THE EFFECTIVE MANAGEMENT OF CUSTOMER ORDERS RECEIVED BY A PHARMACEUTICAL MANUFACTURER

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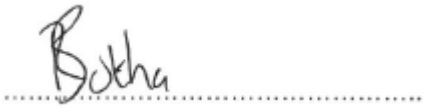
DECLARATION

I, RISCA BOTHA, hereby declare that the treatise for Master of Technology in Logistics (Research) to be awarded is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.



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ABSTRACT

There is a great need for a pharmaceutical manufacturer to provide its customers with the right product at the right time, place and price and also to deliver the product in the right quantity and quality. Should pharmaceutical customers not receive their orders on time from the pharmaceutical manufacturer, the customers might face out-of-stock situations. As a result, the patients or customers might turn to an alternative product from a different pharmaceutical manufacturer, which has the required stock readily available. This could lead to loss in sales and even death amongst its customers.

The main objective of this study was to determine the key factors that form part of the demand and operations planning strategies to ensure that these factors are in place to effectively manage and execute the supply chain and logistics processes to reduce possible out-of-stock situations amongst its customers.

As a starting point to the study, an analysis was performed based on the review of relevant research and literature from various text books, journals, publications, as well as internet sources. The literature study covered various aspects such as demand planning, production planning, the use of different demand and operations planning strategies, as well as the importance of continuous internal and external customer service levels to ensure that customer orders are delivered on time. The analysis of the literature review was used to establish a theoretical basis for the design and structure of the questionnaire that was used as a research instrument in this study.

A survey was conducted amongst the employees that are responsible for executing the supply chain and logistics processes within Aspen Pharmacare. These employees resided within the three main departments of the pharmaceutical manufacturer, namely, the Demand and Operations Planning, Production and Packing, as well as the Warehouse and Distribution departments. Each question posed in the questionnaire related to the role of each employee within these departments that are responsible for the logistics processes within Aspen Pharmacare.

The empirical results from the study indicated that the respondents were in support that specific key factors are important for a pharmaceutical manufacturer to manage incoming customer orders efficiently and effectively to reduce possible out-of-stock situations amongst its end customers.

However, the respondents also highlighted that there were a number of obstacles preventing them from implementing the key factors that are required to manage incoming customer orders more efficiently within the pharmaceutical manufacturer. Some of these obstacles include: the lack of pro- activeness; lack of accountability; and the lack of constant communication between the employees from the three main departments. Furthermore, incomplete hand-over information during shift changes amongst the employees of the Production and Packing department created unnecessary down-time. Also, the employees from the Warehouse and Distribution department were not informed timeously when changes to the production schedule were made. These obstacles will have a negative impact on the ultimate customer delivery dates and need to be addressed.

The empirical results highlighted some recommendations to assist pharmaceutical manufacturing companies to more effectively and efficiently manage their incoming customer orders to reduce or eliminate any possible out-of-stock situations amongst its end customers. Some recommendations include: improved communication between the three main departments; to react immediately to out-of-stock products; and to ensure that internal and external customer service levels are adhered to at all times.

The implementation of the recommendations based on the empirical findings of the study will assist the pharmaceutical manufacturing company to achieve excellence and to become a world-class supplier of generic pharmaceutical products. In this way, all incoming customer orders can be fulfilled on time.

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CHAPTER 1

INTRODUCTION, PROBLEM STATEMENT, OBJECTIVES AND RATIONALE

1.1 INTRODUCTION

There are a number of generic pharmaceutical manufacturers in South Africa competing in the global pharmaceutical market, with Aspen Pharmacare being the leading manufacturer in the field in South Africa. Other generic pharmaceutical manufacturers in the country include: Bodene, Be-tabs Pharmaceuticals, Cipla Medpro, Columbia Pharmaceuticals, Dr. Reddy's Laboratories Pty. Ltd., Merck Generics and Sandoz SA (National Association of Pharmaceutical Manufacturers (NAPM, n.d.). These pharmaceutical manufacturers develop, launch, manufacture and supply generic medication and products to various pharmaceutical customers which include private and State hospitals, as well as retailers in both the local and international market.

A pharmaceutical manufacturer not only needs to be a reliable supplier, but also needs to be flexible and able to react timeously to both planned and unexpected demands from its customers. Usually pharmaceutical customers place their orders with pharmaceutical manufacturers three months in advance as per an agreed contract between the two parties. However, a number of situations often occur which create out-of-stock situations. Firstly, for example, the overselling of certain medication and products because of unexpected high demands in excess of the contracted amounts might result in out-of-stock situations at the customers' end. Secondly, as some medication and products are seasonal, the quantity and selection of customer orders received by pharmaceutical manufacturers may not always be received in a consistent manner. Thirdly, customer orders received by pharmaceutical manufacturers from State hospitals are dependent on the Government's health budget and driven by tenders, with contracts often taking a number of months to be allocated.

A series of consequences might occur should a pharmaceutical customer run out of stock of certain medication and products. For example, when a patient or customer does not receive his/her prescribed medication on time, the patient or customer's illness might be prolonged and even result in death. Therefore, it is vital for pharmaceutical manufacturers to have sufficient stock available at all times to satisfy the demands of its patients and customers.

In the competitive environment in which they operate, pharmaceutical manufacturers, such as Aspen Pharmacare, strive to deliver the required medication and products to its customers at the right time, place and price, as well as in the right quality and quantity – generally known as the *five rights* in the logistics profession (Aspen Pharmacare, n.d.; Pienaar & Vogt, 2012:1). Aspen Pharmacare applies demand and operations planning strategies to continuously improve its ability to fulfil customer orders timeously to minimise the risk of unwanted out-of-stock situations. The latter cause further problems such as back orders, lost business and lost customers.

This study examines the supply and logistics processes which a pharmaceutical manufacturer, in this case more specifically Aspen Pharmacare, needs to have in place to ensure the effective management of customer orders received, and thereby reduce out-of-stock situations amongst its customers. The fundamental elements of the literature review, together with the empirical results obtained, have been used to create the necessary knowledge for a better understanding of which specific planning strategies have an impact on Aspen Pharmacare as a generic pharmaceutical manufacturer. In this way, the study allows for Aspen Pharmacare to recognise the influence of the continuous interactions involved between all the different departments, which ultimately have an impact upon the logistics processes. And, in doing so, the best methods of reducing the number of possible out-of-stock situations amongst its end customers were identified.

1.2 PROBLEM STATEMENT AND RESEARCH OBJECTIVES

1.2.1 Problem statement

As was indicated in the introductory section, there is a need for a pharmaceutical manufacturer, as is the case with any manufacturer, to provide its customers with the right product at the right time, place and price and also to deliver the product in the right quantity and quality. Achieving this objective will ensure that all its customers' demands and objectives are met timeously, by continuously managing the entire logistics processes and thereby avoiding possible out-of-stock situations.

In the case of Aspen Pharmacare, as is the case with most pharmaceutical manufacturers, the Sales and Marketing department, together with the Demand and Operations Planning department, use *forecasting* to balance supply and demand (Bowersox, Closs, Cooper & Bowersox, 2013:122; Wallace, 1999:20). *Forecasting* can be described as predicting potential customer orders that will be received in the future, based on previous customer orders received. However, forecasts might not always be accurate. According to Fawcett, Ellram and Ogden (2007:109), as well as Wallace (1999:28), the Sales and Marketing department of a business organisation is normally responsible for the sales forecasts, as those involved are the experts on both the planning and execution of the demand side of the business.

Once the Sales and Marketing department has a clear view of the upcoming forecast, they need to discuss the customer orders received from the customers with the demand manager of the Demand and Operations Planning department. As soon as the customer orders have been confirmed by the demand manager, the Sales and Marketing department needs to insert the correct customer order requirements for the next three months. These volumes are captured onto the pharmaceutical manufacturer's electronic database. The Demand and Operations Planning department then needs to verify whether all the necessary structures are in place to manufacture all the customer orders received for the next three months. The various structures include: production capacity;

manpower; and the availability of raw materials and components required to manufacture a specific product (Aspen Pharmacare, n.d).

The Sales and Marketing department must ensure that there is continuous improvement in reducing the forecast error. Therefore, this department needs to review, update and modify the sales forecast, as this department is the manufacturer's primary contact with its customers, who are in turn the drivers of demand. Sales forecasts need to be discussed amongst product managers and be reviewed frequently in order for product managers to have a complete and realistic approach to the overall demand requirements.

A customer order from a pharmaceutical customer is normally placed with Aspen Pharmacare's Sales and Marketing department exactly three months in advance. Normally, no unplanned customer orders are placed with Aspen Pharmacare during the fixed three month period. However, should any unexpected order(s) be placed with the pharmaceutical manufacturer during the three month fixed period, it is likely that the pharmaceutical manufacturer may not be able to deliver the customer order(s) on time, thereby creating an out-of-stock situation at the customer's end (Frazelle, 2001:5-10; Wisner, Tan & Leong, 2008: 347-349).

Once a pharmaceutical customer order is received, the following checks need to be performed by the master production scheduler (MPS) within the Demand and Operations Planning department to ensure on-time delivery of the customer order(s) (Aspen Pharmacare, n.d):

- Ensure the availability of sufficient machine and manpower capacity within the production process

- Check whether all the necessary raw materials and components are currently available in the warehouse to manufacture a specific product. Should the material

not be available, the buyers need to be informed of any shortages so that the necessary raw materials and components can be ordered

- Once all of the above-mentioned checks have been performed, the MPS needs to schedule the specific products into a feasible production schedule (Wisner, Tan & Leong, 2008: 347-349; Pienaar & Vogt, 2012:58)

- Once the production schedule is shared with the Production and Packing department, a tentative delivery date is then given to the Sales and Marketing department who will then ultimately inform the customer.

In cases where unexpected orders are received, the above-mentioned process checks need to be repeated again by the MPS to establish whether the unplanned customer orders can be accommodated in the current production schedule.

Any pharmaceutical manufacturer can suffer great losses once an imbalance exists between supply and demand. According to Langley, Coyle, Gibson, Novack, and Bardi, (2009: 65), the following problems may potentially transpire:

- Customer service levels are affected when a manufacturer cannot deliver its products to its customers on time. This causes customer lead-time violations which may result in increased out-of-stock situations. Customers may turn to an alternative pharmaceutical manufacturer, which may damage the existing manufacturer's reputation

- Operating costs might increase as the need for overtime arises owing to un-forecasted orders being received

- The quality of the product could also be affected when production is rushed – defects might occur, resulting in re-calls of specific products which need to be re-manufactured or re-packed depending on the level of the defect.

Another important factor that plays a vital role in customer satisfaction is the level of internal customer service throughout the entire logistics processes within a pharmaceutical manufacturer (Rohner, 2010:4-8). By improving internal customer service levels, the manufacturer's ability to deliver the right products to the market or customer at the right time, place, quality and quantity may in turn decrease the number of products becoming out of stock. As a result, the pharmaceutical manufacturer could keep its customers satisfied for a longer period, which will enhance future sales.

Swartzlander (2004:38) explains that customer service has an impact on the operations of an organisation, but that not all departments generally recognise internal customer service as a priority. As a result, a communication gap is often created between the different departments of a pharmaceutical manufacturer. For example, Aspen Pharmacare consists of three main departments that are responsible for the logistics processes, namely:

- Demand and Operations Planning department
- Production and Packing department
- Warehouse and Distribution department

In order for Aspen Pharmacare to be successful, it is imperative that all three of the above-mentioned departments integrate and communicate well with each other to ensure a steady execution and flow of all the logistics processes. The logistics processes start with the customer order which is received by the Sales and Marketing department. The Sales and Marketing department then communicates this data to the Demand and Operations Planning department that would then schedule the required products in accordance with the Production and Packing department (Aspen Pharmacare, n.d).

Once the products have been scheduled and manufactured, samples of the products are sent for the necessary testing to be performed by the manufacturer's laboratory. As soon as the results of the samples become available and are successfully approved by

the Laboratory department, the MPS then schedules the products to be packed into the required packaging. Once the products have been packed successfully, the Quality Assurance department releases the end products for distribution.

Below is an illustration of the relationship between the three main departments mentioned above that are responsible for the logistics processes at Aspen Pharmacare.

Figure 1.1: The relationship between the three main departments of the logistics processes within Aspen Pharmacare

Source: Researcher's own construction

1.2.2 Research objectives

As was indicated in the introductory section of this chapter, the primary research objective of this study is to determine which demand and operations planning strategies are required to effectively and efficiently manage incoming customer orders received by

a pharmaceutical manufacturer, more specifically Aspen Pharmacare. In this way, Aspen Pharmacare can ensure that its customer orders are delivered on time. Should pharmaceutical customers not receive their orders on time from the pharmaceutical manufacturer, the customers might face out-of-stock situations. As a result, the patients or customers might turn to an alternative product from a different pharmaceutical manufacturer, which has the required stock readily available.

In support of the main objective, the sub-objectives of the study are as follows:

- To determine the extent to which the Demand and Operations Planning department believes that the use of demand and operations planning strategies are required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

- To determine the extent to which the Production and Packing department believes that the use of demand and operations planning strategies are required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

- To determine the extent to which the Warehouse and Distribution department believes that the use of demand and operations planning strategies are required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

By analysing the above-mentioned sub-objectives, the pharmaceutical manufacturer, in this case, Aspen Pharmacare, will be able to establish ways in which out-of-stock situations amongst its customers can be reduced and eliminated should they appear.

1.3 REVIEW OF RELATED LITERATURE AND RESEARCH

Very few studies that relate to the effectiveness of applying demand and operations planning strategies to manage customer orders within a pharmaceutical manufacturer have been performed previously. Moreover, the few available studies have not been performed for a specific pharmaceutical manufacturer. No articles relating to this topic were found in association with any pharmaceutical company, despite searching a number of databases. A number of related studies that were found are mentioned in the following paragraphs and are discussed in more detail in Chapter Two of this research study.

Rothner (2010:13) compiled a dissertation on improving internal customer service by effectively managing the logistics processes within a pharmaceutical manufacturer. The main finding of this study was that competent staff that are involved with logistics processes needs to be aware of the principles of both internal and external customer service throughout the business in order to have a positive influence on the success of a pharmaceutical manufacturer.

Wallace (1999:7) compiled a handbook on how to implement sales and operations planning methods, and how the logistics processes within a pharmaceutical manufacturing company could benefit from these methods.

Rohner and Shook (2003:41) identified the so-called *value stream* that is needed to produce a specific product by using three critical management tasks, namely problem-solving; the information management of new products; and the physical transformation tasks involved – from the raw material stage to the finished product.

Slack, Chambers and Johnston (2001:482) stated the importance of manufacturers adapting to the use of the just-in-time (JIT) principle/system at all levels within a manufacturing plant. According to them, continuous improvement should be a competitive strategy in any manufacturing environment. Aspen Pharmacare is currently

using the JIT system. The JIT system plays a significant and supporting role in assisting internal service departments to understand the importance of on-time delivery to the customer, as it helps to reduce the possibility of out-of-stock situations.

The Sales and Marketing department needs to be aware when other pharmaceutical manufacturers' products are running out of stock in the market. An opportunity then exists for another pharmaceutical manufacturer to deliver its alternative products to the market quicker than the original manufacturer. This attempt could result in ongoing future sales for the more effective pharmaceutical manufacturer to deliver its products first to the market and possibly gain additional customers (Hampton, 2009:215).

Pibernik (2006:1) explains that when an out-of-stock situation occurs in the market, the manufacturer should manage the allocation of available products on the basis of customer orders and priorities, as well as contractual agreements. Pibernik (2006:1) further explains how utilising certain order methods could contribute to the effectiveness of managing a customer's out-of-stock situation.

1.4 RESEARCH DESIGN AND METHODOLOGY

In an attempt to address the objectives of this study, the following research design and methodology processes were implemented:

This research study used mainly a quantitative approach, as the study required an analysis of the fundamental factors which impact on the customers' delivery times. As such, the relationships between the three main departments that are responsible for the logistics processes at Aspen Pharmacare, were statistically tested and this required a quantitative approach.

A literature review consisting of books, journals and the Internet has been conducted to assess the existing body of knowledge and research on the effectiveness of managing incoming customer orders received by a specific pharmaceutical manufacturer, in this

case Aspen Pharmacare. Related topics such as the importance of internal customer service and effective logistics processes between the various departments, as well as the importance of continuous communication within a pharmaceutical manufacturer, are also discussed.

The researcher conducted interviews with middle and senior management staff members of all races and genders. These interviews were conducted on site at Aspen Pharmacare during lunch breaks and under controlled regulations. Department managers that have been interviewed were from the Demand and Operations Planning department, Production and Packing department, as well as from the Warehouse and Distribution department. Once these interviews have been conducted, a detailed questionnaire was compiled by the researcher to analyse the different views of the various departments regarding effective and efficient operations. The questionnaire was constructed to collect the primary data based on the role of each department, as well as on the importance of communication between the three main departments within the pharmaceutical manufacturer.

The sample size for this study was determined after a discussion between the researcher and the Demand and Operations manager of Aspen Pharmacare. The sample consisted of 70 employees from the three main departments of Aspen Pharmacare (N=70) which are responsible for the logistics processes at Aspen Pharmarcare. The questionnaire was divided into four sections. Section One consisted of demographical data only. Sections Two to Four consisted of statements that the respondents from the three main departments were required to rate on a five point Likert-scale. These statements included the key factors applicable to the employees' respective department for effectively managing and executing the supply chain and logistics processes at Aspen Pharmacare.

The information gathered from the questionnaires relating to each department, was captured using the *SPSS 23, Statistica 12*, and *Microsoft Excel* computer software

programmes. A more detailed discussion of the research design and methodology is done in Chapter Four of this study.

1.5 SCOPE/DELIMITATION OF THE STUDY

The research area was delimited as follows to make the study manageable from a research point of view:

- Geographical location

The research was specifically focused on the pharmaceutical manufacturing industry in Port Elizabeth that is situated in the Eastern Cape Province of South Africa. Since the researcher resides in Port Elizabeth, it made it easier for the researcher to distribute and collect the questionnaires.

- Manufacturing company on which the study focused

This study focused on the logistics processes at Aspen Pharmacare, the generic pharmaceutical manufacturer situated in Port Elizabeth. The researcher is employed by Aspen Pharmacare. As the study focused on the three main departments that are responsible for the logistics processes at Aspen Pharmacare, it was decided to approach the Demand and Operations Planning, Production and Packing, as well as the Warehouse and Distribution departments to complete the questionnaire.

1.6 DEFINITION OF KEY CONCEPTS

In the context of this study, the following key concepts have been identified and are explained below:

- Demand planning: Refers to demand forecasts that can be used in planning, production and inventory planning processes (Krajewski, Ritzman & Malhotra, 2007:521).

- Master Production Scheduling (MPS): Occurs when demand from the market is balanced with the capabilities and capacities of the manufacturer in real-time terms (Pienaar & Vogt, 2012:58; Proud, 1999:29).

- Forecasting: Stock and Lambert (2006:76) define forecasting as making statements based on the forecasted outcomes performed.

- Frozen zone: Refers to the time period for the next 21 days as applied by Aspen Pharmacare.

- Logistics processes: Refers to all the entities involved in moving a product from the supplier to the customer. Entities include people, technology, activities, information and resources (Rothner, 2010:3).

- Just-in-time (JIT) process: A production strategy that strives to improve a manufacturer's return on investment by reducing in-process inventory and related carrying costs (Langley, Coyle, Gibson, Novack & Bardi, 2009:310; Womack & Jones, 2003).

1.7 SIGNIFICANCE/CONTRIBUTION OF THE RESEARCH

The value of this study lies in determining how the effectiveness of managing incoming customer orders in a pharmaceutical manufacturer can be improved. The results of this study provide direct information on how Aspen Pharmacare operates as a whole, and how improved teamwork could be implemented to ensure future success.

The information gathered from this study can be used to create new ideas within the pharmaceutical manufacturer to ensure that all the supporting departments understand

the negative impact of customers being out of stock. The importance of inter-company service delivery was also investigated to underline the importance of a steady flow of the logistics processes. Recommendations on how to manage incoming customer orders are provided to senior management employees of the Demand and Operations Planning department, the Production and Packing department, as well as the Warehouse and Distribution department of Aspen Pharmacare to ensure on-time delivery of customer orders.

Finally, the outcome of this study will enable senior management staff members of Aspen Pharmacare to educate its employees on the importance of fulfilling each customer order correctly and explaining the consequences of out-of-stock situations. This will enable all the employees to gain insight into how the pharmaceutical manufacturer is performing in the market and what impact their respective roles have on the business.

1.8 CHAPTER OUTLINE

This study is divided into six chapters which are structured as follows:

Chapter One gives the background and rationale for the study and outlines the problem statement, as well as the main objective and sub-objectives.

Chapter Two provides a review of related literature and research by considering the importance of using supportive demand and operations planning strategies to assist the pharmaceutical manufacturer to reduce out-of-stock situations amongst its customers. A number of supporting planning strategies are explained in detail, as well as the role of each department within the logistics processes at Aspen Pharmacare. The importance of continuous internal and external customer service levels, is also explained.

Chapter Three explains the demand and operations planning strategies which are being used in practice at Aspen Pharmacare. The operations of the three main departments

which are responsible for the logistics processes within Aspen Pharmacare are addressed separately to improve the level of understanding needed to deliver customer orders on time.

The research design and methodology used in this study are outlined in Chapter Four. The sampling method and the measuring instrument used to collect the required data and determine the different responses of the participants of this research study, are also explained.

Chapter Five outlines and explains the empirical results of the study. The results of the empirical study are interpreted, reviewed and discussed. Furthermore, recommendations regarding supportive planning strategies are offered, and certain conclusions are drawn on how to improve the effectiveness of managing incoming customer orders.

A summary of the study, as well as recommendations for further research, are given in Chapter Six.

CHAPTER 2

CONTEXTUALISATION OF DEMAND AND OPERATIONS PLANNING STRATEGIES

2.1 INTRODUCTION

Manufacturing companies utilise both demand and operations planning strategies to plan and coordinate the necessary type, quantity and timing of the final products and available resources within the overall production operations of their business. These planning strategies tend to be a major source for the coordination of resources such as inventory levels of material inputs, cash flow, capital and human resource needs within a manufacturing company (Chapman, 2006:46). The purpose of this chapter is to discuss the rationale for using demand and operations planning strategies by pharmaceutical manufacturing companies as a means to fulfil customer orders on time.

In view of meeting the objectives of this chapter, the significance of demand and operations planning, which involves the Sales and Operations Planning (S & OP) process, as well as the importance of setting appropriate customer order lead-times, are firstly explained. Following this, the actual production planning process involving the scheduling of operation sequences, as well as the importance for a manufacturing company to be able to reschedule its operation sequences when necessary, are discussed. The various production planning techniques used during this production planning process are outlined, as well as the importance of workload control (WLC) within a manufacturing environment. The use of appropriate production control policies during this process is also discussed. Thirdly, the challenges and opportunities faced by pharmaceutical manufacturing companies to manage and reduce possible out-of-stock situations amongst its pharmaceutical customers are explained. Finally, the importance of internal and external customer service levels between a manufacturing company and its customers is outlined.

2.2 DEMAND PLANNING

Demand planning involves the interaction between the Sales and Marketing department as well as the Demand and Operations Planning department within a manufacturing environment, ahead of compiling the production schedule (Chapman, 2006:92). During the demand planning phase, sales forecasts are normally reviewed by the Sales and Marketing department during the Operations Planning Process (S & OP) to ensure that the forecasted sales volumes of each product, covering the next 12 months, are valid. Factors such as price changes, competitive products in the market place, current economic conditions, as well as the latest sales figures received from the Sales and Marketing department, are taken into consideration when revising the actual sales forecasts (Jacobs, Berry, Whybark & Vollmann, 2011:122-124).

However, sales forecast errors may occur when the Sales and Marketing department bases its product volume prediction on demand only, as it may include incomplete information. Normally, sales forecasts are calculated as the average of customer orders received based on historical data, including some safety stock to accommodate customer order variations, plus a small margin of error. Safety stock is also known as ‘buffer stock’ which is kept in the manufacturer’s distribution warehouse to negate negative consequences, should the manufacturing company run out of stock of a particular product (Chapman, 2006:145).

Therefore, sales forecasts need to be analysed carefully for accuracy and changed when necessary by the Sales and Marketing department, in order for the Demand and Operations Planning department to review the most accurate product volumes at all times. Accurate forecasting is thus imperative when drafting the production plan to ensure that each customer’s demand is fulfilled at best at all times.

2.2.1 The Sales and Operations Planning (S & OP) process

The Sales and Operations Planning (S & OP) process can be defined as the long-term planning of production and sales, relative to the forecasted demand. It involves making decisions on each product family by grouping similar products of the same nature together during the planning horizon of 15 to 18 months (Olhager, 2013:6836-6843). These decisions are made based on the most recent product sales forecasts, as well as on recommendations received from middle and top management's knowledge of the prevailing business conditions (Jacobs et al. 2011:121-124). Feng, Zhang, Wu and Yu (2011:4223-4243) explain that more focus should be placed on the S & OP aspect of a manufacturing company to ensure that more accurate sales forecast calculations are made. This will result in the more effective and efficient execution of the various logistics processes involved.

The monthly S & OP process normally begins shortly after a month's end and would continue for a few days. Jacobs et al. (2011:123-124) explain that the following five phases are followed before the actual monthly S & OP process commences:

> Phase one: Run sales forecasting reports. During this phase the latest information on actual sales, production and inventories on hand is accumulated shortly after a month's end, to update the data in the information files. This data will then be used by the Sales and Marketing staff to create sales analysis reports and to amend the current sales forecasts.
>
> Phase two: The demand planning phase. During this phase, the Sales and Marketing staff review the information received in phase one to create a new forecast covering the next 12 months. When revising the sales forecasts, the following aspects are considered: possible new product launches; possible new customers; price changes; as well as competitive economic conditions. The actual sales, production and inventory data from the past month, are also considered. Once all of these aspects have been reviewed by the Sales and

Marketing staff, the new sales forecasts are distributed to the Demand and Operations Planning staff so that they can make the necessary changes to their operations plan.

