST increased its inventory level accordingly. Moving into 2009, the overall sales revenue improved in line with its projection. However, the inventory level also increased to an unexpected level and caused cash flow and operational issues to the company in the middle of the year.

Month	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08
Sales Revenue	$19,886,560	$ 7,998,879	$ 15,429,570	$15,312,100	$12,121,933	$12,780,657
WARE / DIST	$ 115,106	$ 170,166	$ 254,990	$ 238,454	$ 259,441	$ 208,497
Inventory Value	$10,474,918	$11,623,549	$ 12,638,718	$12,586,234	$12,115,156	$ 9,973,161
CASH AT THE END OF THIS MONTH	$ 6,987,716	$ 2,095,086	$ 1,371,415	$ 2,154,565	$ 2,264,804	$ 2,916,461
Inventory Turns	3.70	3.21	3.52	3.64	3.82	5.29
Days of Inventory to Sell out	98.61	113.61	103.81	100.19	95.46	68.98
MAA Inventory Turns	4.31	4.33	4.36	4.38	4.34	4.40
MAA Days of Inventory	84.74	84.30	83.76	83.30	84.10	82.87

Table 4.1: Key Financial Indicators January- June 2008 (Empirical data collected)

As illustrated in Table 4.1 above and Table 4.2 below, the year to date sales as at the end of June 2008 increased to just above $98 million from $83.5 million, which is the sales figure of 2008 for the same period. The sales increased by $14.5 million or 18% on top of those in 2008 for the same period. As a consequence, the net cash at the end of June 2009 increased to $5.27 million while the net cash for the same period in 2008 was $2.92 million. It seemed that Company ST was in a very positive financial position looking purely at it sales achievement and cash flow for the first six months of 2008.

However, some key financial indicators delivered a negative message to the business. The inventory value at the end of June 2009 was just above $18 million, an increase of $9.1 million compared with the same figure as at the end of June 2008. In other words, the inventory level had increased by 81% while the sales figure only increased by 18% for the same period. The inventory turn at the end of June was 5.29; the equivalent of Company ST selling out their inventory after 69 days. However, this figure decreased to 3.79 by the end of June 2009; in other words, it would sell out its inventory after 96 days. From an inventory turnover point of view, the inventory level was 39% worse than it was in June 2008.

Due to the high level of inventory, the cash flow was projected to be decreased by about $4.5 million in July and reach negative $3.7 million in August 2009 taking into account the payment terms with different suppliers. Another indicator is the monthly average warehouse and distribution costs. As a consequence of the high inventory level, the average warehouse and distribution costs of the first six months of 2009 were as high as $286,055 which increased by 38% based on the same costs of the same period of 2008.

The senior management of Company ST believed that the inventory holding was too high and therefore caused a ‘cash flow issue’ to the company. The management team decided to investigate further what was going on within the company and to support this initiative, an external business consultant company called MBCG was contracted to diagnose and resolve the high inventory problem.

Month	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09
Sales Revenue	$20,693,662	$ 7,358,017	$17,144,438	$19,331,464	$16,505,195	$17,150,418
WARE / DIST	$ 423,224	$ 186,471	$ 301,957	$ 225,243	$ 300,243	$ 279,193
Inventory Value	$13,693,586	$15,853,587	$19,125,736	$17,370,409	$19,042,101	$18,044,097
CASH AT THE END OF THIS MONTH	$ 4,556,164	$ 1,380,650	$ 8,070,021	$ 7,379,554	$ 1,114,782	$ 5,267,102
Inventory Turns	3.56	3.60	3.35	3.61	3.37	3.79
Days of Inventory to Sell out	102.54	101.53	109.05	101.10	108.30	96.38
MAA Inventory Turns	4.29	4.34	4.32	4.32	4.26	4.15
MAA Days of Inventory	85.05	84.04	84.48	84.55	85.62	87.91

Table 4.2: Key Financial Indicators January- June 2009 (Empirical data collected)

4.4 Identifying the Problems

MBCG started their investigation process by data collection and analysis for the period from July 2009, and supported this with direct observations of the operational aspects of Company ST. The following areas of operation were focused on inventory planning, demand forecasting, customer service level, and cross-function communication within the business's value chain.

4.4.1 Inventory Planning

As briefly described in the previous chapter, Company ST reviews its sales forecast on a monthly basis and all functions in the company are working together towards this target. In order to facilitate achieving its monthly sales target, the supply chain team of Company ST utilise a periodic review process to review its inventory on a monthly basis. At the same time, the periodic review process allows the company to achieve economies of scale and reduce freight and transportation costs. First of all, it allows consolidating multiple SKU’s from the same supplier into the same shipments, therefore saving ordering associated costs. Second, the consolidated orders size qualifies for full container load (FCL) shipment discounts. Because most of the goods are travelling long distance from overseas, FCL’s can also minimise in transit damage and theft. Thirdly, the consolidated orders allow the suppliers to reduce their order processing cost and at the same time the FCL shipments also allows the suppliers to achieve economies of scale. As a consequence, Company ST is in a good position to negotiate the transfer price with suppliers and therefore reduce its investment in inventory.

However, Company ST did not utilise the ‘periodic review process’ properly and caused stock issues related to both having too much inventory of some SKU’s and running out of stock of some other SKU’s. As illustrated by equation 2.1, the overall inventory level is decided by average cycle stock and safety stock. In other words, the inventory level is reduced when the cycle stock and/or safety stock is reduced.

By definition, cycle stock is inventory that results from the replenishment process and is required in order to meet demand under conditions of certainty. When the company can predict demand and lead times are constant and known, orders are scheduled to arrive just as the last unit is sold. Thus, no inventory beyond cycle stock is required. In this scenario, the average cycle stock is half of the demand for that period and therefore half of the order lot size. According to equation 2.3, when the demand of the period, the inventory carrying costs as a percentage of the product, and the value of one unit of inventory are considered unchanged or nearly unchanged, the ordering costs per order/ shipment are increased when the lot size is increased.

Company ST reviews its inventory every month but replenishes the inventory every one, two, or three months depending on the volume of predicted demand. Therefore, the cycle stock being held equates to the demands of a half month, one month, or one and half months respectively. It therefore seemed that the company was holding lots of unnecessary cycle stock. It was considered possible to increase the ordering frequency and reduce the average cycle stock and inventory carrying costs. The optimal cycle stock level and order lot size are decided by annual demand, transportation costs, and transportation constraints.

Another determining factor of inventory is safety stock. By definition, safety stock is held in excess of cycle stock because of uncertainty in demand or lead time (Stock and Lambert, 2000). When the lead time is considered nearly certain in the scenario of Company ST, safety stock is held to cover the excessive demand due to demand uncertainty. Equations 2.4 and 2.5 indicate that the safety stock level is decided by four elements: predetermined customer service level (CSL), standard deviation of demand forecast, lead time, and order intervals. The safety stock level is increased when CSL, standard deviation of the demand of the period, the length of lead time, and the order intervals are increased.

However, it seemed that Company ST never focused on a safety stock calculation. It was decided by the management team to hold safety stock to cover the demand of certain periods by instinct or experience. For some SKU's or product groups, the safety stock was maintained at a certain amount of inventory, which actually conflicted with the fact that the demands for all of the products of the company are dramatically seasonal. There was therefore plenty of room for the company to improve its safety stock management and therefore control its overall inventory more proficiently.

Based on the calculation of safety stock, it is actually determined by the standard deviation of demand of each period because in the scenario of Company ST, CSL is pre decided and lead times and order intervals are relatively fixed. The standard deviation measures the accuracy of the demand forecast of each period. If the company can improve its demand forecast accuracy, the standard deviation of demand per period can be reduced and the safety stock can be reduced as a logical consequence.

4.4.2 Demand Forecasting and Communication Within the Company

Some findings related to demand forecasting from data analysis and interviews with the management team of Company ST indicated the causes of the 'inappropriate' safety stock level of the company.

First of all, the demand forecast accuracy caused an area of concern. The long term demand forecast is actually less accurate than the short term forecast which made the situation even worse. According to the analysis of the comparison between the actual demand and the demand forecasts generated in different periods, the demand forecast from three months ago was generally less accurate than the forecast from two months ago, which in turn was less accurate than the forecast from one month ago.

For example, at the beginning of each month, the sales team are forecasting for the demand of the next twelve months. The August demand was forecast initially in June and the average forecast error of A Class SKU's was 50.31%. The August demand was also forecast in July and the forecast error was reduced to 47.71%. When the August demand was forecast at the beginning of August, this figure improved to 41.74%. As previously discussed, the average lead time required by the suppliers of Company ST is two months. Every month the supply chain team is planning for the inventory to fulfill the demand occurring in two months. It is therefore difficult to adjust the replenishment given the long lead time with little flexibility. Thus, it is critical for the company to improve its demand forecast accuracy.

Secondly, the demand forecast is poorly communicated between different functional departments within Company ST. At the beginning of each month, the sales department was forecasting for the next twelve months and considers this sales forecast as their target to work towards. The supply chain department utilised a more sophisticated demand forecasting application to generate a systematic demand forecast based on the analysis of historical demand data. Normally the demand forecast generated by the computer system was used to support the inventory requirement planning process. At the same time, the market department also had its own marketing plan for demand. For example, sometimes the marketing department was running a promotional plan without communicating this to the supply chain in advance. Sometimes the sales department only decided upon a pricing related activity only a few weeks before it started. When such promotions and activities were eventually communicated to the supply chain team it was too late and there was insufficient time left for stock replenishment. The promotion or activity could therefore possibly end up with two situations - either running out of stock of certain products being promoted in the middle of the activity, or being out of stock completely after the activity.

4.4.3 Customer Service Level

Customer service level is the performance target specified by management. It defines inventory performance objectives. A customer service level is often measured in terms of an order cycle time, case fill rate, line fill rate, order fill rate, or any combination of these (Bowersox, Closs & Cooper, 2002). The management of Company ST set the customer service level target for A Class SKU's at 98% and 95% for B and C Class SKU's. The management considered customer service level as one of the most important measurements of the supply chain performance. However, it never connected it with the inventory planning process. According to Equation 2.4, customer service level is one of the factors determining safety stock level.

Table 4.3 below demonstrates the customer service level of A, B and C Classes for the period between September 2008 and August 2009. It seems that inventory availability performance for this period was extremely good. The customer service levels of A Class for ten months out of twelve are above the management's target 98% and the average service level for the same period is as high as 99.16%. With regards to the customer service levels of B and C Classes, this figure had always been considerably higher than the management's requirements.

The customer service levels decided by the management team are the optimal service levels balancing inventory carrying costs and the costs of lost sales when out-of-stock situations occur. The extremely good inventory availability indicated that unnecessary inventory was being held and the company was paying excessive inventory carrying costs and too much capital was invested in inventory. This indication was in line with the outcome of the inventory analysis which was illustrated by Tables 4.1 and 4.2 that the overall inventory level was too high.

Meanwhile, in those months when the customer service level was less than 100%, only a minor number of SKU's were out of stock. The customer service levels of these SKU's in the particular months they were out of stock was therefore lower than the targets. This therefore also indicted that the customer service level targets were not directly linked to the safety stock calculation.

In summary, the below problems were identified as factors causing the inappropriate inventory level of Company ST.

1. The lot size of stock replenishment was not set up properly and therefore the average cycle stock was not appropriate.
2. The accuracy of the demand forecast was lower than expected.
3. The communication about balancing demand and supply between sales, marketing and supply departments was disconnected.
4. The average customer service level was much higher than the optimal targets which were decided by management.

Customer Service Level			
Month	**A Class**	**B Class**	**C Class**
Sep-08	98.64%	100.00%	99.83%
Oct-08	100.00%	99.83%	99.33%
Nov-08	99.75%	100.00%	97.92%
Dec-08	100.00%	98.29%	99.12%
Jan-09	97.27%	98.64%	98.92%
Feb-09	96.00%	99.20%	99.38%
Mar-09	98.86%	99.45%	98.95%
Apr-09	100.00%	99.36%	99.30%
May-09	100.00%	99.81%	99.71%
Jun-09	100.00%	98.36%	99.34%
Jul-09	99.35%	98.00%	97.69%
Aug-09	100.00%	98.19%	98.13%
MAT Average Aug 09	**99.16%**	**99.09%**	**98.97%**

Table 4.3: Customer Service Level Sept 2008- Aug 2009 (Empirical data collected)

Chapter 5 – Discussion of Case Study

5.1 Introduction

After the problems within Company ST were identified, MBCG proposed a process to improve both inventory efficiency and demand forecasting accuracy. Taking into account the operational processes of the company, the recommended areas of improvement included the following major steps.

1. Introduction of the demand forecasting and inventory requirement planning system being used by Company ST - MerciaLinc.
2. Reviewing the inventory requirement planning process in order to redefine the optimal cycle stock and safety stock level and therefore improve inventory efficiency.
3. Analysing the demand forecasting process and finding the approach that best fits the company.
4. Implementing the new demand forecasting process.
5. Reviewing supply chain performance three months after the new process was implemented and determining whether it is necessary to modify the process in order to improve overall inventory performance.
6. Modifying the scheduled process to better suit the company based on the performance review of the first three months in order to further improve the demand forecast and inventory performance.
7. Reviewing supply chain performance every three months and determining whether it is necessary to modify the processes.
8. Constantly improving the demand forecast and inventory requirement planning processes in order to improve overall inventory performance.

5.2 Introduction of MerciaLinc

Company ST utilised MerciaLinc - a sophisticated demand forecasting and requirement planning software application to generate systematic forecasts based on historical data to calculate the optimal cycle stock and safety stock levels. MerciaLinc was integrated with the company's ERP system. It was therefore possible to import the data from the ERP system when it was necessary and generate a systematic demand forecasting and inventory requirement plan.

MerciaLinc is a set of sophisticated software including multiple modules. The following three modules are the most important: data administration, demand forecasting, and requirement planning.

The data administration module allows the data used by MerciaLinc to be synchronised with the ERP system when it is necessary. The synchronised data includes product detail information, stock on hand, the demand of each sales account, and outstanding purchase orders for each SKU. After being imported into MerciaLinc, all the information is saved as part of the database of the software. The software supports all the necessary calculations required for demand forecasting and requirement planning modules.

The demand forecasting module is utilised to generate a model of future demand for each SKU based on the historical demand information synchronised with the ERP system. The demand information of different accounts is consolidated to produce an overall national demand figure. Since the demands for imported goods from all Australian states are supplied from the same distribution centre in Sydney, the consolidated demand data at national level is sufficient to generate trend, level, and volume for future demand from the perspective of systematic forecasting. The module allows the user to manually adjust the trend, level, and volume of each SKU in order to generate a future demand with less standard deviation. The user is also able to manually enter the future demand on a month by month basis as marketing intelligence. This is particularly useful when no sufficient historic demand is available.

The requirement planning module calculates the inventory requirements of each SKU based on the forecast generated by the demand forecasting module and takes into account stock status and outstanding purchase order information integrated from the ERP system. The user is allowed to edit product information in this module including supply lead time, order frequency or order interval, units per container, space capacity of the warehouse every week, and safety stock requirements. The unit of time utilised for lead time and order interval calculations is in weeks. This module is therefore able to calculate the weekly inventory requirement based on the above information entered into MerciaLinc. It is therefore possible to plan for the optimal inventory level generated by MerciaLinc in order to achieve a balance between inventory carrying costs and customer service level.

5.3 Reviewing the Inventory Requirement Planning Process

5.3.1 Improving Cycle Stock Reviewing Process

As discussed previously, Company ST utilised a 'periodic review process' to review its inventory requirements on a monthly basis. Products from the same supplier are consolidated into a single purchase order to achieve cost efficiency through negotiating a volume-based price discount with the supplier. Each product order arrived every month or every multiple months depending on which product family they belonged to and which supplier they came from. Different product families could come from the same supplier. For the A Class SKU's, the orders were scheduled to arrive every month because the volumes were sufficient to achieve economies of scale for both Company ST and its suppliers.

