Managing Finished Goods Inventory at Regional Level

A case study on Dalda Foods (Pvt.) Limited Pakistan

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ABSTRACT

Degree project Advanced Level - Business Administration, School of Management and Economics at Linnaeus University, Business Process and Supply Management, FE 4FE02E , Spring 2010

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Title: Managing Finished Goods Inventory at Regional Warehouse in Dalda Foods (Pvt.) Ltd.

Background: Lahore region is one of the nine regions through which Dalda Foods operate with in the whole country. Management of finished goods inventory at regional level consist of downstream relation with agents and upstream relation with factory warehouse. At regional level they manage the finished goods inventory to increase accuracy in the flow of finished goods.

Research questions:

- How does Dalda manage the flow of finished goods inventory at regional level (Lahore region)?
- What are the causes behind the inaccuracy in the flow of finished goods inventory at regional level?
- How can ABC analysis, safety stock and forecasting model be used to improve the accuracy in the flow of finished goods inventory at regional level?

Purpose: The purpose of this thesis is to identify that how Dalda is managing the flow of finished goods inventory as well as the causes behind the inaccuracy in the flow of finished goods inventory at regional level. How these causes can be removed through ABC analysis, safety stock and forecasting technique?

Methodology: This is an exploratory case study. Deductive approach has been used in this thesis. Both qualitative and quantitative research methods have been used. Data collection methods like primary and secondary has also been used in this thesis to collect data.

Conclusion: Currently no any technique of inventory management is being followed properly at regional level for accuracy. There are some causes behind the inaccurate flow of finished goods inventory like not classifying SKUs properly, don’t consideration of safety stock and

unreliable method of forecasting. These causes can be removed by properly using ABC analysis, safety stock and forecasting techniques.

Suggestions on future research: A Distribution Requirement Planning (DRP) system can be implemented by using our study as a base. Moreover a system of collaborative, planning, forecasting and replenishment (CPFR) can also be used for systematic replenishment of inventory.

Key words: ABC analysis, Forecasting, Safety stock, Finished goods inventory, Inventory management,

Paper Type: Master Thesis

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1. INTRODUCTION

It is not sufficient in today's competitive environment by only making the right products and putting them to factory warehouse to win competition. Goods should be available at every point of distribution to deliver the customer when it is needed. Firms need to understand the importance of the smooth flow of finished goods. Current chapter of introduction gives the explanation and background of the research; discuss the problem and then the research question. Purpose and limitations for this thesis are also a part of introduction.

1.1 Background

With the every coming day, firms are trying to build and increase their strong relationship with their partner in supply chain to achieve the effectiveness, flexibility and competitive advantage on their competitors. Every partner tries to strengthen the collaborative relationship by creating the unique values for other partner, which is very difficult for any single partner to create. Thus it is very difficult for single business to succeed without the help of other partner in supply chain (Corsten and Kumar, 2005). The American Production and Inventory Control Society (APICS) define "inventory management as the branch of business management concerned with planning and controlling inventories" (Toomey, 2000).

If we see in simple terms towards inventory management then we will say, it deals with internal issues that how much goods to hold at what time and how usually to reorder. Fulfilling the requirement of the customer is the main purpose of the inventory management (Mercado, 2008). Inventories are common for all business enterprises. Inventory can be classified into different heads. Raw material is that material that comes to factory and used to produce the goods. Work-in-process is the material that is currently in process and at last finished goods inventory. This classification on inventory helps in keeping the eye on the activities of material (Mercado, 2008).

Finished goods are the products, complete to fulfill the customer needs and ready to send to the customer (Mercado, 2008). These finished goods can be forwarded to the distributers, wholesalers, retailers or directly to the customers (David, 1996). Finished goods inventory helps to organizations to get the benefit from the huge production. Firms produce the goods more then their demand and then distribute them according to the order. It also helps organizations to respond quickly when there is a fluctuation in demand (Grant *et al.,* 2006).

Necessary level of inventory can be defined by using different models like safety stock, forecasting and ABC analysis. These models can be used to predict when to order, what the exact demand at every distribution center is, and how much safety stock should be hold. (Nahmias, 2005).