Phase three: The supply (capacity) planning phase. During this planning phase, the new operations plan for each product group is compared with the changes made in the sales forecast. If necessary, the operations plan needs to be modified by the production planner to ensure that the manufacturing company has the ability and capacity to supply the required products. These issues will then be discussed during the pre- S & OP meeting.

Phase four: The pre- S & OP meeting phase. During this meeting, decisions are made regarding the balance between demand and supply. Problems are also resolved during this meeting where any differences in recommendations exist amongst the representatives from various departments.

Phase five: The executive S & OP meeting phase. During this phase, senior executives in the manufacturing company meet to make the final decisions on the sales and operations plans for each product group. They would also review issues relating to any customer service problems that may have occured, as well as actual business performances.

Following the above-mentioned phases, the S & OP process creates a basic planning flow of logistics processes, which are used to incorporate and consolidate the data needed for the Sales and Marketing, Production and Packaging, Purchasing, as well as the Warehouse and Distribution departments to perform their respective duties. A basic planning flow of the S & OP process can be summarised as follows (Wang, Hsieh & Hsu, 2012:248-262):

- Demand forecasts are calculated by the Sales and Marketing department in terms of product groups

- The production planner balances the capacity for each production run

- Simulation of scenarios are explored by the production planner to ensure feasible production plans for the entire range of logistics processes to be performed within the manufacturing company

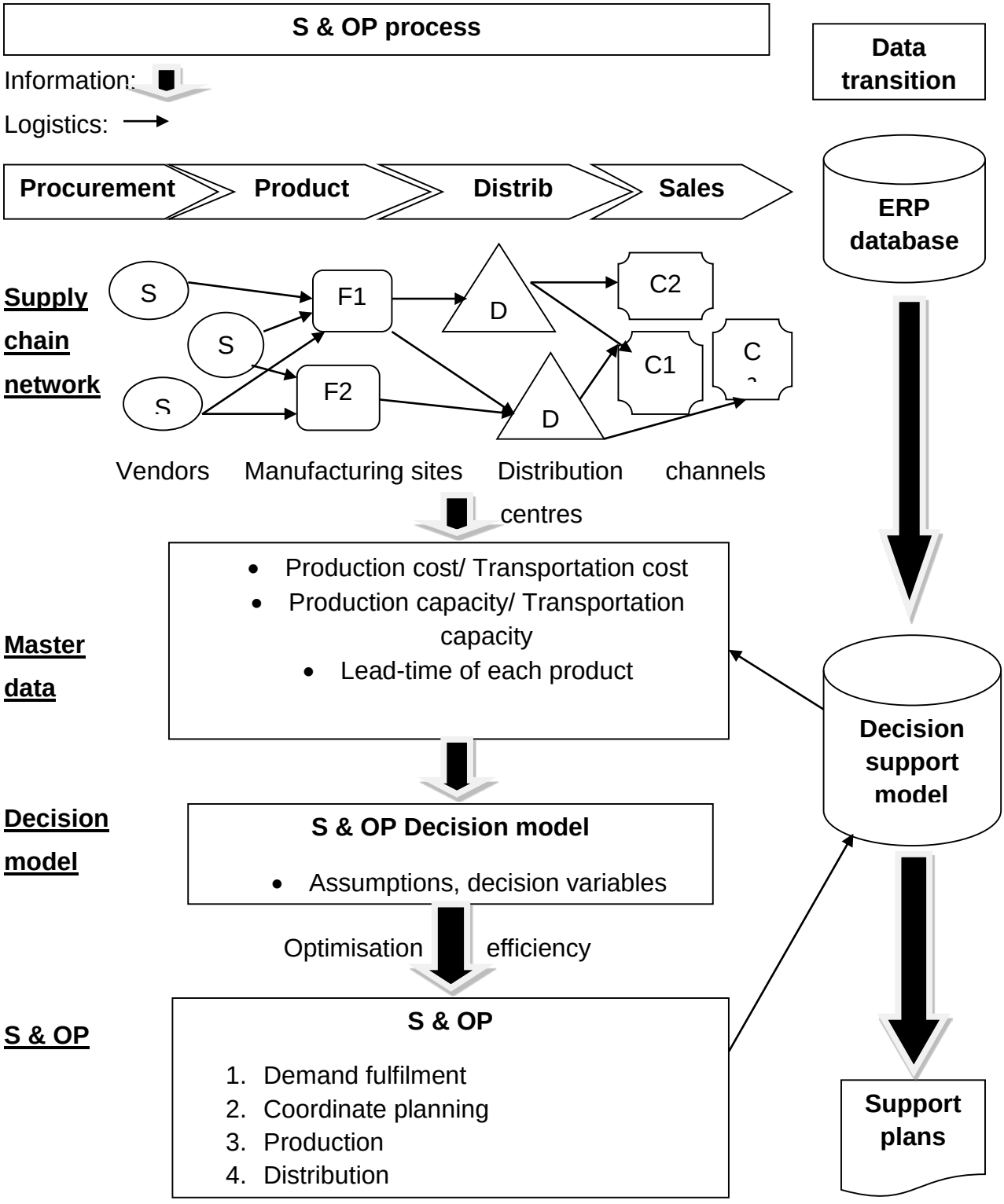
- Resource requirements and availabilities are checked, while production plans are compiled and validated by the production planner

- Different scenarios are compared by the production planner to select the best optimum production plan during the monthly planning process.

Illustrated below is an example of a S & OP process used during the decision-making process of a manufacturing company, where customer orders are received and converted into a specific production order (refer to Figure 2.1).

In terms of the planning framework illustrated in Figure 2.1, the total demand from global market orders is used to collect the operational data from the enterprise resource planning (ERP) database, as drivers for the decision-making process (Wang, Hsieh & Hsu, 2012:248-262). This planning framework generates real-time procurement, production, distribution and sales plans for each vendor, manufacturing site and distribution centre. In this case, all the data relating to a specific product, for example, the purchasing price of the raw materials used to manufacture an end product, is collected during the master data step. The lead-time of each raw material item is also taken into consideration during the master data step, which will influence the ultimate decision-making process. During the final decision-making process, the production planning and distribution plans are discussed in detail by the Planning and Production departments, to ensure that the necessary support plans are in place for a steady flow of the S & OP process.

Figure 2.1: S & OP process used in the decision-making process



Source: Wang, Hsieh & Hsu (2012:248-262).

2.2.2 Customer order lead-times

A critical challenge which forms part of the S & OP process is the managing of customer order lead-times between a manufacturing company and its customers. The concept ‘customer order lead-times’ refers to the time taken from when the customer order is received by a manufacturing company until the completed order is delivered to the customer (Teo, Bhatnagar & Graves, 2010:400-403). Yang and Geunes (2007:440-441) explain that the customer order lead-time is agreed upon before the customer order is accepted by the manufacturing company.

The setting of the agreed upon customer order delivery lead-time is based on a cross-functional decision made by the Sales and Marketing, as well as Production departments. To calculate the actual customer order lead-time or delivery date might be challenging for a manufacturing company, since it may include decisions based on raw material delivery dates which may have long supply lead-times. It is to be noted that the necessary production running times are also included in the calculation of the customer order lead-times (Muthayan, 2006:12-14).

Once a manufacturing company gives the confirmed customer order delivery date to its customers, the manufacturing company must ensure that it adheres to the agreed upon delivery dates in order to fulfil the customers’ expectations. Manufacturing companies that deliver customer orders quickly and reliably generate a competitive advantage, which will enable them to reduce their prices, and as a result gain more customers and increase their revenue. It is also important that an assurance of delivery reliability exists, based on previous order-delivery records.

The supply relationship with a customer might be at risk should the promised delivery dates be extended by the manufacturing company to create a longer lead-time. This is not an ideal situation as this may negatively influence the customer’s level of expectations and could negatively impact on any future relationships. The customer order lead-time may also influence demand as most customers value and prefer quick

order fulfilment to reduce their own costs that are associated with long supply lead-times. Pharmaceutical customers are also not willing to accept long lead-times or delivery dates from a pharmaceutical manufacturing company as it could have serious consequences for the patients, which may even include death. Lead-time-sensitive customers are even willing to pay an additional price per unit for reducing the delivery lead-time on critical products. However, longer supply lead-times allow a manufacturing company to have greater planning flexibility, which reduces a manufacturing company's operations costs.

A fixed lead-time strategy is adopted by manufacturers where the lead-times are dictated by the market and when demand certainty is valued by its customers. It is important for the manufacturer to be aware of its current market position in terms of pricing, the competitors' lead-times, market requirements, as well as its own ability in meeting the customers' lead-times.

2.3 OPERATIONS/PRODUCTION PLANNING

Operations/production planning is the process of allocating the timing for the use of equipment, facilities and human interaction within a manufacturing company (Stevenson, 2002:728). During the operations planning process, it is important to create feasible production plans to ensure that production, inventory and distribution costs are kept at a minimum. This process incorporates and consolidates data received from the Sales, Production, Distribution and Procurement departments within the logistics processes. It also specifies the capacities of various production sites as well as the costs of certain production requirements.

The next section explains the scheduling of operation sequences, the rescheduling process, as well as a few planning techniques that are recommended and used in some manufacturing companies. The importance of workload control (WLC) and the use of appropriate production control policies within a manufacturing company are also explained.

2.3.1 Scheduling of operation sequences

Dong and Medeiros (2012:831-841) explain that a manufacturing company should focus its attention on creating the most cost-effective production sequence and duration of production orders on the production plan. (Please note: ‘It is accepted production terminology to refer to and use the term ‘on the production plan’). Production schedules can be measured according to customer order due date adherences, as well as according to the total changeover times between the relevant production batches (Greef & Ghoshal 2004:249-250). It is important for the production planner to distribute the workload evenly amongst the different production machines, and to schedule the production batches in the most accurate sequence to ensure that customer order due dates are met timeously.

The following aspects apply when scheduling operation sequences (Greef & Ghoshal 2004:249-250):

- The shortest set-up time of each production campaign needs to be identified. The set-up time is the time used to set up a machine to perform a specific production run (Chapman, 2006:127)

- Reduced set-up times can be obtained by sequencing similar products together in line with the required production machines (Mishra, Kumar, Chan & Tiwari, 2012:535-550)

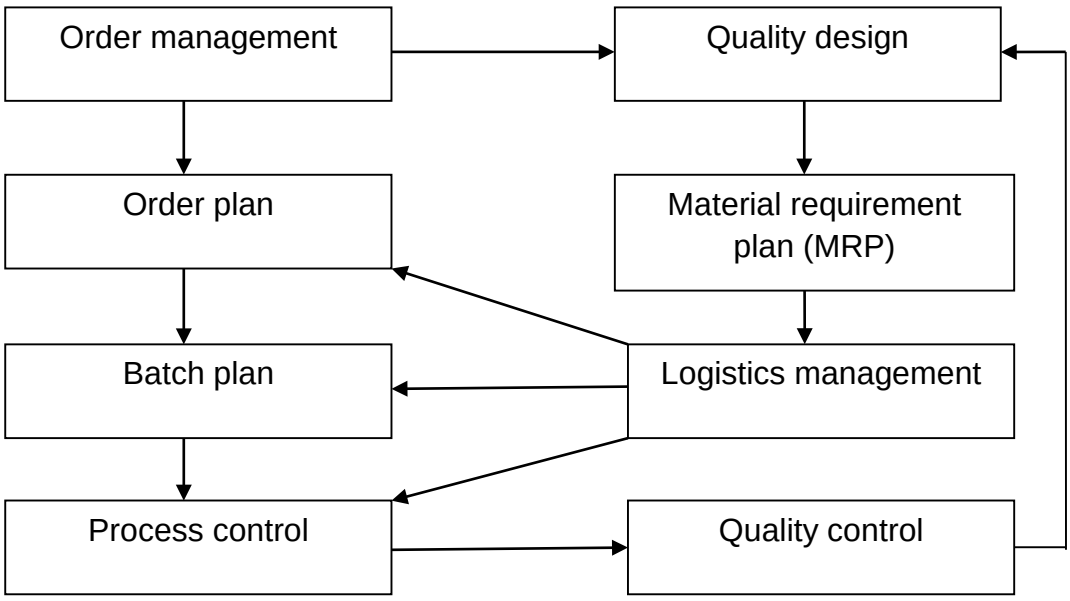
- The shortest processing time of each product on the production plan needs to be highlighted

- The earliest due date of each final product needs to be communicated timeously to the end customer

- The preferred production order sequence must be incorporated into the production plan and needs to be adhered to throughout the production schedule.

The production planner normally starts by arranging the production orders on the production plan according to the priority-based rule, which means that the most important batches (those with the earliest due dates) are manufactured first (Muthayan, 2006:12-15). This process can become complicated as it usually includes multi-constraint, multi-objective functions and a high level of uncertainty. Multi-objective functions such as re-scheduling, order management and control, quality management, production process control and logistics management, are considered when compiling the production plan. These functions are used to achieve maximum optimisation during uncertain demand conditions. Dong and Medeiros (2012:831-841) conclude that production should be controlled by using a manufacturing execution system (MES) which supports its multi-objective functions (see Figure 2.2).

Figure 2.2: MES functions used during production processes



Source: Dong and Medeiros (2012:831-841).

As illustrated above, the production process starts with the order management function, whereby all the incoming customer orders are received by the manufacturing company. Following this, the order plan function is used by the production planner to review all the incoming customer orders and group them into production batches based on the raw material release dates from the laboratory, the similarity of the products, and according to quantity requirements. Next, the raw materials which are required to manufacture a specific batch are ordered using the material requirement planning (MRP) function. Once all raw materials are on site and available for production, each production batch is allocated with a specified start and delivery date which reflects on the production plan. When the production planner loads the different production batches on the production plan, each batch will start according to the priority value that has been assigned to each batch.

Thereafter, once the production batch is ready to be manufactured, it is released to production during the production control function. Once the production batch has been manufactured successfully, the batch will be inspected by the Quality Assurance (QA) department. This department forms part of the quality control function to ensure that the batch is manufactured in accordance with the required quality specifications. Finally, the logistics management function is then used to coordinate the customer order plan, the batch plan and the process control function.

2.3.2 Rescheduling of the production schedule and the importance of manufacturing companies being flexible

Rescheduling occurs when the production planner is informed by the Sales and Marketing department to manufacture a product sooner or later than previously agreed upon (Jacobs et al. 2011:359). Various reasons could lead to rescheduling, such as: when the current product is not selling according to the forecast and needs to be cancelled or deferred on the production schedule; or when a customer requests an urgent order, which needs to be pulled forward on the production schedule and needs to be manufactured as soonest.

In a market situation characterised by extreme competitiveness, it is important for production planners to be willing to reschedule the production plans more frequently to adapt to the continuous changes in market conditions and customer requirements. The rescheduling process enables manufacturing companies to incorporate changes and to produce a more realistic production schedule that maximises production output. Also in the case of pharmaceutical manufacturing companies, it is imperative for them to respond and adapt to ongoing changes in the market place in order to continuously satisfy their customers.

Manufacturing companies should not only be willing to reschedule their production schedules according to the demanding customers' (changing) needs, but should also focus on the importance of being flexible in the global fast-moving business environment. According to Greef and Ghoshal (2004:183), manufacturing companies should be flexible and be willing to adapt to changing customer requirements. The following fundamental elements would apply:

- The manufacturing company needs to be in complete control of the production process by consistently delivering quality products to its customers

- The manufacturing company's production planner should be able to schedule production in a specific way to ensure that the production capacity is maximised and that the customer delivery dates are met on time

- The manufacturing company should be able to operate with the minimum levels of raw materials and component stock kept in the warehouses at any time

- Therefore, the manufacturing company should be aware of all available materials in the plant and whether they have been allocated to the correct production order

- It is important for a manufacturing company to be aware of the flow of materials in and between the different production processes

- The manufacturing company needs to be aware of the amount of resources, manpower and equipment which are available, and necessary, to execute a successful production process

- Finally, the manufacturing company has to manage the physical production process to ensure maximum material efficiency and capacity utilisation, and must also be able to identify any quality deficiencies at all times.

All of the above-mentioned elements are required by a manufacturing company to be more flexible and to respond more efficiently and effectively to any possible changes in a customer order requirement. The appropriate response techniques require prompt and accurate decision-making throughout the production planning process.

Another key element for achieving flexibility and profitability amongst manufacturing companies is to minimise production costs by means of simulation optimisation. Dong and Medeiros (2012:831-841) suggest that an on-line simulation-based scheduling tool be used in order to keep the production costs of batches at a minimum. The simulation optimisation tool includes a simulation function which estimates the cost and processing time of each production order on the production plan, helping to keep production costs at a minimum. To minimise production costs, the manufacturing company should also try and reduce downtime caused by unnecessary changeovers between production batches to ensure that each customer order is completed within its specified delivery time period (Dong & Medeiros, 2012:831-841).

In the current global competitive market, manufacturing companies must ensure the continuous supply of high quality products manufactured in less time and at reduced manufacturing costs. Failing to maintain this goal, manufacturing companies are at risk of losing market share. As a result, manufacturing companies require appropriate planning techniques to manage the physical production process that include: the number of machines and factories needed to manufacture a specific product; as well the size of the warehouse needed to store the raw materials and components needed to

manufacture the required products (Mishra et al. 2012:535-550). The next section explains the various planning techniques which have been used successfully by manufacturing companies in recent years.

2.3.3 Various planning techniques

As per Mishra et al. (2012:535-550), there are a number of planning techniques which have been used successfully by manufacturing companies in recent years. These planning techniques include:

- Advanced computer-aided planning processes (ACAPP)
- Computer-aided process planning (CAPP)
- The Kanban system
- Campaign planning
- Material requirement planning (MRP)
- Outsourcing
- The Hierarchical planning method.

An attempt has been made to overcome possible shortcomings during the planning of appropriate product sequences in production. A need was created by manufacturing companies to make use of more realistic computer-aided process-planning techniques in the manufacturing supply chain environment in an effort to reduce production costs and time. Mishra et al. (2012:535-550) explain that an *advanced computer-aided planning process (ACAPP)* is used by manufacturing companies to resolve planning and distribution problems in a supply chain environment. *ACAPP* is considered as a relatively new concept across the supply chain of manufacturing companies. It involves the extension of technologies that have been widely used to improve efficiency within the supply chain environment.

Sankar, Asokan and Prabhaharan (2008:5561-5587) also addresses the development of a new generative *computer-aided process planning (CAPP)* technique for

manufacturing operations. The *CAPP* technique is characterised by machine processes, machine set-up times and production tools, which improve the efficiency of the manufacturing process. Sankar et al. (2008:5561-5587) concludes that using the *CAPP* technique results in a significant reduction in machine run-times and production costs. Kumar and Rajotia (2003:297-300) highlight the importance of integrating production scheduling and *CAPP* which result in more realistic process plans to improve the effectiveness of the manufacturing system as a whole. These computer-aided process planning techniques minimise the overall production costs and time related to an operations sequence. In this way, the products will be manufactured more often on time and in the correct sequence to meet the required delivery date of the customer.

Feng et al. (2011:4223-4243) explain that an effective production/operations planning method or technique plays an important role in the production management system of a manufacturing company. Strohhecker, Sibbel and Dick (2013:1-7) explain that process manufacturing industries, such as the pharmaceutical, chemical or food industries, use an integrated production planning method, which is called *Kanban.* Kanban originated from a Japanese word meaning ‘visible record’ which basically operates as a signaling system. Kanban is a pull system which is based on the forecasted future needs of a manufacturing company. During the pull system, raw materials and components are purchased and delivered only as and when required by production (Brown & Vondracek, 2013:28-46).

The Kanban system replaced the traditional production-driven, centralised, push-oriented planning techniques with market-driven, decentralised and pull-oriented principles (Hopp & Spearman, 2004:133-148). Kanban can also be associated with just-in-time (JIT) delivery as it forms part of a larger JIT system. The JIT system is used when products are manufactured just-in-time as required by a customer. Pull production is developed as a component of JIT manufacturing to eliminate inefficiencies during the production process.

There are both advantages and disadvantages inherent to the Kanban system. Some advantages that have been identified, include (Muthayan, 2006:12-14):

- The system provides quick and precise information about the current production stage of each product, should the shop-floor feedback be up to date

- Low costs result from the transfer of product information between two or more work centres or production machines

- It provides a quick response time to any possible changes in the production schedule

- The system eliminates the over-production of certain products, as a manufacturing company would only manufacture what is required by the customer

- It offers a reduction in set-up times, lot sizes, and lead-times.

A study performed by Gross and Mclnnis (2003:181) explains that the Kanban system is a very good tool for the shortening of production processes, but highlights the limitations of using this system as a planning tool. Subsequently, the disadvantages of using Kanban in a manufacturing company are that (Muthayan, 2006:12-15):

- Should production orders with short production runs be manufactured, it might be difficult for the Kanban system to be feasible as this may include a number of unnecessary changeovers between smaller production batches

- Lengthy down-times created by unnecessary changeovers could disrupt the entire flow of the production schedule.

Kanban may represent a promising concept for campaign-producing companies as it reduces the overall set-up times and production costs during the production process.

‘Campaign planning’ is when multiple products of the same characteristics follow each other simultaneously on the production line without any unnecessary set-up and cleaning times (Susarla & Karimi, 2011:2990-3001). During campaign planning, set-up times between two or more batches of the same characteristics are much shorter than the set-up times between two or more different production batches. When batches of the same characteristics are grouped together on the production machine, it allows the manufacturing company to control any possible loss of capacity created by unnecessary set-ups.

While campaign planning helps to reduce set-up times and production costs, it may also result in extended total through-put time (TPT). ‘Through-put time’ is the average time taken for a product to be manufactured from start to finish on the production line. When campaign planning is utilised by a manufacturing company, it may also create some scheduling problems when the start dates of single production batches are moved out of the production plan to accompany the products which form part of a campaign group.

In campaign-producing companies, incoming customer orders are incorporated into a central ERP system, which supports the material requirement planning (MRP) system and creates a master production schedule (MPS) with production orders for each production machine. The MRP system handles the planning aspect of a manufacturing company, while Kanban handles the daily scheduling of production and prevents possible over-production (Muthayan, 2006:14).

MRP is a useful tool for generating forecasts, as well as ordering the correct quantities of raw material and components with long lead-times. The MRP system converts production forecasts into a dynamic set of raw material and component forecasts. The MRP system includes inventory data related to the lead-times and safety stock of each product to measure production schedules and raw material requirements. Each finished product is broken down into various parts and components as shown in the bill of materials (BOM). The BOM specifies all the raw material ingredients and quantities of each intermediate part which is required to produce a single product in the production

process (Jacobs et al, 2011:196). The MRP system also includes the shop-floor feedback received from the production staff to ensure that the production plan is followed and adhered to at all times (Olhager, 2013:6836-6848).

There are two types of planning parameters that play an important part when regulating the production run of each product, namely the planned lead-times (PLT) in the MRP, and the planning window in the MPS. The PLT include the key information needed to project the running times of each product needed during each step of production. However, a trade-off exists in setting the PLT - a short PLT leads to a more uneven workload at the workstation (machine area), while a long PLT leads to more work-in-process (WIP) at the workstation. The planning window is the difference between the set delivery lead-time and the total planned production lead-time for each production run (Teo et al, 2010:400-403).

A longer planning window allows for a smoother MPS, which may lead to fewer changeovers during capacity loading. Olhager (2013:6839) explains the importance of production smoothing amongst manufacturers as they need to react to a customer's demand for greater flexibility in product volume and product mix. A stable MPS assists with process and quality improvements. It also ensures a more constant requirement for raw materials and components which leads to a more stable delivery schedule for raw material suppliers.

In addition to MRP, Framinan and Leisten (2010:3079-3103) explain that many manufacturing companies adopted the available-to-promise (ATP) logic in the master schedule, which allows them to establish immediately how many finished products are available for immediate delivery. ATP is calculated when establishing the material on hand, followed by adding the MPS, and subtracting the total number of customer orders in the system (Jacobs et al, 2011:191-193).

Another favourable planning method used by manufacturing companies is called *outsourcing.* Outsourcing can be defined as the act of obtaining semi-finished products,

finished products or services from an outside manufacturing company at a lower cost than when performed internally (Dolgui & Proth, 2013:6769-6777). A number of manufacturing companies make use of outsourcing when they hope to increase their production capacity without jeopardising the delivery date of the customer order (Lane, 2007:80-82).

Lane (2007:80-82) advises that the following aspects need to be taken into account before a manufacturing company decides to make use of outsourcing*:*

- The exact time period needs to be established as to what length of time is needed for outsourcing companies to produce the manufacturer's product

- The financial implications, such as the production costs involved, need to be calculated ahead of making the final decision to outsource a product

- A manufacturing company needs to decide if it will allow the outsourcing company to make use of its tooling in order for the outsourcing company to produce the identical product for the customer

- A manufacturing company should decide if it will send some of its own raw materials and components over to the outsourcing company to enable the outsourcing company to produce the product sooner

- Both the manufacturing company and the outsourcing company need to come to an agreement before the final decision is made as to who will take the responsibility should the customer receive a bad quality product, or if the customer orders are not delivered on time.

Jacobs et al. (2011:300-301) emphasise that the most important aspect of using outsourcing companies is that they have the ability to be more flexible and responsive to changes in demand from the customers. In addition to this, the benefits of making use of outsourcing include (Dolgui & Proth 2013:6769-6777):

- Improvements in customer order fulfilment for a manufacturing company, as an outsourcing company may deliver the customer orders more efficiently

- Manufacturing companies benefit by taking advantage of external expertise from outsourcing companies

- Employees from a manufacturing company are freed from tedious tasks to allow them to focus on fulfilling their core activities instead

- Greater financial flexibility is achieved by selling production assets that were formerly used in the outsourced activity to improve the overall cash flow of a manufacturing company.

However, while there are many recognised advantages of outsourcing production, the decision to outsource may also contain disadvantages, such as (Dolgui & Proth 2010):

- The quality of the final product may be at risk should the outsourcing company not adhere to the customer's quality specifications, as previously agreed with the manufacturing company

- The customers' delivery date might be at risk when the outsourcing company does not adhere to the agreed delivery dates quoted between the manufacturing company and its end customers

- The manufacturing company is at risk of losing the production of a product to the outsourcing company should the product quality and supply be better from the outsourcing company.