In a periodic inventory review process, the inventory planner compares current inventory with forecast demand, and placed an order for the necessary quantity at a regular, specific time (Stock & Lambert, 2000). In Company ST, the inventory of each product family is reviewed individually. If the lead time required by the suppliers is taken as N months and the fact the company always kept safety stock which is sufficient to cover one month's demand, the inventory of each product family is ordered to a projected inventory level to cover the demands of month N (cycle stock) and month N+1 (safety stock). For example, at the beginning of June 2009, the planner was planning for the stock to arrive at the beginning of September 2009 and the stock was supposed to be sufficient to cover the demands of September and October. Since the stock of the product families of the A Class items are scheduled to arrive every month, the demand for July and August was supposed to be supplied by the orders scheduled to arrive in those months. Theoretically, the average cycle stock is equivalent to the average demand of 15 days. This is demonstrated by Table 5.1 (old cycle stock performance indicators).

Product Family	Inventory Review Period	Lead Time	Old Order Arrival Interval	Old Days of Average Cycle Stock to Sell Out
MM	1 Month	2 Months	1 Month	15 Days
JA	1 Month	2 Months	1 Month	15 Days
GA	1 Month	2 Months	1 Month	15 Days
GF	1 Month	2 Months	1 Month	15 Days
FR	1 Month	2 Months	1 Month	15 Days
SY	1 Month	2.5 Months	1 Month	15 Days
SR	1 Month	2 Months	1 Month	15 Days
PH	1 Month	2 Months	1 Month	15 Days
CT	1 Month	2 Months	1 Month	15 Days
MG	1 Month	2 Months	1 Month	15 Days

Table 5.1: Old Cycle Stock Performance Indicators (Empirical data collected)

However, some further analysis on the supply chain of Company ST indicated that it was possible to reduce the order interval and therefore the average cycle stock of A Class SKU's significantly. First of all, there are weekly ocean freight services existing between the locations of most suppliers and the distribution centre of the company. That makes it possible for the company to receive goods every week. Secondly, the overall cost of shipping a container is nearly unchanged as soon as the company ships more than a certain amount of containers from the same country to Australia per annum and it is much cheaper than shipping the same amount of goods on loose pallets. On the other hand, the suppliers also charge Company ST a cheaper rate when it orders a full container load (FCL) of stock every time. In other words, the company is able to achieve economies of scale as soon as it orders on an FCL basis. Thirdly, the combined demand of each A Class SKU and the SKU's from the supplier per month is more than or equal to an FCL per month. It is therefore possible for the company to break down the monthly inbound shipments into smaller lot size and therefore reduce the average cycle stock. Last but not least, the supply lead time requested by the vendors is the minimum lead time requirement. It cannot be shortened. However, it is possible to request the supplier to extend their lead time. The orders being placed every time can therefore be requested to arrive in different weeks beyond the lead time requirement based on the requirement plan generated by MerciaLinc.

After reviewing the inventory requirement of A Class SKU's and the SKU's from the same supplier, the order arrival intervals of most product families including A Class SKU's can be reduced to 2 weeks or even one week. As a result, the average cycle stock can be improved to the equivalent of demands of seven days or every three and half days if the company implement the new order policy. The proposed improved order intervals and average cycle stock can be found in Table 5.2 below.

Product Family	Inventory Review Period	Lead Time	Improved Order Arrival Interval	Improved Days of Average Cycle Stock to Sell Out
MM	1 Month	2 Months	2 Weeks	7 Days
JA	1 Month	2 Months	1 Week	3.5 Days
GA	1 Month	2 Months	1 Week	3.5 Days
GF	1 Month	2 Months	2 Weeks	7 Days
FR	1 Month	2 Months	2 Weeks	7 Days
SY	1 Month	2.5 Months	1 Month	15 Days
SR	1 Month	2 Months	1 Month	15 Days
PH	1 Month	2 Months	2 Weeks	7 Days
CT	1 Month	2 Months	1 Week	3.5 Days
MG	1 Month	2 Months	1 Week	3.5 Days

Table 5.2: Improved Cycle Stock Performance Indicators (Empirical data collected)

5.3.2 Improving Safety Stock Reviewing Process

The management of Company ST set up a certain amount of safety stock for each SKU. The pre-determined safety stock was normally equal to the average monthly demand and inventory requirement of the relevant SKU. The monthly demand and inventory requirement was based on the sales budget of the current financial year which was finalised before the beginning of the year.

However, the demands of all the products of Company ST fluctuate throughout the whole year due to a few macro environmental factors including weather, holidays, government legislation, etc. Normally there are two peak sales periods during the year. The first peak season is January of each year, just before the government increases the tax rate on alcoholic beverage. The second peak season occurs in July every year before the second tax increase on alcoholic beverage on 1st August. The last and most important peak sales season, which is due to increases in physical consumption, starts in the October of each year and ends at the end of the January of the next year.

The peak season that covers the last quarter of each year is the most important sales period every year. Around 30% of the company's annual sales revenue is generated during these three months. The consumption of inventory also accounts for around 30% of the full year's inventory consumption. The detailed seasonality of sales and inventory consumption is illustrated in Table 5.3 below. Three external factors decide the major peak season. First of all, Australia is located in the Southern Hemisphere where summer season is between October and January of the following year. The consumers normally drink more alcoholic beverages during the summer than any other season. At the same time, the major holidays including Christmas and New Year fall in the same period. The consumers purchase gifts for their family and friends to celebrate Christmas and New Year as a tradition. Finally, almost all retailers run intensive discount activities and gift-with-purchase (GWP) promotions around the Christmas and New Year period in order to achieve the maximum sales performance before the end of the year.

The January of each year is another important peak sales period due to the following two reasons. First of all, the majority of wholesalers and retailers need to replenish their stock in January after the major sales of the last quarter of the previous year. Secondly, every year the government increases the tax rate on alcoholic beverages at two distinct times. The tax rate is initially increased on the first of February and the sales prices are always increased accordingly. Most wholesalers are keen to purchase some additional stock in order to take advantage of the comparatively lower price before the tax increase takes effect. As shown in Table 5.3, the January sales figures account for approximately 9% of the company's annual revenue.

July of every year is another peak sales period. The second tax increase of alcoholic beverages occurs on the 1^{st} August every year. The customers usually place big orders before the end of July in order to reduce their cost investment in inventory. Table 5.3 indicates that the sales revenue of July accounts for more than 11% of the whole year in terms of dollar value and more than 10% of inventory is consumed during this period.

February is normally the month with the poorest sales performance and therefore inventory consumption is also the lowest of the year compared with other months. The sales in February only account for just more than 3% of every year and the inventory consumption only accounts for just less than 4% of every year. This is generally due to two reasons. First, most wholesalers hold excessive stock at the end of January because they order too much stock before Christmas of the previous year to avoid missing any sales opportunity, and they order more stock in January in order to take advantage of the lower prices before the tax increase takes effect. Secondly, the overall retail performance becomes softer moving into January. The final consumer spends lots of money on celebration and gifts for the Christmas and New Year holidays and therefore starts to reduce their spending when the holiday period ends.

Month	Sales Revenue	Sales Revenue Seasonality	Cost of Good Sales	Costs of Goods Sales Seasonality	Sales Units (Cases)	Sales Units Personality
Sep-08	$ 18,597,743.53	7.95%	$ 4,504,732.00	7.38%	106,630	8.18%
Oct-08	$ 24,511,853.71	10.48%	$ 6,222,016.09	10.20%	143,835	11.03%
Nov-08	$ 24,368,810.40	10.42%	$ 6,390,693.39	10.48%	141,710	10.87%
Dec-08	$ 25,162,642.28	10.76%	$ 6,423,652.02	10.53%	149,187	11.44%
Jan-09	$ 20,693,662.20	8.85%	$ 5,545,747.60	9.09%	134,682	10.33%
Feb-09	$ 7,358,016.96	3.15%	$ 2,254,925.07	3.70%	51,264	3.93%
Mar-09	$ 17,144,437.58	7.33%	$ 4,650,175.05	7.62%	92,152	7.07%
Apr-09	$ 19,331,463.97	8.26%	$ 4,876,968.71	8.00%	96,057	7.37%
May-09	$ 16,505,194.91	7.06%	$ 4,346,951.72	7.13%	83,421	6.40%
Jun-09	$ 17,150,417.64	7.33%	$ 4,595,831.14	7.53%	88,505	6.79%
Jul-09	$ 26,119,369.78	11.16%	$ 6,589,277.99	10.80%	134,352	10.30%
Aug-09	$ 16,999,030.59	7.27%	$ 4,599,113.62	7.54%	82,299	6.31%
Annual Total	**$233,942,643.55**	**100.00%**	**$ 61,000,084.40**	**100.00%**	**1,304,095**	**100.00%**

Table 5.3: Demand Seasonality (Empirical data collected)

The seasonality of sales and inventory consumption of the other seven months takes into account 7% or 8% of the annual total respectively. This is also shown in Table 5.3.

In summary, the demand and inventory requirement of Company ST reaches its peak between October and January and reaches the bottom of its sales cycle in February every year. The difference between the peak and the bottom of the cycle is substantial and has significant implications on the inventory holding of the company.

It was not wise to keep certain amounts of safety stock for each SKU respectively through the whole year because it does not cover the demand uncertainty of each month properly. The inappropriate safety stock normally causes two consequences. When the actual demand of a certain SKU is significantly higher than the expected demand, the company will encounter the issue of being out of stock more frequently. On the other hand, when the actual demand of a certain SKU is significantly lower than the expected demand, the opposite will apply and the company will hold excessive inventory of this SKU for a period of time.

The negative consequences of holding inappropriate safety stock can be indicated by Table 5.4 and Table 5.5. In the below tables, inventory days of forward cover relates to moving forward in how many days the current inventory can be sold out. Inventory turns equal to the total days of a full year (365 days) divided by inventory days of forward cover. By definition, the lower the inventory days of forward cover, the lower the inventory level is. On the other hand, the higher inventory turns are indicating a lower inventory level.

It is therefore the logical consequence that when the actual demand is in excess of the expected demand, the company will possibly face the situation of stock shortages. If the safety stock level is lower than the necessary level, an out of stock situation will occur and the customer service level will be lower than expected. This situation is magnified if it happens within or just before the peak season. On the other hand, when the actual demand is less than the expected demand, the company will be holding high levels of unnecessary inventory and therefore be wearing the significant cost associated with holding excessive levels of inventory. The company will also tend to hold excessive inventory for a longer period if the demand is lower than the average monthly demand at the start of a peak period.

The above negative consequences of holding an inappropriate safety stock level are also illustrated by Table 5.4 and Table 5.5. First, the overall inventory turns did not meet the expectations of the management team. Second, the customer service level did not always increase accordingly when the inventory level increased. The inventory level dramatically increased when the actual sales of some months were substantially lower than the forecast. The company's key inventory performance measures were also below expectation. In November 2008, the company only achieved 82% of its sales forecast. Consequently the inventory value at the end of December increased by $916,243 compared to November. Although the company achieved 99% of their sales forecast in December, the inventory days of forward cover increased significantly from 70.42 days at the end of November to 97.70 days at the end of December. The inventory turns during this period reduced from 5.18 to 3.74. The inventory situation did not improve in January of the next year, although sales figures were 9% above the sales target. This was due to three reasons. First, part of the cycle stock of November was accrued into the overall inventory because it was not depleted as planned. Secondly, the lead times of most suppliers are two months and not flexible. Therefore, although the sales forecast was not achieved in November, the stock ordered for the later months was still to be delivered as scheduled. Last but not least, the safety stock was set up as the certain quantity as the average monthly inventory requirement.

Excessive inventory was therefore accumulated before it was moving into a period with sales performance or inventory requirement lower than average. When it came to the month with less than average inventory requirement such as February, the safety stock became excessive and was accumulated to the overall inventory level. The inventory performance indicators in Table 5.4 show that average inventory turns for nine months out of 12 are lower than the management's requirement of 4.5. The average inventory turn of the studied 12 months was 4.29, also lower than the 4.5. The average MAT inventory turn is another indicator measure of long term inventory performance. According to Table 5.5, none of the average MAT inventory turn values achieved the target requirement. The same scenario of sales forecast accuracy - inventory relationship was also found in the later months when the sales forecasts were not made as shown in Table 5.4. Most of the months with excessive stock fell between February and June 2009 which are just between the two peak sales seasons.

Period	Sales Forecast	Actual Sales	Actual Vs. Forecast	Inventory Days of Forward Cover	Inventory Turns
Sep-08	102,915.23	106,630.17	104%	56.07	6.51
Oct-08	120,295.95	143,835.46	120%	67.71	5.39
Nov-08	172,776.00	141,710.05	82%	70.42	5.18
Dec-08	151,409.49	149,186.66	99%	97.70	3.74
Jan-09	123,008.03	134,682.08	109%	102.54	3.56
Feb-09	77,301.71	51,263.88	66%	101.53	3.60
Mar-09	111,737.92	92,152.08	82%	109.05	3.35
Apr-09	100,109.52	96,057.25	96%	101.10	3.61
May-09	81,708.73	83,421.30	102%	108.30	3.37
Jun-09	83,279.75	88,504.92	106%	96.38	3.79
Jul-09	113,016.97	134,352.25	119%	85.38	4.27
Aug-09	93,113.28	82,299.17	88%	71.07	5.14

Table 5.4: Relationship Between Sales Performance and Stock Level (Empirical data collected)

On the other hand, customer service level was not increased accordingly when the inventory level was increased. Theoretically, the high inventory availability is indicating high customer service level. This theory seemed to be true in the case of Company ST. According to Table 5.5, the average inventory turns between September 2008 and August 2009 was 4.10 and the average inventory days of forward cover was 88.94 days. At the same time, the average customer service level for the same period was 99.02%, which was higher than the customer service level target of 98% previously decided by management.

Period	Inventory Value	Inventory Days of Forward Cover	Inventory Turns	MAT Average Inventory Days of Forward Cover	MAT Average Inventory Turns	Customer Service Level
Sep-08	$11,562,884.00	56.07	6.51	81.94	4.45	99.75%
Oct-08	$14,015,494.63	67.71	5.39	83.93	4.35	99.52%
Nov-08	$12,623,797.78	70.42	5.18	84.14	4.34	98.63%
Dec-08	$13,540,041.21	97.70	3.74	84.72	4.31	99.00%
Jan-09	$13,540,041.21	102.54	3.56	85.05	4.29	98.68%
Feb-09	$15,333,320.00	101.53	3.60	84.04	4.34	99.00%
Mar-09	$18,487,371.46	109.05	3.35	84.48	4.32	99.07%
Apr-09	$16,881,581.46	101.10	3.61	84.55	4.32	99.39%
May-09	$18,726,344.01	108.30	3.37	85.62	4.26	99.76%
Jun-09	$17,765,497.54	96.38	3.79	87.91	4.15	99.16%
Jul-09	$16,484,434.56	85.38	4.27	88.43	4.13	97.93%
Aug-09	$16,514,510.10	71.07	5.14	88.94	4.10	98.33%
Average	**$15,456,276.50**	**88.94**	**4.29**	**85.31**	**4.28**	**99.02%**

Table 5.5: Inventory Performance September 2008 - August 2009 (Empirical data collected)

If analysing the information included in Table 5.5 in more detail, it can be determined that the overall customer service level does not always increase when the overall inventory level is increased. During the first three months of the analysed period; September to November 2008, the average Inventory days of forward cover were 64.73 days and the average inventory turns were 5.69. At the same time, the average customer service level for this three month period was 99.3%. All the inventory performance indicators were above either the target value or the average of the 12 months. However, these indicators changed significantly in the second three month period because only 82% of the sales forecast was achieved in November. Between December 2008 and June 2009, the average inventory days of forward cover dramatically increased to 100.59 days and the average inventory turns reduced to 3.63 respectively. However, the average customer service level for the same period did not increase in line with the increase in inventory level but reduced to 98.89%. If comparing the same figures between the first quarter and the last quarter of the studied period, the average customer service level was reduced again when the inventory level was increased. The average inventory days of forward cover of the last quarter were 84.28 and the average inventory turns were 4.40. Both figures indicated that the inventory level of the last quarter was much higher than the first quarter of the studied period. However, the average customer service level was 98.48%, which was lower than the first quarter 99.30%.