ABC analysis is the most commonly used technique for classifying the different SKUs (Chen *et al.*, 2008). Items that fall in the A Class always have the huge proportion in the total value and the items that fall in the B class always have the low proportion and the items that fall in the C category always have very little proportion in total value (Ramanathan, 2006).

Safety stock protects against uncertainty which may take place from inner process like production lead time or from unknown customer demand (Stadtler, 2008). If the problem is with the delivery of product to the market so it means there is uncertainty with timing and using safety lead time in this situation is more beneficial. If there is uncertainty in the quantity, then using safety stock is more beneficial. (Vollmann *et al.*, 2005).

Different types of simulation models can also be used to forecast the demand from the past data (Vollmann *et al.,* 2005). Correct and accurate forecasting helps in improving inventory management at distribution level. If firms could not forecast then it would be very difficult to know about their future demand at distribution level. Obviously this will leads to shortage of the inventory of finished goods at distribution centers or it will leads to the

excess of the inventory of finished goods at distribution centers (Toomey, 2000).

1.2 The company Presentation

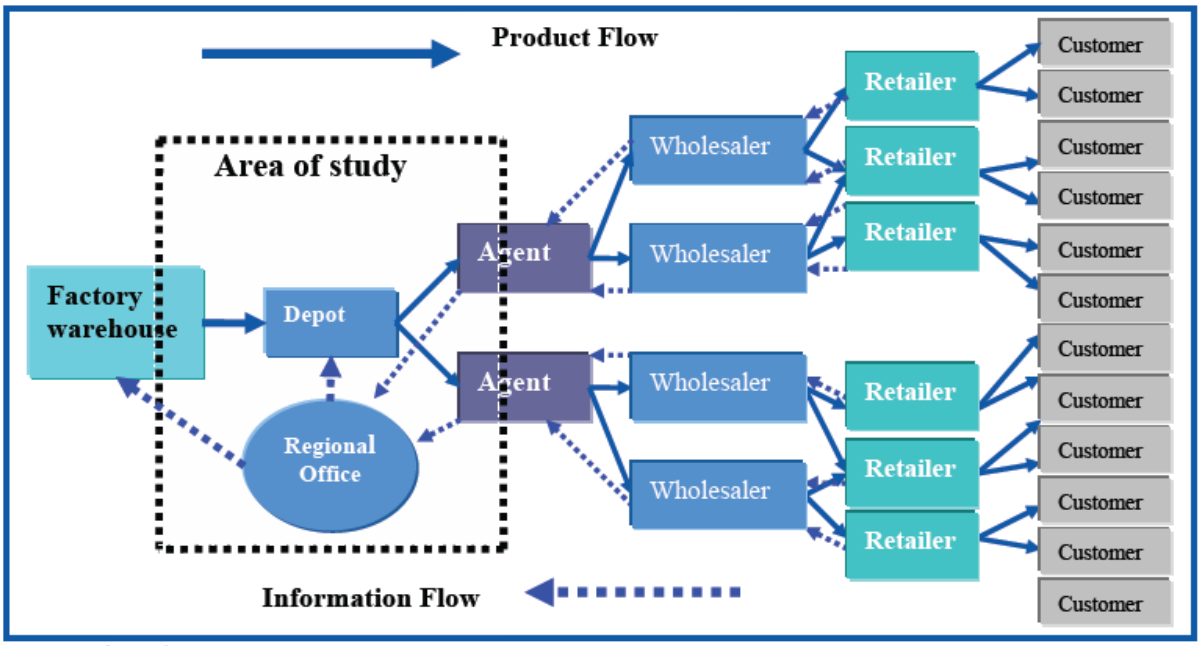
Dalda's story begins in early 1930's when Hindustan Vanaspati Manufacturing Company (today's Hindustan Lever Limited) wanted to start manufacturing Vanaspati locally. At that time hydrogenated vegetable oil was imported in India by a Dutch company, Dada & Co. In 1999 Unilever acquired International Technology to evolve Dalda Banaspati to Dalda VTF, making it the only Virtually Trans-fat Free Bansapati in Pakistan. In July 2004 Unilever Pakistan sold its "Dalda" brand to Westbury Group in collaboration with Unilever Employee Welfare Group, who formed a separate company as Dalda Foods (Private) Ltd.