From the various production planning techniques mentioned up to this stage, one method that has been shown to be particularly successful, is the *hierarchical planning method*. The hierarchical planning method involves the setting up of a manufacturing

structure and layout (structuring task) by establishing the throughput-times of all the manufacturing steps involved in producing a single product. This structuring task is used to establish the necessary planning methods and procedures through MRP (Timm & Blecken 2011:3431-3453). The manufacturing planning tasks are divided into a number of quantitative partial tasks. These partial tasks are hierarchically connected by process definitions and can thus be used as manufacturing planning methods when computed sequentially by a production planner (Timm & Blecken, 2011:3431-3453).

Alternatively, it would be possible to solve the prior manufacturing planning tasks using an aggregate planning process (Kistner & Steven, 2001). This planning process simultaneously creates optimal production, inventory, and employment levels over a finite planning horizon to meet the total demand for all products that share the same limited resources (Timm & Blecken, 2011:3431-3453). However, studies by Timm and Blecken (2011:3431-3453) have also shown that a hierarchical planning method is the most favourable planning method suitable for any type of manufacturing company.

The following planning methods have been identified by Günther and Tempelmeier (2005:8) to ensure that production planning can be made more effective:

- The number of unnecessary production machines need to be assessed so that it can be removed to make space for value-adding production machines which will ensure that the production capacity is utilised effectively

- The availability of skilled and qualified employees needs to be considered when new products are scheduled on the production plan

- Qualified employees with unique skills can be trained to obtain additional qualifications, to ensure that all the employees are multi-skilled when new products are planned to be manufactured

- The decision to make or buy certain production parts depends on the specific MRP procedures for which these products are scheduled during the manufacturing process

- The number, characteristics and sequence of the processing steps required to manufacture a specific part or product need to be determined when selecting alternative manufacturing processes

- A demand-based strategy needs to be selected for each part to determine the required planning and control methods. The configuration of a demand-based strategy is accomplished by the parameter's re-order level where order cycles and lot sizes are determined

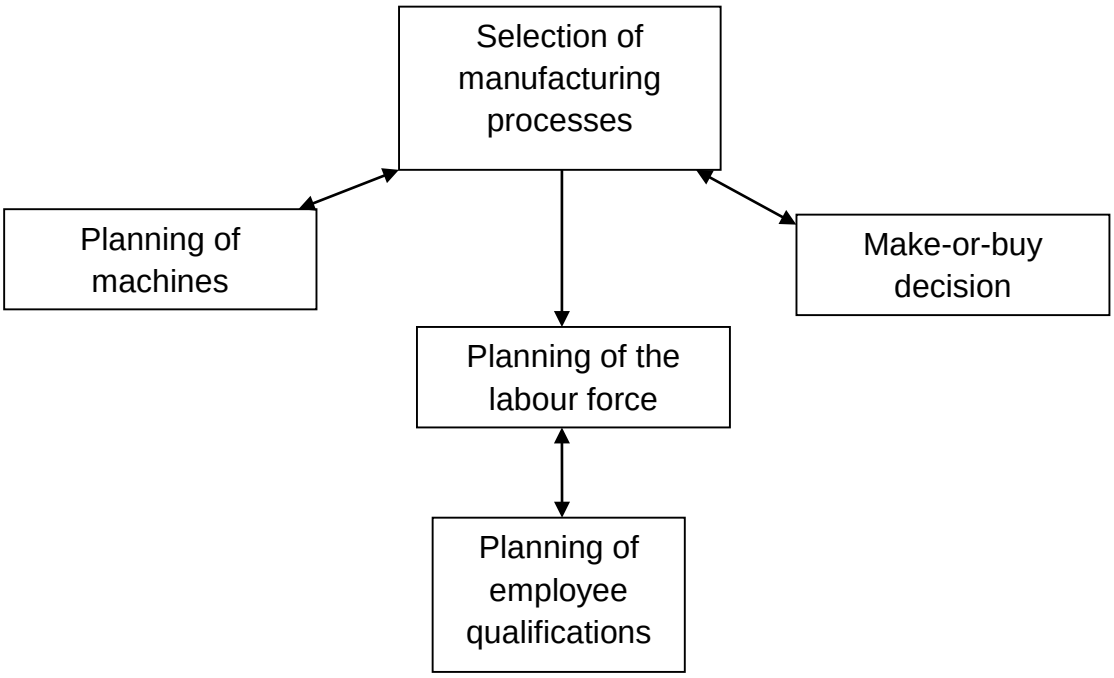
- Accurate stock levels of raw materials and components that will be used to manufacture the production orders, need to be identified in advance to ensure that the customer orders will be fulfilled in accordance with the lead-time given to the customer.

By dividing the above-mentioned planning methods into several sub-sections, the following benefits emerge (Timm & Blecken, 2011:3431-3453):

- Several time horizons can be analysed in the different levels of the hierarchical planning process. A time horizon refers to a fixed point of time in the future when certain processes are being evaluated. The different levels of aggregation can be used to successfully solve any possible problems which may occur with certain products with a longer time horizon. It would be feasible to use a detailed data base for a longer time horizon, especially in cases where forecasting problems may occur.

- By dividing all the planning tasks into a set of hierarchically partial layers and by integrating production feedback, an overall good planning solution for manufacturing companies would be ensured (see Figure 2.3).

Figure 2.3: Dependencies of the different planning methods



Source: Timm and Blecken (2011:3434).

The above-illustrated diagram is composed of three layers and depicts that tasks which are mutually dependent need to be solved in one similar partial model. The first model or top layer includes the decisions made regarding alternative manufacturing processes, make-or-buy decisions, as well as machine availability. The make-or-buy decision is directly connected to the machine availability because purchased items do not require capacities in the manufacturing process. The second partial model or layer is based on the decisions made during the first model or top layer which optimises the labour force and the development of skills and qualifications amongst employees. Partial model three involves the decision whether to use a consumption-orientated or demand-orientated strategy whereby the re-order level of orders is established. Decisions regarding the labour force and the employee qualifications are also grouped together at this layer.

2.3.4 The importance of workload control (WLC)

Workload control (WLC) is a leading production planning and control solution for make-to-order (MTO) manufacturing companies to improve overall production processes. Thürer, Silva and Stevenson (2011:1151-1171) explain that WLC plays an important part in the production planning and control aspect of MTO strategies when regular production or shop-floor feedback is done timeously to improve production performance. As explained earlier, shop-floor feedback is normally done by the production employee who advises on the current status of the work-in-process (WIP) step of a particular product currently being manufactured. During this step, the number of possible work areas is identified in the routing of a specific production run of a product. The routing of a specific product refers to the production time and steps taken to produce a particular product (Stevenson, Henry & Kingsman, 2005:1151-1171).

Stevenson and Silva (2008) highlight that one of the key barriers experienced by MTO manufacturing companies for successfully implementing WLC, is to determine the appropriate workload norms. Workload norms are “parameters which are set based on the current capacity load level of a particular work centre, the planned output, and the degree of control required over production queues on the shop floor” (Thürer et al, 2011:1151-1171).

There are normally two different types of workload norms: a maximum norm, which is the upper workload restriction of the backlog; and the minimum norm, which is the lower workload restriction of the backlog. The minimum norm is mostly used to avoid production starvation and the upper norm is used to balance the shop floor capacity (Stevenson & Henry, 2006:676-693). It is important that shop floor feedback regarding information on the progress of WIP is constant and reliable to ensure that adequate workload norms are used by production (Stevenson & Henry (2006:676-693). By gathering the correct feedback information from the shop floor, the workload norms can be adapted dynamically, based on the current load at each work centre in production.

2.3.5 Production control policies

Process manufacturing companies execute an effective production management policy by optimising the production planning method. It is especially important to create ways to solve problems relating to demand uncertainty and planning inadequacy. Process manufacturing companies need to develop different scientific and practical production planning methods to ensure improved production efficiencies and reduced production costs. An effective optimisation method can improve production planning and control to meet the requirements of the technical levels of production to improve production planning and control in process manufacturing companies.

To ensure ongoing competitiveness in the current challenging market place, manufacturing companies require appropriate production control policies to improve their logistics performances by reducing production lead-times and adhering to the customers' delivery dates (Economopoulos & Kouikoglou, 2011:2019-2034). An appropriate production control policy involves making decisions about when to accept incoming orders from customers, and which quantities to produce. These decisions have several effects on a number of operational aspects, such as through-put times, backlog levels, as well as the quality of service. A backlog occurs when the customer order has not been completed on time and is still due to be completed or delivered to the end customer (Jacobs et al. 2011:296-298). These operational aspects affect the mean profit rate of the system and include various elements such as the profit made from sales, the costs related to inventory shortages, backlogs, delays in order fulfilment, as well as the possible loss of sales created during out-of-stock periods.

For pharmaceutical manufacturing companies to manage incoming orders during out-of-stock periods, many of them apply a 'lost sales (LS) policy', which refers to all incoming orders being rejected, or a complete 'backordering (CB) policy', which refers to all incoming orders being accepted. When applying LS, there is no cost of delay in fulfilling the customer orders, but the loss of sales to a competitor during out-of-stock periods forces a pharmaceutical company to keep sufficient levels of inventory on hand. On the

contrary, when applying CB, manufacturing companies experience long delays in fulfilling customer orders, since the backlog queues may become too long. This could lead to potential loss of sales to expectant customers.

A control policy which creates a balance between the loss of sales and long delays between LS and CB, is called the 'base backlog policy' (Economopoulos & Kouikoglou, 2011:2019-2034). When the base backlog policy is in use, the incoming customer orders are accepted by pharmaceutical companies during out-of-stock periods as long as the backlog level is less than a certain level called the *base backlog*. Once a base backlog policy is applied to systems with zero stock levels, the policy is called *make-to-order* (MTO). Under this MTO policy, a customer order would form part of the backlog queue only if a particular customer order has not been completed on time as per the agreed due date. Pharmaceutical manufacturing companies who are continuously late to deliver orders on time may experience a potential loss in future sales because of dissatisfied expectant customers. Satisfying these customers play an important role when controlling inventory and backlog levels in production systems (Economopoulos & Kouikoglou, 2011:2019-2034).

The basic optimisation methods for production planning include linear programming, dynamic programming, transportation tables and logical mathematical programming (Josef, 2005:339-373). Byrne and Hossain (2005:225-229) propose an extended linear programming system based on the problem of incorporating demand uncertainty in a multi-period and multi-product production planning environment.

Cai and Zeng (2006:16-20) identify the following optimisation techniques:

- Production requirements must be based on accurate demand forecasts received from the Sales and Marketing department

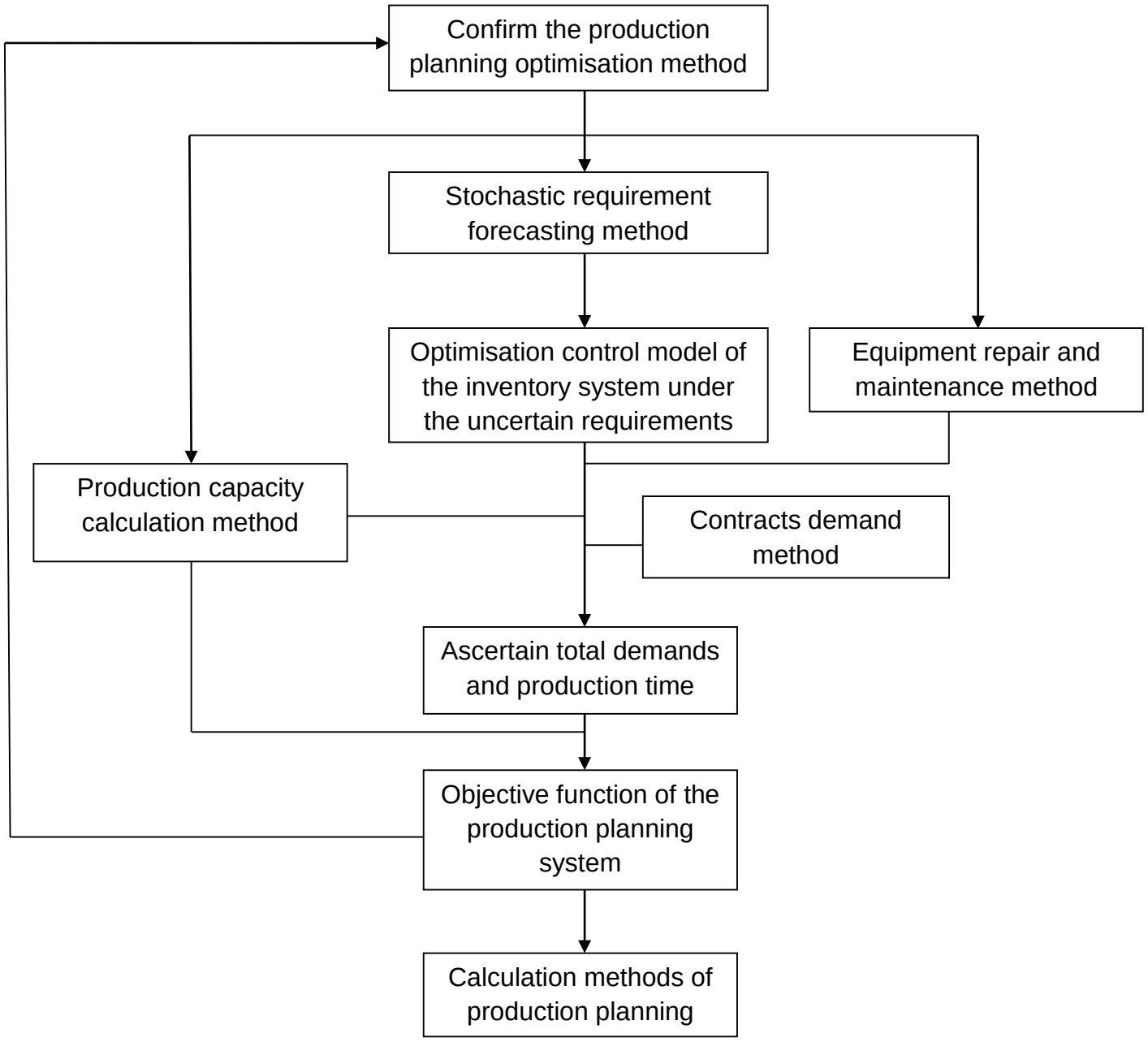
- Stock levels and inventory costs must be kept at a minimal level

- Production running-times should be taken into account when order due dates are given to customers

- Possible down-time for equipment repair and maintenance should be provided for in advance.

Based on these techniques, a modeling strategy for optimum production planning is shown in Figure 2.4. The first step of the model shown in Figure 2.4 refers to the production planning optimisation method where the sales forecasting, production capacity and equipment precautionary methods are used as controls and restraints to minimise inventory costs. The total production quantities and production requirements related to orders received from the manufacturer's customers are also taken into consideration during this step. This is followed by the second step when the required production demands are drawn from the optimisation control method of the inventory system, the contracts demand method, as well as from the production capacity method. During this phase, the equipment repair and maintenance requirements are also taken into consideration. After this, the third part of the model illustrates that the production planning system is used to ultimately calculate the methods used for successful production planning.

Figure 2.4: A modeling strategy used during the production planning optimisation method



Source: Feng et al (2011:4223-4243).

The production planning and control system ultimately supports the operational decision-making with regard to cost- and time-oriented objectives. A study performed by Olhager (2013:6836-6843) on operations planning and control concludes that manufacturing companies have become aware that more factors should be taken into account to achieve operational excellence - not only for internal operations, but also for complete supply chains because supply chains include suppliers and customers. These factors involve product design and any new concepts and approaches which might be needed to successfully deliver the finished product to the end customer. Olhager (2013:6836-6843) also highlights that quality improvements, flow orientations of the production processes, set-up and lead-time reductions play important roles in simplifying the production planning and control processes.

2.4 CHALLENGES AND OPPORTUNITIES FACED BY THE PHARMACEUTICAL INDUSTRY

In terms of the discussion up to now in this chapter, the pharmaceutical industry is also faced with ongoing challenges and opportunities to increase the efficiency and effectiveness of its planning, production and distribution systems and to reduce the overall supply chain costs. The most important aspect of the pharmaceutical industry is the accessibility and availability of the necessary medication to treat various patients. To meet this important facet, different elements of the drug distribution system have received attention in an effort to decrease distribution costs so that customers and eventually patients can afford and have access to their required drugs. Pharmaceutical manufacturers are also making use of advances in new technology, especially in the expansion of electronic commerce (the internet) which has facilitated and improved the process of distributing pharmaceutical products in developed countries.

Recent studies by Tabibi, Mohammadi, Maleki and Tourani (2012:148-154) show that there has been a 50.0% increase in the world’s drug consumption market over the past number of years, accompanied by a greater variety of health products in the global consumer market. This has resulted in a need to create and implement new and

improved pharmaceutical distribution methods to distribute pharmaceutical drugs and products more efficiently to the demanding customer.

Table 2.1: Key themes and sub-themes used in evaluating the pharmaceutical drug distribution system in Iran.

THEMES	**SUB-THEMES**
Distribution policy implementation	Regulatory requirements of pharmaceutical products, research and development (R&D) in the pharmaceutical industry, legal supervision of the pharmaceutical system, the private sector's participation in the drugs distribution system, as well as internet trading.
Pharmaceutical drugs planning	Technological solutions to drug distribution, disaster management and the drug distribution system, product shortages in the supply chain, consumers and electronic commerce.
Drugs distribution structure	Pharmaceutical products, supply chain, wholesale distribution, wholesalers' role in pharmaceutical products, direct distribution approach, and pharmacy chains
Drugs distribution process	National drug distribution, provincial distribution chains, interaction between pharmaceutical producers, wholesalers and pharmacies in the drug distribution system.
Drugs distribution control	Protecting the supply chain and combating the trafficking of fake pharmaceutical drugs.
Monitoring drug quality	The pharmaceutical industry evaluating the quality of drug distribution firms.

Source: Tabibi et al (2012:151).

A typical example of a pharmaceutical drug distribution system is used by the Iranian pharmaceutical distribution system whereby six themes were identified as key factors in the pharmaceutical drug distribution system (Tabibi et al, 2012:148-154). These six themes are shown in Table 2.1 and explained below.

Theme one: Pharmaceutical distribution policy implementation. The pharmaceutical industry was forced to implement a proper distribution policy to fulfil the ongoing demands of patients.

Theme two: Pharmaceutical drug distribution planning. The main challenge of the Iranian pharmaceutical distribution system was the vast amount of product shortages in the country. However, the problem was resolved when they started to make use of a high technology and pharmaceutical programme to distribute the drugs more effectively and efficiently to the patients.

Theme three: Drug distribution structure. The importance of pharmacies in supplying patients with higher quality pharmaceutical drugs at the lowest possible cost and price within the shortest possible time, was recognised.

Theme four: Drug distribution process. Pharmacies form part of the last section of the supply chain before pharmaceutical drugs reach the patients. These pharmacies purchase products mostly from wholesalers and often directly from the manufacturers to reduce distribution costs. Pharmacies are ultimately responsible for keeping adequate supplies of medicines and other pharmaceutical drugs in store for patients. They also need to be able to provide relevant product information to patients as required.

Theme five: Monitoring drug distribution. Fake pharmaceutical products are often produced and distributed by companies who are not authorised or licensed to produce these products. These products are considered global threats, as they may not contain the correct ingredients, which is potentially harmful to human health. According to the

World Health Organisation (WHO), more than 5% of pharmaceutical drugs were counterfeit in the global market in 2006.

Theme six: Monitoring drug quality. It is important that the quality of pharmaceutical products becomes a priority for healthcare institutes.

The above themes indicate that supportive supply chains in the pharmaceutical industry can lead to improvements in the level of commitments made to patients. Pharmacies should strive to keep adequate supplies of medicines and other pharmaceutical products, which will result in improvements in the drug distribution process for pharmacies. The study suggests that the Iranian pharmaceutical product distribution system needs serious attention in order to fulfil the patients' needs more timeously.

Osuji and Umahi (2012:139-167) explain that multinational pharmaceutical companies play an important role in achieving global access to medicines, especially in developing countries. These companies usually have the facilities to do the necessary research and development on new products needed to manufacture essential medicines. However, multinational pharmaceutical companies are struggling to produce sufficient life-saving medicines to patients in developing countries. The high costs of pharmaceutical products would increase the national budget of developing countries, which makes the effective provision of some life-saving medicines unaffordable for certain governments.

According to statistics revealed by the World Health Organisation (WHO) in 2006, many patients in developing countries are dying as a result of inadequate access to medicines required to control diseases because they are either unaffordable or out-of-stock. Poverty is also a main cause of death amongst poor populations in developing countries (Osuji & Umhati, 2012:139-167). Therefore, Hoen and Von Schoen-Angerer (2009:1-30) encourage pharmaceutical companies to manufacture generic drugs which would reduce the high costs of medicine, so that these products are more accessible to patients in developing countries.

Some pharmaceutical companies, including GlaxoSmithKline (GSK), Merck, Johnson & Johnson and Sanofi-Aventis, coordinated by the high profile campaigner in Global Alliance for Vaccine and Immunisation (GAVI), announced that they are willing to reduce the prices of certain vaccines in developing countries. GAVI and the pharmaceutical companies involved predicted that higher prices in richer developed countries would subsidise the prices in developing countries, thus generating some funds for global research and development programmes. It is claimed that this initiative will enable the pharmaceutical companies to fulfil the patients' right to proper healthcare.

Generic pharmaceutical manufacturing companies are also faced with the ongoing challenges in retaining their customers on a daily basis. Should one of the generic manufacturers' products become unavailable to the dispenser at the time of purchase, it is easy for the dispenser to recommend an alternative product to the customer. Normally, a competitor's generic product has the same function as the original product and usually does not cost the customer more than the original generic product. If the alternative generic product is available when required, it may simply result in generic brand switching. However, winning the customer back to use the original generic product, is normally a difficult task and may result in a loss of sales of that specific generic product by a pharmaceutical company (Rothner, 2010:19-20).

2.5 IMPORTANCE OF INTERNAL AND EXTERNAL CUSTOMER SERVICE LEVELS

A pharmaceutical manufacturing company consists of a number of stakeholders, including internal employees and customers. Building better relationships amongst all of these stakeholders assists the manufacturing company in developing intangible, but valuable assets which can be sources of a competitive advantage (Zhang, 2010:112). A competitive advantage amongst stakeholders plays an important part in the success and sustainability of a manufacturing company.

The next two sections describe the importance for a manufacturing company to focus on its internal customer service levels, as well as external customer service levels with its customers.

2.5.1 Internal customer service

All employees are both service providers and customers to the staff with whom they interact internally at various times. Internal customer service involves the interaction amongst all the internal departments within a manufacturing company. Internal customer service and quality is important to ensure that internal employees receive good service at all times, resulting in improvements to external customer service levels. It is therefore of vital importance that internal employees are well trained and dedicated to each of their responsibilities at their different work stations within the manufacturing company where they are employed.

Employees' behaviour within a manufacturing company should be carefully coordinated and managed by the manufacturing company to ensure that positive feelings and judgements concerning the manufacturing company are generated. If employees are satisfied with their different roles within a manufacturing company, employee absenteeism will decrease, while productivity and performance improve (Swartzlander, 2004:59). Employees with positive behaviours will also be more productive in their different roles within the manufacturing company. However, negative employee behaviour can destroy a productive working environment, resulting in high levels of stress, absenteeism, minor illnesses, and even depression amongst employees (Kattara, Weheba & El-Said, 2008:310).

As far as pharmaceutical manufacturing companies are concerned, the internal staff within a pharmaceutical manufacturing company needs to work together as a team to supply the correct product to its end customers on time. This will result in reduced out-of-stock situations amongst pharmaceutical customers; sales would be maximised; generic brand switching will be minimised; and customers would remain loyal and

satisfied. A manufacturing company can therefore not afford to have internal employees and departments that cannot work together as a team. The level of internal service between internal staff needs to be continuously assessed and addressed if necessary to improve cooperation and responsiveness to external customer orders.

2.5.2 External customer service

External customer service refers to the relationship between a manufacturing company and its external customers. Strong external relationships can result in shorter delivery times of customer orders and reduced service costs. Moreover, when an end customer has a strong relationship with a manufacturing company, the customer is less likely to turn to alternative manufacturers (Rothner, 2010:16-17). Good customer service is an important method through which a manufacturing company can distinguish itself from its competitors. However, good customer service takes a long time to develop. Therefore, it is difficult for competitors to immediately acquire the same level of customer service excellence (Cook & Verna, 2002:49; Rapp, Taylor & Agnihotri, 2010:1232). In terms of this, Swartzlander (2004:1) explains that customer service is only considered exceptional when it continuously meets and exceeds a customer's needs and expectations.

The key drivers in the exchange relationships between a manufacturing company and its customers are good customer service levels and the delivering of a good quality product to its end customer. Manufacturers are no longer able to compete in the market place based on price only, but rather need to focus on developing ways to maintain excellent customer service levels and to deliver a good quality product to its customers (Rothner, 2010:14).

The continuous personal interaction between the customer and the front line staff of a manufacturing company has a positive influence on the customers' satisfaction, brand loyalty and ongoing future sales of a manufacturing company (Rapp et al, 2010:1230). Customer satisfaction consists of high levels of supplier capabilities and performances,

manufacturing efficiencies, sales performances and forecast accuracy (Rothner, 2010:18-25). Customer satisfaction, loyalty, and acquisition can result from a manufacturing company's ability to build and strengthen external relationships with customers (Rapp et al, 2010:1231). Normally, customer satisfaction increases when performance exceeds the customer's expectations, and decreases when the performance is below expectations.

Customer satisfaction can thus be increased or decreased depending on the different interactions between customers and the front line staff of a manufacturing company (Rohner, 2010:4-10).

By focusing on the customer's needs, the following benefits can be gained by a manufacturing company (Rohner, 2010:4-10):

- The promotion of internal customer and supplier relationships
- Increased productivity and reduced product costs
- The assurance that products and services are delivered "right the first time"
- Increased customer satisfaction and retention
- The bringing about of continuous improvements within the operations of a manufacturing company.

2.6 CONCLUDING REMARKS

From the discussion in this chapter it is clear that pharmaceutical manufacturing companies need to make use of appropriate production planning techniques to ensure a steady flow of the production process so that products can be manufactured on time to meet the customers' orders timeously.