Consequently, this caused three major issues for Company ST because the management decided to hold safety stock at the average monthly inventory requirement for each SKU. First, excessive inventory was significantly increased after the period when the actual sales achievement was substantially behind the sales projection. Secondly, excessive inventory was also increased before the period when the sales performance was lower than average. Last but not least, the customer service level did not always increase when the inventory level was increased.

It was discussed in Chapter 2 that the solution to the above issues was to link the safety stock to the inventory requirements of the next period rather than a fixed quantity of inventory for each SKU.

Safety stock is held in excess of stock because of uncertainty in demand or lead time (Stock & Lambert, 2000). In the context of Company ST, the supply is considered as certain and safety stock in considered to be required to cover the uncertainty in demand. According to Chopra and Meindl (2007), safety stock can be evaluated by the following equation in the periodic review process.

Equation 4: $SS= Fs\ (-1)\ (CSL) \times \sigma_{T+L}$

Equation 5: $\sigma_{T+L}= \sqrt{(T+L)}\ \sigma_D$

Where:

- D= Average demand per period
- σ_D= Standard deviation of demand per period
- L= Average lead time for replenishment
- T= Review interval
- σ_{T+L}= Standard deviation of demand during T + L periods

Thus, there is a linear relationship between safety stock and standard deviation of demand per period when CSL is certain. The safety stock level is reduced when the standard deviation is reduced. The standard deviation of the demand per period measures the accuracy of the demand forecast. In other words, demand forecast accuracy is the key to optimising safety stock level.

5.4 Reviewing and Redefining the Demand Forecasting Process

Based on the previous discussions, demand forecast accuracy is vital to both cycle stock level and safety stock level because when other factors including supply lead time, customer service level are considered as certain or pre-decided, the stock is required to cover the projected demand and the uncertainty in demand.

The previous discussion in Chapter 4 concluded two problems exist in the demand forecasting process. First, the demand forecast accuracy is inadequate. The long term demand forecast is less accurate than the short term forecast which in turn, made the situation even worse. Second, the demand forecast is disconnected between different functional departments within Company ST. Each department (i.e. the supply chain, sales teams, and marketing) had their own demand forecasts. They did not always communicate their forecast with each other. When there was a disagreement and the consensus forecast could not be achieved, the supply chain department normally replenished the inventory based on its own demand forecast generated from historical demand data.

MBCG carried out a more in-depth analysis of the demand forecast and requirement planning processes and identified more detailed issues within the process. These issues are as follows:

1. The supply chain team procured purely based on the systematic demand forecast generated from the analysis of historical data. There was normally not enough input from the sales team and/or marketing team. The information related to promotions and discounting activities was not always communicated to the supply planner. This could lead to a situation where there was insufficient inventory to supply the significant increases in inventory requirements caused by promotional activities occurring in the next few months.

2. The sales team had no accountability for the sales forecast. The sales teams only reviewed whether they achieved the sales forecast in terms of dollar value rather than quantity of inventory depleted. The consequence of this was that the supply chain was always blamed for the stock shortage and nobody was accountable for the stock shortages caused by inaccurate demand forecasts.

3. When the sales team generated the sales forecast for the next 12 months, the information of inventory availability was not seriously taken into account. In other words, the sales forecast for the next two or three months could be unachievable because they were increased significantly without taking into account the stock projection and fixed supply lead time required by the suppliers.

4. When a new product was launched, the marketing team did not have adequate communication with the sales team with regards to the short term and midterm depletion plan. Theoretically this could result in two significant consequences for the company. First, if the marketing plan overestimated the demand of the new product, the company could end up holding too much stock. The considerable capital invested on the inventory of this new product would therefore have a lower return on investment (ROI) and the overall profitability of the business would be lower than expected. Substantial inventory write-off costs could also occur if the new product had limited shelf life. On the other hand, if the marketing department underestimated the demand of the product, the launch of the new product would not be successful due to insufficient stock supply. It seemed that the first scenario happened more frequently in Company ST. Just at the beginning of 2008, the company had to write off more than $150,000 worth of inventory of a new product line when the stock expired.

In order to fix the above problems, MBCG proposed the following steps to improve the demand forecast process.

1. Introduce a simulation forecast method to predict the future demand of the company. A simulation forecast method combines the systematic demand forecast generated by demand forecasting software with the sales forecast generated by the sales team, which was considered a causal forecast. It was also suggested to combine a simulation forecast with a judgement forecast.
2. Introduce a new measurement method to measure the accuracy of the combined demand forecast.
3. Introduce a 'Sales and Operations Planning' process to balance the demand and supply of the company.
4. Continuously improve the Sales and Operation Planning process.

5.4.1 Combining Systematic and Causal Forecast with Judgemental Forecast in Simulation

It was discussed in the previous sections that the systematic demand forecast method and the causal demand forecast method had their own unique advantages and disadvantages. The optimal forecast method is considered to be a simulation forecast which combines a systematic forecast, a causal forecast, and a judgmental forecast in order to produce a more accurate result.

In the case of Company ST, the systematic demand forecast was generated by the demand forecasting software MerciaLinc. This software is able to calculate the trend, level and seasonality of future demand based on historical demand data. The MerciaLinc user can run the demand forecasting module to achieve the future demand with the lowest standard deviation. However, the demand of alcoholic beverage is heavily driven by promotional and discounting activities, especially during the special occasion periods. A systematic forecast purely based on historical data does not take into account the volume uplift for future demand if there is insufficient input of marketing intelligence and therefore, its forecast for the periods with activities is not accurate enough.

On the other hand, the sales forecasts generated by the sales teams were mainly based on the best marketing intelligent including promotions, price incentive activities, special occasions, short-term forecast from the major customers, etc. The forecast from the sales team could be classified as a causal forecast because it was highly correlated with certain factors in the environment. However, there were a few disadvantages with the causal forecast being used by the sales team. First of all, marketing intelligence was not constant. Sometimes the customers (wholesalers and retailer groups) would change their promotional schedules and provide very short notice. Normally such a change did not give the company enough time to respond due to the supply lead time. Secondly, the customers normally only wanted to commit to short term (6 - 8 weeks) promotions and activities. More uncertainty however exists beyond this short term period. Finally, the sales team did not take into account any statistical demand data when they predicted the demand. A classic case is that they might predict the increased demand caused by an upcoming promotion correctly but did not consider the impact on the period after the promotion.

It was discussed in Chapter 2 that when future demand can be indicated by historical demand, as well as affected by related environmental factors, it is the better option to utilize a simulation forecast method which combines the systematic forecast and the causal forecast. Remus (1995) also suggested that a judgmental forecast method could be used to improve forecast accuracy because humans may be better able to detect patterns in systematic data and integrate external information.

5.4.2 Demand Forecast Accuracy Measurement

After determining the forecast methods to be used to predict the company's future demand, it was necessary to set up a proper measurement system to measure whether the new forecast method was suitable for the company and whether the demand forecast accuracy was ultimately improved.

The supply lead time required by most suppliers is normally two months. Generally the planner is scheduling for the stock to arrive in the third month for orders placed in the current month. From a procurement point of view, not only is the demand forecast accuracy of the current month important but also the demand forecast accuracy for the 2nd and 3rd months is equally important for inventory requirement planning because the planner has to take into account the demands for the next three months.

Based on the inventory requirement planning process and the demand forecasting process, MBCG tailored its demand forecast accuracy measurement system to review the forecast performance of each A Class SKU of the company. Every month, the sales team forecasts the monthly sales of the next 12 months. The new measure compares the actual demand of the current month with the forecasts generated two months ago, one month ago, and the current month. For example, when the company measures the sales forecast accuracy of August 2008, the management should compare the actual sales of August with sales forecasts from three different months.

First, Demand Forecast Accuracy M2 compares the actual August demand with the August sales forecast decided by the management at the beginning of June, because this was the forecast for the current month when generated two months ago. Second, Sales Forecast Accuracy M1 compared the actual August demand with the August demand forecast decided at the beginning of July. Sales Forecast Accuracy M0 compared the actual August sales with the August sales forecast decided at the beginning of August.

Table 5.6 is an example that reviews the Sales Forecast Accuracy M2, M1 and M0 of 23 A-Class SKU's for August 2009. Table 5.6 indicated a few negative signals existing in the sales forecast system of the company. First of all, the overall forecast accuracy does not meet requirements.. This is measured by the forecast error which is discussed in Chapter 2. The forecast error is the comparison ratio used to measure the difference between the forecast and actual sales of a certain period. The less the forecast error, the more accurate the forecast is. Table 5.6 shows that the forecast error of demand forecast 2M of 11 A Class SKU's out of 23 is higher than 30%. The same figure of 11 SKU's for sales forecast 1M is higher than 30% and eight SKU's for demand forecast 0M. Second, the M2, M1 and M0 values for most of the SKUs are inconsistent. Comparing the difference between sale forecast accuracy 2M and 0M, the differences of ten SKU's out of 23 are more than 30%. If comparing 1M and 0 M, the differences of 7 SKU's are more than 30%. Third, the forecast for a longer period is less than the forecast for a shorter period. Table 5.6 indicates that the average sales forecast error for August was 65% for 2M, 64% for 1M, and 35% for 0M.

SKU	Demand Forecast Accuracy (2M)	Forecast Error (2M)	Demand Forecast Accuracy (1M)	Forecast Error (1M)	Demand Forecast Accuracy (0M)	Forecast Error (0M)
CT1Y	123%	23%	120%	20%	123%	23%
CT7Y	123%	23%	156%	56%	129%	29%
FR7B	89%	11%	96%	4%	42%	58%
GA1Y	139%	39%	71%	29%	138%	38%
GA7Y	114%	14%	112%	12%	80%	20%
GF7X	238%	138%	218%	118%	134%	34%
IL4Y	56%	44%	60%	40%	98%	2%
JA7X	83%	17%	85%	15%	79%	21%
MB4Y	63%	37%	69%	31%	94%	6%
MG3X	122%	22%	108%	8%	112%	12%
MG5F	74%	26%	76%	24%	82%	18%
MI1F	129%	29%	130%	30%	125%	25%
MI5F	157%	57%	151%	51%	114%	14%
MI7F	56%	44%	53%	47%	60%	40%
MI7G	224%	124%	224%	124%	49%	51%
ML4X	72%	28%	98%	2%	129%	29%
MS4Y	64%	36%	67%	33%	96%	4%
ON7A	112%	12%	107%	7%	98%	2%
P75B	509%	409%	541%	441%	136%	36%
PA7X	74%	26%	77%	23%	85%	15%
SR1Y	308%	208%	310%	210%	307%	207%
SR7X	79%	21%	82%	18%	83%	17%
SY7X	201%	101%	199%	99%	205%	105%
Average	**139%**	**65%**	**140%**	**63%**	**113%**	**35%**

Table 5.6: Sales Forecast Accuracy Analysis August 2009 (Empirical data collected)

5.4.3 Introducing S&OP

It was discussed in Chapter 2 that the S&OP Process was the best approach to combine a systematic forecast and a causal forecast with a judgmental forecast method. The five steps of an S&OP process standardised by Wallace and Stahl (2006) should be customised to fit Company ST. The standard five step S&OP process is as follows:

The first step is data gathering, which includes three elements. These consist of updating the files with data from the month just ended, generating information for sales and marketing teams to use in developing the new forecast, and disseminating this information to the appropriate people. This step is to be completed within a day or two after the end of each month (Wallace and Stahl, 2006).

The second step is demand planning, which includes analysis of last month's variance, the new statistical forecast, field sales input, marketing intelligence, new product plans, promotional plans, planned price changes, competitive activity, industry dynamic, economic conditions and seasonality. Demand forecasting needs to be finalized by a short meeting of senior level sales and marketing people to get their buy-in, allow them to challenge the new forecast, and make any necessary amendments (Wallace and Stahl, 2006). An unconstrained demand forecast is established in this step (Lapide, 2005).

The third step is the supply capacity planning stage which is undertaken in order to modify the operational plans for any families or subfamilies that require it and check capacity. The outputs of the supply capacity planning include updated operation plans, related capacity planning reports, and a list of supply problems (Wallace and Stahl, 2006). The rough-cut and constrained demand plans are also developed during this step (Lapide, 2005).

The fourth step is the Pre-Meeting which generally consists of five tasks, including making decisions regarding the balancing of demand and supply, resolving problems and differences by making a single set of recommendations to be presented in the executive S&OP meeting, identifying the areas where agreement cannot be reached, developing scenarios showing an alternative course of action to solve a given problem, and setting the agenda for the executive S&OP meeting. The key participants in the Pre-Meeting should include representatives from demand planning, product development, operations, representatives from finance and the owner of the executive S&OP process (Wallace & Stahl, 2006). Lapide (2005) also suggested finalising the alignment of the demand and supply plans at this step.

The last step, the executive meeting, normally has the following objectives. The first objective is to make decisions on each product family - whether to accept the recommendation from the pre-meeting team or to choose a different course of action. Secondly, the executive meeting needs to authorise changes in production or procurement rates. Thirdly, it is necessary to relate the currency-valued version of the executive S&OP information to the business plan. The executive meeting needs to make the decisions on topics the Pre-Meeting team was unable to reach a consensus. Finally, the meeting reviews customer service performance, new product issues and special productions Wallace and Stahl, 2006). Lapide (2005) suggested running the executive meeting with a fixed agenda. A pre-specified amount of time needs to be allocated to the meeting. It is necessary to start the meeting with a review of previous plans and end up with a consensus-based alignment of demand and supply plans.

However, it was not practical for a company to implement all of the five steps completely because it would involve substantial investment and effort in changing both the management process and computer system. The company however would not achieve the expected result if it could not adapt well to the S&OP process. According to the discussion in Chapter 2, it is wiser to implement S&OP using a step-by-step approach based on the maturity of the S&OP process in the company. This also allows for constant improvement in S&OP over time.

First, it is necessary to tailor the S&OP process to fit the current situation of the company's demand forecasting process. This tailored S&OP process may not include all of the elements of the standard five steps as above. Secondly, review the key demand and supply performance measures and the maturity of the S&OP process at the end of the third month of the implementation in order to judge whether the current S&OP process is suitable for the company. It is at this stage that a review of what has actually been achieved and what needs to be improved takes place.. After that, the company can improve the S&OP process according to the findings in the last step so that it can fit the company better and therefore improve its demand and supply performance further. Finally, review the demand and supply performance measures on a quarterly basis and adjust the S&OP process accordingly.

5.4.4 Implementation and Constant Improvement in the S&OP Process

Dougherty and Gray (2006) suggested that different companies could tailor the S&OP process to make the process work better for them depending on the specific needs of their business. Lapide (2005) recommended that businesses should use the maturity models to diagnose what stage their companies are currently at when trying to implement or improve their S&OP process. Each business can then begin to move to the next stage by formalising the planning processes, increasing the frequency of S&OP meetings, and continuing to increase and enhance their collaborative relationships with suppliers and customers.

The implementation of an S&OP process in Company ST would require three or four stages until the ideal process could be fully achieved. Before implementing each stage, the management team will review the current S&OP process and decide whether it is the right time to move on to the next stage. The S&OP process should be reviewed every three months. If the current stage is matured and the KPI's have improved, the company will then move on to the next stage. Otherwise, it will stay at the current stage and wait for the next review.