Now Dalda is the leading brand in edible oil in Pakistan, they are growing remarkably with the growth rate of 25% per year. Their market share is 28% in Pakistani edible oil market. Currently they are exporting to Australia, New Zeeland, Afghanistan and Egypt. They are having 43 SKUs in their portfolio. They are operating two production plants in Pakistan, Karachi and Hyderabad and they are serving the market with 9 depots (regional warehouse) and 470 agents in Pakistan (Adnan, 2010-03-18).

The network of Dalda is expanding in Pakistan day by day. Their flow with all depots (regional warehouses) is also increasing and due to this, the flow of information and finished goods is increasing at regional level (Adnan, 2010-03-18). Today each regional office organizes its downstream flow of information and goods with its agents. At regional level, order is received in advance through a system which is called DBRs (demand based replenishment system) on weekly basis. Then order is delivered to the agent according to the particular requirement. There is also upward flow of information with factory warehouse, sending them the demand of whole region then receiving the inventory. The requirement and planning functions are performed at every regional office. Receiving of goods from factory and

dispatching them to agents, are done at depot (regional level). That is explained below in figure 1.1.

Figure1.1: Main focus of thesis



Source: (Own)

1.3 Problem discussion

Due to an increase in the flow of finished goods, Dalda has problem with the finished goods inventory at depot level (regional warehouse). Some time it happens that agent (who receive the delivery form depot and distribute to the different wholesalers) demands from depot and at that time depot don't have the inventory to fulfill the requirement of the agent. Then the agent waits for several days and after receiving the supply form the factory warehouse at depot, order delivers to the agent (Anwar, 2010-03-26).

Sometime it happens that the agent demands specific SKUs from the depot (regional warehouse), then depot delivers only available or at the time present SKUs instead of required SKUs by the agent. For example if agents demand from depot for 2 ton cooking oil in 5 litter bottle and at that time depot don't have the inventory of 2 ton cooking oil in 5 litter bottle. They have 1.5 ton in 5 litter packing and rest 0.5 ton they sent in 2.5 liter packing to the agent due to the shortage at depot (Anwar, 2010-03-26).

It can be assessed that the main problem is finding the demand accuracy at regional level that may be the reason of the poor finished goods flow of inventory management (Anwar, 2010-03-26). At regional level, the operation manager doesn't know the exact and accurate demand of every agent. That inaccurate demand is forwarded to the factory warehouse. On the basis of that demand, inventory is received at regional level. Lack of accuracy in demand and poor forecasting creates shortage of some of SKUs at depot level (Anwar, 2010-03-26).

This problem in the flow of finished goods inventory at depot level will be improved by using safety stock, forecasting model and ABC analysis. It creates a motivation factor for us, to conduct a research consideration. We think that in this area there is a lot to learn, due to its importance and wide range. The research questions for thesis are given below.

1.4 Research Questions

RQ #1: How does Dalda manage the flow of finished goods inventory at regional level (Lahore region)?

RQ # 2: what are the causes behind the inaccuracy in the flow of finished goods inventory at regional level?

RQ # 3: How can ABC analysis, safety stock and forecasting model be used to improve the accuracy in the flow of finished goods inventory at regional level?

1.5 Purpose

The purpose of the study is to investigate how Dalda is managing the flow of finished goods at regional level. Causes behind the inaccuracy in the flow of finished goods inventory should be identified. An ABC analysis would be used to classify all SKUs according to their importance. Safety stock calculation and forecasting model would be suggested to improve the accuracy in the flow of finished goods inventory.