This chapter also explained the use of accurate sales forecasts, the effective and efficient setting of customer order lead-times, the scheduling of operation sequences, suitable planning techniques, as well as the importance of workload control within a

manufacturing company. The use of appropriate production control polices and the challenges and opportunities faced by pharmaceutical manufacturing companies to manage and reduce possible out-of-stock situations amongst pharmaceutical customers, have also been discussed. Furthermore, the importance of internal and external customer service levels between a manufacturing company and its customers, was explained.

Chapter Three involves a discussion of how demand and operations planning is done in practice at Aspen Pharmacare. It describes the role of the master production scheduler, as well as the demand and operations planning strategies used by Aspen Pharmacare. The role of each department in terms of the various logistics processes is also discussed.

CHAPTER 3

DEMAND AND OPERATIONS PLANNING IN PRACTICE AT ASPEN PHARMACARE

3.1 INTRODUCTION

As discussed in Chapter Two, many pharmaceutical manufacturers are experiencing out-of-stock situations amongst its customers due to various reasons, which could have serious consequences. For example, a pharmaceutical manufacturer might be unable to supply the required product to its customers due to capacity constraints in the manufacturer's production area. In some cases, out-of-stock situations might also occur due to the unavailability of certain raw materials and components required to manufacture a specific product for a customer.

During the past few years, the Demand and Operations Planning department at Aspen Pharmacare managed to significantly reduce the total number of out-of-stock situations amongst its customers, by following strict demand and operations planning strategies on a daily and monthly basis. These planning strategies are primarily being followed by each master production scheduler (MPS) who forms part of the Demand and Operations Planning department at Aspen Pharmacare. Each MPS would follow these strategies to ensure that all efforts are made to deliver the right product on time to the customers.

This chapter explains the role of the MPS within the Demand and Operations Planning department at Aspen Pharmacare, as well as the demand and operations planning strategies that are being followed on a daily and monthly basis. The role of each supporting department that forms part of the supply chain and logistics processes within Aspen Pharmacare, is also discussed.

3.2 THE ROLE OF THE MASTER PRODUCTION SCHEDULER (MPS) AT ASPEN PHARMACARE

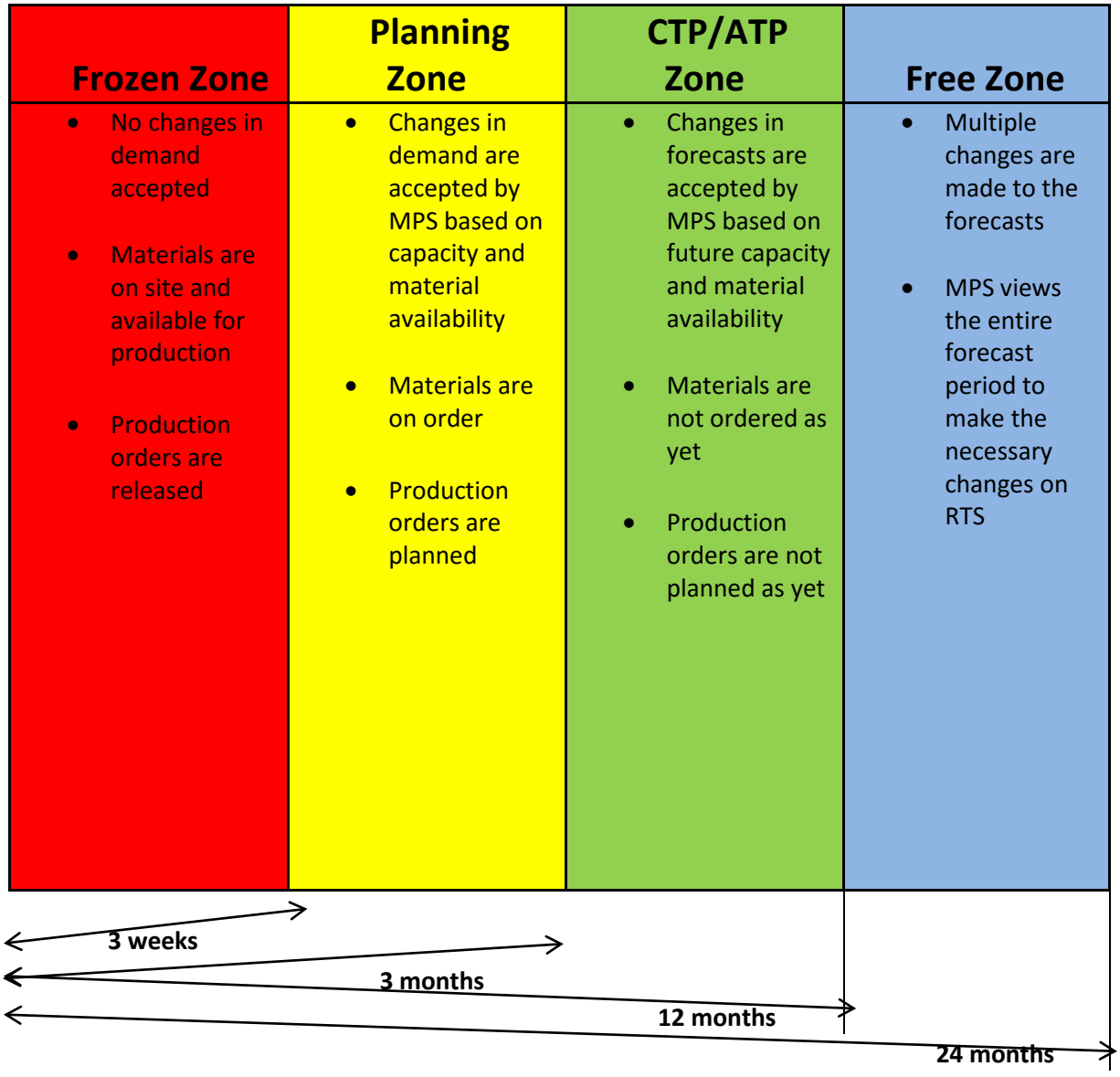
As per Litman (2013:1-2), the most important role of a MPS within a manufacturing company is to create a logical and systematic production schedule, which is adhered to at all times by the production staff, to ensure that a successful end product is delivered to its customers on time. Also at Aspen Pharmacare, the MPS is responsible for creating a successful monthly production schedule, by ensuring that only the required products are manufactured, packed and delivered on time to all its customers.

In order for the MPS to compile an effective monthly production schedule, the MPS at Aspen Pharmacare makes use of a computer software planning tool, which is called *wayRTS*. This planning tool was specifically designed by professional computer programmers in Germany, to assist pharmaceutical manufacturers in managing their entire supply chain and logistics processes successfully (Wassermann, n.d.). It is recommended for high-volume production planning and is currently being used successfully by a number of pharmaceutical manufacturers around the globe.

The MPS's overall decision-making process regarding the compiling of a production schedule, might be influenced by other aspects apart from what the *wayRTS* planning tool is requesting the MPS to manufacture. Therefore, this planning tool may not include certain aspects required to plan a specific product for production. For example, the *wayRTS* planning tool would not indicate if and when a certain product becomes out of stock in the market place. It remains the core responsibility of the Sales and Marketing department to immediately inform the MPS of an out-of-stock situation, whereby the MPS would need to re-schedule the production plan accordingly. Therefore, each MPS should use the *wayRTS* planning tool as a guideline only when planning the necessary products for production. Ultimately, each MPS should still be able to use his/her own planning skills and expertise while scheduling the different products on *wayRTS*.

However, before the actual production scheduling process can commence, the MPS must understand the necessary planning time fences, as it represents the different planning periods that exist for each product over the next 24 months. The following flow diagram forms part of the *wayRTS* planning tool that specifies the different planning time fences (see Figure 3.1):

Figure 3.1: Planning time fences



Source: Extract from *wayRTS* (2012).

The different planning zones are explained as follows:

Frozen Zone: This refers to the time period for the next three weeks. During this period, all the required raw materials and components should be available from the Laboratory and Quality Control (QC) department, to ensure a steady flow in the issuing of raw materials and components to production. No further scheduling changes should be made by the MPS during this time period, since it could impact on the already confirmed delivery dates of existing production batches being manufactured during the three week period (Jacobs et al, 2011:203).

Planning Zone: It refers to the time period over the next three months. During this period, customer orders should be firmed up and remain unchanged in the system, so that the necessary raw materials and components can be ordered on time from the relevant suppliers. Some raw materials and components have long lead-times, which need to be monitored closely by the relevant product buyer within the Purchasing department (Chapman, 2006:242-243).

Capable To Promise (CTP) or Available To Promise (ATP): These 12-month time periods refer to the time to market the finished products, as each product has a different ATP time fence. The MPS uses ATP logic to allow the pharmaceutical manufacturer to promise a realistic delivery date to its customers. It is vital for the manufacturer to communicate clearly to its customers with regard to delivery time-lines, to ensure that the customer orders are being met timeously (Chapman, 2006:83).

Free Zone: This refers to the time period for the next 24 months, in which the Sales and Marketing department is free to make any changes to the demand forecasts received from the relevant customers. The MPS can view the entire period for each product on *wayRTS* to ensure that the necessary machines and materials are available to fulfil the production schedule (Wassermann, n.d.).

Once the above-mentioned planning time fences have been taken into consideration, the MPS can proceed to follow the necessary demand and operations planning strategies, referred to in the previous chapter, to compile a successful monthly production schedule.

3.3 DEMAND AND OPERATIONS PLANNING STRATEGIES USED BY ASPEN PHARMACARE

A number of planning strategies are being used by the MPS within the Demand and Operations Planning department at Aspen Pharmacare, to ensure that customer orders are being met timeously. By utilising effective demand and operations planning strategies, a more realistic production schedule is compiled and executed effectively (Omar, 2011:327). In what follows, each strategy used at Aspen Apharmacare is explained in detail.

3.3.1 Backward planning

The MPS at Aspen Pharmacare would start the overall production planning process by making use of *backward planning*. Backward planning is used to calculate the time from when a product is due (promised) to be delivered to the customer and uses lead-time information to work backwards to establish the relevant start date of each product in production. Therefore, this process is being followed by the MPS to determine when the production of a product should start and be completed by each work centre or production area.

The backward planning process starts by analysing the end product (pack) requirement and calculate backwards to schedule the necessary bulk requirements on the production schedule. The number of bulk batches that need to be manufactured are basically driven by the pack requirements. In practice, this refers to the forecasted demand received from the customer. Bulk refers to the tablets or capsules which are being manufactured and ultimately packed into specific containers, and sold to the end

customer or user. For example, when the pack requirement is asking for five packed batches of a specific product, the MPS must schedule to manufacture five corresponding bulk batches.

For backward planning to be used successfully, a feasible production planning system must be implemented. It is important that the planning tool *wayRTS* includes accurate Bills of Materials (BOM) data and routing estimates, to ensure that all the products are manufactured according to the correct time-lines and specifications. BOM data refers to all the necessary raw materials and components that make up a specific product (Jacobs et al., 2011:185). Routing estimates include all the different steps that need to be followed during the production or packing process with allocated time-lines for each step. These routing estimates need to be taken into consideration by the MPS when scheduling production batches on the production schedule. Over and above backward planning, the MPS at Aspen Pharmacare makes use of *Lean thinking.*

3.3.2 Lean thinking

Lean thinking refers to a way to do more with less – less human effort, less equipment, less time, and less space to fulfil a customer order on time (Womack & Jones, 2003:44). Generic pharmaceutical manufacturers, such as Aspen Pharmacare, strive to make use of Lean thinking by identifying the value stream of all the actions required to manufacture a specific product for the customer. Lean thinking leads to lean manufacturing, which increases the cash flow of an organisation by achieving the following benefits (Dolcemascolo, 2006:3-4):

- Reducing inventory and lead-time of the products being manufactured
- Improving productivity and quality of the products produced
- Increasing overall customer satisfaction.

Business organisations who apply Lean thinking and Lean manufacturing achieve the above-mentioned benefits by identifying the following three principles to eliminate non-value-adding activities (Womack & Jones, 2003:44)*:*

- Specify value: The actual planning process starts with the customer that would define value – if a customer is willing to pay for a product or service, it adds value.

- Identify the value stream: Once value has been clearly defined, value streams are clearly defined. A value stream is a set of all the actions required to convert raw materials into end products for the customer. The value stream consists of three critical tasks, namely: problem-solving; the information management of new products; and the physical transformation of tasks. These tasks should be executed timeously to ensure that the product is manufactured successfully and delivered on time to the relevant customer (Dolcemascolo, 2006:32-39).

- Pursue perfection: Once the value stream has been implemented, this Lean thinking process is used to eliminate waste, so that the manufacturer can continuously improve on meeting the customers' delivery dates. Waste in this case includes overproduction, unnecessary inventory and any possible defects.

Lean thinking is continuously being used by the MPS at Aspen Pharmacare to ensure that the most feasible and lean production schedule is compiled and executed.

3.3.3 Outsourcing

Another successful planning strategy which is being used by the Demand and Operations Planning department at Aspen Pharmacare, is called *Outsourcing*. As explained in Chapter Two, O*utsourcing* can be defined as the act of obtaining semi-finished products, finished products or services from an outside manufacturer at a lower cost than when performed internally (Dolgui & Proth, 2013:6769-6777). Aspen

Pharmacare makes use of outsourcing several of its products to different outside pharmaceutical manufacturers to increase its production capacity without jeopardising the delivery date of customer orders.

3.3.4 Monthly planning workflow/process

Jacobs et al. (2011:122) explain that the monthly planning process involves making decisions on each product group pertaining to the production schedule, while taking the current backlog into consideration. Decisions include the current sales history of the products, future demand forecasts, as well as recommendations of middle and top management's knowledge of the current business conditions.

The monthly planning workflow/process forms part of the *wayRTS* planning tool and was adopted by the MPS at Aspen Pharmacare to create a more effective monthly production schedule. In this way, the MPS ensures that all the necessary products are manufactured on time, and in accordance with the customers' delivery dates.

It needs to be noted that the MPS will always start with the monthly planning workflow/process and not with the daily planning process, since this is the first process to follow when compiling the monthly production schedule. The MPS would follow the following three steps as part of the monthly planning process in an effort to create a successful monthly production schedule on *wayRTS* (Wassermann, n.d):

- Step one: Demand checks

The Sales and Marketing department, together with the Demand and Operations Planning department at Aspen Pharmacare, have monthly sales and operations planning meetings to discuss the relevant demand forecasts for each product. During these meetings, the Sales and Marketing department would perform demand checks on each product to identify any slow-selling products, as well as any unexpected increases

in demand for a specific product. The MPS would then be forced to postpone the slow-selling products' production to a later period within the next three months to accommodate for other high-demand products. The high-demand products can then be manufactured sooner than anticipated. This would assist the pharmaceutical customer to avoid any possible out-of-stock situations.

Each product's demand forecast consists mainly of sales predictions made over the next three months, which include information on actual sales, as well as the current inventories of each product on the system. Once the Sales and Marketing department and the Demand and Operations Planning departments have agreed upon the new sales forecasts for the next three months, the MPS can proceed with the next step of the monthly planning process, namely that of checking raw material availability.

- Step two : Check material availability

The MPS will move the necessary demand requirements to the desired time periods based on the customer order delivery dates, by using the *Rough-cut* planning tool in *wayRTS.* It is of vital importance to ensure that during this process, the Frozen Zone time fence is not affected while shifting the requirements or loads to the desired time periods.

Once this process has been completed, the MPS will check the availability of raw materials and components that are required to manufacture the necessary products, by using the *Navigator* planning tool on *wayRTS*. Simultaneously, the *Load Profile* planning tool in *wayRTS* will also be used to view the machine capacity for the next three months. In this way, the MPS can identify if any additional machine capacity is available or required. This will allow the MPS to pull any urgent products forward so that it can be manufactured sooner than anticipated (Aspen Pharmacare, n.d.). Once this step has been finalised, the MPS can proceed to harmonise the loading per area.

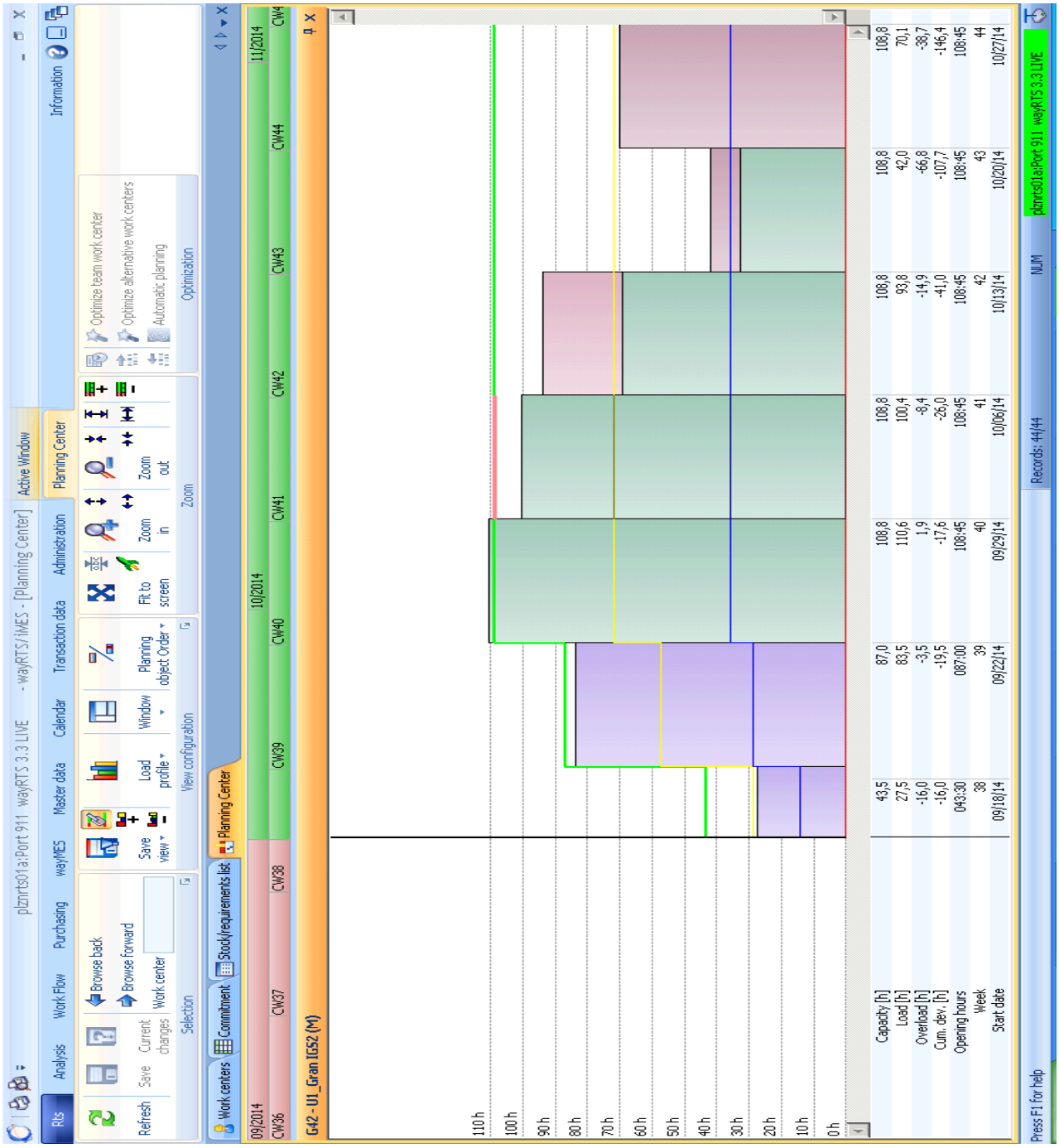
- Step three: Rough cut capacity planning (capacity harmonisation)

By using the *Load profile* planning tool in *wayRTS*, the entire load for the next three months can be analysed to harmonise the capacity in *wayRTS.* In the case of over-load, the extra demand needs to be pulled forward or postponed based on raw material availability, as well as machine capacity. Alternatively, in the case of under-load, more production can be pulled in to fill up the machine capacity. Again, the necessary raw materials and components need to be analysed by the MPS before the loading can be smoothed out.

During high-volume production scheduling, the MPS arranges the same products into groups, also referred to as *campaigning* in *wayRTS,* which makes scheduling much easier and would also influence the loading per area. As mentioned in Chapter Two, similar products are scheduled in campaigns to avoid the unnecessary cleaning of production machines between production batches.

An example of a *Load profile* of a specific area in production is illustrated in Figure 3.2 (Wassermann, n.d.).

Figure 3.2: A *Load profile* of a specific area in production



Source: Extract from *wayRTS* (2014).

The above-mentioned figure which shows a computer screen-dump of the *Load profile* on *wayRTS*, is viewed in a weekly format and indicates the loading or work that has been scheduled on one of the production machines. Each block of colours represents different types of production batches, which are grouped together into campaigns. The "green" line indicates that the loading is almost full, as it is set at three shifts for the first five weeks. The "yellow" line indicates that two shifts are required to fulfil the production schedule, while the "blue" line represents one shift. Normally, the following month's work is started during the second last and final week of the current month to ensure that ample time is given for the end products to be made available by the Laboratory and Quality Control department. In this case, the overall production area is fully loaded for the month, but more work might be pulled in during the second last and final week of the month, when these areas are not fully occupied with work.

Once the products have been smoothed out successfully by the MPS on *wayRTS,* the Sales and Marketing department can be notified of any possible changes to the customers' delivery dates (Woolf, 2007:168). The MPS may proceed to distribute the monthly production schedule in the form of a commitment list (printed from *wayRTS*) to all the supporting departments. These departments include the Production and Packing department, Laboratory and Quality Control (QC) department, Quality Assurance department, as well as the Warehouse and Distribution department. Finally, the MPS can proceed to follow the daily planning workflow/process to ensure that all the production batches are manufactured on time as per the production schedule.

3.3.5 Daily planning workflow

The daily planning workflow also forms part of the *wayRTS* planning tool and was adopted by the Demand and Operations Planning department at Aspen Pharmacare to enable the MPS to monitor each production run on a daily basis. The MPS would follow the daily production scheduling process as follows:

- Step one: Backlog recognition and elimination

The concept ‘backlog’ in this case refers to any process steps that need to be taken to address the load of a specific production batch that was not delivered on time with workload or with a due date in the past. It is imperative for each MPS to recognise any backlog in the system and eliminate the necessary backlog immediately to ensure a clean start for the next production run as indicated on the production schedule (Wassermann, n.d.). The MPS would eliminate the necessary backlog by marking the completed process steps as “complete” on *wayRTS,* which the production staff might have forgotten to do.

- Step two: Double check the availability of raw materials and components

The MPS must double check the availability of raw materials and components with the Laboratory coordinators to ensure that the start date of the next product on the production schedule is still on track as planned. The Laboratory coordinators will arrange to test and release the necessary raw materials and components in accordance with the production start dates on *wayRTS,* as planned by the MPS.

- Step three: Fine planning

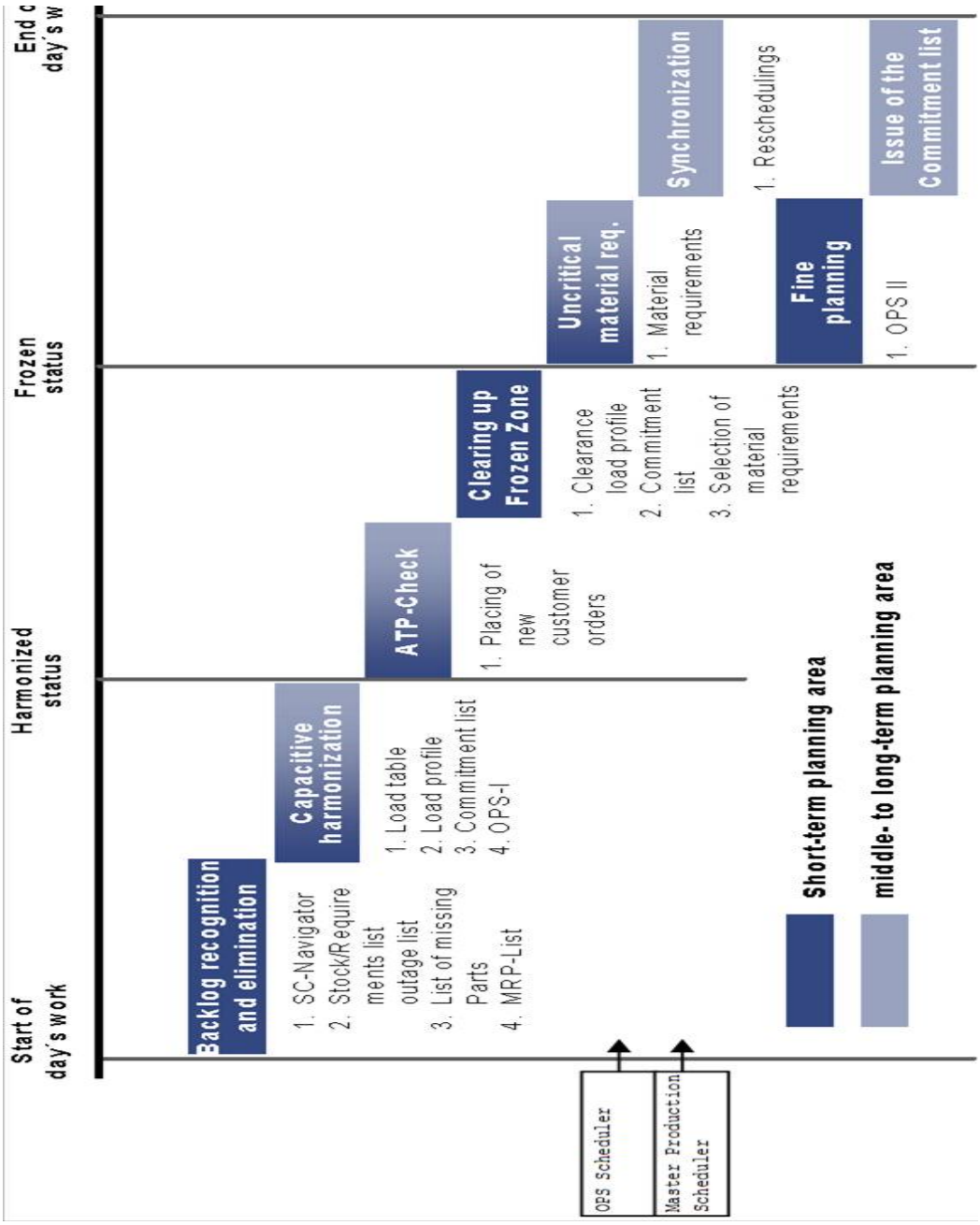
Fine planning must be done on critical work centres or production areas where some areas are suddenly over-scheduled due to some production orders’ start dates which have been moved around in the system. This is due to some production orders which might have been required sooner or later by the end customer. During this step, the over-scheduled work or loading can be moved between alternative work centres or production areas to ensure that the capacities remain evenly spread amongst all work centres.