During the first three months, the different functions of the company were educated in the five-step S&OP process. Each department needed to understand the role they play in the S&OP process and made aware of their particular responsibilities. The agenda, meeting dates, and attendees of the Executive's S&OP Meeting are decided in the first month. All departments involved with the S&OP process are working towards the Executive's S&OP Meeting. All five steps of the S&OP process were implemented in the first month - September 2009. At the end of November 2009, all the relevant demand and supply chain KPI's were reviewed. The reason for this being that the management team needed to find out what was working in the process and what needed to be improved. The outcome of this being that the S&OP process was modified based on the recommendations that emanated from the first stage review.

The S&OP process was modified at the beginning of December 2009 based on the review results at the end of November. All of the five steps were modified or improved to better fit the current status of the company. The demand and supply performance were also reviewed again at the end of February 2010 in order to find out how Stage 2 of S&OP process had worked.

The same exercise of reviewing the performance of the S&OP process was undertaken again at the end of May 2010 and August 2010. The ultimate purpose is to achieve the ideal S&OP process. At this stage, the S&OP processes previously discussed are fully-enabled. The process is supported by systems that constantly keep track of supply and demand in real-time, and when necessary, alert everyone that is part of the S&OP process that they need to meet immediately. Meeting attendees or proxies would therefore need to be tracked down and notified that a meeting needed to take place as soon as possible (Lapide, 2005). However, the ideal process might never have been achieved but for the introduction of a benchmark for guiding the continuous improvement of the process. It is vital for the company to continuously improve their S&OP process due to the constant changes taking place in both the external and internal business environments. It is also equally important for the company to constantly improve its demand and supply performance.

5.5 Implementing the New Demand Forecasting Process

MBCG started the implementation of an S&OP process in Company ST by selecting the team members to be involved in the process. It was decided to set up an S&OP meeting including the following people from the company: managing director, marketing general manager, sales general manager, operation and finance general manager, demand and supply planner, and logistics manager. The managing director represents the board of the company. The managers of different departments of the company are the representatives from the necessary functions. The demand

and supply manager would drive the S&OP process and coordinate between different departments.

The implementation of the S&OP process was started in September 2009 based on the five-step process summarised by Wallace and Stahl (2005). However, the standard process was customised from the beginning in order to fit the situation of Company ST at 1st August 2009. Only a few basis elements of the five-step process would be implemented at the first stage because the forecasting and planning processes of the company were less formal and it was not ready for the implementation of the completed S&OP process.

5.5.1 Data Collection

The first step is collecting data, which includes three elements: updating the files with data from the month just ended, generating information for sales teams to use in developing the new forecast, and disseminating this information to the appropriate people.

Company ST already has a process in place to update their database with the data from the month just ended, with this information then being communicated to the different departments. Navision, the ERP system being used by the company, is able to export the relevant information including the detailed depletion per SKU per sales channel, inventory status of each SKU, detailed sales revenue, outstanding purchase orders, and outstanding sales orders to an Excel spread sheet when required.

At the end of each month, the operations manager extracted the detailed information from Navision and transferred it to an Excel spread sheet. At the same time, the demand and supply planner extracted information including demand at the overall company level, inventory status of all DC's, outstanding purchase orders, physical configurations of all SKU's, account information of all SKU's to an Excel spread sheet.

It takes one business day to transfer the data into the information readable by the respective departments or software. At the first business day of the next month, the detailed sales report is communicated to all sales managers and marketing managers. The demand and supply information related to inventory including demand at the overall company level, inventory status of all DC's, outstanding purchase orders, physical configurations of all SKU's, account information of all SKU's is also imported to MerciaLinc as mentioned earlier.

5.5.2 Unconstrained Demand Planning

The second step is demand planning. At this stage the supply is not taken into account and the demand forecast is unconstrained. The unconstrained demand forecast includes analysis of last month's variance, the new statistical forecast, marketing intelligence, new product plans, planned price incentive activity, competitive activity, industry dynamics, economic conditions, and seasonality. Demand forecasting needs to be finalised by a short meeting of senior level sales and marketing people to get their buy-in, allow them to challenge the new forecast and make any necessary amendments (Wallace and Stahl, 2006; Lapide, 2005).

Within Company ST this step was completed through two separate approaches. From the second to the fourth business day, the sales teams generate their sales forecasts respectively based on marketing intelligence, planned price incentive activities, and competitive promotions. On the fourth business day, the sales forecasts of different channels were consolidated through Cognos, which is the budgeting and forecasting system used by the company. After the sales forecasts were consolidated, the senior management from the board, the sales general manager and the marketing general manager reviewed the overall forecast taking into account macro-environmental factors including industry dynamics, economic conditions, legislative changes, and seasonality.

At the same time, the demand and supply planner generates the statistical demand forecast of all SKU's based on historical data via the MerciaLinc system. The trend and level of the demand of each SKU can be calculated based on the consolidated demand of up to the last four years and adjusted according to the short-term and mid-term plans of the company. The seasonality is also calculated based on historical demand data.

MerciaLinc can not only calculate the level, trend and seasonality of demand, but also demonstrate the historical demand and the calculated demand in pattern. The graph in figure 5.1 is an example of how MerciaLinc visually demonstrates the demand history and forecast. The lateral axis represents the timeline which includes four years in the graph. The vertical axis represents the level of demand. The coloured curve shows how the demand of this SKU fluctuates. The purple curve represents the actual demand of the last three years. The green curve represents the statistical demand forecast generated by the system. The MerciaLinc user can visually compare the green curve with the purple curve and judge whether the statistical demand forecast best reflects the level and seasonality of the demand for the SKU being analysed.

If the green curve does not meet the expectations, the MerciaLinc user needs to adjust the green curve for two main reasons. First, the green curve can be adjusted to best fit the purple curve representing the historical demand for most SKU's when the demands of these SKU's are statistically distributed. Secondly, sometimes it is necessary to adjust the trend and level of the demand forecast pattern in order to match the overall volume of the future demand of certain period with certain quantity if the company is expecting a significant increase or decrease in the next period or next fiscal year.

The seasonality, trend and level of demand forecast can be adjusted on a statistical basis in a few ways. The seasonality of each SKU can be adjusted by changing the periods of history to be used in generating the forecasting pattern. The trend of the demand forecast curve can also be changed by entering the required trend figure into the system. The larger the trend figure, the stronger the future demand. The level of demand pattern is represented by the grey line in the middle of the graph in figure 5.1. It is plotted by the average demand per month. If necessary, it is possible to increase or decrease the demand level in order to make the system generated demand forecast more in line with the midterm plan of the specific SKU of the company.

MerciaLinc also allows the user to manually enter the demand of each period into the system. It is not overwriting the system generated forecast but exists in the database separately as marketing intelligence. The user can use the system generated demand forecast or marketing intelligence, or a combination of both, for future analysis, requirement planning and reporting. This provides the opportunity to compare the patterns of systematic demand forecast and the marketing intelligence. As shown in graph 1 below, the green curve represents the systematic forecast as previously described and the pink curve represents the manually entered marketing intelligence. If there is any obvious variance of A Class SKU's between the values, the demand and supply manager will discuss it with the sales general manager and try to achieve a consensus forecast with the sales team before the Executive's S&OP meeting.

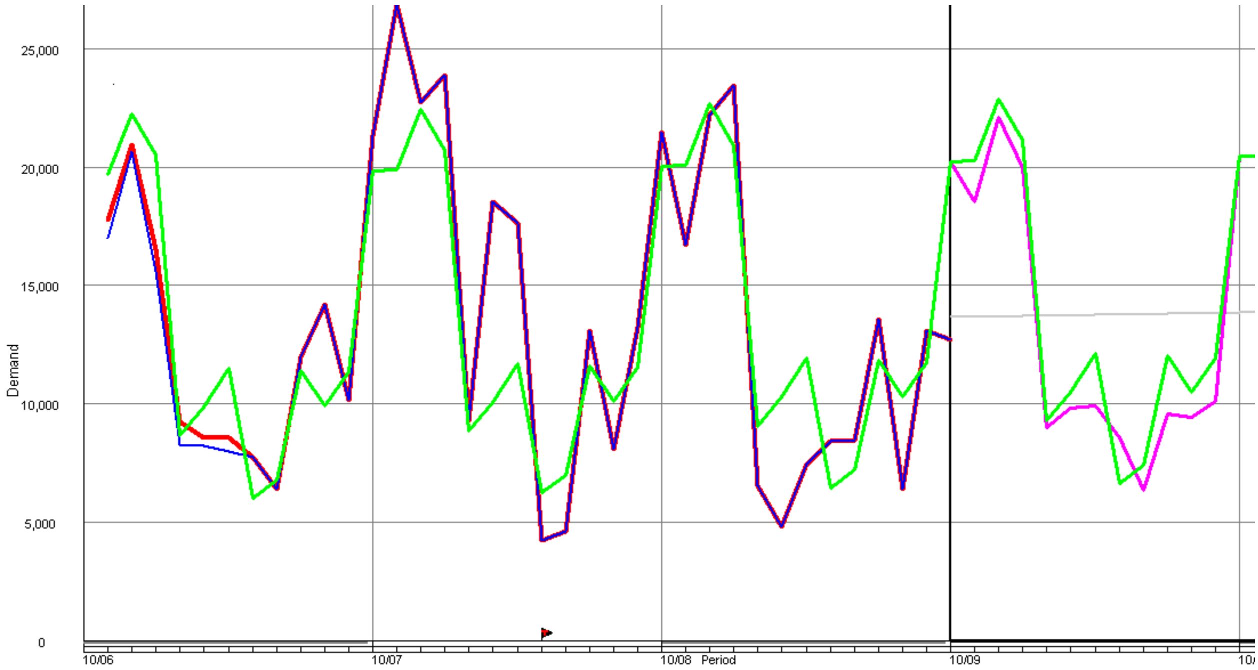

Figure 5.1: MerciaLinc Demand Forecasting Module (Empirical data collected)

Red line: sales history
Blue line: demand history
Green line: statistical demand forecast
Purple line: marketing intelligence

5.5.3 Supply Requirement Planning

The third step is the supply requirement planning process which is undertaken in order to modify the operational plans for any families or subfamilies that require it and to check capacity. The outputs of the supply requirement planning process include updated requirement plans, related capacity planning reports, and a list of supply problems (Wallace and Stahl, 2006; Lapide, 2005).

The demand and supply manager runs the requirement planning module of MerciaLinc based on the analysis from demand forecasting and information from other inputs. First of all, the requirement planning process is based on the consensus forecast of A Class SKU's and the system-generated forecasts of other SKU's. Second, the requirement planning process is based on the necessary safety stock level calculation, taking into account the customer service level required by management. Third, the requirement planning process is also based on the order frequency suggested in Table 5.2. Finally, the product configuration (i.e. the quantity of cases per container) is incorporated into the process. As previously discussed, it is necessary to order stock on an FCL basis in order to reduce international freight costs and avoid loss of stock from the shipment whilst the goods are in transit. Most products are ordered and shipped from overseas on an FCL basis.

Due to the fixed supply lead time from the supplier, demand will not be completely fulfilled if the demand of the next two months is expected to increase dramatically or the additional inventory requirement is more than the safety stock being held. The demand and supply manager will need to take note of these SKU's if and when such situation occurs. All of the potential supply issues will be communicated to the sales general manager in the next step of the S&P process.

5.5.4 The Pre-Meeting

The fourth step is the Pre-Meeting which generally has five tasks including: making decisions regarding the balancing of demand and supply, resolving problems and differences by making a single set of recommendations to be presented in the executive S&OP meeting, identifying the areas where agreement cannot be reached, developing scenarios showing an alternative course of action to solve a given problem, and setting the agenda for the executive S&OP meeting (Wallace & Stahl, 2006; Lapide, 2005).

The Pre-Meeting at the first stage in Company ST was undertaken in a more flexible format. The Pre-Meeting needs the input of the marketing team. The key players of the Pre-Meeting in the first stage include the demand and supply manager who is the owner of the S&OP process, the sales general manager and, the respective marketing manager who is managing a certain brand. In Company ST, one brand manager of the marketing department manages certain brands. It is not necessary to include all brand managers in the Pre-Meeting because not all of the brands are discussed every time. Instead of having one single Pre-Meeting, the demand and supply manager organises a few short meetings involving the sales general manager and the respective brand managers. The alignment of the demand and supply plans is finalised at this step. If the consensus forecast is not achieved, the disagreement will be taken to the next step, the Executive S&OP Meeting.

After all necessary Pre-Meetings, the demand and supply manager prepare the agenda for the Executive S&OP Meeting in Microsoft PowerPoint. The agenda needs to be provided to all the Executive S&OP Meeting attendees at least 24 hours before the Executive S&OP Meeting so that the meeting attendees have enough time to prepare before the meeting. At the first stage, the meeting including the following content:

- The A Class SKU’s that had issues of demand and supply in the previous month.
- The A Class SKU’s of which the consensus forecast was not achieved between different departments.
- The new product development project.

When the A Class SKU’s with issues were discussed, the below items relating to a particular SKU would be covered in the meeting.

- The N+1 period demand forecast accuracy review as discussed in the previous section
- The comparison between the patterns of the systematic demand forecast and marketing intelligence
- The inventory projection for the next four months
- The review of the sales performance of the current month

5.5.5 The Executive's S&OP Meeting

The last step, the executive meeting, was suggested to have the following objectives. The first objective is to make decision on each product family - whether to accept the recommendation from the pre-meeting team or to choose a different course of action. Secondly, the executive meeting needs to authorise changes in production or procurement rates. Thirdly, it is necessary to relate the currency-valued version of the executive S&OP information to the business plan. Then, the executive meeting needs to make the decision where the Pre-Meeting team was unable to reach a consensus. Finally, the meeting reviews customer service performance, new product issues and special productions (Wallace and Stahl, 2006). Lapide (2005) suggested running the executive meeting with a fixed agenda. A pre-specified amount of time needs to be allocated to the meeting. It is necessary to start the meeting with a review of previous plans and end with a consensus-based alignment of demand and supply plans.

A decision was made to hold the Executive S&OP Meeting on the 10th business day of each month. The standard meeting process was tailored as per the below in order to suit the situation of Company ST at the beginning of August 2009. First, only the A Class SKU's were to be discussed at the meeting because the 23 A Class SKU's represented more than 80% of the annual sales gross profit of the company in the last 12 months. When the demand forecast and requirement planning of the A Class SKU's are managed well, the demand forecast and requirement planning of all product families are managed well.

Secondly, the demand forecast accuracy M2, M1 and M0 of each sales account of the month just finished (discussed in section 5.3.2) are reviewed at the meeting. This is because the supply lead time required by most suppliers is on average two months. It is therefore necessary to review the August demand forecast performance by reviewing the forecast the sales teams generated in June, July and the beginning of August.

Thirdly, the meeting reviews the variance between the statistical forecast and sales forecast for the A Class SKU's of which the consensus forecasts were not achieved prior to the meeting. The sales general manager and marketing general manager need to explain the reasons if the expected sales volumes for the next periods are significantly higher or lower than the volume suggested by the statistical demand forecast. The senior management team needs to make the decision on whether to use the demand forecast based on statistical analysis or the sales forecast from the sales team, or a combination of both, as the target for the company to achieve and as the foundation for further requirement planning. If the consensus forecasts are accepted as being significantly higher or lower than the statistical forecast, it is also necessary to discuss the impact of the new agreed forecast on the periods that follow.

Fourthly, the meeting also needs to discuss any changes to the replenishment rates and inventory holding policy related to the A Class SKU's including average cycle stock, safety stock, and order frequency and lot size. As previously discussed, it was necessary to reduce the cycle stock in order to avoid holding unnecessary stock. Table 5.2 shows the average cycle stock value for each product family. The order frequency and order lot size need to be changed accordingly. The safety stock level of each SKU also needs to be adjusted according to the customer service level requested by the management team and the demand forecast accuracy.