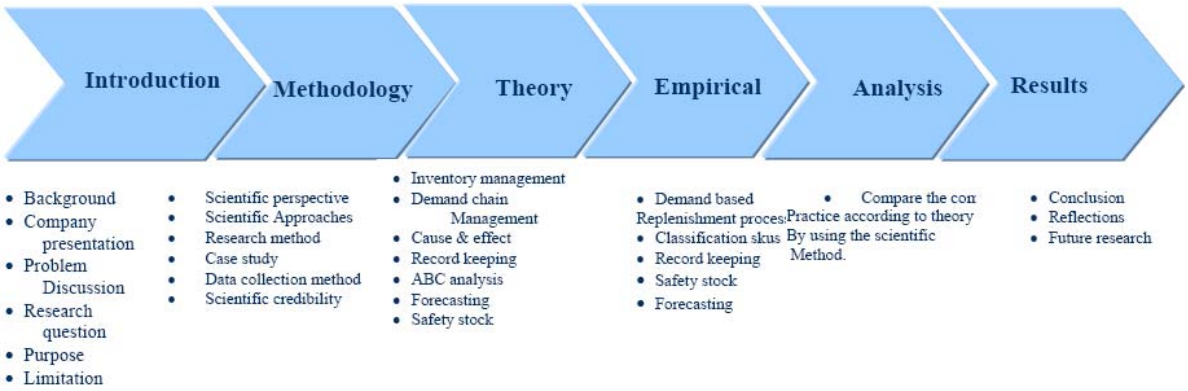
1.6 Limitations of Our research

In this thesis, authors will focus only on managing the accurate flow of finished goods inventory at regional level. Our study will be based only on Lahore region that is one of the nine regions across the country. This study has been conducted within the particular time span given by department of logistic and supply chain management, Linnaeus University.

1.7 Disposition of the thesis

Below given figure is explaining the disposition of the whole thesis.

Figure1.2: Disposition of thesis



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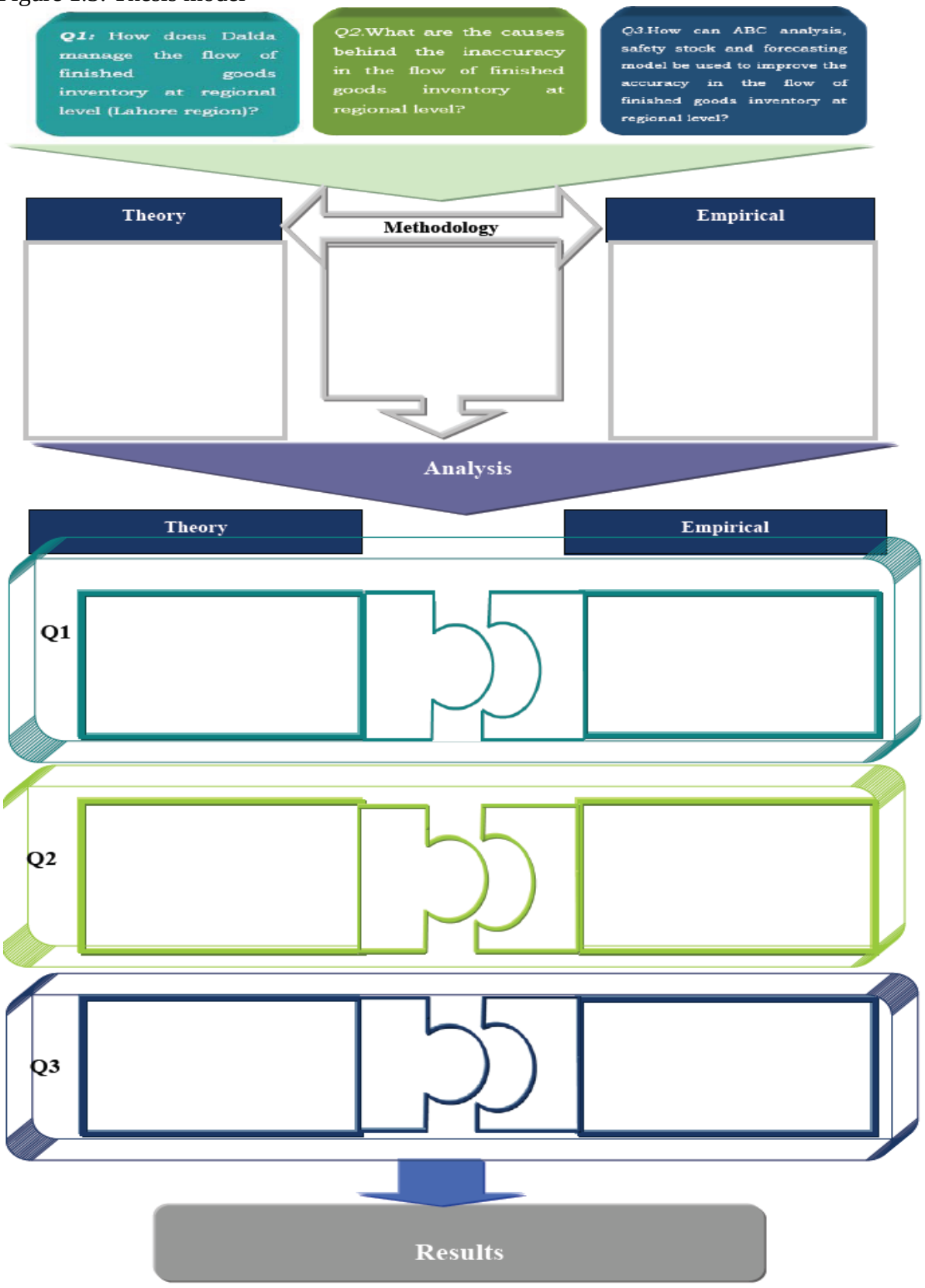
1.8 Thesis model