- Step four: Rescheduling

In the event of unforeseen circumstances where the raw materials or components will not be available on time for manufacturing, or when any machine stoppages occur owing to production issues, the MPS will need to reschedule the production schedule accordingly. It is important that the MPS be informed timeously of any of such issues, so that the MPS can reschedule the start date of the next product on the production line and thereby inform the Sales and Marketing department of a possible delay in a customer's deliver date.

The following flow diagram (as seen in Figure 3.3) illustrates the daily planning workflow, which includes all of the above-mentioned steps.

Figure 3.3: Daily planning workflow



Source: Extract from *wayRTS* (2014).

The MPS must follow all of the afore-mentioned steps pertaining to the daily planning workflow on a daily basis to ensure that each production run is started and completed on time as per the production schedule. It is also of vital importance that the MPS meets with the group leaders from the Production and Packing department on a daily basis. This daily interaction is required to track the progress of the production schedule, as well as to discuss any production or packing related issues which might jeopardise the start date of the next product on the production schedule. In this way, the MPS ensures that the current month's production schedule is adhered to successfully.

3.4 THE ROLE OF EACH DEPARTMENT WITHIN THE SUPPLY CHAIN AND LOGISTICS PROCESSES AT ASPEN PHARMACARE

As discussed in Chapter One of this research study, there are three main departments which play a vital role in the supply chain and logistics processes at Aspen Pharmacare. These departments are the Demand and Operations Planning department, the Production and Packing department, as well the Warehouse and Distribution department. Each of these departments interacts with the supporting departments on a daily basis to ensure that the production schedules are executed successfully. As mentioned earlier in this chapter, the supporting departments include the Sales and Marketing department, the Purchasing department, as well as the Laboratory and Quality Control department.

To interact by way of constant communication remains one of the fundamental elements for a successful manufacturing and operations environment. A pharmaceutical manufacturer could face a number of consequences should there be a gap in communication and coordination between all of these interdependent departments. Consequences include unnecessary out-of-stock situations amongst pharmaceutical customers which have been created, for example, by the Production and Packing department who did not adhere to the monthly production schedule. Sometimes during night shifts the employees from this department would make their own scheduling decisions regarding the production schedule, without informing the relevant MPS. This

happens due to employees not adhering to the initial production planning instructions. This could create unnecessary re-scheduling issues relating to the start dates of the next product on the production line. In some other cases the Warehouse department is not informed timeously by the Production and Packing department to get the necessary raw materials and components ready for production/packing purposes. This results in unnecessary downtime in the start-up of a new production batch which could affect the end date to the customer.

Therefore, in order for Aspen Pharmacare to be successful, it is important that all of the above-mentioned departments are well integrated to ensure a steady flow of the supply chain and logistics processes. These departments need to communicate well with each other on a daily basis to ensure that all the departments function together as one team, thereby ensuring that all manufacturing targets are met on time (Rothner, 2010:2).

The respective roles of each department that forms part of the supply chain and logistics processes at Aspen Pharmacare, are as follows:

- Sales and Marketing as well as the Purchasing departments

The overall supply chain process starts with the customer order which is received and accepted by the Sales and Marketing department. This department is responsible for inserting the correct customer order requirements into the *wayRTS* system so that the Demand and Operations Planning department can acknowledge the customer's demand. Once the MPS has converted the customer order requirements into firm-planned batches on *wayRTS,* the responsibility moves to the Purchasing department. This department is responsible for purchasing the required raw materials and components for the next three months. As soon as the Purchasing department has ordered all the necessary raw materials and components from the respective suppliers, it must ensure that the supplier delivery dates of the purchase orders are adhered to.

Many raw materials and components are ordered by the Purchasing department from all over the world and some even have a delivery lead-time of up to six months, depending on whether they are air or sea freight orders. The costs incurred in ordering and shipping have to be taken into consideration, and traded off with the loss of potential out-of-stock situations and penalties incurred on the late delivery of customer orders to the market place (Muthayan, 2006:27).

Since the MPS schedules the start date of each product in production or packing, based on the actual delivery dates of the raw material and components, the MPS must be informed immediately should any supplier delivery dates be at risk. Should the supplier delivery dates not be met accordingly, the MPS will be forced to reschedule the start dates of the products affected. This may have a negative impact upon the rest of the products scheduled on the production schedule. As a result of re-scheduling, the customer order might not be met on time as agreed upon, which may create an out-of-stock situation of a specific product at the customer's end. This is not an ideal situation, as the customer's relationship with the manufacturer may be affected negatively. Most importantly, the patients or customers are not receiving their desired medication as promised, which may have serious repercussions. It is, therefore, important that the Purchasing department receives confirmed delivery dates from its suppliers and be in constant communication with them to ensure that all delivery dates are met timeously.

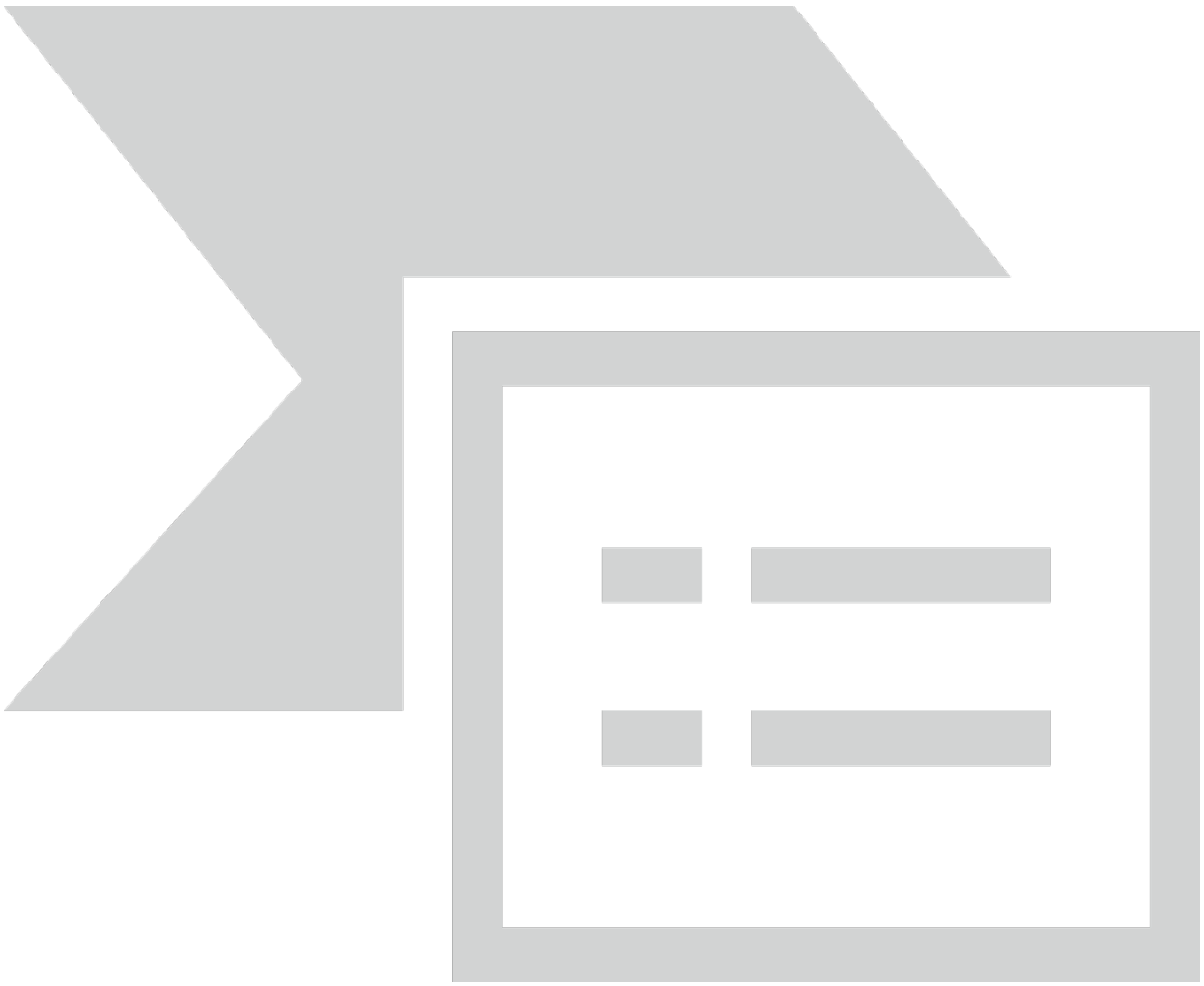
- Demand and Operations Planning department

The Demand and Operations Planning department is responsible for communicating all requests or product volumes received from the Sales and Marketing department, to all the other supporting departments within the supply chain. The MPS, who forms part of this department, is ultimately responsible for managing the entire supply chain and logistics processes to ensure that all the customer orders are manufactured and delivered on time. Customer orders might often exceed Aspen Pharmacare's ability to manufacture all the required products. This is when an out-of-stock situation occurs in the market place. To keep track of these outstanding orders, this department distributes

a monthly out-of-stock report to all the relevant employees who form part of the supply chain and logistics processes, to illustrate the current out-of-stock situation amongst its customers.

Illustrated below in the form of a pie chart, is an example of an Aspen Pharmacare's customers' out-of-stock report (see Figure 3.4).

Figure 3.4: An example of an Aspen Pharmacare's customers' out-of-stock report



Source: Tool created by Aspen Pharmacare's Sales and Marketing department.

The above-illustrated pie chart enables all the employees to have a visual insight into how the manufacturer is performing in the market place amongst all its different customers. In this case, the area which is the most affected by an out-of-stock situation, is the anti-retro viral (ARV) customer. It indicates that 56% of the orders are on stock-out, followed by the State as market customer on 12%. This result could be mainly due to the unavailability of raw materials which are required to manufacture the necessary ARV medication. Since many pharmaceutical manufacturers are in recent years also competing with each other in the global market place, the demand in recent times seems to be higher than the supply. The ARV raw material manufacturers could then be struggling to keep up with the increase in demand for ARV raw materials and components.

- Production and Packing department

The Production and Packing department is responsible for successfully manufacturing a specific product into a bulk/tablet form and ultimately packing the bulk/tablets into the necessary packaging components as requested by the customer. The Production and Packing department should inform the MPS of any downtime experienced in these respective areas caused by various reasons, which may jeopardise the customer order delivery dates.

The Production and Packing department also ensures that each product is dedicated to a specific work centre or production area so that all the different products are manufactured or packed in a designated work centre. In this way, the progress of production can be monitored closely to ensure that the product is manufactured and packed within the allocated lead-time.

- Laboratory and Quality Control (QC) department

Once the raw materials and components have been delivered from the suppliers, each product is sent to the Laboratory and QC department to have the necessary analytical

and quality tests performed. The MPS would schedule the start date of each product on the production schedule according to the release date received from the Laboratory and QC department. The Laboratory coordinators from the Laboratory and QC department interact with the MPS from the Demand and Operations Planning department on a daily basis. These daily interactions ensure that the raw materials and components are made available for use in production or packing as and when the materials are required in accordance with the production schedule.

Once a bulk product is manufactured successfully, samples of each product are sent to Aspen Pharmacare's Laboratory and QC department to conduct the necessary analytical testing. As soon as the product's results become available and are successfully approved by the Laboratory and QC department, the MPS then schedules the product to be packed into the required packaging.

As per Ruiz-Torres, Ablanedo-Rosas and Otero (2012:691-705), pharmaceutical products need to undergo multiple tests at the quality control (QC) stage to ensure that the right level of transparency, strength and safety measurements is met. These tests should be completed in accordance with the requirements of the legal authorities, such as the Food and Drug Administration (FDA), to approve the products for distribution and consumption. When the Laboratory coordinators schedule these tests, a complex problem might occur due to the limitations on resource capabilities. When a laboratory is unable to complete all the necessary testing within a given time period, the Laboratory coordinators might have to outsource the testing of batches to other approved laboratories. This process can become costly to an organisation and should be avoided. However, the Laboratory and QC department at Aspen Pharmacare has the ability to group the tests of similar products to increase the laboratory's efficiency.

Ruiz-Torres et al. (2012:691-705) further explain that there are two types of tests during the QC laboratory planning process. The first type of test is conducted when a batch is manufactured in the plant and is waiting for release into packaging and final distribution. Each batch forms part of a single product type, which requires various QC testes. The

second type of test is a batch that is already in the market and needs to be occasionally retested to confirm that it has maintained the required characteristics. This type of test is called *stability testing*. These types of tests normally need to be completed within a specified time period, as requested by the regulatory agencies. Should the manufacturer fail to complete these tests within the specified time period, the manufacturer may face unnecessary fines and penalties.

The exact same types of testing methods are also being used by Aspen Pharmacare's Laboratory and QC department. When the final testing of the end product has been completed successfully, this department evaluates the laboratory results, and if the results adhere to the current specifications, the final end product is made available for distribution to the relevant customer.

- Warehouse and Distribution department

Aspen Pharmacare's Warehouse and Distribution department makes use of electronic data interchange (EDI) to speed up the order delivery process between this department and the end customer. EDI refers to a computer-to-computer communication system between the distribution warehouse and the customer. EDI makes it possible to direct all electronic information throughout the entire supply chain process by using interconnected computers. For example, customer orders are now entered into the Sales and Marketing department's computer system and transmitted electronically to the end customer's computer (APICS, 2005:205). In this way, the end customer can view the status of their orders in real-time. Using the EDI system could result in reduced order cycle times and even higher turnover in sales. EDI can also reduce a manufacturer's expenditure by reducing human intervention and materials such as paper documents (NIST, n.d.).

3.5 CONCLUDING REMARKS

This chapter explained the overall demand and operations planning procedures which are being used in practice by the MPS at Aspen Pharmacare. It remains the core responsibility of the MPS to manage the entire supply chain and logistics processes, from the time the customer order is received, until the order is distributed to the relevant end customer on time. In this way, the number of out-of-stock situations at the customers' end, are kept at a minimum level.

The next chapter explains the research design and methodology used in this study. The design and structure of the questionnaire, its method of administration, the pilot study, and the sample size, are discussed.

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

In Chapter Two, the general rationale for using demand and operations planning strategies by manufacturing companies to fulfil their customer orders on time, was explained. A discussion on how the demand and operations planning strategies are being followed in practice at the pharmaceutical manufacturer, Aspen Pharmacare, to reduce the number of possible out-of-stock situations with its customers, was given in Chapter Three.

The main objective of this study is to establish the extent to which Aspen Pharmacare is efficiently and effectively applying and executing demand and operations planning strategies to manage its incoming customer orders. Furthermore, the study aims to examine whether all the supporting departments understand the underlying logistics processes to ensure high levels of internal and external customer service delivery, constant communication, and continuous improvement. Therefore, an empirical study was required to identify any possible problems which could prevent the three main departments within Aspen Pharmacare from implementing and achieving its main objectives.

This chapter outlines the research design and methodology that was used to collect the empirical data for this study. The results of this study will provide the researcher with direct information on how efficiently and effectively Aspen Pharmacare operates as a whole, and how improved teamwork could be implemented to ensure future success, if necessary. This chapter also discusses the purpose of data collection, the various research methods available to the researcher, as well as the rationale for the empirical data collection method that was used to meet the primary objectives for this research

study. Furthermore, the sampling method, the criteria used to determine the participants of the study, as well as the measuring instrument, are explained in this chapter.

4.2 THE PURPOSE AND METHODS OF DATA COLLECTION

According to De Koker (2003:84), research is the process of collecting and analysing empirical data. Leedy and Ormrod (2001:4) explain that the purpose of a research study is to understand a specific problem and then to communicate the results of the study to the public. Rothner (2010:65) adds that it is important to identify the correct research method, as it determines the way in which the research study is designed, how the data is collected and analysed, as well as the way in which a dissertation/thesis is written.

There are two main types of research methodologies, namely, qualitative research and quantitative research. In what follows, a brief description of each research methodology is provided.

4.2.1 Qualitative research

Qualitative research is primarily exploratory research that is used to gain an understanding of underlying reasons, opinions, and motivations required for a particular study. It assists in developing ideas or hypotheses for potential quantitative research studies (Thomas, 2004:25). A hypothesis is an idea or proposition that is developed from a specific theory, which can be tested by using statistics (Collis & Hussey, 2009:63). The acceptance of a hypothesis is always temporary, as new data may surface that could lead to the rejection of the hypothesis.

Qualitative research involves the use of various qualitative research methods which are not necessarily expressed in numbers, and may use words, pictures, drawings and films to achieve the purpose of a study (Struwig & Stead, 2001:13). Qualitative research is especially effective when gathering culturally specific information on the values, opinions, behaviours, and social contexts of certain populations. Normally, the sample

size for qualitative research is relatively small, which could lead to a low level of reliability and a high level of validity when this research methodology is utilised (Rothner, 2010:66).

The following qualitative research methods have been identified (Collis & Hussey, 2009:143-153):

- Particular observations: These are suitable for collecting data on naturally occurring behaviours of the participants whereby the researcher observes and records what each participant says or does.

- In-depth interviews: In-depth interviews are favoured for collecting data on the participants' personal histories, views and experiences, especially when sensitive topics are being explored.

- Structured depth interviews: During these interviews, projective techniques are used to allow the respondent to provide information when he/she is reluctant or unable to verbalise their attitudes or beliefs.

- Focus groups: These are effective in obtaining data on the cultural norms, race and sex of a specific sample group.

4.2.2 Quantitative research

Quantitative research is used to quantify the research problem by way of generating numerical data and transforming this data into useable statistics. This kind of research is often used to quantify attitudes, opinions, behaviours, as well as defined variables (Collis & Hussey, 2003:189). It also uses measurable data to formulate facts and uncover patterns in research. Therefore, quantitative data involves the analysis of relationships between variables and the use of hypothesis testing to determine these relationships. Variables can be described as any characteristics of a specific unit in

which the researcher wants to collect the characteristics of the group, for example, the gender and age of the participant. During quantitative research, a larger sample size is utilised in comparison with qualitative research (Rothner, 2010:66). Normally, quantitative researchers will collect the relevant data and use statistical techniques to decide whether or not to reject or accept the hypothesis.

The data collection methods used in quantitative research are more structured than qualitative data collection methods. Quantitative data collection methods include various forms for surveys. When surveys are used, a sample of a population is studied to generalise the study's findings to the larger population. This involves obtaining information from one or more groups of people by means of structured questionnaires and tabulating their responses (answers), as well as by using interviews. As per De Koker (2003:86), a questionnaire is a set of questions designed to obtain the necessary data for accomplishing the objectives of a research project. The questionnaire responses are summarised in terms of frequency counts and expressions, from which an assumption or judgement is made regarding the entire population.

According to Hair, Bush and Ortinau (2000:256), a self-administered survey is the most widely used form of survey method used by researchers. A self-administered survey is a data collection method in which each respondent is expected to complete the questionnaire on their own without the presence of the researcher. Hair et al. (2000:261-263) further explain that a self-administered survey can be divided into sub-types, namely, direct mail, mail-panel and drop-off survey. When using direct mail, the questionnaire is mailed to a list of respondents who return the completed questionnaires by mail. In a mail-panel survey, the questionnaire is sent to a group of respondents who agreed to take part in the survey. In the case of a drop-off survey, the questionnaire is hand-delivered by the researcher to each respondent whereby the completed questionnaires are mailed to, or collected by, the researcher. Howell (2005:114-115) added that another form of survey that is recently being used, is called a web-based survey. A web-based survey is when the researcher sends the respondent an e-mail with an attachment of the questionnaire whereby the respondent would click on an

address that would take the respondent to a secure site to complete the questionnaire. This type of survey normally saves a lot of time as the questionnaire is completed and returned immediately by the 'click of a button.'

As mentioned earlier, another method for collecting quantitative data is by using interviews, namely, face-to-face interviews, telephone interviews, and structured interviews. These are discussed in the following paragraphs.

- Face-to-face interviews

Face-to-face interviews are also known as 'personal interviews' and are the most costly and time consuming method of surveying. This type of survey may also be more time consuming in comparison with telephone surveys. However, the researcher has the advantage of gaining insight into the respondent's true opinions and beliefs as both verbal and body language can be studied (Jackson, 2008:96-97).

- Telephone interviews

In this case, the researcher can access any participant who owns a phone, and expect a response rate that is normally higher in comparison with e-mailed questionnaires (Cook, 2009:102). Telephone interviews can be completed more quickly in comparison with any other survey method, since there is no travel delay and respondents can be found immediately (Ferreira, 2011:36). Local telephone surveys are also relatively affordable in comparison with other survey methods. However, the samples collected during these telephone interviews might be biased, as people without telephones are automatically excluded.

- Structured interviews

Structured interviews are performed when it is known what specific information is required (De Koker, 2003:88). The interviewer compiles a list of fixed questions relevant to the research problem. The interviewer or researcher then contacts the relevant participants by means of telephone to agree to meet with them at a specific time and place, for example, in a dedicated room or public place. As the participants express their views during the interviews, the researcher records the information on a Likert-scale. According to Muthayan (2006:46), the Likert-scale is the most widely-used form of scaled items where the respondents select a point on a scale that best represents their views.

In conclusion, the key difference between quantitative and qualitative research methods is their flexibility (Qualitative Research Methods, no date). On the one hand, quantitative research methods such as surveys are generally inflexible. The advantage of this inflexibility is that it allows for the meaningful comparison of responses amongst participants, while it also requires a thorough understanding of the most important responses to the questions asked. On the other hand, qualitative research methods are normally more flexible, since the participants are generally requested to answer open-ended questions in their own words.

The next section describes the design and structure of a questionnaire in detail, as well as the sampling methods that are available to a researcher.

4.3 DESIGN AND STRUCTURE OF A QUESTIONNAIRE

The questionnaire design process requires the researcher to focus on the wording of the questions and to perform proper planning on how the variables will be grouped, scaled and coded after acknowledging receipt of the responses. The researcher also needs to focus on the general appearance of the questionnaire.

As proposed by Struwig and Stead (2001:89-91), the following sub-sections explain the guidelines that are to be followed when designing a questionnaire:

4.3.1 Questionnaire design guidelines

General guidelines when constructing a questionnaire include:

- Instructions should be precise and must clearly specify how the questions should be answered
- The questionnaire must be divided into logical sections
- The questionnaire should start with general questions followed by more specific questions
- Personal or sensitive questions should only be stated towards the end of the questionnaire
- The number of questions must be limited to avoid respondent fatigue.

4.3.2 Wording of the questionnaire

When selecting the proper wording of the questionnaire, a researcher needs to (Struwig & Stead, 2001:89-91):

- Be concise
- State definite questions that require definite/specific answers
- Ask one question at a time
- Avoid leading questions
- Make provision for all possible answers
- Avoid wording that can create respondent humiliation.

4.3.3 Phrasing of the questions

Requirements for the phrasing of questions include that the researcher (Cook, 2009:104):

- Defines the specific issue at hand in detail
- Establishes whether the participant will be able to provide the information required
- Ensures that the questions are adequately covering the content for which they are responsible
- Phrases the questions in such a way that it prevents the respondents from giving general answers.

These guidelines were thoroughly considered prior to finalising the questionnaire that was used in the study.

4.3.4 Types of questions available to researchers

There are various types of questions which are available to researchers in order to gather primary data when using a questionnaire. The researcher may use a specific type or a combination of different types of questions. The following main types of questions are available to the researcher (Cook, 2009:106):

- Open-ended questions: The respondents answer these questions in their own words and express themselves freely. These types of questions are normally used for introductory questions, after which further clarification is required.

- Multiple-choice questions: These questions allow the respondents specific alternatives to choose from, which allow recording, tabulation, and editing.

- Dichotomous questions: In this case, the respondents are offered a choice between two options, for example, “Yes” or “No”. These types of answers may have an advantage similar to those of multiple-choice questions, but they cannot be analysed.

- Scaled-response questions: The purpose of this question format is to collect data on the attitudes and perceptions of the respondents. Examples include Likert-scale questions, which are linked to a number of statements in a five to seven point scale, and the semantic differential scale, which only displays two bipolar adjectives on a scale between five and seven points.

- Ranking questions: In this format, the respondent is asked to rank a set of items according to the importance or value he/she assigns to the items.

4.4 THE SAMPLE AND SAMPLING METHODS

Collis and Hussey (2009:209) explain that a sample is a group of unbiased participants that represent the target (larger) population, from which data is collected for statistical purposes. Once data is collected from the sample, the researcher will analyse the data to draw conclusions that could be generalised over the entire target population (Cook, 2009: 107). The reasons for using a sample, rather than collecting data from the entire target population, are that sampling results in more reliable feedback, since fatigue is reduced amongst respondents and fewer errors occur from a smaller sample group. It is much easier to distribute, for example, 100 questionnaires to 100 representatives than trying to reach 1000 people who fall within the target population (Sekaran, 2003:267).

According to Thomas (2004:106-107), there are two major types of sampling methods, namely, probability sampling and non-probability sampling. These methods are explained in the following paragraphs.

4.4.1 Probability sampling

When using probability sampling, the researcher aims to obtain a sample group of the population that is representative of that specific target group. Samples are drawn randomly from a list of all the population units, which is also known as a 'sampling frame.' Probability sampling includes the following methods of random selections (Thomas, 2004:106-108):

- Simple random sampling: A complete list of the population is required, also known as the sampling frame. Each sample within the population is given a number. A set of numbers is then picked randomly from the list, whereby each sample is selected in accordance with the correspondence of other samples.