Fifthly, the demand and supply manager reports the supply constraints to the meeting based on the scenario that the meeting decides to accept the aggressive demand forecast as the consensus forecast for the next few periods. Because the supply lead time requested by the suppliers is generally two months, if the demand increased dramatically before the next replenishment arrives and the inventory requirement is in excess of the buffer stock, a stock shortage situation could occur. The senior management team should make the decision and finalise the solution during the meeting.

Finally, all the decisions made during the Executive S&OP meeting need to be documented in the meeting minutes. Each attendee should be assigned some tasks to follow up after the meeting in order to execute the decisions being made during the meeting and achieve the agreed targets. All meeting attendees should be accountable for their tasks. At the beginning of the next meeting, the meeting minutes from the last meeting will be reviewed and all meeting attendees will be held accountable for the completion of their tasks from the last meeting.

5.6 Actions and the Review of Stage 1

5.6.1 Actions During Stage 1

The first meeting identified some problems existing in the forecasting and planning processes of the company and requested the relevant departments to take actions to improve them. First of all, the sales team were requested to pay more attention to the sales forecasts of the next three months rather than just the current month. Due to the fixed supply lead time, it is necessary to take into account at least the demands of the next three months when planning inventory requirements. However, it seemed that the sales managers were only focusing on improving the sales forecast accuracy of the current month. Secondly, the supply chain team were requested to calculate the safety stock level based on the standard deviation of demand forecast and customer service level.

5.6.2 The Review of Stage 1

The S&OP process described above was implemented at the beginning of September 2009 in Company ST. MBCG and the senior management of the company decided to review the S&OP process every three months and then ascertain where improvements needed to be made and how to improve the process. The first review was undertaken at the end of November 2009 and the review results are presented in Table 5.7.

First of all, the management team reviewed the M2, M1 and M0 demand forecast accuracy of the first three months after implementing the S&OP process. The management compared the forecast error of the demand forecasts done after August with the demand forecasts done in August. Regarding the demand forecasts M2, the M2 of October 2009 was generated in August and the November M2 was generated in September. It improved from 48.17% to 41.74%. The demand forecasts M1 of September was generated in August and the M1 of October was in September and the M1 of November in October. The regarding forecast error increased to 50.31% for October but then decreased to 42.26% for November. The demand forecast M0 of each month was generated for the current month at the beginning of each month. The forecast error of demand forecasts M0's fluctuated between August and November. Comparing the August M0 and November M0, it improved from 41.76% to 26.8%. In the first three months of the implementation of S&OP process, the overall demand forecast accuracy slowly improved.

The sales general manger and the demand and supply manager believed the unsatisfied demand forecast accuracy and the inconsistent forecast errors are mainly due to two reasons. First of all, most of the sales managers did not review their sales forecast according to the supply plan, especially for the SKU's with potential stock issues. That increased the possibility of stock shortages and therefore loss of sales. Second, the sales managers were still focussing on the forecast of the current month (M0). As shown in Table 5.7, the M0 forecast is generally more accurate than M2 and M1. Because of the inflexible lead time (two months), it is imperative to improve the forecast accuracy of rolling S&OP demand forecasts M2 and M1.

KPI	Aug-09	Sep-09	Oct-09	Nov-09
Cost of goods Sold	$ 4,599,114	$ 5,415,732	$8,225,018	$8,558,503
Inventory Value	$ 16,514,510	$ 17,149,654	$ 14,015,495	$ 17,172,196
Days of Inventory Carrying Forward	71	62	52	93
Inventory Turns	5.14	5.84	7.00	3.91
MAT Days of Inventory Carrying Forward	89	89	88	90
MAT Inventory Turns	4.10	4.08	4.14	4.05
A Class Out of Stock Days	-	21	11	33
A Class Customer Service Level	100.00%	98.60%	97.61%	91.75%
B Class Out of Stock Days	11	-	-	9
B Class Customer Service Level	99.00%	100.00%	100.00%	99.10%
C Class Out of Stock Days	21	5	17	45
C Class Customer Service Level	99.20%	99.80%	99.43%	98.27%
Overall Out of Stock Days	70	97	28	87
Overall Customer Service Level	98.33%	97.89%	99.39%	97.83%
M2 Forecast Error	50.31%	34.59%	48.17%	41.74%
M1 Forecast Error	47.71%	31.32%	50.31%	42.26%
M0 Forecast Error	41.76%	29.85%	47.71%	26.80%
M2 Demand Forecast per Unit	101,268	114,241	159,668	184,930
M1 Demand Forecast per Unit	100,314	111,354	159,421	184,336
M0 Demand Forecast per Unit	93,733	100,495	156,877	179,866
Total Actual Demand per Unit	78,929	121,383	151,651	172,338

Table 5.7: Demand and Supply KPI Review August - November 2009 (Empirical data collected)

Secondly, the inventory performance of the first three months was reviewed. The MAT average figures were changing slowly because it takes the average of the last 12 months. As shown in Table 5.7 that the MAT average inventory turns were fluctuating between 4.05 and 4.14 but overall slightly reduced from 4.10 to 4.05. However, the inventory turns of each month changed dramatically between October and November. The days of inventory carrying forward was reduced from 71 days in August to 62 days in September and to 52 days in October. However, it dramatically bounced back to 93 days in November. Therefore, the inventory turn was improved from 5.14 turns in August to 7.00 turns in October. As a result of the dramatic increase of days of inventory carrying forward, the inventory turn was decreased to 3.91 at the end of November.

The dramatic change of inventory level from October to November was because the actual demands of October and November were considerably less than the rolling S&OP demand forecasts M2 and M1. As discussed in the previous section, all of the three months' rolling S&OP demand forecasts M2, M1 and M0 have a significant impact on the inventory holding level. In October 2009, 151,691 units of inventory were depleted. However, the M2 demand forecast was

159,668 units, 159,421 units for M1 forecast and 156,877 units for M0 forecasts. Because the required supply lead time is about three months, the inventory for October 2009 was planned for and ordered in August based on the demand forecast M2. About 8,000 units of unnecessary inventory was ordered for October and accrued to November. At the same time, the actual demand of November 2009 was 172,338 units while the M2 forecast was 184,930 units and the M1 forecast was 184,336 units. About 12,000 units of unnecessary inventory were ordered for November 2009. Because the demands of both October and November were considerably behind M2 and M1 demand forecasts, the inventory level at the end of November 2009 dramatically increased to 93 days from 52 days in October and the inventory turns reduced from 7.00 to 3.91.

After reviewing the first three months after the implementation of the S&OP process, the S&OP team believed that the increased level of inventory was caused by three reasons. First of all, the demand forecast accuracy was not accurate enough to give sufficient support to inventory requirement planning. The forecast errors are shown in Table 5.7.

Secondly, the cycle stock volume was based on the demand forecast of each period. When the active demand is excessive, the predetermined cycle stock is not enough to cover the demand of such a period. Finally, the safety stock level was inappropriate. As previously discussed, the supply chain needs to calculate the safety level of each SKU based on the demand forecasts of the next period and forecast accuracy.

Thirdly, the customer service level of the first three months was also reviewed. Theoretically, the average customer service level is improved when the overall inventory level is increased because the higher inventory level represents higher inventory availability. However, the review of the results of the three months included in Table 5.7 shows that the customer service level is not always improved along with an increase in the overall level of inventory. When the days of inventory carry forward increased from 52 days to 93 days in November, the overall customer service level decreased from 99.39% in October to 97.83% in November.

There are always two possible consequences when the demand forecast is not as accurate as expected. When the actual demand is in excess of the forecast, the situation of stock shortages could possibly occur. On the other hand, when the actual demand is less than the forecast, unnecessary inventory will be purchased (Wacker & Lummus, 2002).

In summary, Stage 1 of the S&OP process did work in terms of reducing inventory levels until the constantly inaccurate demand forecasts negatively influenced the inventory levels. Further modifications therefore need to be made to the S&OP process in order to improve both demand forecast accuracy and inventory efficiency.

5.7 S&OP Process Stage 2 and the Review

5.7.1 Progressing the S&OP Process to Stage 2

The S&OP team decided to modify the S&OP process based on the review of Stage 1 and move on to Stage 2. The following changes took effect from the beginning of December 2009.

First of all, it was necessary to complete the data collection step earlier than in Stage 1 in order to improve the efficiency of the whole S&OP process. One of the disadvantages of Stage 1 was that the Executive's S&OP Meeting was held on the 10th business day of each month. The procurement process of the A Class SKU's to be discussed at the meeting had to be postponed until after the meeting was finished. It was important to undertake the procurement process as early as possible each month, especially for the A Class SKU's and the related product family, because of the importance of these SKU's to the company and the fixed supply lead time.

In order to bring forward the data collection process, the Information Technology (IT) department of the company developed an internal website called Intranet. All of the data requested by the S&OP process, including detailed sales data, inventory information, etc., could be viewed via the Intranet on a real time basis. Therefore, the necessary information could be reported to the sales team and supply chain team on the last business day of the month.

The second step, unconstrained demand forecast, was brought forward because the data collection was completed on the last business day of the month. The sales team was required to accomplish the unconstrained sales forecast by the second business day of the month. The cut-off time for the sales forecast was set up as 5:00 pm of the second business day of each month. No forecast data was able to be entered into the system by the sales mangers after that time until after the Executive's S&OP meeting. This is in order to make sure the unconstrained sales forecast was accomplished on time.

Another big change to the demand forecast process was setting up a new sales account called National Chain (NC) in order to separate the sales of national chain customers from the other wholesale customers. The other sales accounts of the previous branches were called Independent sales accounts. The NC sales team would be responsible for the sales performance and forecast of the NC account. The national chain customers to be included in NC account mainly included the two major national supermarket chains in Australia, Woolworths and Coles. This change took into account features of the NC business.

First of all, the sales of national chain customers were actually managed by an individual sales team - the national chain team. At the same time, the forecast volumes belonging to the NC customers were segmented as part of the sales volume of each branch of the company based on geographic difference. Secondly, the sales revenue generated by the national chain customers took into account around 40% of the business in 2009. Thirdly, each of the national chain customers always place orders for all of their DC's and stores through the same procurement team. Last but not least, usually all of the retail stores of the same national chain run the same promotion at the same period and always sell the same SKU at the same price nationwide. It therefore made it possible for each sales team to be accountable for their corresponding sales performance and forecast accuracy by forecasting the NC sales separately.

The major improvement to the third step - supply requirement planning - was redefining the safety stock policy of the company. Previously the company kept a certain amount of safety stock for each SKU. The amount of safety stock was usually decided to equal the average inventory requirement per month. After reviewing the demand and supply performance of the first month after implementing the S&OP process, the management decided to change the way the company calculated their safety stock level according to MBCG's advice.

From December 2009, the safety stock of each product family will be calculated based on three factors. First of all, the safety stock needed to be calculated based on Equation 2.4 and 2.5 discussed in Chapter 2, which takes into account the required customer service level, standard deviation of the demand forecast and the length of the supply lead time. Secondly, the safety stock calculation needed to be based on the inventory requirements of the following periods due the seasonality of the demands during the year. Thirdly, it was necessary to set up the replenishment period unit as one week. More than 80% of the products of the company were imported from overseas. The most cost efficient way of transportation is via sea freight shipment. It was also the safest method for the goods due to the long travelling distance. The new safety stock of the A Class SKU's still needed to be discussed and approved via the Executive's S&OP Meeting.

Compared with Stage 1, the only change to the fourth step - the Pre-Meeting - is including the NC sales manager in the discussions. After the Pre-Meetings, the below topics were added to the agenda for the Executive's S&OP Meeting in addition to the meeting agenda of Stage 1.

- The NC account was added to the rolling S&OP demand forecasts analysis. However, it would start from January 2010 due to the fact that the NC demand forecast has only been separated from other sales accounts since December 2009.
- The new safety stock level of the A Class SKU's needed to be discussed at the meeting.
- It was important to reduce the demand forecast volume accordingly if the supplier would not be able to fulfil all of the projected demands.

The Executive's S&OP meeting was held on the eighth business day of the month from December 2009. The meeting was able to be brought forward two days because of the efficiency improvement at the data collection and demand forecast steps. The meeting at the second stage discussed the following topics and made decisions accordingly.

1. The N+1 period demand forecast accuracy review as discussed in the previous section. The national chain account forecast accuracy was also reviewed separately from the January 2010 meeting. The NC sales team would be responsible for the sales performance and forecast for the business related to the key national chain customers.
2. The comparison between the patterns of systematic demand forecast and marketing intelligence was reviewed. Regarding the A Class SKU's which the sales team and supply chain team could not achieve agreement was focused on. The demand and supply manager explained the trend and level of the future demands of these SKU's from the statistical point of view. The sales general manager also explained why the sales forecasts appear significantly different against the statistical forecast. Normally the difference was due to promotions if the sales forecast is higher than the statistical forecast. The managing director made the judgmental decision that the supply chain team should adjust its requirement plan and try to fulfil the projected excessive demand.
3. The inventory projection of each A Class SKU for the next four months based on the unconstrained sales forecast was also reviewed at the meeting. This was in order to understand where the future demand might not be fulfilled

4. The review of the sales performance of the current month.
5. The safety stock level of the A Class SKU's and the related product family was discussed and the respective safety stock levels were determined as below in Table 5.8. The figures represent the number of weeks of inventory requirement. It needed to be reviewed every year according to the changes in the required customer service level, consensual demand forecast accuracy and supply lead times.

SKU	Product Family	Safety Stock Level (number of weeks)
CT1Y	CT	5
CT7Y	CT	5
FR7B	FR	4
GA1Y	GA	6
GA7Y	GA	6
GF7X	GF	6
IL4Y	RTD	4
JA7X	JA	4
MB4Y	RTD	4
MG3X	MG	6
MG5F	MG	6
MI1F	MI	6
MI5F	MI	6
MI7F	MI	6
MI7G	MI	6
ML4X	RTD	4
MS4Y	RTD	4
ON7A	ON	4
P75B	PH	5
PA7X	PA	4
SR1Y	SR	5
SR7X	SR	5
SY7X	SY	8

Table 5.8: Safety Stock Levels of A Class SKU's and Relevant Product Family (Empirical data collected)

5.7.2 The Review of Stage 2

It is always beneficial to review the business process in order to find out what works for the company and what does not. Stage 2 of the S&OP process was reviewed at the end of February 2010 when the process had been implemented for six months. The demand and supply performances were reviewed from three perspectives as at the end of Stage 1: demand forecast accuracy, inventory efficiency and customer service level.

First of all, the rolling S&OP demand forecast accuracy for the period between December 2009 and February 2010 was reviewed. Although the rolling demand forecasts of December 2009 was slightly less accurate that the same figures of November, the accuracy of the three rolling demand forecasts was gradually improved from December 2009 to February 2010. As illustrated in Table 5.9, the demand forecast accuracy M2 was improved from 48.82% where it was in December 2009 to 34.59% in January 2010 and 27.14% in February. The demand forecast M1 was improved from 41.30% to 34.03% and then 26.25%. The demand forecast M0 was also improved from 34.25% to 31.22% then 24.82% in February 2010. The rolling S&OP demand forecast accuracy also indicated that the company had started focusing on not only the forecast accuracy of the current month, but also the forecast of the following two months.

The further detailed analysis of the rolling demand forecast accuracy of each sales account indicated that the significant improvement of the demand forecast accuracy was due to the separation of the NC sales accounts from the Independent sales accounts. Firstly, the right sales teams were held accountable for their sales forecasts. Previously the sales activities to the national chain customers were conducted by the NC sales team but the regarding sales forecasts were generated by the sales team of the branches based on their geographic differences. Secondly, from a statistical point of view, the more segments the overall forecast is integrated from, the more accurate the forecast will be. The increase of a number of sales accounts increased the accuracy of the overall demand forecasts of the whole company.