Figure 1.3: Thesis model



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2. METHODOLOGY

In this chapter we explained that how this study has been conducted. Scientific perspective of this is mainly positivistic. Deductive approach has been used in this case study. Both qualitative and quantitative research methods have been used to carry out in this thesis. Primary and secondary data were collected by using the different data collection methods. At the end, the validity and reliability for the thesis is discussed.

2.1 Scientific perspective

Scientific perspective concerns the matter of what is regarded as acceptable knowledge in a particular discipline. Sometime it is also referred to as epistemological consideration which means that how we know the things. Scientific perspective also measures and seeks with having a good and complete knowledge of theory in such a way that how the researcher relates the theoretical part with empirical part. There are two approaches to measure the scientific perspective i.e. positivistic and hermeneutics (Bryman and Bell, 2007).

Positivistic approach concerns the theory that an idea, thought or concept is valuable only if it can be seen or measured in a real and actual way. In this approach the researcher uses a general theory as an outline and guideline that has been followed through out the research (McNabb, 2002).

Hermeneutics refers to an approach that was basically developed to the understanding or interpretation of text. So it means that in hermeneutics approach researcher will interpret the theory as well as the text with regard to the context. The main idea behind the hermeneutics approach is that the analysis of text and theory must try to find out the meanings of a text from the perspective and context of its authors (Bryman and Bell, 2007).

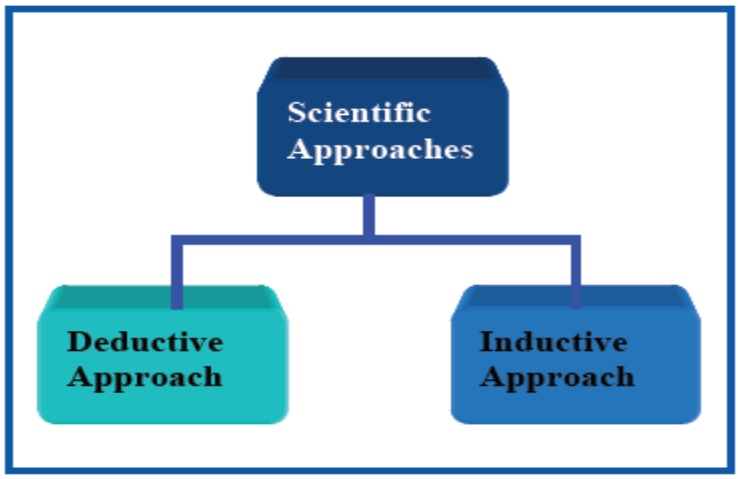
2.1.1 Scientific perspective of this thesis

Positivistic approach has been used in this study. In this we explained general theory such as related to demand based management, improvements in inventory management, ABC analysis, safety sock and forecasting techniques as support to conduct a study. At first information and data related to research were gathered like demand base replenishment (DBR), flow of finished goods inventory management at regional level. Then on the basis of empirical data and theory we have done analysis.