- Systematic random sampling: To select a sample of a certain size, the sampling fraction is calculated. The sample size is divided by the population size. For example, the sampling fraction for a sample of 10 from a population of 100 is 1/10.

- Stratified random sampling: In this case, the researcher is familiar with the characteristics of the population. During stratified random sampling, the population is divided into two groups, for example, male and female, from which random samples are drawn.

- Cluster sampling: This method is used when no complete sampling frame exists for the population of interest and where it might be impractical to create one. Samples are then randomly taken at various levels.

4.4.2 Non-probability sampling

Non-probability sampling does not involve random selections, which may result in biased samples that are unrepresentative (Thomas, 2004:106-107). Instead, non-probability sampling methods include (Thomas, 2004:106-108):

- Quota sampling: A particular number (a quota) of population members with specified characteristics, are selected during quota sampling. For example, the researcher can consciously or, most likely, unconsciously, select a certain group of males and females, which may result in a biased sample.

- Availability/convenience sampling: When using this sampling method, no particular sample is selected. Respondents may even include volunteers, who are, by description, self-selected. This type of sampling method is mostly used for pilot and exploratory studies.

- Purposive sampling: In this case, the researcher already has sufficient knowledge about the study, but selects a few samples, which have characteristics relevant to the objectives of a study. The researcher then uses the extra information from the samples to gather more detailed data to examine further studies relating to a particular study.

- Theoretical sampling: Theoretical sampling is used when the researcher aims to test and develop the data gathered to extend the theory.

4.5 RATIONALE FOR THE EMPIRICAL DATA COLLECTION METHOD USED

Since this particular study contains all the characteristics of the quantitative research methodology (as mentioned earlier in this chapter), it can be concluded that the decision to use the quantitative research methodology was most suitable. By using the

quantitative research methodology, the empirical survey for this study was designed so that it would contribute to achieving the research objectives as stated in the introductory section of this study. For the purpose of this study, the researcher made use of a questionnaire as a structured research instrument to gather reliable and appropriate data from the relevant respondents.

As mentioned earlier, this study also focuses on the importance of communication between the three main departments within Aspen Pharmacare, namely, the Demand and Operations Planning, the Production and Packing, as well as the Warehouse and Distribution departments. The relationships between these departments that are responsible for the supply chain and logistics processes within the organisation, had to be statistically tested, thus requiring a quantitative approach.

The next section describes the sample make-up of the target population that was used for this particular research study. The construction of the questionnaire, the pre-testing of the pilot questionnaire, as well as the administration of the questionnaire that was used for this particular research study, are also discussed.

4.5.1 The sample make-up of the target population

For the purpose of this study, the researcher used stratified random sampling, which forms part of the probability sampling strategy. As mentioned earlier in this chapter, this strategy focuses on the use of known characteristics of the target population during sampling, which increases the probability of choosing a representative sample (Thomas, 2004:107).

In this study, the target population was the three main departments mentioned above that are responsible for the supply chain and logistics processes at Aspen Pharmacare. The researcher selected a sample group of 70 (n = 70) employees of the three main departments at Aspen Pharmacare as participants/respondents as follows: 20 employees from the Demand and Operations Planning department; 30 employees from

the Production and Packing department; as well as 20 employees from the Warehouse and Distribution department. These 70 employees amongst the three main departments form part of lower and middle management positions, and have regular and direct interactions with each other.

4.5.2 The layout of the questionnaire

The researcher first created a pilot questionnaire based on the literature review that was done for this study, as well as on her observations and experience regarding the practical methods currently used by Aspen Pharmacare. The researcher then conducted structured interviews with the departmental managers from the Demand and Operations Planning, Production and Packing, and the Warehouse and Distribution departments to discuss the questions posed in the pilot questionnaire. These structured interviews were conducted inside each of the departmental managers' offices during lunch breaks at Aspen Pharmacare. During these structured interviews, the managers were asked whether they agreed with the questionnaire and they were welcome to make suggestions and add questions which they thought were necessary to assess the levels of efficiency and effectiveness in Aspen Pharmacare's operations. This process enabled the researcher to make the necessary adjustments, and add more detail to the questions in the pilot questionnaire.

The questionnaire used in this research study was divided into four sections. Section One consisted of the demographical data only, which included multiple-choice questions that the respondents had to answer by ticking the appropriate boxes. The answers to these questions provided the researcher with general information regarding the respondents, as well as the department in which they reside within Aspen Pharmacare. These questions were exactly the same for all the respondents from the three main departments.

Sections Two to Four consisted of Likert-scale statements (see Annexure B) whereby the respondents were requested to rate their level of agreement on a given subject on a

five point Likert-scale. Section Two's statements were created specifically for the respondents of the Demand and Operations Planning department; Section Three's statements were only applicable to the respondents of the Production and Packing department; while Section Four's statements were only created for the respondents of the Warehouse and Distribution department. This ensured that the respondents of the three main departments quantified the key specific factors applicable to their respective department for effectively managing and executing the supply chain and logistics processes at Aspen Pharmacare.

For example, the respondents were asked whether the production schedule was easy to understand and to follow. The respondents would then tick the appropriate box to rate their level of agreement. The Likert-scale included a middle point reflecting the neutral responses of all the respondents to ensure that the possibility of biased comments was minimised.

The respondents had to answer the Likert-scale statements as follows:

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree.

The advantage of using the above-mentioned five point Likert-scale was that the respondents did not simply answer "Yes" or "No", but were allowed to express their level of opinion. The researcher also included three additional open-ended questions at the end of the questionnaire which requested the respondents to indicate if any improvements/recommendations need to be made to execute the production schedule more effectively. These responses/recommendations are discussed in Chapter Five of this research study.

4.5.3 Questionnaire pre-testing procedure

The questionnaire pre-testing procedure allows for the necessary corrections to be made on a pilot questionnaire before the final version of the questionnaire is distributed to the relevant respondents (Rohner, 2010:70). It assists the respondents who might find it difficult to complete or to understand the questions issued to them. For the purpose of this research study, the pre-testing of the questionnaire assisted the researcher in making sure that the questions were relevant and phrased clearly and unambiguously. This also minimised the respondents' ability to provide generic answers.

For this particular research study, the researcher started the pre-testing procedure by printing the final version of the pilot questionnaire and presenting it to a pilot group of six employees, two from each of the three main departments, to complete as though they were respondents. This procedure allowed for these employees to indicate any corrections to be made and to give further suggestions to clarify statements which may not have been clear to them. However, all six of the selected employees were satisfied with all the relevant questions posed in the pilot questionnaire, and they encountered no problems with the questions and suggested no additions.

Following this, the researcher was able to print, copy and distribute the final version of the questionnaire. Ten of the 70 respondents in the sample had no access to e-mail correspondence and their departmental managers were asked to hand-deliver copies of the questionnaires to them. The other 60 questionnaires were e-mailed to the employees who have access to e-mail.

4.5.4 Administration of the questionnaire

The researcher was able to administer the questionnaires without any difficulty. A covering letter (see Annexure A) which explained the purpose of the research study, was distributed together with each questionnaire. The questionnaires were administered

and returned only to the researcher by means of e-mail and some hand-delivered within three weeks of distribution.

4.6 CONCLUDING REMARKS

This chapter described the purpose of research in general and briefly explained the differences between qualitative and quantitative research methods. It also explained the rationale for the empirical data collection methods that were used for this study, as well as the design and structure of the questionnaire.

The next chapter outlines the empirical findings and interpretation of the empirical data that was collected by means of the distributed questionnaires.

CHAPTER 5

EMPIRICAL FINDINGS AND INTERPRETATION OF THE EMPIRICAL DATA

5.1 INTRODUCTION

The previous chapter explained the research design and methodology, as well as the design of the questionnaire that was used in this research study. In this chapter, the results of the empirical study are discussed and interpreted with the aid of tables and figures based on the responses received from the respondents who completed the questionnaire. The empirical findings collected from the empirical study are discussed in relation to the literature study and according to the sub-objectives mentioned in Section 1.2.2 of Chapter One.

A literature study (Chapters Two and Three) was carried out to determine the theoretical and key factors that play a vital role in effectively managing and executing the supply chain and logistics processes at pharmaceutical manufacturing companies, including Aspen Pharmacare. The empirical study conducted (see Annexure A and B) was based on this literature study to determine the role of the Demand and Operations Planning, the Production and Packing, and the Warehouse and Distribution departments that form part of the logistics processes at Aspen Pharmacare. This study aimed to determine whether the key factors that form part of demand and operations planning strategies, are actually applied and executed efficiently and effectively within the three main departments. Knowing this would help to identify the reasons why the departments do not implement and apply these key factors, together with the problems caused by its non-implementation.

The next section discusses the data analysis method, the response rate and interpretation of the data, the validity and reliability of the study, followed by an outline of the attainment of the respective study objectives.

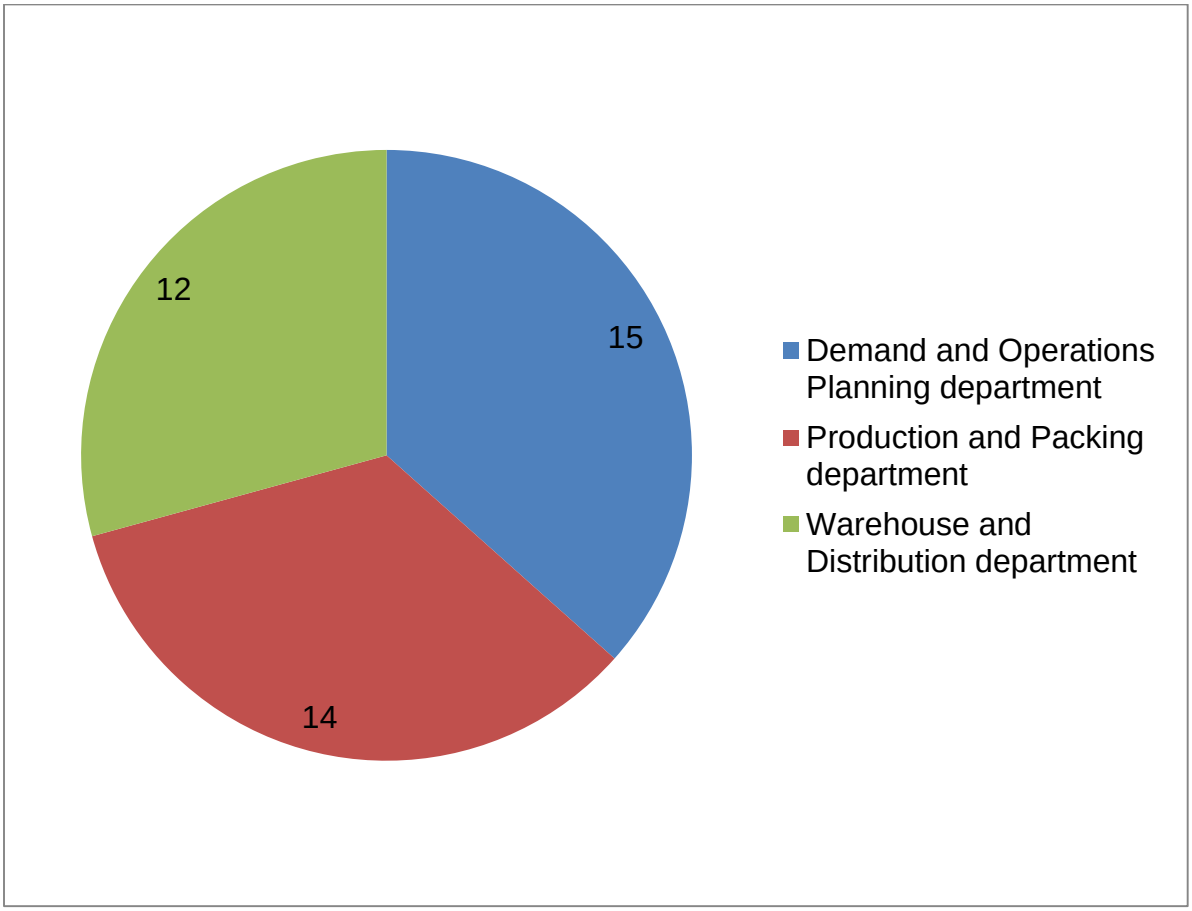
5.2 DATA ANALYSIS METHOD, RESPONSE RATE AND INTERPRETATION OF THE EMPIRICAL DATA

As mentioned in Chapter Four of this research study, the researcher made use of a questionnaire to gather all the necessary empirical data from the respondents in an effort to determine the key factors required to effectively manage and execute the supply chain and logistics processes at Aspen Pharmacare. The results also had to indicate the level of internal and external customer service delivery, as well as the importance of constant communication and continuous improvement amongst all the supporting departments. The results gathered from the questionnaire were captured using the *SPSS 23, Statistica 12*, and the *Microsoft Excel* computer software programmes.

As explained in the previous chapter, a total number of 70 respondents from the three main departments were selected to complete the questionnaire. The 20 respondents from the Demand and Operations Planning department were mainly master production schedulers (MPS) and buyers. The 20 respondents from the Warehouse and Distribution department were mainly warehouse group leaders and pickers. The 30 respondents from the Production and Packing department were mainly production group leaders, pharmacists, as well as machine operators.

The respondents were requested to return the completed questionnaires to the researcher within three weeks, but in some cases, no responses were received. Despite numerous follow-up e-mails which were sent to the non-responding respondents and their managers, the overall response was poor. The reason for this poor response could be attributed to time constraints. Some respondents were too busy to answer the questionnaire, while other respondents simply refused to respond. Some respondents refused to respond out of fear that their responses may not be treated confidentially despite the questionnaire clearly stating that the data would only be used by the researcher for research purposes. The actual number of responses received per department is illustrated in Figure 5.1.

Figure 5.1: Number of responses received per department



Source: Researcher's own construction

The researcher received a total number of 41 completed questionnaires from the three main departments. This gives a total response rate of 58.6%, which was regarded as sufficient to make suitable and meaningful conclusions. Only 15 completed questionnaires (75.0%) were received from the respondents of the Demand and Operations Planning department. The researcher's ideal number of responses for this department was 20. The Warehouse and Distribution department only submitted 14 completed questionnaires (70.0%) from the ideal sample size of 20 respondents, while only 12 completed questionnaires (40.0%) were received from the Production and Packing department where the ideal sample size was 30.

5.3 VALIDITY AND RELIABILITY

To ensure that the measuring instrument, in this case a questionnaire, used in this study measured the empirical data accurately, the reliability and validity of the study needed to be tested. Validity can be defined as the extent to which the research findings accurately reflect the observable fact of the study (Collis & Hussey, 2009:65). There are two main types of validity that were considered for this research study, namely, face validity and content validity. On the one hand, face validity ensures that the tests or measurements that were used by the researcher actually measured what they were supposed to measure or represent. For example, whether the wording and the phrasing of the questions were correct, and whether the responses from the participants in the questionnaire were appropriate. On the other hand, content validity is the extent to which the questionnaire measures the actual perceptions related to the key research question (Howell, 2015:120).

Reliability refers to the absence of differences in the results should the research be repeated (Collis & Hussey, 2009:64). This means that one would get similar results from the same questionnaire should the study be repeated soon afterwards with the same employees from the three main departments at Aspen Pharmacare. During this research study, the questions posed were specifically related to the respondents' current job functions. In this way, the validity and reliability of this study could be guaranteed.

To ensure credibility and accuracy during this study, all the questionnaires were completed only by qualified and experienced employees from the three main departments that are responsible for the supply chain and logistics processes at Aspen Pharmacare. Overall, the researcher was able to conclude that the respondents understood the questions and completed the questionnaires as was required. The level of accuracy of the research can therefore be declared as being acceptable.

Since the questions posed in the questionnaire were specifically related to the respondents' current job function, the answers received from all the respondents were to a large extent consistent with one another. In this way, the validity and reliability of this study could be guaranteed.

5.4 DEMOGRAPHICAL FINDINGS OF THE EMPIRICAL DATA

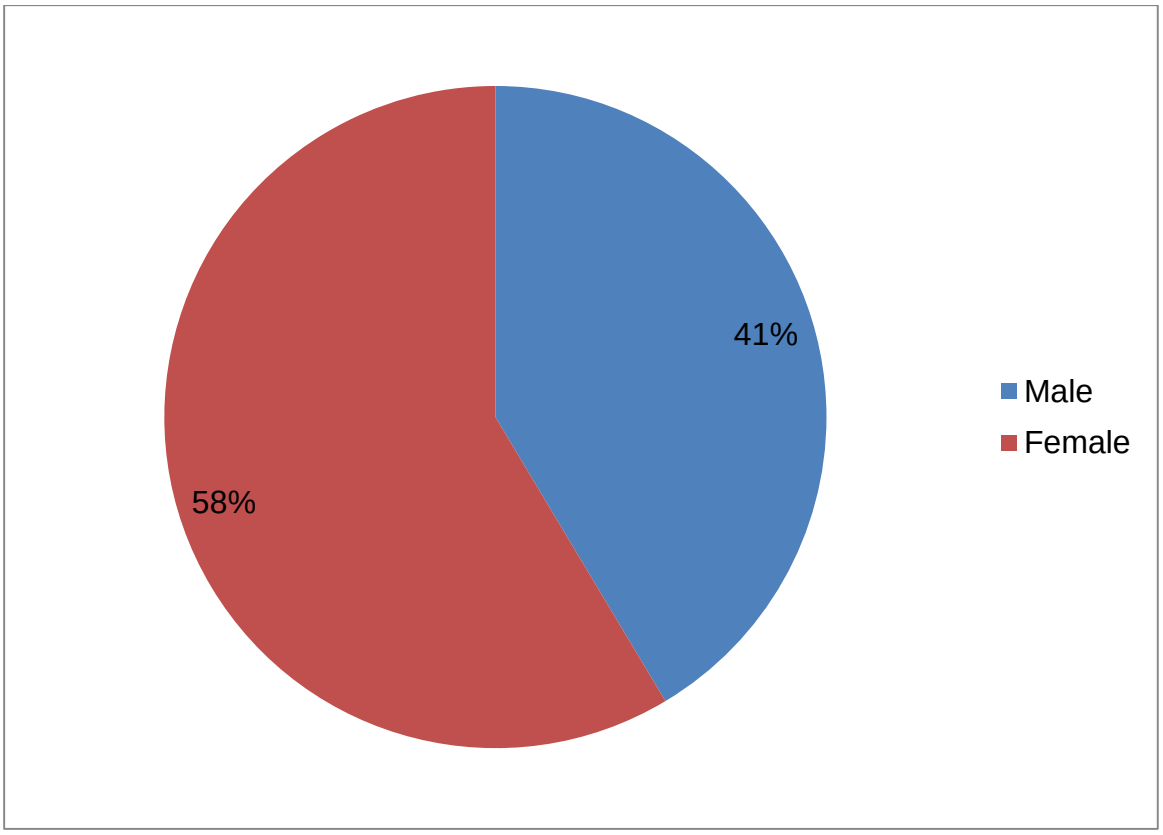
As discussed in Chapter Four of this research study, the researcher created a questionnaire that was divided into four sections. Section One of the questionnaire included a "General Information" section, which forms part of Annexure B, that asked questions relating specifically to the respondents, for example, their gender, age, as well as the number of years which they have been working at Aspen Pharmacare. Even though these questions were not required to achieve the study's objectives, the researcher included them to obtain additional information that could be of interest to the reader and management at Aspen Pharmacare and also useful for future studies. The results for the questions posed in Section One of the questionnaire, are illustrated in figures 5.2 to 5.4.

- Gender of the respondents

In Section One, the respondents were asked to specify their gender. The results from the respondents are illustrated in the form of a pie chart (see Figure 5.2). This pie chart indicates that 58.6% of the respondents was female and 41.4% was male. The high percentage of females (58.6%) was attributed to the large number of females operating in the Demand and Operations Planning department. As mentioned earlier, the highest number of responses received for this research study was from the Demand and Operations Planning department. A total of 12 of the 15 respondents from this department were female, representing 80% of the total respondents from this particular department. This department had seven Master Production Schedulers (MPSs) of which five were female. There were also four Material Planners (Buyers) and two Launch Coordinators who were all female in gender.

The other 41.4% of the total respondents was male. This attributes mainly to the fact that mostly males were operating in the Production and Packing department, as well as in the Warehouse and Distribution department at Aspen Pharmacare.

Figure 5.2: Pie chart representing the gender of the respondents



Source: Researcher's own construction

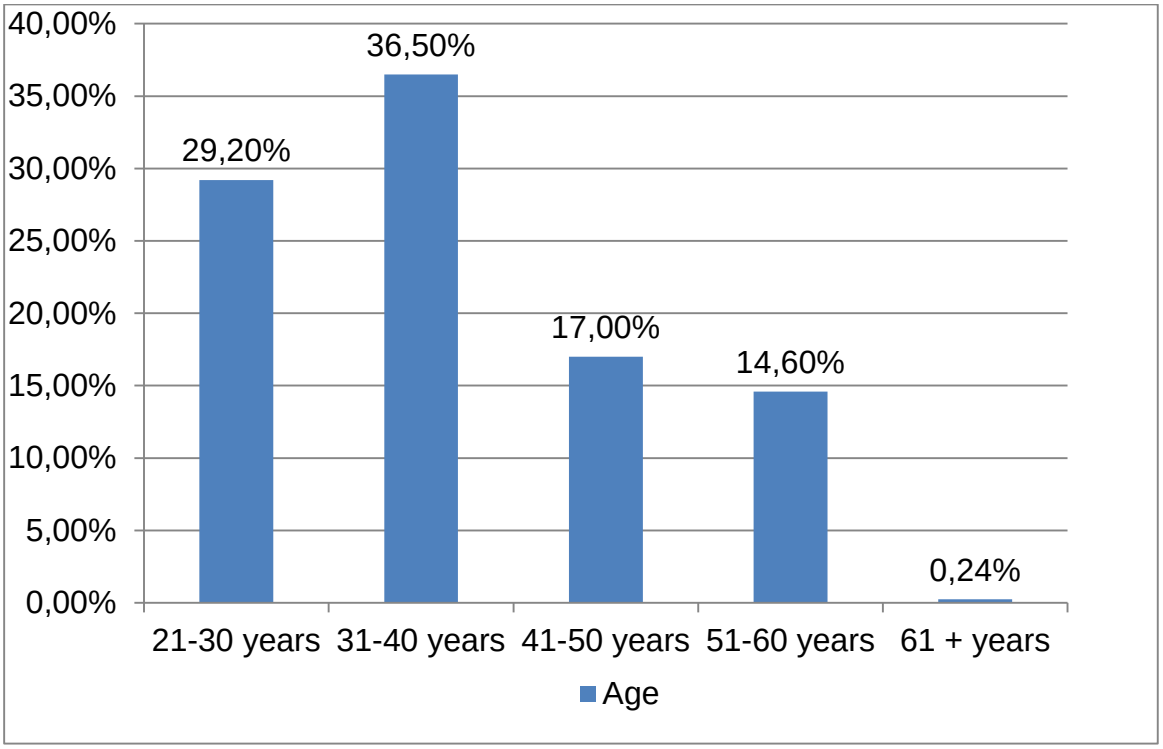
- Age bracket of the respondents

The respondents were asked to indicate in which age bracket they fall. The results from the questionnaires are shown in the form of a column chart (see Figure 5.3). This chart indicates that 29.20% of the respondents was in the age bracket of 21-30 years; 36.50% was between 31-40 years; 17.0% was between 41-50 years; 14.60% was

between 51-60 years; and only 0.24% was 61 years and older. The fact that the highest percentage (36.5%) of respondents that was between the ages of 31-40 years, could be attributed to the degree of experience and level of expertise acquired by the respondents at Aspen Pharmacare. It was interesting for the researcher to find that the next highest percentage of 29.20% consisted of respondents between the ages of 21-30 years. This indicates that a significant number of young employees with the necessary qualifications were employed in the three main departments.

The lower percentages of respondents between 0.24% and 17.0% fall into the age brackets of between 41 and 61 years and older. This indicates that fewer employees between these age brackets were currently operating amongst the three main departments that form part of the logistics processes at Aspen Pharmacare. There was no particular reason for this finding, but the researcher found that employees between the ages of 41 and 61 years were residing mostly in the other supporting departments, namely, the Engineering department, Quality Assurance department, Information Technology department and the Finance department at Aspen Pharmacare.