The inventory performance of Stage 2 was also reviewed. The improvement of demand forecast accuracy does not influence the inventory of the company immediately because of the long and inflexible lead time. However, Table 5.9 still shows a good trend that the inventory performance of the company was slowly improved along with the improvement in the demand forecast accuracy. The MAT average inventory performance indicators best illustrate the trend of the inventory improvement. As shown in Table 5.9, the MAT average days of inventory carrying forward were improved from 90 days where it was at the end of November 2009 to 89 days in December, 87 days in January 2010 and 86 days in February. As a consequence, the MAT inventory turns were improved from 3.91 to 4.09, 4.21 and then 4.26 for the same periods. However, the inventory efficiency was still below the expectation from the management.

The inventory levels of each individual month further indicate the relationship between the sales and inventory performances as well as the impact of the new safety stock policy. The days of inventory carrying forward were decreased from 93 days where it was at the end of November 2009 to 83 days at the end of December and then decreased further to 72 days at the end of January 2010. The improvement in inventory efficiency in December was mainly caused by the new replenishment cycle policy. The inventory replenishment in December was planned in October when the company had just implemented the new replenishment cycle policy. For most of the A Class SKU's, the replenishment cycle was reduced from one month to one week and therefore the average cycle stock was reduced. However, the inventory level was not reduced as expected due to two reasons. Firstly, the under performance of the November sales generated excessive stock which was accumulated into December. Secondly, the rolling S&OP demand forecasts M2 and M1 of December were significantly higher than the actual demand. Although the demand forecast M0 were about 10,299 units lower than the actual demand, substantial excessive inventory was still created at the end of December. The low demand forecast M0 of December in fact had some possible impact for January and February 2010 in terms of reducing the excessive inventory though.

In January 2010 the days of inventory carrying forward were improved from 88 days to 72 days and the inventory turns were increased from 4.10 to 5.10. The major reason for this improvement is due to the increase of rolling the S&OP demand forecast accuracy. The M2 forecast error of January was 34.59% and 34.03% for M1 and 31.22% for M0. This is the first time all of the three rolling S&OP demand forecast errors are lower than 35%. The difference between the total rolling demand forecast and the actual demand in units was also improved. The M2 forecast was only about 28,512 units more than the actual demand in January and this figure was 44,608 units. The M1 forecast was only 10,958 units more than the actual demand, which was improved from 40,335, identical to that in December 2009. The M0 forecast was 11,822 units than the actual demand and in December the M0 was 10,299 less than the actual demand.

In February 2010, the inventory performance had not changed favourably. The days of inventory carrying forward increased from 72 days to 89 days and the inventory turns decreased from 5.10 to 4.10. Once of the major reasons for this was that the actual demand in January was 28,512 units less than the M2 forecast, 10,958 units less than the M1 forecast and 11,822 units less than the M0 forecast. As a result, the inventory value at the end of January was close to $10 million. At the same time, the peak sales season finished when moving into February every year and February is always the month with lowest demand and inventory requirement of the whole year. The inventory replenishment of January was planned in November 2009 when the company was still using the average monthly inventory requirement as the safety stock level. Obviously excessive safety stock was already ordered for the end of January 2010 because the inventory requirements of February usually account for less than 4% of the annual total. Based on Table 5.3, in 2008 the inventory requirement of February was only 51,264 units and the average monthly requirement was 108,675 units in 2008. Besides, the actual inventory requirement in January was 28,512 less than the M2 forecast. The difference between the M2 forecast and the actual requirement was also accumulated into February. As a consequence, the inventory performance of February 2010 became worse than January.

The management also reviewed the customer service levels of the second stage. Table 5.9 indicates that the CSL's between December 2009 and February 2010 were not achieved. Although the average overall CSL of this period was 97.17% which was not far from the customer service level of 98% requested by the management, the CSL of A-Class SKU's was some distance from the management's expectation. The average CSL of A-Class SKU of December 2009 was 90.95%, and slightly improved to 94.24% in January 2010 and 93.68% in February 2010. The average of these three months was only 92.96%. In other words, more than 7% of the sales orders of A-Class SKU's were not fulfilled. Since the A-Class SKU's represent more than 80% of the company's business, the loss of sales was substantial during this period.

KPI	Dec-09	Jan-10	Feb-10
Cost Of Goods Sold	$ 7,647,387	$ 6,063,564	$ 2,845,157
Inventory Value	$ 14,263,892	$ 9,992,458	$ 12,976,288
Days of Inventory Carrying Forward	88	72	89
Inventory Turns	4.13	5.10	4.10
MAT Days of Inventory Carrying Forward	89	87	86
MAT Inventory Turns	4.09	4.21	4.26
A Class Out of Stock Days	38	23	24
A Class Customer Service Level	90.95%	94.24%	93.68%
B Class Out of Stock Days	5	26	14
B Class Customer Service Lev	99.52%	95.41%	97.41%
C Class Out of Stock Days	35	45	36
C Class Customer Service Level	98.72%	97.22%	97.66%
Overall Out of Stock Days	78	94	74
Overall Customer Service Level	98.14%	96.36%	96.99%
M2 Forecast Error	48.82%	34.59%	27.15%
M1 Forecast Error	41.30%	34.03%	26.25%
M0 Forecast Error	34.25%	31.22%	24.82%
M2 Demand Forecast per Unit	185,504	152,509	74,187
M1 Demand Forecast per Unit	181,231	134,955	78,772
M0 Demand Forecast per Unit	130,597	135,819	74,864
Total Actual Demand per Unit	140,896	123,997	70,880

Table 5.9: Demand and Supply KPI Review December 2009 - February 2010 (Empirical data collected)

The more specific sales forecast accuracy review against the A Class SKU's indicates why the CSL's decreased in Stage 2 of the S&OP process. Table 5.10 demonstrates the comparison between the actual demand and the rolling S&OP demand forecast of each A Class SKU for each month of Stage 2. Firstly, the sales of some SKU's were significantly in excess of S&OP rolling forecasts. The safety stock was not sufficient to fulfil the unexpected massive demands. For example, the sales volume of SKU CT7Y was equal to 220% of the M2 or M1 demand forecast. The additional sales drained all inventory of this SKU in January and as a consequence the company was not able to fulfil customer orders for a few days until the next replenishment arrived. Secondly, the sales of some SKU's had been constantly better than the rolling demand forecasts.

The demands of SKU GF7X were significantly higher than all rolling forecasts in December 2009, January and February 2010. The constant excessive sales performance caused a stock shortage of this SKU. The sales general manager suggested that the excessive demands were caused by the intensive promotional and price incentive activities around the Christmas and New Year periods. It was also suggested that the demands from NC accounts had been driving the excessive demands.

Table 5.11 demonstrates the comparison between the actual demand and the rolling S&OP demand forecast of NC account of each A Class SKU for each month of Stage 2. The figures included in Table 5.11 indicate that the strong demands from NC accounts were driving the excessive demands of the company. The NC account sales manager explained that usually they were only advised by the NC customers six weeks prior to the promotions. It seemed that the company did not have any choice but support the NC promotions because the two major supermarket chains represent more than 40% of the company's business.

	2 M	1 M	0 M	2 M	1 M	0 M	2 M	1 M	0 M
SKU	**Dec-09**	**Dec-09**	**Dec-09**	**Jan-10**	**Jan-10**	**Jan-10**	**Feb-10**	**Feb-10**	**Feb-10**
CT1Y	107%	119%	92%	166%	166%	129%	83%	92%	87%
CT7Y	83%	74%	79%	220%	220%	138%	86%	98%	98%
FR7B	93%	150%	150%	150%	158%	153%	74%	62%	93%
GA1Y	99%	86%	86%	60%	60%	63%	159%	101%	82%
GA7X	87%	86%	90%	87%	87%	70%	76%	85%	92%
GF7X	171%	161%	161%	214%	205%	234%	154%	165%	151%
IL4Y	67%	97%	97%	66%	68%	72%	130%	147%	130%
JA7X	50%	72%	72%	90%	93%	89%	92%	82%	61%
MB4X	113%	188%	188%	43%	42%	47%	51%	46%	84%
MG3X	101%	89%	89%	83%	93%	83%	182%	222%	192%
MG5O	82%	95%	95%	95%	95%	82%	91%	123%	112%
MI1F	62%	71%	71%	78%	99%	102%	77%	45%	117%
MI5F	73%	85%	99%	104%	108%	118%	99%	73%	85%
MI7G	99%	122%	122%	122%	122%	99%	157%	118%	109%
ML4X	92%	131%	131%	131%	131%	92%	39%	37%	43%
MS4Y	102%	102%	66%	47%	47%	54%	138%	159%	134%
ON7A	33%	38%	33%	119%	119%	119%	33%	33%	38%
P75B	75%	75%	75%	60%	92%	61%	194%	272%	132%
PA7X	67%	88%	88%	95%	109%	98%	98%	95%	109%
SR1Y	77%	66%	66%	107%	84%	166%	111%	111%	310%
SR7X	82%	84%	84%	82%	82%	83%	42%	42%	43%
SY7X	92%	105%	105%	78%	64%	42%	42%	78%	64%

Table 5.10: Overall Actual Demand vs. S&OP Forecasts December 2009 - February 2010 (Empirical data collected)

	2 M	1 M	0 M	2 M	1 M	0 M	2 M	1 M	0 M
SKU	**Dec-09**	**Dec-09**	**Dec-09**	**Jan-10**	**Jan-10**	**Jan-10**	**Feb-10**	**Feb-10**	**Feb-10**
CT1Y	233%	233%	233%	253%	253%	163%	202%	202%	202%
CT7Y	104%	132%	132%	216%	216%	139%	98%	98%	104%
FR7B	125%	175%	175%	125%	125%	125%	130%	130%	156%
GA1Y	132%	132%	132%	85%	60%	26%	53%	82%	109%
GA7X	73%	79%	79%	62%	59%	66%	84%	95%	95%
GF7X	370%	370%	370%	258%	258%	259%	292%	269%	269%
IL4Y	94%	94%	94%	70%	70%	76%	136%	136%	136%
JA7X	63%	65%	65%	139%	133%	133%	117%	117%	154%
MB4X	124%	124%	124%	46%	46%	56%	86%	86%	86%
MG3X	81%	102%	102%	120%	120%	120%	101%	101%	101%
MG5O	86%	86%	86%	76%	76%	78%	162%	81%	81%
MI1F	72%	46%	46%	14%	540%	18%	180%	12%	16%
MI5F	87%	108%	108%	152%	152%	152%	120%	69%	69%
MI7G	101%	121%	121%	141%	141%	163%	166%	128%	119%
ML4X	124%	124%	124%	140%	140%	140%	0%	0%	0%
MS4Y	81%	95%	95%	29%	29%	33%	184%	184%	184%
ON7A	76%	93%	93%	53%	53%	53%	23%	23%	46%
P75B	63%	63%	63%	35%	29%	20%	201%	279%	140%
PA7X	101%	101%	101%	71%	71%	88%	218%	218%	218%
SR1Y	64%	54%	54%	71%	52%	143%	110%	110%	405%
SR7X	72%	72%	72%	71%	71%	71%	55%	55%	55%
SY7X	63%	88%	88%	112%	64%	35%	0%	0%	0%

Table 5.11: NC Actual Demand vs. S&OP Forecasts December 2009 ~ February 2010 (Empirical data collected)

The review at the end of February 2010 suggested a few problems still existed in the S&OP process. First of all, the demand forecast accuracy of NC account had significant influence on the overall demand forecast accuracy. The management needed better methods for dealing with the forecasts and expected demands from NC customers. Secondly, most sales managers did not pay enough attention to the S&OP rolling demand forecasts M2 and M1. The forecast errors of M2 and M1 were significantly higher than the M0 forecast. Last but not least, the demand forecasts were not tailored according to the inventory planning and supply constraints, although it was already indicated in the Executive S&OP meeting that the company might not be able to supply all of the projected demands.

5.8 S&OP Process Stage 3 and the Review

5.8.1 Stage 3 of the S&OP Process

Stage 3 was modified in order to improve the problems being found in Stage 2. The changes focused on demand forecast, especially the demand forecast of NC accounts and the balancing act between demand and supply. Only three changes were made for Stage 3 compared with Stage 2.

In the first step data collection, the only change is that the NC accounts were divided into different NC states accounts based on the geographic difference. The sales activities were still managed by the sales team but they needed to forecast the demand of each NC state account separately. This helped the NC teams to generate and review their forecasts more specifically.

The only change to step 2, unconstrained demand forecasting, is that the NC sales team forecast the different NC state sales accounts first and then integrated them together. The multiple NC state accounts helped the NC team forecast the demands more specifically and improve the forecast accuracy. However, when the S&OP meeting reviewed the sales performance and demand forecast accuracy, the NC account would be still considered as one account because it was managed by the same team and each customer of this account is the same customer nationwide.

In the third step, inventory requirement planning, the supply chain planned for inventory based on the new cycle stock and safety stock strategies decided in Stage 1 and Stage 2. The change to the demand forecast step did not have any impact on the requirement planning process because it was only reviewed at the overall national level.

In the fourth step - Pre-Meetings, the communication between demand and supply manager and sales managers was enhanced, especially the communication with the NC sales team. In Stage 1 and Stage 2 of the S&OP, the communication between demand and supply was not successful. Although the demand forecasts and supply constraints of A Class SKU's were discussed between the supply chain, marketing and sales teams, the purpose of balancing demand and supply was never achieved.

The sales team was never keen to reduce their sales expectation or cancel or postpone the sales activities although they were fully aware of the potential stock issues. The marketing team also never wanted to give up or delay the promotion either. Although the disagreement was brought to the Executive S&OP Meeting for judgement by the senior management, the decision almost always leaned towards the unconstraint demand forecast and the supply chain team was instructed to try their utmost to assist achieving the demand forecast. Two main factors drove the senior management to make such decisions. Firstly, the company normally needed to prepay the costs associated with sales activities including advertising and the reimbursement to the major customers for the discounted prices. Although sometimes the customers, especially the NC customers, only gave the company six weeks' notice of running a promotion, the company still needed to settle the costs which were responsible by the company prior to when the promotion was confirmed. If the company cancelled the promotion, the costs of advertising and reimbursement would be a total financial loss to the company. Secondly, some of the marketing promotions were planned for special occasions. The sales opportunities of those would be lost once the occasions finished.

However, the negative consequence of this decision was very obvious according to the demand and supply performance review concluded by Table 5.9. The CSL of Stage 2 was noticeably reduced compared with previous periods. In order to reduce the excessive inventory level, the replenishment strategies were reviewed and improved. However, the new strategies were based on the statistical analysis of the demand forecast accuracy. Although the overall demand forecast accuracy was improved by combing the statistical forecast and causal forecast methods, the demand forecast accuracy of a few A Class SKU's was disappointing. Whilst the excessive inventory was caused when the actual demand was less than the demand forecast, the CSL was also reduced when the actual demand was significantly higher than the demand forecast.

The sales teams and marketing team started to realise that it was necessary to reduce their demand expectations according to the inventory requirement planning in the case that it was not possible to fulfil all of the recently increased demand expectations. If the company insisted to pursue the demands without taking into account the supply constraints, the loss to the company would not only be just the lost opportunities of sales but also the investment on the promotional activities. The Pre-Meetings decided to discuss the solution at the Executive's S&OP Meeting.

Only a few changes were made to the Executive's S&OP Meeting in Stage 3. It was proven that the new inventory planning strategies implemented in Stage 1 and Stage 2 had possible impacts on the overall inventory performance. However, it was necessary to improve the demand forecast accuracy further in order to increase the CSL and improve the inventory performance further.