2.2 Scientific Approach

The basic phenomenon of the scientific approach is to find out that how the people work for achieving the goals. This believes encourages to ask the questions. For this purpose, we need to understand how concept of systematic narrates makes a good scientific answer (Steven and Kemp, 2004). In fact, the answer should be addressing the question that a certain method is appropriate to improve the work (Dubois and Gadde, 2002). There are mainly two different scientific approaches, deductive and inductive approaches that are being used for conducting research.

Figure 2.1: Scientific Approach



Source :(Steven & Kemp, 2004)

2.2.1 Deductive approach

Deductive approach is a common observation point between the research and theory. The researcher, deduces the hypothesis, and provides possible solutions that may be one or more to deduct the theory which is recommended in the research (Bryman and Bell, 2007). Conclusion of the existing problem, assumes through the process of pervious experience, perception of researcher and on the basis of existing theory that is called deductive approach, based on the scientific method (Vandenbosch, 2003).

2.2.2 Inductive approach

Inductive approach is a process that starts with specific observation and then filter the data according to the observe situation to formulate some possible hypotheses and finally it end on general conclusion and theories. Inductive approach is more effective and reliable towards the problem solving techniques (Vandenbosch, 2003). Inductive approach is a traditional and untested approach that is suitable area of exploration and investigation, where the notion and perception not give the transparent result under the theory (Hyde, 2000).

2.2.3 Scientific approach of this thesis

In our research, we used the deductive approach. We started with the existing theory which was related to improving the inventory management and demand based management. In this thesis, theory such as forecasting techniques, safety stock and ABC analysis has also been introduced to improve the accuracy and flow of finish goods at regional level. It helps us to conclude and analysis the result of our research question.

2.3 Research method

Research method is the technique that is used to gather the data from the different sources (Bryman and Bell, 2007). The reason to get the information is to use it for problem solving (Ghauri and Gronhaug, 2005). There are tow most common methods of business research one is quantitative research methods and second is qualitative research methods.

2.3.1 Qualitative research

"Qualitative research allows researchers to get at the inner experience of participants, to determine how meanings are formed through and in culture, and to discover rather than test variables" (Corbin and Strauss, 2008). In qualitative research data is collected in natural setting, means researcher have face to face interaction. Data is collected from the field where participants experience the problem. Data can be collected in the form of interviews, observations, and documents (Creswell, 2009).

2.3.2 Quantitative Research

Quantitative research is a resource for testing the theories, by investigating the relationship between different variables. Research is able to quantify in numbers. Different statistical procedures are used to analyze the data, which decide whether the theory is true or falls. This method builds protections against business and improves the credibility of the quantitative research (Creswell, 2009).

Table: 2.1 Quantitative and Qualitative Method

Quantitative Methods	Qualitative Methods
• Critical and logical approach • Statistical analysis and interpretation • Importance to verification • Result oriented • Reasons of the social events are focus	• Text and image analysis • Process oriented • Importance to understanding • Rational approach • Focus on the understanding from the poi of view of person who is replying

Source: (Ghauri, Gronhaug, 2005 & Creswell 2009)

2.3.3 Research method for this thesis

In this thesis both quantitative and qualitative research methods has been used to collect quantitative data like safety stock level requirement of every agent at regional level. This data has been used to identify the shortage of the required SKUs and also to identify the safety stock of every SKU and for making forecasting. It will help us to increase the accuracy in flow of finished goods at regional level. In order to the deeper knowledge in our area of study qualitative research method had also been used. For example information about, how at depot level they receive the demand from every agent and sent to factory warehouse and how they combine the demand of all agents.