Figure 5.3: Column chart representing the age brackets which the respondents fall into

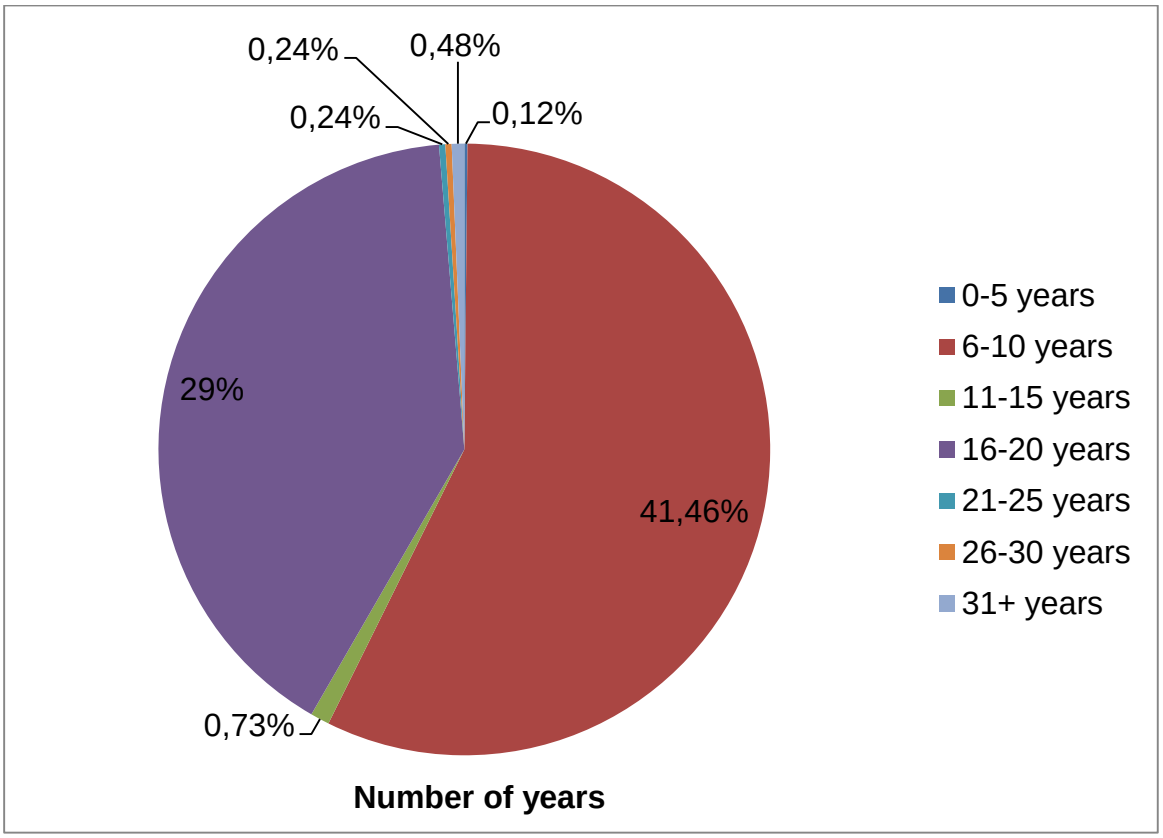


Source: Researcher's own construction

- Number of years working at Aspen Pharmacare

As indicated in Figure 5.4, the highest percentage of the respondents (41.46%) has been working at Aspen Pharmacare for between 6-10 years. The second highest percentage of the respondents (29.0%) has been working for between 16-20 years at Aspen Pharmacare. The lowest percentage of the respondents (0.12%) has been working for 31 years and above. This attributes mainly to the fact that a large number of employees had reached their retirement age and were asked to end their employment thereafter. As a result, middle aged employees (31-40 years as indicated in Figure 5.3) dominated the three main departments at Aspen Pharmacare.

Figure 5.4: Pie chart indicating the number of years the respondents have worked for Aspen Pharmacare



Source: Researcher's own construction

Therefore, it can be concluded from all of the above-illustrated results of the questionnaire that the majority of the respondents who resided within the three main departments at Aspen Pharmacare, were female, between the ages of 31-40, and had been working for between 6-10 years at the company.

5.5 ATTAINMENT OF THE RESPECTIVE STUDY OBJECTIVES

As was indicated earlier, the main objective of this study was to determine the key factors required to effectively manage and execute the supply chain and logistics processes at Aspen Pharmacare. To create a research strategy to solve the main objective of this study, a number of sub-objectives were identified. Sections Two, Three and Four of the questionnaire used in this study were designed in such a manner that the answers to the sub-objectives could be more easily obtained. The results for the statements posed in Sections Two, Three and Four, are illustrated in Tables 5.1 to 5.3. The mean for each statement was calculated according to the *Sheffe test*: <3 & >3. For example, when the result of the mean was smaller than three, more respondents have disagreed with the statement, while three and higher indicate that more respondents agreed with the relevant statement.

In what follows, each sub-objective is stated and the relevant responses to these individual sub-objectives are presented. The findings of the empirical study are also discussed in terms of the literature study.

5.5.1 Sub-objective one: To determine the extent to which the Demand and Operations Planning department believes that the key factors indicated in the questionnaire, are indeed required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

The respondents from the Demand and Operations Planning department were asked to respond to a series of 28 possible key factors to which employees within a pharmaceutical manufacturer should adhere (see Table 5.1). In this way, all incoming customer orders should be managed effectively to reduce possible out-of-stock situations amongst its customers. This table illustrates the relevant responses given by all of the respondents, as well as the means obtained for all the responses.

Table 5.1: Synopsis of responses (expressed in %) for questions 1-28 in Section 2 of Annexure B of the questionnaire

		A	B	C	D	E	F
	Key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Mean**
1	The validated forecast numbers for the next three months, which are distributed by the Marketing department, are accurate and reliable	13.30	60.00	26.70	0.00	0.00	2.13
2	Possible forecast errors are kept at a minimum level	6.70	33.30	46.70	13.30	0.00	2.67
3	The master production scheduler (MPS) ensures that sufficient bulks are manufactured on time to cover the forecast requirements	0.00	20.00	0.00	53.30	26.70	3.87
4	Little scheduling changes are made by the MPS during the *Frozen zone* (within the three month period), unless Aspen loses the tender or when unexpected changes in demand occur in the market place	6.70	40.00	26.70	26.70	0.00	2.73
5	The production schedule is firm-planned in advance by the relevant MPS by means of *wayRTS,* to ensure that the necessary raw materials and components are ordered on time to meet the production start dates	0.00	26.70	13.30	40.00	20.00	3.53
6	*wayRTS* is an effective planning tool to schedule the production batches effectively on the production schedule	0.00	0.00	6.70	80.00	13.30	4.07
7	The relevant buyer would purchase the necessary raw materials and components on time to ensure that the goods are delivered in accordance with the production start dates	0.00	0.00	26.70	73.30	0.00	3.73
8	Raw materials and components are readily available from the Laboratory to meet the production start dates	0.00	33.30	40.00	20.00	6.70	3.00
9	The MPS is always aware of the current stock situation on the system	0.00	26.70	6.70	66.70	0.00	3.40
10	The MPS is aware when certain raw materials and components have been allocated to a specific production order	6.70	0.00	20.00	73.30	0.00	3.60
11	The production schedule is shared in advance with the Production, Packing and Warehouse department, to prepare for the necessary shifts required to fulfil the production schedule	0.00	0.00	20.00	66.70	13.30	3.93
12	The production schedule is easy to understand and to follow by the respective departments	0.00	0.00	13.30	80.00	6.70	3.93
13	The production schedule is adhered to on a daily basis, unless unexpected machine breakdowns occur in the Production/Packing department	0.00	6.70	6.70	80.00	6.70	3.87

		A	B	C	D	E	F
14	The MPS ensures that the production schedule is executed effectively at the end of each month	0.00	0.00	13.30	66.70	20.00	4.07
15	The Planning department is communicating any possible changes to the production schedule timeously to the Production, Packing and Warehouse departments	0.00	6.70	33.30	40.00	20.00	3.73
16	Employees who form part of the logistics process, react promptly to unexpected changes in demand requirements as communicated by the Planning department	0.00	0.00	20.00	73.30	6.70	3.87
17	Employees who form part of the logistics process, communicate immediately if they cannot meet a specific deadline or task	0.00	13.30	13.30	60.00	13.30	3.73
18	Each employee within the logistics process is aware of the critical products reflecting on the monthly stock-out report	0.00	6.70	20.00	60.00	13.30	3.80
19	3rd Party customer-products are managed with extra caution since future business is at stake	0.00	0.00	13.30	60.00	26.70	4.13
20	Internal employees and specialists are well-trained and some even multitasked	0.00	0.00	13.30	86.70	0.00	3.87
21	Internal employees and specialists are dedicated to each of their responsibilities.	0.00	0.00	20.00	80.00	0.00	3.80
22	The level of internal communication is clear between all the different departments throughout the logistics process.	6.70	33.30	26.70	33.30	0.00	2.87
23	Internal customer service levels between the different departments are adhered to	0.00	26.70	33.30	40.00	0.00	3.13
24	Employees across all the different departments have good work ethics	0.00	20.00	33.30	46.70	0.00	3.27
25	All employees follow good manufacturing practices as per the standard operating procedures	0.00	13.30	40.00	46.70	0.00	3.33
26	All employees should be motivated continuously by their respective managers to ensure productivity	0.00	20.00	20.00	40.00	20.00	3.60
27	All employees understand the impact of not supplying a specific product on time to the customer as communicated by the Planning department	0.00	26.70	6.70	66.70	0.00	3.40
28	Every effort is made by each employee to ensure that the end-products are shipped/distributed on time to the relevant customers	6.70	6.70	40.00	40.00	6.70	3.33

The first two statements in Table 5.1 relate to the accuracy and validity of the forecast numbers received from the Sales and Marketing department. By adding up the percentages for column D and calculating the averages for the two statements, it was evident that only 6.65% of the respondents agreed with these statements, while column C indicates that 36.70% had chosen to be neutral. According to the averages calculated

for columns A and B, 46.65% of the respondents disagreed, while 10% strongly disagreed with these statements. Since the averages of the means for column F resulted in a range of 2.4, it was evident that more respondents disagreed with these statements. This was mainly due to the fact that the Demand and Operations Planning department was not entirely confident that these forecasts were in fact accurate. The reason for this was that forecast numbers were being distributed by the Sales and Marketing department without any further intervention from the Demand and Operations Planning department. To ensure forecast accuracy so that the correct amount of products are planned and manufactured, it is important for the Demand and Operations Planning department to review the forecast of each product for the next three months. During this review stage, the MPS would then validate the forecast volumes of each product to ensure that there is sufficient man- and machine power available to execute the necessary plans for the next three months.

The next five statements in Table 5.1 (from 3 to 7) refer to the actual scheduling aspect of the production schedule to ensure that: sufficient bulks were manufactured to cover the forecast requirements; little scheduling changes were being made in the *Frozen zone* (three month planning period); and that the MPS ensured that the production schedule remains firm-planned in order for the relevant buyer to purchase the necessary raw materials timeously. It also encloses that *wayRTS* was an effective planning tool to schedule production and that the relevant buyer would ensure that the necessary raw materials were ordered and delivered on time to meet the production start dates. Based on the averages calculated for the five statements in column D, 54.7% of the respondents agreed that these key factors were being used to ensure that a doable production schedule was created and executed to assist Aspen Pharmacare to reduce possible out-of-stock situations. According to the averages calculated for column B, only 17.34% of the respondents disagreed with these statements. Since the averages of the means for column F resulted in a range of 3.59, it was evident that more respondents were in agreement with these statements. All of these results indicate that most of the respondents were in favour of the production schedule and that

wayRTS was an effective planning tool to compile and execute the production schedule effectively.

The next eight statements in Table 5.1 (from 8 to 15) relate to the role of the MPS within the Demand and Operations Planning department. The averages calculated for columns B, C and D indicate that 61.7% of the respondents was in agreement with these key factors relating to the role of the MPS to assist the pharmaceutical manufacturer in managing incoming customer orders more effectively. Some 19.16% of the respondents had chosen to be neutral, while 9.14% disagreed with these statements. Based on the averages of the means for column F, a range of 3.69 was found which indicates that most of the respondents were in agreement that the MPS plays a vital role in managing incoming orders effectively by ensuring that all the necessary raw materials and components were available as and when required for production. The MPS also ensured that the monthly production schedule was shared with all the employees who were responsible for the supply chain and logistics processes so that all the employees were aware of the products planned for the month.

Following this, statements 16 to 19 in Table 5.1 refer to the role of the employees that were responsible for the supply chain and logistics processes. Based on the averages calculated for column D, an average of 84.4% of the respondents was in agreement that: their response time to unexpected changes to the production plan were prompt; communication was clear; they were aware of the products currently appearing on the stock-out report; and that all of the 3rd party customer orders were handled with extreme care. According to the averages of the means calculated for column F, a range of 3.88 was established. These results were a clear indication that most of the employees, who were responsible for the supply chain and logistics processes, were aware of what was expected from them to ensure that incoming customer orders were being managed effectively to ensure continuous success of the pharmaceutical manufacturer.

Statements 20 to 23 in Table 5.1 relate to the internal employees and the level of internal customer service levels. These statements implied that the internal employees

were well-trained, dedicated specialists and some even multi-tasked in their roles, which resulted in positive outcomes for a pharmaceutical manufacturing environment. It also referred to the level of internal communication between all the different departments and questions whether internal customer service levels were adhered to. The averages of the results calculated for columns B, C and D indicate that, on average, 60.0% of the respondents was in agreement, while 23.33% had chosen to be neutral in their responses. However, 15.0% of the respondents disagreed with these statements. According to the averages of the means for column F, a range of 3.42 was established. Based on these results, most of the respondents were in agreement with these statements, but more emphasis should be placed on the level of internal customer service levels between the different departments to ensure that the customer orders are being delivered on time.

The last few statements (from 24 to 28) in Table 5.1 involve the key factors relating to the employees' work ethics, standard procedures, productivity, as well as the importance of delivering the end product to the customer on time. Based on the averages calculated for columns B and D, only 48.02% of the respondents agreed with these statements, while 17.34% disagreed with these statements. Some 28.0% of the respondents had chosen to be neutral in their responses. According to the averages for column F, the means resulted in a range of 3.39. Since the range was relatively close to 3.00, it was evident that the employees were well trained in their different roles. However, management staff from the Demand and Operations Planning department should ensure that the employees are being kept motivated in their different roles. These aspects were necessary to ensure that all the employees understand the importance of managing incoming customer orders efficiently and effectively to ensure the future success of Aspen Pharmacare.

5.5.2 Sub-objective two: To determine the extent to which the Production and Packing department believes that the key factors indicated in the questionnaire, are indeed required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

The respondents from the Production and Packing department were asked to rate the level of agreement with the statements, as presented in Table 5.2. This table contains a series of 20 possible key factors to which a pharmaceutical manufacturer should adhere in order to manage all incoming customer orders effectively. It also contains the means obtained for all the responses.

Table 5.2: Synopsis of responses (expressed in %) for questions 1-20 in Section 3 of Annexure B of the questionnaire

		A	B	C	D	E	F
	Key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Mean**
1	*wayRTS* is an effective tool to perform production shop-floor feedback timeously, and to ensure that schedule adherences are being kept up to date	0.00	0.00	28.60	50.00	21.40	3.93
2	Raw materials and components are delivered on time by the Warehouse department as requested by the Production and Packing department	0.00	14.30	28.60	57.10	0.00	3.43
3	The production schedule is shared in advance with the Production/Packing department, to prepare for the necessary shifts required to fulfil the production schedule	0.00	0.00	14.30	57.10	28.60	4.14
4	The production schedule is easy to understand and to follow by the respective departments	0.00	7.10	0.00	64.30	28.60	4.14
5	The Planning department is communicating any possible changes to the production schedule timeously to the Production/Packing departments	0.00	7.10	0.00	64.30	28.60	4.14
6	The production schedule is adhered to on a daily basis, unless unexpected machine breakdowns occur in the Production/Packing department	0.00	0.00	14.30	57.10	28.60	4.14
7	The Production/Packing department ensures that the production schedule is executed effectively at the end of each month	0.00	28.60	0.00	57.10	14.30	3.57
8	Employees who form part of the logistics process, react promptly to unexpected changes in demand requirements as communicated by the Planning department	0.00	0.00	7.10	71.40	21.40	4.14
9	Employees who form part of the logistics process, communicate immediately if they cannot meet a specific deadline or task	0.00	7.10	14.30	64.30	14.30	3.86

		A	B	C	D	E	F
10	Each employee within the logistics process is aware of the critical products reflecting on the monthly stock-out report	0.00	14.30	14.30	57.10	14.30	3.71
11	3rd Party customer-products are managed with extra caution since future business is at stake	0.00	7.10	7.10	57.10	28.60	4.07
12	Internal employees and specialists are well-trained and some even multitasked	0.00	0.00	35.70	57.10	7.10	3.71
13	Internal employees and specialists are dedicated to each of their responsibilities	0.00	0.00	35.70	57.10	7.10	3.71
14	The level of internal communication is clear between all the different departments throughout the logistics process	0.00	14.30	28.60	57.10	0.00	3.43
15	Internal customer service levels between the different departments are adhered to	0.00	14.30	42.90	42.90	0.00	3.29
16	Employees across all the different departments have good work ethics	0.00	28.60	28.60	42.90	0.00	3.14
17	All employees follow good manufacturing practices as per the standard operating procedures	0.00	14.30	57.10	21.40	7.10	3.21
18	All employees should be motivated continuously by their respective managers to ensure their productivity and commitment	0.00	0.00	14.30	50.00	35.70	4.21
19	All employees understand the impact of not supplying a specific product on time to the customer as communicated by the Planning department	0.00	14.30	28.60	42.90	14.30	3.57
20	Every effort is made by each employee to ensure that the end-products are shipped/distributed on time to the relevant customers	0.00	0.00	42.90	57.10	0.00	3.57

As discussed in Chapter Three of this research study, the employees from the Production and Packing department are responsible for manufacturing and packing all the products reflected on the monthly production schedule. These employees are also responsible for sending production feedback on the shop floor to the MPS to keep track of the production and packing progress during the month. These employees make use of the *wayRTS* computer tool to send feedback to the MPS on the current status of a specific batch currently running in production and packing. According to the results of the averages calculated for columns D and E, 50.0% of the respondents was in agreement that *wayRTS* was an effective tool for performing production shop floor feedback timeously, and ensuring that schedule adherences were being kept up to date. A further 21.40% of the respondents strongly agreed with this statement. Based on the results for column F, the means resulted in a range of 3.93, which indicate that the

respondents were fairly comfortable using the *wayRTS* computer tool to carry out shop floor feedback. In this way, the MPS would keep track of the production and packing progress on a daily basis to ensure that schedule adherences are being kept up to date.

The second statement in Table 5.2 related to the availability of raw materials and components from the Warehouse and Distribution department as requested by the Production and Packing department. Based on the averages calculated for columns B, C and D, 57.10% of the respondents agreed that raw materials and components were always readily available at Aspen Pharmacare for the production and packing processes, while 28.60% was neutral. Some 14.30% of the respondents disagreed that raw materials and components were always available in time for the production or packing processes. This could be because, in some instances, the Warehouse and Distribution department was not informed timeously to pick the necessary raw materials and components for the Production and Packing department. This could lead to unnecessary production or packing stoppages which ultimately impact on the delivery date of a product to the end customer. Based on the results for column F, the mean represented a range of 3.43, which indicates that the respondents were relatively in agreement that raw materials and components were readily available for the production or packing process, but that there was still an opportunity for improvement. The Production and Packing department needs to inform the Warehouse and Distribution department timeously whenever raw materials or components are required for the production or packing process.

Statements 3 to 7 in Table 5.2 relate to the production schedule and whether it was being made available in advance, and was easy to follow, to ensure that the Production and Packing department adheres and reacts promptly to the necessary planning requests. Based on the averages calculated for column D, 59.98% of the respondents agreed that the production schedule was distributed timeously and that it was easy to follow. As per the averages for column E, a further 25.74% strongly agreed with these statements. According to the averages calculated for column F, the means represented a range of 4.03. This indicates that a high percentage of respondents were in

agreement with this statement relating to the production schedule. It also implied that the production and packing employees were manufacturing and packing in accordance with the monthly production schedule to ensure that the production schedule is executed effectively.

The next few statements (from 8 to 11) in Table 5.2 relate to the performances of the internal employees to react promptly to unexpected changes in demand requirements and to communicate immediately should they be unable to meet a specific task or deadline. Internal employees needed to be made aware of the critical products which were currently on stock-out and whether the 3rd party products were managed with extra care. Based on the averages calculated for columns B and D, 62.48% of the respondents agreed with these statements, while only 7.13% of the respondents disagreed with these statements. According to the averages calculated for column F, the means indicate a range of 3.95. This indicates that a high percentage of the internal employees was behaving positively in their respective roles and thereby ensuring a steady flow of the logistics processes.

Following this, statements 12 to 15 in Table 5.2 represent the level of skill of the internal employees, as well as their dedication to each specific task to ensure that internal communication was clear between all the different departments. These statements also refer to the internal customer service levels between the different departments. According to the averages calculated for columns B, C and D, 53.55% of the respondents agreed, while 35.7% was neutral and 17.88% disagreed with these statements. Based on the averages calculated for column F, the means represented a range of 3.54. The results indicate that internal employees were fairly confident to perform their daily tasks. However, more focus is required on the level of internal communication and customer service levels between all the different departments to ensure that customer orders are delivered on time.

The last few statements (from 16 to 20) in Table 5.2 relate to the work ethic of each employee, and questions whether they follow good manufacturing practices as per the

standard operating procedures. These statements also dealt with the level of motivation given by management to employees and whether employees understand the impact of not supplying a specific product on time to the customer. Based on the averages calculated for column B, 11.44% of the respondents disagreed with these statements. As per the averages calculated for column D, 42.86% of the respondents agreed with these statements. As per column E, a further 11.42% of the respondents strongly agreed. According to the averages calculated for column F, the means represented a range of 3.54. In this case, mixed reactions were given by the respondents, which suggested that more effort should be made by the Demand and Operations Planning department to ensure that all the employees are made aware of the impact of not supplying a product to the market. Whenever a product is not supplied to a customer, the manufacturer could face a possible *buy-out*, which means that the customer can cancel their orders with the manufacturer and order the stock from any other manufacturer that is able to deliver immediately. Therefore, it remains critical for Aspen Pharmacare to continuously deliver its customer orders on time.

The management staff from the Production and Packing department should also ensure that all their employees remain motivated in their roles and follow good manufacturing practices at all times, as per the standard operating procedures implemented by Aspen Pharmacare.

Overall, the responses reflect that respondents from the Production and Packing department were in strong support that these key factors are important for the pharmaceutical manufacturer to manage incoming customer orders efficiently. In this way, possible out-of-stock situations can be minimised or reduced amongst its end customers.

5.5.3 Sub-objective three: To determine the extent to which the Warehouse and Distribution department believes that the key factors indicated in the questionnaire, are indeed required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

Finally, the respondents from the Warehouse and Distribution department were asked to rate their level of agreement with the statements as presented in Table 5.3. This table contains a series of 19 possible key factors which a pharmaceutical manufacturer should adhere to in order to manage all incoming customer orders effectively. This table also contains the means obtained for all the responses.

Table 5.3: Synopsis of responses (expressed in %) for questions 1-19 in Section 4 of Annexure B of the questionnaire

		A	B	C	D	E	F
	Key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Mean**
1	*wayRTS* is an effective tool to perform warehouse feedback timeously, and to ensure that schedule adherences are being kept up to date	0.00	0.00	25.00	58.30	16.70	3.92
2	Raw materials and components are delivered on time by the Warehouse department as requested by the Production and Packing department	0.00	0.00	16.70	66.70	16.70	4.00
3	The production schedule is shared in advance with the Warehouse department, to prepare for the necessary shifts required to fulfil the production schedule	8.30	8.30	41.70	33.30	8.30	3.25
4	The production schedule is easy to understand and to follow by the respective departments	0.00	0.00	41.70	50.00	8.30	3.67
5	The Planning department is communicating any possible changes to the production schedule timeously to the Warehouse department	8.30	25.00	41.70	16.70	8.30	2.92
6	Inventory/stock levels are kept at a minimum level in the respective warehouses, unless changes in demand requirements occur	0.00	0.00	58.30	33.30	8.30	3.50
7	Employees who form part of the logistics process, react promptly to unexpected changes in demand requirements as communicated by the Planning department	0.00	0.00	33.30	58.30	8.30	3.75
8	Employees who form part of the logistics process, communicate immediately if they cannot meet a specific deadline or task	0.00	8.30	41.70	50.00	0.00	3.42
9	Each employee within the logistics process is aware of the critical products reflecting on the monthly stock-out report	0.00	8.30	41.70	41.70	8.30	3.50
10	3rd Party customer-products are managed with extra caution since future business is at stake	0.00	0.00	8.30	58.30	33.30	4.25

		A	B	C	D	E	F
11	Internal employees and specialists are well-trained and some even multitasked	0.00	0.00	33.30	58.30	8.30	3.75
12	Internal employees and specialists are dedicated to each of their responsibilities	0.00	8.30	33.30	50.00	8.30	3.58
13	The level of internal communication is clear between all the different departments throughout the logistics process	0.00	8.30	25.00	66.70	0.00	3.58
14	Internal customer service levels between the different departments are adhered to	0.00	8.30	8.30	66.70	16.70	3.92
15	Employees across all the different departments have good work ethics	0.00	8.30	58.30	33.30	0.00	3.25
16	All employees follow good manufacturing practices as per the standard operating procedures	0.00	25.00	66.70	0.00	8.30	3.83
17	All employees should be motivated continuously by their respective managers to ensure their productivity and commitment	0.00	0.00	16.70	33.30	50.00	4.33
18	All employees understand the impact of not supplying a specific product on time to the customer as communicated by the Planning department	8.30	8.30	58.30	0.00	25.00	3.83
19	Every effort is made by each employee to ensure that the end-products are shipped/distributed on time to the relevant customers	0.00	8.30	58.30	0.00	33.30	4.17

As explained in Chapter Three of this research study, the employees from the Warehouse and Distribution department are responsible for managing the inventory in the respective warehouses and distributing raw materials and components to the Production and Packing department. The warehouse employees are also given a monthly production schedule which allows them to pick the necessary raw materials and components timeously for production and packing. They are also responsible for providing feedback on the picking step of a specific production or packing document so that the MPS can keep track of the production or packing progresses throughout the month. Employees from the Warehouse and Distribution department also make use of the *wayRTS* computer tool to send feedback on the necessary inventory information. As per the results for columns D and E of the first statement in Table 5.3, 58.3% of the respondents agreed, while 16.70% strongly agreed that the *wayRTS* computer tool was an effective tool for performing feedback on the picking status of a specific production or packing document. Based on the results for column F, the mean reflected a range of

3.92, which indicates that the *wayRTS* computer tool was used effectively by all the employees from the Warehouse and Distribution department of Aspen Pharmacare.

Statement 2 in Table 5.3 related to the availability of raw materials and components from the Warehouse and Distribution department as requested by the Production and Packing department. The results for columns D and E indicate that 66.70% of the respondents agreed, while 16.70% strongly agreed with this statement. Based on the results for column F, the mean reflected a range of 4.00, which indicates that the Warehouse and Distribution employees were confident that they deliver the necessary raw materials and components on time to the Production and Packing department.

The next few statements (from 3 to 5) in Table 5.3 relate to the production schedule and whether it was being made available in advance, easy to follow, and that the Warehouse and Distribution department adhered and reacted promptly to the requests from the MPS. Based on the averages calculated for columns B, C and D, 33.33% of the respondents agreed with these statements, while 41.70% was neutral. However, 11.00% of the respondents disagreed with these statements. According to the averages calculated for column F, the means reflected a range of 3.28. In this case, mixed reactions were given by the respondents. It was clear that: more effort should be made by the MPS to ensure that the production schedule is distributed timeously to the employees of the Warehouse and Distribution department; to ensure that these employees understand the monthly production schedule; and to inform them in advance should any changes be made to the current production schedule.