Two changes were made to the meeting in Stage 3. Firstly, the NC sales manager was invited to attend the Executive's meeting from March 2010 onwards due to the importance of the NC business to the company. The NC sales manager was able to explain the enquiries regarding the NC demands and provide suggestions and possible solutions. Secondly, the meeting would discuss alternative plans for the A Class SKU's which could possibly encounter stock shortage in the new few months based on the unconstrained demand forecasts. The other part of the meeting agenda remained the same as in Stage 2.

The discussion of an alternative plan was based on the simulation models developed by the supply chain team. The simulation models took into account multiple scenarios of demands and inventory projections, which could possibly occur in the next three or four months. The senior management team then made the decision based on the stimulation model analysis whether to adjust the projected demand according to the supply constrain and how to adjust it. The meeting attendees took action on the tasks which were assigned to them after the meeting in order to achieve the optimal output of the S&OP process.

5.8.2 Demand and Supply KPI Review of Stage 3

It is always important to review the KPI's after implementing a new business process on a periodic basis. The review of the results of demand and supply KPI's for the period between March and May 2010 were concluded in Table 5.12 below.

First of all, the demand forecast accuracy was fluctuating within an acceptable range. The forecast errors of all kinds of S&OP rolling forecasts were between 28% and 36%. Although the demand forecasts were not as accurate as February, the difference of the forecast error between M2, M1 and M0 has been significantly reduced. The forecast accuracy of the three months was much more consistent than any previous periods. In terms of the comparison between demand forecasts and actual sales, the overall difference between all of the rolling forecasts and the actual demands was improved and acceptable to the management.

The most direct impact of the improvement of demand forecast accuracy was in the reduction of the inventory level. The days of inventory carrying forward improved from 89 days where it was at the end of February to 86 days in March and gradually reduced to 82 days at the end of May. The inventory turns increased accordingly from 4.10 in February to 4.47 in May. The MAT Average days of inventory carrying forward improved from 86 days in February to 84 days in March, 83 days in April and 80 days in May. The MAT average inventory turns increased from 4.26 in February to 4.36 in March, 4.42 in April and 4.55 in May.

KPI	Mar-10	Apr-10	May-10
Cost Of Goods Sold	5,643,214	3,604,165	4,113,846
Inventory Value	11,088,970	12,594,000	12,887,000
Days of Inventory Carrying Forward	86	86	82
Inventory Turns	4.25	4.24	4.47
MAT Average Days of Inventory Carrying Forward	84	83	80
MAT Average Inventory Turns	4.36	4.42	4.55
A Class Out of Stock Days	-	2	-
A Class Customer Service Level	100.00%	99.52%	100.00%
B Class Out of Stock Days	-	8	16
B Class Customer Service Level	100.00%	98.65%	97.18%
C Class Out of Stock Days	64	12	10
C Class Customer Service Level	96.39%	99.29%	99.38%
Overall Out of Stock Days	64	22	26
Overall Customer Service Level	97.74%	99.19%	98.99%
M2 Forecast Error	33.77%	32.41%	35.62%
M1 Forecast Error	33.23%	33.77%	35.73%
M0 Forecast Error	34.59%	30.13%	28.56%
M2 Demand Forecast in Unit	110,251	104,867	99,582
M1 Demand Forecast in Unit	110,935	108,377	97,625
M0 Demand Forecast in Unit	107,805	103,014	93,242
Total Actual Demand in Unit	125,481	82,755	86,278

Table 5.12: Demand and Supply KPI Review March - May 2010 (Empirical data collected)

Compared with the previous period, the customer service levels were significantly improved. The CSL of A Class SKU's was dramatically increased from 93.68% in February to 100% in March. This is not only because of the improved demand forecast accuracy, but also the excessive inventory accumulated from February into March. This figure decreased slightly to 99.52% in

April but returned to 100% in May. The overall CSL was fluctuating between 97.74% and 99.19% within these three months and the average overall CSL was better than 98% which was the expectation from the senior management. Apart from the excessive inventory level left from February, the excellent CSL achievement was driven by the improved rolling S&OP demand forecast accuracy and better communication between the marketing, sales and supply functions of the company.

However, the new strategy balancing demand and supply did cause some issues to the company. When the management team decided to limit the overall demand to supply constraints, the available inventory of certain SKU's was not split properly between the sales accounts. That caused arguments of who should get the stock and how much. In early April 2010 one of the NC customers could not replenish its stock for one of the A Class SKU's for its major promotion prior to the Easter holiday period. A stock shortage situation occurred in some of its supermarkets in the middle of the promotion. At the same time, plenty of stock of the same SKU was supplied to another Independent customer who still had sufficient stock sitting in its warehouse. The consequence to the company was the angry customer and the negative effects on this brand.

5.9 S&OP Process Stage 4 and the Review

5.9.1 Stage 4 of the S&OP Process

Because most of the decisions and strategies from Stage 3 seemed to be working very well and the KPI's results at the end of May 2010 were very encouraging, the S&OP team decided to keep the process the same as Stage 3 except for one change. For those A Class SKU's which could potentially have stock shortages in the next period, the stock of this SKU would be allocated to each sales account according to their revised demand forecast based on the supply constraints. If there was already a promotional activity fixed for this SKU with some customer, especially the NC customer, the inventory required by the promotion should be prioritised.

After the meeting, each sales manager needed to allocate the stock to their customers and communicate the available inventory quantities to the customers respectively. The customer could then place the orders to Company ST accordingly. When the stock allocation was well organised and communicated between sales accounts and customers, the negative influence of the stock shortage was minimised.

5.9.2 Review of Stage 4

The demand and supply performance of Stage 4 was also reviewed from three perspectives: inventory performance, demand forecast accuracy and customer service level. The results of the review of stage four are concluded in Table 5.13 as below.

The rolling S&OP demand forecast accuracy was substantially improved compared with the previous periods. The M2 forecast errors increased from 29.87% to 21.32% within the three months gradually. The M1 forecast error was improved from 30.02% to 20.18% and the M0 forecast error was improved from 22.33% to 14.76% from June to August 2010. If comparing the three rolling forecasts for the same months, it is easily found that the difference of forecast errors was not substantial. In other words, the sales team did pay more attention to the M2 and M1 demand forecasts and achieved satisfying results.

The improvement of inventory efficiency is the logical consequence of the improvement of demand forecast accuracy. The days of inventory carrying forward level improved from 82 days in May to 77 days in June. This figure increased slightly to 80 days in July but improved again to 63 days in August. The inventory turns improved accordingly from 4.47 in May to 4.76 in June. It decreased to 4.58 temporarily in July and increased again in August to 5.83. The MAT average inventory performance seemed to be improving more constantly. The MAT average days of inventory carrying forward increased from 80 days in May to 79 days in June, 78 days in July and

77 days in August. The MAT average inventory turns also increased from 4.55 in May to 4.64 in June, 4.67 in July and 4.71 in August. Both inventory turns and MAT average inventory turns achieved the target requested by the company.

The customer service level was also improved. The CSL of the A Class SKU had stayed at 100% for the three months. The overall CSL of the three month period had also been higher than 98%. The excellent CSL performance and inventory efficiency indicated that the balance between demand and supply of the company had been significantly improved.

KPI	Jun-10	Jul-10	Aug-10
Cost Of Goods Sold	4,056,083	5,471,124	5,052,651
Inventory Value	13,066,000	14,332,807	12,440,915
Days of Inventory Carrying Forward	77	80	63
Inventory Turns	4.76	4.58	5.83
MAT Days of Inventory Carrying Forward	79	78	77
MAT Inventory Turns	4.64	4.67	4.71
A Class Out of Stock Days	-	-	-
A Class Customer Service Level	100.00%	100.00%	100.00%
B Class Out of Stock Days	1	4	4
B Class Customer Service Level	99.83%	99.33%	99.30%
C Class Out of Stock Days	20	27	11
C Class Customer Service Level	98.82%	98.41%	99.32%
Overall Out of Stock Days	21	31	15
Overall Customer Service Level	99.22%	98.85%	99.42%
M2 Forecast Error	29.87%	24.68%	21.32%
M1 Forecast Error	30.02%	23.27%	20.18%
M0 Forecast Error	22.33%	15.53%	14.76%
M2 Demand Forecast per Unit	88,817	108,933	105,727
M1 Demand Forecast per Unit	91,073	106,822	87,542
M0 Demand Forecast per Unit	77,244	102,198	83,242
Total Actual Demand per Unit	79,207	100,168	95,553

Table 5.13: Demand and Supply KPI Review June - August 2010 (Empirical data collected)

5.10 Inventory Performance during the First Year of the S&OP Process

The overall demand forecast and inventory performance of the company was significantly improved after implementing the S&OP process to the company properly. The specific improvements have already been illustrated by the above discussions and tables. Overall the rolling demand forecast errors M2, M1 and M0 improved from 50.31%, 47.71% and 41.74% in August 2009 to 21.32%, 20.18% and 14.76% in August 2010. The inventory efficiency was also improved. The MAT average days of inventory carrying forward improved from 89 days in August 2009 to 77 days in August 2010 and the MAT average inventory turns improved from 4.10 to 4.71 for the same period. Meanwhile, the improvement of overall customer service level was also noticeable. This figure was improved from 98.33% in August 2009 to 99.42% in August 2010.

Figures 5.2, 5.3 and 5.4 best demonstrate the link between inventory effectiveness and efficiency and the performances of demand forecasts accuracy and other business improvements the company put in place. Figure 5.2 indicates that the accuracy of all of the three S&OP rolling demand forecasts started to be constantly and gradually improved from April 2010 after Stage 3 of the S&OP process was implemented in the business. From Stage 3, not only was 'the proper' demand forecasting method implemented to the business, but also the company started trying to balance the demand and supply on a mutual basis.

Figure 5.3 indicates that the inventory level had been gradually improved since November 2009. The company started the new cycle stock strategy in September 2009. It took two weeks to see the effect because the supply lead time is two months. The overall inventory level started meeting the 4.5 MAT average inventory turns target which was required by the senior management within 4 months of the introduction of the new safety stock strategy being implemented. The overall inventory level had been gradually improving since then and average inventory turns had never been less than 4.5 MAT again.

The fluctuation in customer service level for this period is demonstrated by figure 5.4. The customer service levels of both A Class SKU and all SKU's had been fluctuating dramatically between September 2009 and February. During this period, the new inventory replenishment strategies were implemented but the new demand forecasting methods were not implemented properly. However, the most suitable methods of forecasting demands and balancing demand and supply were implemented in March 2010 and the customer service levels had been steady and above 98% since then.

To sum up, the new strategies of inventory replenishment, demand forecast and balancing the demand and supply, had a very positive impact on the inventory control of the company. Both inventory level and customer service level were significantly improved after the new strategies were properly implemented and adjusted to fit the company.

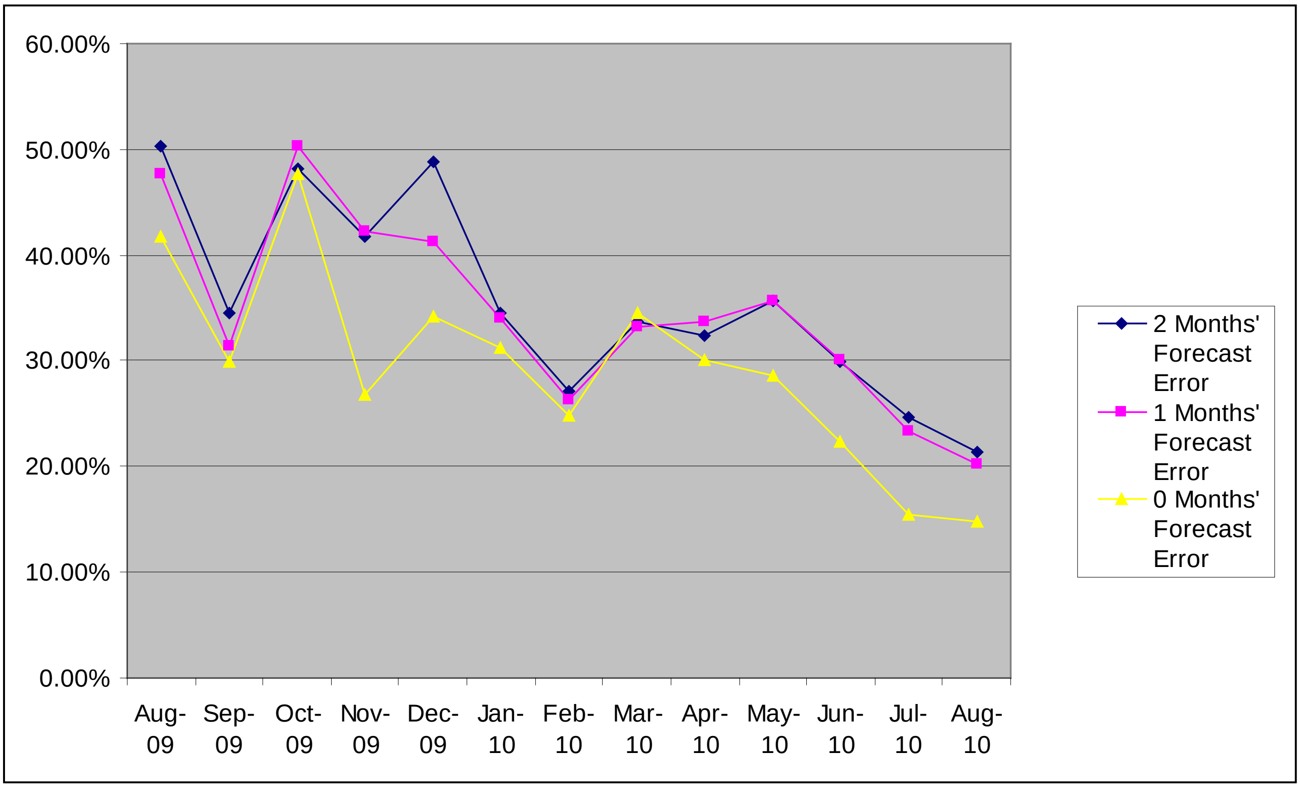

Figure 5.2: Rolling S&OP Demand Forecasts August 2009 - August 2010 (Empirical data collected)