2.4 Case study

A case study is a research methodology that is very commonly used in most of the fields of the social science (Shepard and Greene, 2003). To explore reasons in order to discover core objects, a case study is usually based on in-depth and through investigation of individual, group or an event (Robert, 2009). Case study method involves an in-depth and comprehensively examination of a single instance or event. It enables the researcher to provide an efficient way of looking at events, collecting data, analyzing information and reporting the results. As a result the researcher get a sharpened and quick understanding of why the instance happened and what might become important to look at more widely in future research. Generating and testing hypotheses are also provided by the case studies to the researcher (Flyvbjerg, 2006).

A case study is generally done to formulate hypothesis, develop theories, test theories and illustrating theories. It is common to use case studies when trying to get an understanding on a deep and bottom level and in the context that the event is really happening (Lundahl and Connections, 1999).

There are four types of case studies like descriptive or illustrative, exploratory, cumulative and critical case studies. Exploratory case studies are condensed case studies in which, fieldwork and data collection are undertaken earlier to the final definition of study questions and hypotheses. Their basic function is to help and identify questions and select types of measurement and initiative prior to the main investigation (Yin, 2003).

2.4.1 Case study of this thesis

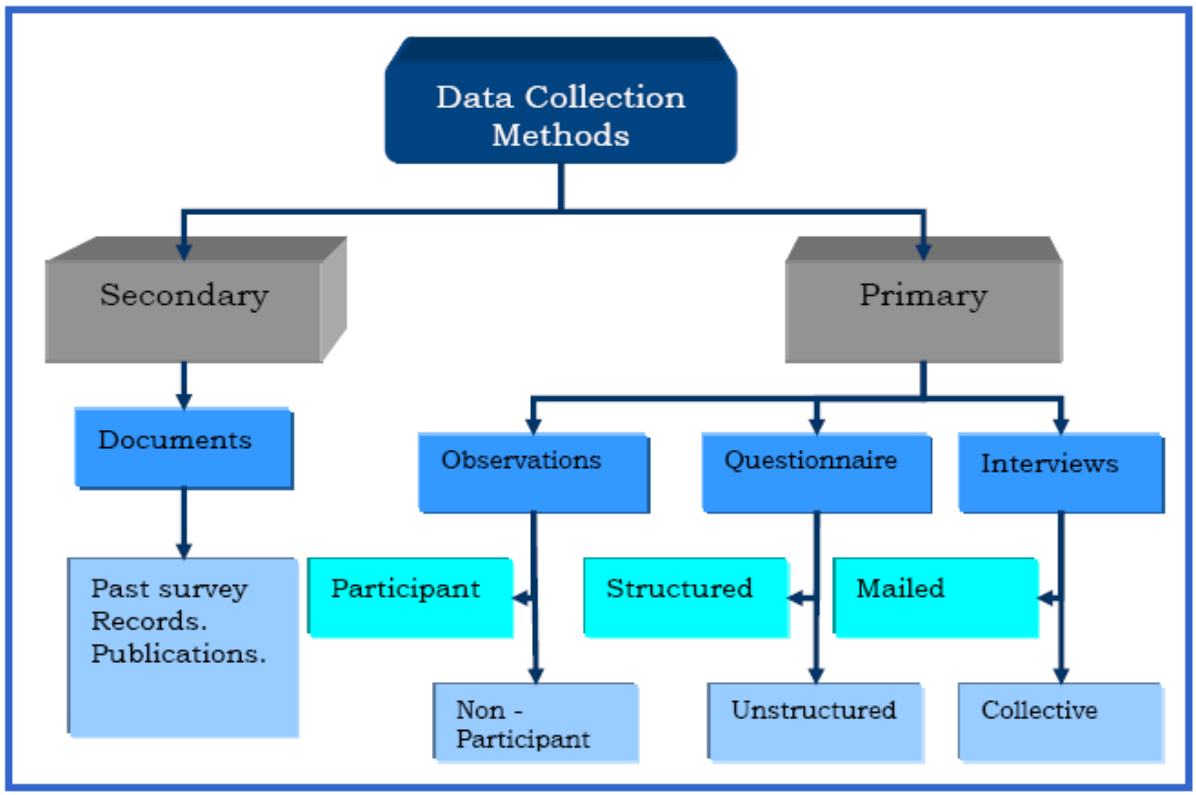
The research questions of our thesis elaborate and describe the management and flow of finished goods inventory at regional level to identify the causes behind the inaccuracy in the flow of finished goods inventory. Our thesis is based on exploratory case study shows how safety stock, forecasting techniques and ABC analysis can improve the accuracy in the flow of finished goods inventory.