Statement 6 in Table 5.3 referred to the inventory or stock levels that were being kept at minimum levels across the respective warehouses. Employees from the Warehouse and Distribution department managed their stock levels by interacting continuously with the buyers from the Purchasing department that form part of the Demand and Operations Planning department. The buyers would only purchase the necessary raw materials and components based on the demand specified in the system. The MPS needs to ensure that the demand which is currently in the system is always accurate so

that only the required raw materials and components are purchased and kept at minimum levels in the respective warehouses. However, according to the results for columns C and D, only 33.30% of the respondents agreed with this statement, while 58.30% was neutral. Based on the results of the mean for column F, a range of 3.50 was established. As a result, the MPS needs to focus more on the accuracy of the demand in the system. In this way, the inventory or stock levels should be kept at minimum levels in the respective warehouses and the risk of potential stock write-offs can be avoided.

The next few statements (from 7 to 10) in Table 5.3 relate to the performances of the internal employees to react promptly to unexpected changes in demand requirements and to communicate immediately should they be unable to meet a specific task or deadline. Internal employees needed to be made aware of the critical products on stock-out and if the 3rd party products were managed with extra care. Based on the averages calculated for columns C and D, 52.00% of the respondents agreed, while 31.25% was neutral. According to the averages calculated for column F, the means reflected a range of 3.73. As a result, a high percentage of the internal employees was behaving positively in their respective roles and thereby ensured a steady flow of the logistics processes within the pharmaceutical manufacturer.

Statements 11 to 14 in Table 5.3 represent the level of skill and dedication of internal employees to their specific task to ensure that the level of internal communication was clear between all the different departments. It also referred to the level of internal customer service levels between the different departments. As per the averages calculated for columns B, C and D, 60.43% of the respondents agreed, while 24.98% was neutral. Only 6.23% disagreed with these statements while the averages of the means calculated for column F resulted in a range of 3.71. These results indicate that most of the respondents were in agreement that the internal employees were well trained, dedicated to their tasks, and that the level of internal communication and customer service levels between all the different departments, was acceptable.

The last few statements (from 15 to 19) in Table 5.3 relate to the work ethic of each employee, and questions whether they follow good manufacturing practices as per the standard operating procedures. It also involves the level of motivation given by management to employees and whether the employees understood the impact of not supplying a specific product on time to the customer. Based on the averages calculated for columns B & C, only 9.98% of the respondents disagreed with these statements, while 51.66% was neutral. According to the averages calculated for column D, 13.32% of the respondents agreed with these statements. As per the averages calculated for column E, 23.32% of the respondents strongly agreed. According to the averages calculated for column F, the means represented a range of 3.88. The same conclusion can be made as for the Production and Packing department's responses. More effort should be made by the Demand and Operations Planning department to ensure that all the employees are made aware of the impact of not supplying a product to the market on time. As explained earlier, when a certain product is not supplied to a customer on time, the manufacturer could face a possible *buy-out* situation. Therefore, it remains critical for Aspen Pharmacare to continuously deliver its customer orders on time.

Based on the results from all the responses received, the respondents of the Warehouse and Distribution department were in support that these key factors are important for a pharmaceutical manufacturer to manage incoming customer orders efficiently and effectively to reduce possible out-of-stock situations amongst its end customers.

5.6 COMPARISONS BETWEEN THE THREE DEPARTMENTS

A comparison was made between the responses received from the respondents from the three main departments, to whom similar statements were posed amongst Sections Two, Three and Four of the questionnaire. In this case, 19 similar statements were posed amongst these three sections of the questionnaire of which 5 of the statements indicate a significant difference in responses. The *Cohen's d* measurement was used to determine the significant differences between the respondents who responded to the 19

similar statements of the questionnaire. *Cohen's d* is an effective size measurement that indicates the practical significance of a statistically significant finding. Its interpretation is as follows (Kelley & Preacher, 2012:137-152):

Probability value indicates statistically significant differences ($p < 0.095$):

Based on the results, the following findings were made on five of the statements which showed a significant difference in the responses received from the various respondents:

5.6.1 Statement 2 of Sections Three and Four of Annexure B:

- *Raw materials and components are delivered on time by the Warehouse and Distribution department as requested by the Production and Packing department.*

Based on the results received, a significant difference in responses was given by the Production and Packing department and the Warehouse and Distribution department, since the probability value between these two groups was valued at 0.0460. On the one hand, the respondents from the Warehouse and Distribution department strongly agreed with the statement that raw materials and components were delivered on time to the Production and Packing department. On the other hand, the respondents from the Production and Packing department agreed significantly less with this statement. A reason for the difference in responses might be that the receiving department (the Production and Packing department) does not always inform the Warehouse and Distribution department timeously when raw and materials and components are required for production and packing activities. The Warehouse and Distribution department would only react to requests from the receiving department once they are in receipt of the outbounds given to them by the Production and Packing department.

5.6.2 Statement 3 of Sections Two to Four of Annexure B:

- *The production schedule is shared in advance with the Warehouse and Distribution department, to prepare for the necessary shifts required to fulfil the production schedule.*

The responses to the above-mentioned statement differed significantly from those received from the Production and Packing department and the Warehouse and Distribution department. In this case, the probability value was 0.0212, indicating that the respondents from the Production and Packing department strongly agreed that the production schedule was shared timeously by the MPS so that the necessary shift structures could be put into place to meet the production schedule. However, the respondents from the Warehouse and Distribution department had chosen to be more neutral with their responses to this statement. A reason could be that the MPS would send the production schedule firstly to the Production and Packing department and only a few days later to the Warehouse and Distribution department.

5.6.3 Statement 5 of Sections Three and Four of Annexure B:

- *The Demand and Operations Planning department is communicating any possible changes to the production schedule timeously to the Production and Packing department, as well as to the Warehouse and Distribution department.*

According to the results of statement five, a significant difference in responses were given by the Production and Packing department and the Warehouse and Distribution department as the probability value equated to 0.0061. On the one hand, the respondents from the Production and Packing department strongly agreed that they were informed timeously by the Demand and Operations department when any changes were being made to the current production schedule. On the other hand, the

respondents from the Warehouse and Distribution department disagreed with this statement. The reason for the difference in responses could be that the Demand and Operations Planning department informs the Warehouse and Distribution department too late when any changes to the production schedule are being made.

5.6.4 Statement 14 of Sections Two and Four of Annexure B:

- *Internal customer service levels between the different departments are adhered to.*

Based on the results received, a significant difference in responses existed for the Demand and Operations Planning department and the Warehouse and Distribution department since the probability value between these two groups was valued at 0.0474. In this case, the respondents from the Warehouse and Distribution department strongly agreed that the internal customer service levels between the different departments were being met, while the respondents from the Demand and Operations department had chosen to be more neutral in their responses. A reason could be that the Demand and Operations Planning department is not always aware if and when the necessary customer service requirements between the supporting departments are executed.

5.6.5 Statement 19 of Sections Two and Four of Annexure B:

- *Every effort is made by each employee to ensure that the end-products are shipped or distributed on time to the relevant end customers.*

According to the results of statement 19, a disparity existed for the responses received from the Demand and Operations Planning department and the Warehouse and Distribution department, as the probability value equated to 0.0370. On the one hand, the respondents from the Warehouse and Distribution department strongly agreed that every effort was made by each employee to ensure that the required end-products were

delivered on time to the end customer. On the other hand, the respondents from the Demand and Operations Planning department had chosen to be more neutral in their responses. The reason for the difference in responses between these two departments could be that the Demand and Operations Planning department is not always satisfied with the level of effort made by all the supporting departments to ensure that the end-products are delivered on time to the relevant customers.

5.7 ADDITIONAL FINDINGS OF THE EMPIRICAL STUDY

To evaluate the respondents' overall perceptions of the key factors required to ensure a successful pharmaceutical manufacturing operation, the respondents were also asked to complete three additional questions which formed part of the last section of each questionnaire, namely:

- *Name and explain the main problem(s) experienced by you in your everyday working environment. List any possible consequences of this problem(s).*

- *What causes the above-mentioned problem(s)?*

- *Please indicate which improvements, if any, can be made to execute the production schedule more effectively in order to deliver the products on time to the relevant customers.*

Only a few respondents responded to the above-mentioned questions. The majority of these respondents highlighted the following reasons or obstacles preventing them from implementing the key factors that are required to manage incoming customer orders more efficiently within Aspen Pharmacare:

- Lack of accountability is experienced amongst employees from all three departments. For example, some employees depend on other employees from a different department to solve certain queries, as some of the employees are not

completely confident to make important decisions on their own. Furthermore, unnecessary time is wasted as queries take too long to be resolved.

- When employees are not informing the supporting departments in advance to react to a particular request from another internal department, unnecessary down-time is created. For example, when the employees from the Dispensary department (that forms part of the Production and Packing department) request raw materials from the Warehouse and Distribution department, a sufficient time period needs to be given for these employees to react to the request to get the materials transferred in time for the dispensing process.

- During shift changes, the handover information between the employees is often incomplete or not clear enough. In some cases, the employees of a new shift are unsure of a specific task which could then result in incorrect decision-making. It is imperative that when an employee is unsure of anything, he/she must contact the relevant shift or production leader to confirm the next step.

- Lastly, the main obstacle which the majority of the respondents gave was the lack of constant communication between the various employees of the different departments. As a result, the lack of communication impacts negatively on their ability to execute their given tasks efficiently and effectively. In this way, the current production schedule might not be carried out as planned. For example, whenever the MPS needs to change the production schedule, it is imperative for each MPS to inform all the relevant supporting departments to ensure that the new production schedule is adhered to at all times.

5.8 CONCLUDING REMARKS

The researcher was satisfied that the findings of the empirical study addressed the defined study objectives of the study comprehensively and were in line with the literature review. The information illustrated in the various figures and tables presented

a true reflection of the responses received from the respondents. The specific responses that were given to each sub-objective relating to the key factors required by the pharmaceutical manufacturer indicate that the questionnaire that was used to gather the research data, was reliable.

The next chapter contains a short summary of all the chapters discussed in this study, as well as recommendations and prospects for future research.

CHAPTER 6

SYNOPSIS, RECOMMENDATIONS AND FINAL CONCLUSIONS

6.1 INTRODUCTION

The previous chapter outlined the empirical findings and interpretation of the empirical data. This chapter provides a synopsis of all the chapters discussed in this research study, followed by recommendations and suggestions for future research.

6.2 SYNOPSIS OF THE STUDY

The main objective of this study was to determine the key factors that form part of the demand and operations planning strategies to ensure that these factors are in place to effectively manage and execute the supply chain and logistics processes within the three main departments at Aspen Pharmacare. To support the main objective of this study, the following sub-objectives were identified:

- To determine the extent to which the Demand and Operations Planning department believes that the key factors indicated in the questionnaire, are indeed required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

- To determine the extent to which the Production and Packing department believes that the key factors indicated in the questionnaire, are indeed required to assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

- To determine the extent to which the Warehouse and Distribution department believes that the key factors indicated in the questionnaire, are indeed required to

assist a pharmaceutical manufacturer to manage incoming customer orders more effectively.

In order to achieve the objectives relating to the topic of this research study, six chapters have been outlined in this study. Chapter One provided a structured outline of the problem statement, the research objectives, as well as the research design and methodology for this particular research study. The second chapter explained the contextualisation of the demand and operations planning strategies that play a vital role in effectively managing and executing the supply chain and logistics processes at pharmaceutical manufacturing companies. Chapter Three gave an explanation of how these demand and operations planning strategies are being followed in practice by the generic pharmaceutical manufacturer, in this case, Aspen Pharmacare. It also explained the role of each supporting department that is responsible for the supply chain and logistics processes at Aspen Pharmacare, to reduce the number of possible out-of-stock situations amongst its customers.

Chapter Four provided an outline of the research design and methodology that was used to collect the empirical data for this study. It also discussed the purpose of data collection, the various research methods available to the researcher, as well as the rationale for the empirical data collection method that was used to meet the primary objectives for this research study. The results of the empirical study have been explained and interpreted in Chapter Five of this research study. These results have been interpreted with the aid of tables and figures based on the responses received from the respondents who completed the questionnaire.

The purpose of Chapter Six is to summarise all the chapters discussed in this research study and to provide recommendations and suggestions for future research.

6.3 RECOMMENDATIONS

Based on the empirical findings, the researcher provides the following recommendations to assist pharmaceutical manufacturing companies to more effectively and efficiently manage their incoming customer orders to reduce or eliminate any possible out-of-stock situations amongst its end customers:

- Communication regarding planning changes between the Demand and Operations planning department and all other supporting departments within Aspen Pharmacare should be clear and on a continuous basis. It is imperative that all the employees are made aware if and when the production schedule is about to change. In this way, unnecessary downtime in production can be eliminated and/or avoided.

- Information regarding specific products currently being out of stock or which are running at low stock levels should be shared amongst all the supporting departments so that employees can make an effort to deliver these products quicker to the customer.

- Management should ensure that employees adhere to internal and external customer service levels. It is important for internal employees to support each other to ensure future success of the whole business.

- Forecast numbers received from the Sales and Marketing department need to be evaluated by the Demand and Operations Planning department to ensure that the correct number of products are planned and manufactured timeously.

- The supply- and cost effectiveness of using *Outsourcing* by pharmaceutical manufacturers needs to be investigated further. *Outsourcing* may assist a pharmaceutical manufacturer to deliver more of its new products to its customers without jeopardising the supply of current products to the market. It may also be

cost-effective for pharmaceutical manufacturers to make use of *Outsourcing* as little or no changes in machine or manpower will be required.

6.4 SUGGESTIONS FOR FUTURE RESEARCH

Since very few studies that relate to the effectiveness of managing incoming customer orders received by manufacturing companies have been performed, it is proposed that more research is conducted especially in the pharmaceutical manufacturing industry. In particular, the importance of the role of each department that is responsible for executing the supply chain and logistics processes within a pharmaceutical manufacturing company, require further study.

6.5 CONCLUDING REMARKS

This chapter provided a synopsis of the research study by reviewing the main facets discussed in the preceding chapters. The researcher provided a number of recommendations for pharmaceutical manufacturers to effectively and efficiently manage their incoming customer orders to reduce or eliminate any possible out-of-stock situations amongst its customers. Finally, this chapter concluded with suggestions for future research projects.

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ANNEXURE A

THE COVERING LETTER

ASPEN PHARMACARE
7 Fairclough Road
Korsten
Port Elizabeth
6001
Tel: 041 4072653

Dear Sir/Madam

I am currently employed at Aspen Pharmacare as a Master Production Scheduler in the Demand and Operations Planning Department. As part of completing my research dissertation, which forms part of completing the Master's Degree in Logistics, I would like you to participate and complete the attached questionnaire.

The questionnaire consists of four sections. You would only complete Section One and either Section Two, Three or Four depending on the specific department in which you operate in. It should not take you longer than 10 minutes to complete both sections. Kindly be completely honest when answering all of the questions in the questionnaire. Please take note that anonymity and confidentiality is strictly guaranteed since you are not required to fill in your name.

Please feel free to contact me should any of the questions be unclear. I can be contacted on my cell phone on 0824914848 or on e-mail rbotha@aspenpharma.com.

Thank you for your time and co-operation. Your assistance is greatly appreciated.

Kind regards

Risca Botha (researcher)

ANNEXURE B

THE RESEARCH INSTRUMENT

Please answer the following questions by marking the appropriate box with an "X".

SECTION 1: GENERAL INFORMATION	Please tick the appropriate box		
Q1: What is your gender?	Male		(1)
	Female		(2)
Q2: What is your age?	Under 21 years		(1)
	21-30 years		(2)
	31-40 years		(3)
	41-50 years		(4)
	51-60 years		(5)
	61 and above		(6)
Q3: How many years have you been working at Aspen Pharmacare?	0-5 years		(1)
	6-10 years		(2)
	11-15 years		(3)
	16-20 years		(4)
	21-25 years		(5)
	26-30 years		(6)
	31 and above		(7)
Q4: In which department of Aspen Pharmacare do you work in?	Demand & Operations Planning department		(1)
	Production & Packing department		(2)
	Warehouse & Distribution department		(3)

SECTION 2: FOR INTERNAL EMPLOYEES WITHIN THE DEMAND AND OPERATIONS PLANNING DEPARTMENT	Please tick the appropriate box				
The following questions are described as key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end. Please indicate your agreement with each of the statements below by choosing the most appropriate option for each statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. The validated forecast numbers for the next three months, which are distributed by the Marketing department, are accurate and reliable.	1	2	3	4	5
2. Possible forecast errors are kept at a minimum level.	1	2	3	4	5
3. The master production scheduler (MPS) ensures that sufficient bulks are manufactured on time to cover the forecast requirements.	1	2	3	4	5
4. Little scheduling changes are made by the MPS during the *Frozen zone* (within the three month period), unless Aspen loses the tender or when unexpected changes in demand occur in the market place.	1	2	3	4	5
5. The production schedule is firm-planned in advance by the relevant MPS by means of *wayRTS,* to ensure that the necessary raw materials and components are ordered on time to meet the production start dates.	1	2	3	4	5
6. *wayRTS* is an effective planning tool to schedule the production batches effectively on the production schedule.	1	2	3	4	5
7. The relevant buyer would purchase the necessary raw materials and components on time to ensure that the goods are delivered in accordance with the production start dates.	1	2	3	4	5
8. Raw materials and components are readily available from the Laboratory to meet the production start dates.	1	2	3	4	5
9. The MPS is always aware of the current stock situation on the system.	1	2	3	4	5
10. The MPS is aware when certain raw materials and components have been allocated to a specific production order.	1	2	3	4	5

The following questions are described as key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end. Please indicate your agreement with each of the statements below by choosing the most appropriate option for each statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
11. The production schedule is shared in advance with the Production, Packing and Warehouse department, to prepare for the necessary shifts required to fulfil the production schedule.	1	2	3	4	5
12. The production schedule is easy to understand and to follow by the respective departments.	1	2	3	4	5
13. The production schedule is adhered to on a daily basis, unless unexpected machine breakdowns occur in the Production/Packing department.	1	2	3	4	5
14. The MPS ensures that the production schedule is executed effectively at the end of each month.	1	2	3	4	5
15. The Planning department is communicating any possible changes to the production schedule timeously to the Production, Packing and Warehouse departments.	1	2	3	4	5
16. Employees who form part of the logistics processes, react promptly to unexpected changes in demand requirements as communicated by the Planning department.	1	2	3	4	5
17. Employees who form part of the logistics processes, communicate immediately if they cannot meet a specific deadline or task.	1	2	3	4	5
18. Each employee within the logistics processes is aware of the critical products reflecting on the monthly stock-out report.	1	2	3	4	5
19. 3rd Party customer-products are managed with extra caution since future business is at stake.	1	2	3	4	5
20. Internal employees and specialists are well-trained and some even multitasked.	1	2	3	4	5
21. Internal employees and specialists are dedicated to each of their responsibilities.	1	2	3	4	5
22. The level of internal communication is clear between all the different departments throughout the logistics process.	1	2	3	4	5

The following questions are described as key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end. Please indicate your agreement with each of the statements below by choosing the most appropriate option for each statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
23. Internal customer service levels between the different departments are adhered to.	1	2	3	4	5
24. Employees across all the different departments have good work ethics.	1	2	3	4	5
25. All employees follow good manufacturing practices as per the standard operating procedures.	1	2	3	4	5
26. All employees should be motivated continuously by their respective managers to ensure productivity.	1	2	3	4	5
27. All employees understand the impact of not supplying a specific product on time to the customer as communicated by the Planning department.	1	2	3	4	5
28. Every effort is made by each employee to ensure that the end-products are shipped/distributed on time to the relevant customers.	1	2	3	4	5
29. Name and explain the main problem (s) experienced by you in your everyday working environment. List the possible consequences of the above-mentioned problem (s). …… …… …… ……					
30. What causes the above-mentioned problem (s)? …… …… …… …… ……					
31. Please indicate which improvements, if any, can be made to execute the production schedule more effectively in order to deliver the products on time to the relevant customers. …… …… …… …… …… ……					
THANK YOU FOR COMPLETING THE QUESTIONNAIRE					

SECTION 3: FOR INTERNAL EMPLOYEES WITHIN THE PRODUCTION AND PACKING DEPARTMENT	**Please tick the appropriate box**				
The following questions are described as key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of stock situations at the customers' end. Please indicate your agreement with each of the statements below by choosing the most appropriate option for each statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. *wayRTS* is an effective tool to perform production shop-floor feedback timeously, and to ensure that schedule adherences are being kept up to date.	1	2	3	4	5
2. Raw materials and components are delivered on time by the Warehouse department as requested by the Production and Packing department.	1	2	3	4	5
3. The production schedule is shared in advance with the Production/Packing department, to prepare for the necessary shifts required to fulfil the production schedule.	1	2	3	4	5
4. The production schedule is easy to understand and to follow by the respective departments.	1	2	3	4	5
5. The Planning department is communicating any possible changes to the production schedule timeously to the Production/Packing departments.	1	2	3	4	5
6. The production schedule is adhered to on a daily basis, unless unexpected machine breakdowns occur in the Production/Packing department.	1	2	3	4	5
7. The Production/Packing department ensures that the production schedule is executed effectively at the end of each month.	1	2	3	4	5
8. Employees who form part of the logistics process, react promptly to unexpected changes in demand requirements as communicated by the Planning department.	1	2	3	4	5
9. Employees who form part of the logistics process, communicate immediately if they cannot meet a specific deadline or task.	1	2	3	4	5
10. Each employee within the logistics process is aware of the critical products reflecting on the monthly stock-out report.	1	2	3	4	5

The following questions are described as key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of stock situations at the customers' end. Please indicate your agreement with each of the statements below by choosing the most appropriate option for each statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
11. 3rd Party customer-products are managed with extra caution since future business is at stake.	1	2	3	4	5
12. Internal employees and specialists are well-trained and some even multitasked.	1	2	3	4	5
13. Internal employees and specialists are dedicated to each of their responsibilities.	1	2	3	4	5
14. The level of internal communication is clear between all the different departments throughout the logistics process.	1	2	3	4	5
15. Internal customer service levels between the different departments are adhered to.	1	2	3	4	5
16. Employees across all the different departments have good work ethics.	1	2	3	4	5
17. All employees follow good manufacturing practices as per the standard operating procedures.	1	2	3	4	5
18. All employees should be motivated continuously by their respective managers to ensure their productivity and commitment.	1	2	3	4	5
19. All employees understand the impact of not supplying a specific product on time to the customer as communicated by the Planning department.	1	2	3	4	5
20. Every effort is made by each employee to ensure that the end-products are shipped/distributed on time to the relevant customers.	1	2	3	4	5
21. Name and explain the main problem (s) experienced by you in your everyday working environment. List the possible consequences of the above-mentioned problem (s). …… ……					
22. What causes the above-mentioned problem (s)? …… …… ……					
23. Please indicate which improvements, if any, can be made to execute the production schedule more effectively in order to deliver the products on time to the relevant customers. ……					
THANK YOU FOR COMPLETING THE QUESTIONNAIRE					

SECTION 4: FOR INTERNAL EMPLOYEES FROM THE WAREHOUSE AND DISTRIBUTION DEPARTMENT	**Please tick the appropriate box**				
The following questions are described as key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end. Please indicate your agreement with each of the statements below by choosing the most appropriate option for each statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. *wayRTS* is an effective tool to perform warehouse feedback timeously, and to ensure that schedule adherences are being kept up to date.	1	2	3	4	5
2. Raw materials and components are delivered on time by the Warehouse department as requested by the Production and Packing department.	1	2	3	4	5
3. The production schedule is shared in advance with the Warehouse department, to prepare for the necessary shifts required to fulfil the production schedule.	1	2	3	4	5
4. The production schedule is easy to understand and to follow by the respective departments.	1	2	3	4	5
5. The Planning department is communicating any possible changes to the production schedule timeously to the Warehouse department.	1	2	3	4	5
6. Inventory/stock levels are kept at a minimum level in the respective warehouses, unless changes in demand requirements occur.	1	2	3	4	5
7. Employees who form part of the logistics process, react promptly to unexpected changes in demand requirements as communicated by the Planning department.	1	2	3	4	5
8. Employees who form part of the logistics process, communicate immediately if they cannot meet a specific deadline or task.	1	2	3	4	5
9. Each employee within the logistics process is aware of the critical products reflecting on the monthly stock-out report.	1	2	3	4	5
10. 3rd Party customer-products are managed with extra caution since future business is at stake.	1	2	3	4	5

The following questions are described as key factors for effectively managing and executing the logistics processes at Aspen Pharmacare to reduce possible out-of-stock situations at the customers' end. Please indicate your agreement with each of the statements below by choosing the most appropriate option for each statement.	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
11. Internal employees and specialists are well-trained and some even multitasked.	1	2	3	4	5
12. Internal employees and specialists are dedicated to each of their responsibilities.	1	2	3	4	5
13. The level of internal communication is clear between all the different departments throughout the logistics process.	1	2	3	4	5
14. Internal customer service levels between the different departments are adhered to.	1	2	3	4	5
15. Employees across all the different departments have good work ethics.	1	2	3	4	5
16. All employees follow good manufacturing practices as per the standard operating procedures.	1	2	3	4	5
17. All employees should be motivated continuously by their respective managers to ensure their productivity and commitment.	1	2	3	4	5
18. All employees understand the impact of not supplying a specific product on time to the customer as communicated by the Planning department.	1	2	3	4	5
19. Every effort is made by each employee to ensure that the end-products are shipped/distributed on time to the relevant customers.	1	2	3	4	5
20. Name and explain the main problem (s) experienced by you in your everyday working environment. List the possible consequences of the above-mentioned problem (s). …… ……					
21. What causes the above-mentioned problem (s)? …… …… …… ……					
22. Please indicate which improvements, if any, can be made to execute the production schedule more effectively in order to deliver the products on time to the relevant customers. …… ……					
THANK YOU FOR COMPLETING THE QUESTIONNAIRE					