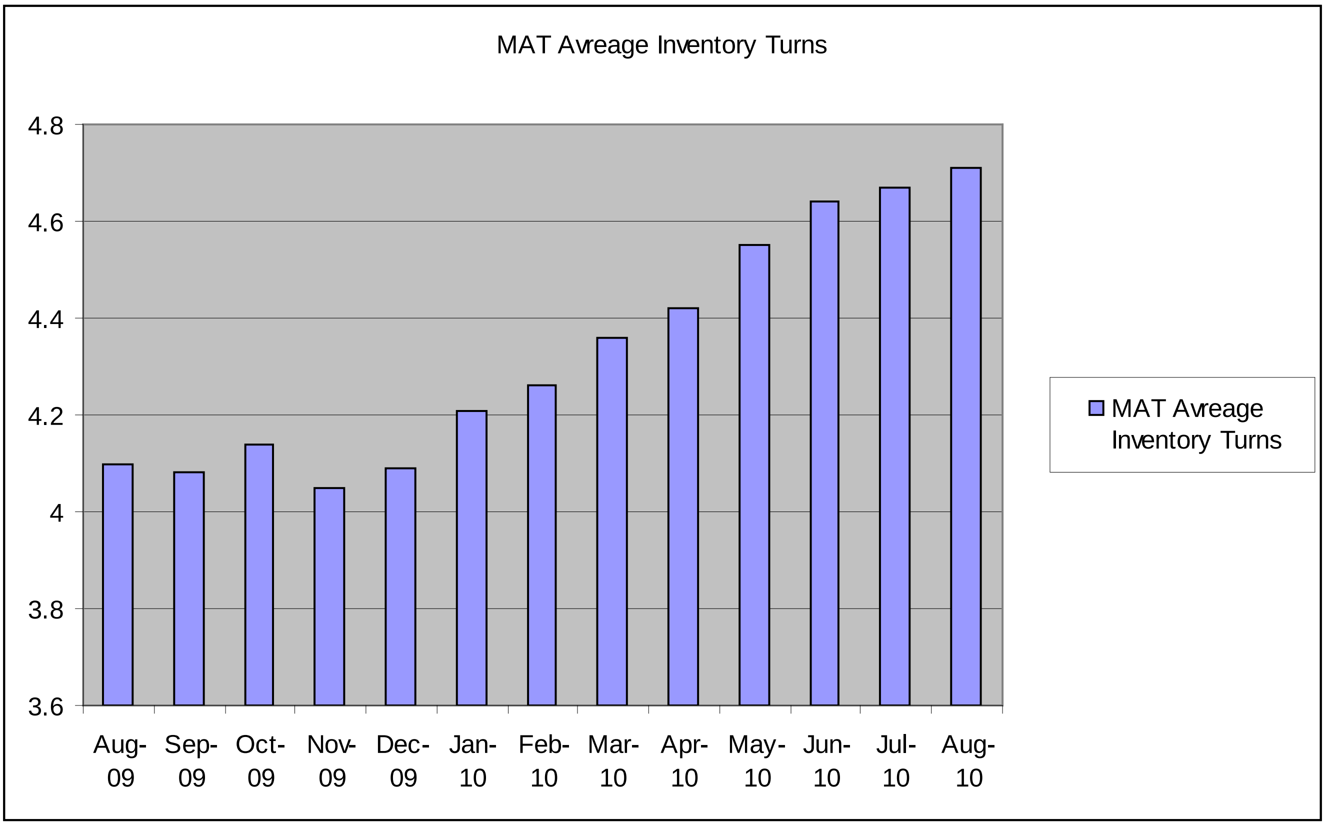

Figure 5.3: MAT Average Inventory Turns August 2009 - August 2010 (Empirical data collected)

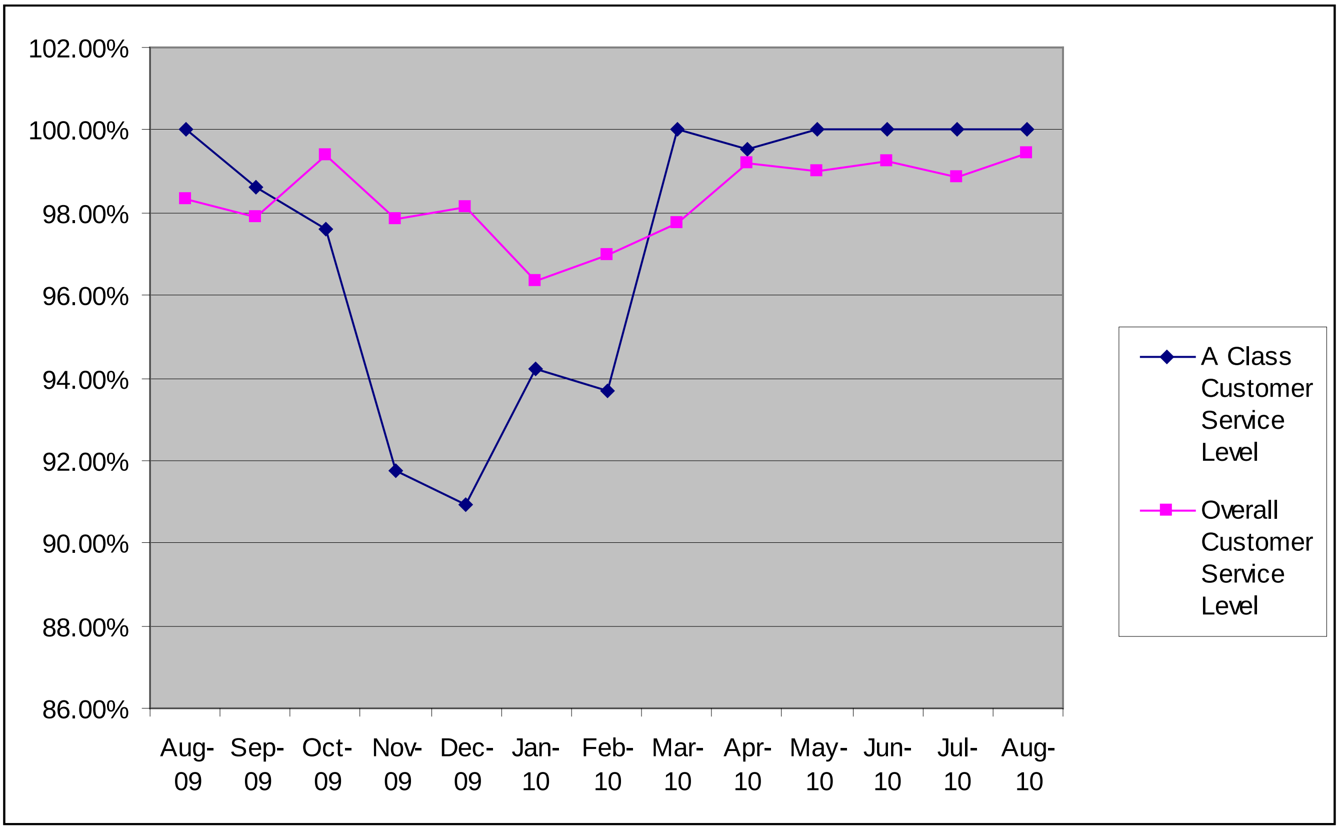

Figure 5.4: Overall Customer Service Level August 2009 ~ August 2010 (Empirical data collected)

Chapter 6 – Conclusion

6.1 Introduction

This thesis illustrates how to improve inventory control by constantly improving demand forecast accuracy and implementing more suitable inventory strategies when the supply of inventory is considered relatively certain via a case study in the alcoholic beverage industry.

The purpose of this study was to evaluate methods of improving inventory levels within a marketing and distribution company in the alcoholic beverage industry by improving demand forecast accuracy. The below key areas were concentrated on during this study:

- The relationship between inventory level and demand forecast as a result of the use of mathematic tools.
- The benefit of correct implementation of systematic forecasting software tools.
- Implementation steps critical to successful use of Sales and Operations Planning within a business.
- The initial impact (6 months) on inventory level and associated financial results through the combined use of tools and market intelligence.
- The midterm impact (12 months) on inventory and finance through the combined use of systems tools and market intelligence.

The research questions for this thesis therefore focused on determining optimised inventory levels, understanding the relationship between inventory levels and demand forecasting, the impacts on demand forecasting of systematic forecasting, communication within the supply chain, and translating forecasts into an optimised inventory level. The scope concentrated on the relationship between inventory and demand forecast when using mathematical tools, implementation of systematic forecasting tools, and use of an S&OP Process. The impacts of changes were reviewed after six and 12 months.

A review of literature suggested, demand forecast accuracy can be improved by combining a statistical demand forecast method and a causal forecast method with a judgemental forecast method. Empirical research also suggested that grouping sales accounts properly when managing the sales performance and forecast, holding each sales team responsible for their own forecast accuracy, especially when the sales projection is significantly over-achieved, and reducing the sales projection to fit the supply constraint when it is necessary are factors that can contribute to improved demand forecasting.

6.2 Conclusions in Respect of the Research Objectives

6.2.1 Research Objective 1

Research objective 1 was to consider the relationship between inventory level and demand forecast as a result of the use of mathematic tools. It was found that management of optimum inventory levels improved when demand forecasts became more accurate. Figures 5.2, 5.3 and 5.4 suggest that when demand forecast accuracy was improved by 15% between March and August 2010, the average inventory turns increased by 0.4 and customer service level was improved by 1% during the same period.

6.2.2 Research Objective 2

Research objective 2 looked at the benefits of correct implementation of systematic forecasting software tools. Figure 5.2 shows that the average demand forecast accuracy was improved by

30% between August 2009 and August 2010. Correct implementation of systematic forecasting software tools is considered one of the major contributors to this improvement.

6.2.3 Research Objective 3

Research objective 3 studied the implementation steps critical to successful use of Sales and Operations Planning (S&OP) within a business. The four step implementation of a S&OP process allowed the business to review what worked and what did not work with the process being implemented and therefore the business was able to make continuous improvement in the process in order to achieve the best outcome. As a result, the overall demand forecast accuracy was improved by 30% and consequently the inventory turns were improved by 0.6 and the customer service level was improved by more than 1% for the same period.

6.2.4 Research Objective 4

Research objective 4 was to review the initial impact (6 months) on inventory level and associated financial results through the combined use of tools and market intelligence. The inventory turns were increased by 0.2 in 6 months and the overall inventory value was reduced by $3.6 million for the same period.

6.2.5 Research Objective 5

Research objective 5 was to understand the midterm impact (12 months) on inventory and finance through the combined use of systems tools and market intelligence. In the 12 months period, as a result of time, refinement of process, data quality of qualitative contribution, the inventory turns were increased by 0.6 or 15% and the overall inventory value was reduced by $4.1 million or 25% compared with pre implementation.

6.3 Implications for Academia

As this thesis is a case study that reviews a number of key points from academic knowledge in the field of supply chain management, in particular from demand forecasting and intra-organisational communication processes, it can be viewed as adding to the general academic body of knowledge.

6.4 Implications for Industry

The implications of this research for industry are primarily related to attaining savings in inventory reduction. As was mentioned in the introduction, inventory related costs are a major contributing factor to an organisation's profitability in the alcoholic beverage industry. The results from the research support the evidence in literature that clear and open communication in the supply chain is a major contributing factor to the efficiency and effectiveness of a supply chain. Supporting contributors to efficiency and effectiveness were found to be the correct implementation of forecast support systems and the need to acknowledge that a number of stages need to be passed to reach an effective S&OP Process that is accepted by the organisation. The key reason for the S&OP Process' implementation was found to be its ability in identifying the existing and potential imbalance issues between demand and supply and providing solutions.

Two additional points were found during the course of this research, which both lead to potential inventory reductions. These were, firstly, that the replenishment cycle does not have to be the same as the inventory review cycle. It can be reduced taking into account both cost effectiveness and transportation convenience. For companies this will allow for a reduction in cycle stock. Secondly, evidence suggests that in industries with highly seasonal sales patterns, the safety stock level should be calculated based on the inventory requirement of the next periods rather than a certain amount of stock. This in turn is able to encourage reduced safety stock and total stock holdings.

6.5 Limitations of the Study

It is acknowledged that some limitations exist in the application of this case study in other organisational settings. First of all, this case study is assuming the supply is certain and therefore it isn't suitable to a company with supply uncertainty. This is not always the case unless extensive service level agreements, which are strictly adhered to, are in place between the organisation and its suppliers. Secondly, this case study is only applicable to a business which procures finished goods from its supplier as no part investigated the impact of manufacturing operations and the associated stock holdings in raw materials and work-in-progress inventory. Last but not least, this case study is only applicable to a company utilising a periodic inventory review process for its inventory requirement planning, due to the structure and regularity of the S&OP Process that was used in the organisation that was studied.

Reference List

Adebanjo, D. & Mann R. (2000). Identifying Problems in Forecasting Consumer Demand in the Fast Moving Consumer Goods Sector. *Benchmarking, An International Journal, 7,* 3, 223- 230.

Berg, B. L. (2007). Qualitative Research Methods for Social Sciences. New York: Pearson.

Biggs, J.R. & Campion, W.M. (1982). The Effect and Cost of Forecast Error Bias for Multiple-stage Production Inventory Systems. *Decision Science, 13,* 4, 570-584.

Chalmbers, J.C., Mullick, S.K. & Smith, D.D. (1971, July- August). How to Choose the Right Forecasting Technique. *Harvard Business Review*, 45-74.

Chopra, S. & Meindl, P. (2007). *Supply Chain Management: Strategy, Planning, & Operation* (3^{rd} Ed). Pearson Education Inc: New Jersey.

Creswell, J. W. (2007). Qualitative Inquiry & Research Design: Choosing Among Five Approaches (2^{nd} Ed). Sage Publications.

Crotty, M. (1998). The Foundations of Social Research: Meaning and Perspective in the Research Process. Allen and Unwin Publishing.

Bowersox, D. J. Closs and M. B. Cooper (2002). *Supply Chain Logistics Management*. McGraw-Hill: Irwin.

Dooley, B. & Higgins, R, (2006, December). S&OP or Just Good Supply Chain Planning**.** *Focus.*

Dougherty, J. & Gray, C. (2006). *Sales and Operations Planning- Best Practices: Lessons Learned from Worldwide Companies*. Partners for Excellence: Belmont.

Ghauri, G. & Gronhaug, K. (2005). Research Methods in Business Studies: A Practical Guide (3^{rd} ed). Prentice Hall: Financial Times.

Goodwin, P. & Wright, G. (1993). Improving Judgmental Time Series Forecasting: A Review of the Guidance Provided by Research. *International Journal of Forecasting, 9*, 147-161.

Helms, M.M., Ettkin, L.P. & Chapman, S. (2000). Supply Chain Forecasting: Collaborative Forecasting Supports Supply Chain Management. *Business Process Management Journal, 6,* 5, 392-407.

Lapide, L (2005, Fall). An S&OP Maturity Model. *The Journal of Business Forecasting.*

Makridakis, S. (1989). Why Combing Works? *International Journal of Forecasting, 5*, 601-603.

Muzumdar, M. & Fontanella, J. (2006, April). The Secrets to S&OP Success. *Supply Chain Management Review*.

Page, C and Meyer, D. (2000), *Applied Research Design for Business and Management*. McGraw-Hill Book Company Australia Pty Limited: Macquarie Park, Australia.

Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods (3rd ed.)*. Thousand Oaks, CA: Sage Publications.

Razi, M.A. & Tarn, J.M. (2003). An Applied Model for Improving Inventory Management in ERP Systems, *Logistics Information Management, 16*, 2, 114-124.

Remus, W., O'Connor, M. & Grigg, K. (1995). Does Reliable Information Improve the Accuracy of Judgmental Forecasts? *International Journal of Forecasting, 11*, 285-293.

Ritzman, L.P. & King, B.E (1993). The Relative Significance of Forecast Errors in Multistage Manufacturing. *Journal of Operation Management, 11*, 51-65.

Stock, J.R. & Lambert, D.M. (2001). *Strategic Logistics Management (*4th Ed). McGraw-Hill Irwin: New York.

Wacker, J. G. & Lummus, R. R. (2002). Sales Forecasting for Strategic Resource Planning. *International Journal of Operations & Production Management*, *22*, 9, 1014-1031.

Wacker, J.G. & Sprague, L.G. (1995). The Impact of Institutional Factors on Forecast Accuracy: a Manufacturing Executive Perspective'. *International Journal of Production Research, 33,* 11, 2945-2958.

Wacker, J.G. & Sprague, L.G. (1998). Forecasting Accuracy: Comparing Relative Effectiveness of Practices Between Seven Developed Countries. *Journal of Operations Management, 16*, summer, 2945-2958.

Wallace, T.F. & Stahl, R.A. (2006). *Sales & Operations Planning: The Executive's Guide*. Wallace & Company: the United States of America.

Wallace, T.F. & Stahl, B (2008). The Demand Planning Process in Executive S&OP. *The Journal of Business Forecasting*. Fall 2008.

Wallace, T. F. & Stahl, R.A. (2008). *Sales & Operations Planning: The How-To Handbook* (3rd Ed.). T.F. Wallace and Company: the United States of America.

Walsham, G. (1995). Interpretive Case Studies in IS Research: Nature and Method. European Journal on Information Systems, 4, 74-81.

Yin, R. (1994). *Case Study Research: Design and Methods* (2nd Ed.). Sage, Thousand Oaks: Newbury Park, CA.

Zinkham, G. & Delorme, D. (1995). Narrative Analysis. *Journal of Marketing, 59,* 3, 99- 101.