We have used these techniques after studying the complete structure of the distribution requirement at regional level and then we took some measurements and techniques to conduct the research. Our study is based on Lahore region that is amongst the nine regions across the country. Moreover we have gathered the data and information about distribution schedule, demand base replenishment, SKUs and demand & supply. So in this way we tried to elaborate and present the solution after studying the concepts in depth.

2.5 Data collection method

The type and quantity of data to be collected depends upon the nature of the study together with its research objective (Hair *et al.*, 2003). There are different data collection methods that are being used in the research, interpretation. The role of researcher set the stage for discussion of issues involved in collecting data (Creswell, 2009). Researcher selects the suitable data collection method according to study limitation. These are describing bellow.

Figure 2.2: Data Collection Methods



Sorce: (Kumar, 2005)

2.5.1 Primary

Primary source provides the first hand information to the researcher. There are many techniques that can be used to collect the primary data. The choice of techniques depends upon the purpose of the study (Kumar, 2005). Telephonic surveys, computer dialogue, mail intercepts, fax survey and face to face interviews are the primary data collection method (Hair *et al.*, 2003).

a) Interview

The Interview data collection is commonly used method of data collection. This method can be used in different ways for conducting interview for data collection. There is some flexibility in collecting data as compare to other data collection method for research purposes (Crouch and Housden, 2003) In interview the researcher has an advantage to answer the question of the respondents inquiry this will be make easier to conduct the study (Kumar,2005).

b) Questionnaire

Questionnaire is a written form of enquiry from the researcher against problems and issues in the study or research. Questionnaires keep the record of the answer of the respondent. In this procedure the respondent red carefully and deduce the question from researcher and note down the answers of these questions (Kumar, 2005).

c) Observation

Observation data collection method describes that data collected by the systematically recording the observation of the people, event and things. Human, mechanical and electronic can be the source of data observation (Hair *et al.*, 2003). There are different approaches and techniques of using observation to collect data. Direct observation involves watching, listening and indirect observing consisting on behaviour of subject, analysis of internal organization or observes something in written report by other (Crowther and Lancaster, 2008).

2.5.2 Secondary

Secondary data collection techniques consists on the company records, evaluating studies published by external sources and examining the physical sketch such as destruction and growth(Smith and Albaum, 2005).Secondary data already exist within the organization or outside the organization via e-mail, internet, fax or past surveys and reports. The time to access secondary data is relatively short and may not be problem specific (Wegner, 2007).

2.5.3 Data collection in this thesis

Regarding the research of this thesis it has been decisive to solve bottomless case study at regional level by conducting the telephonic interviews and sending questionnaire via e-mail to responsible persons at Lahore region, detail is given in table 2.2. We have used primary and secondary source of data collection methods in our thesis, primary source include company

database and annual reports, telephonic interview as well as questionnaire. Secondary source like university library books related research article, different journals, World Wide Web sites, Google books, has also been used to collect the data. We usually sent our questions about the data in advance to the company for their better understanding; afterwards we were conducted telephonic interviews.

Table 2.2: Overview of interview at Dalda

Name	Position	Type of interview
Kabir Anwar	Operations Manager	Telephonic/ E-mail questionnaire 2010-03-18 to 2010-5-5
Adnan Rashid	Sales Executive	Telephonic/ E-mail questionnaire 2010-03-18 to 2010-5-5
Muhammad Rubbani	Director Sales & Distribution	Telephonic/ E-mail questionnaire 2010-03-18 to 2010-4-20

Source: (Own)

2.6 Scientific credibility

2.6.1 Validity

In research major importance is given to the validity of the procedures. Validity can be defined in different ways; very basic refers to the method that is used in research, how sound or authentic it is or it talks about the reality of the data. Asking different types of open questions helps in increasing the validity (Graziano and Raulin, 2007). The validity is the ability of a tool to measure in the term of what is design to measure. According to definition of different authors validity is scale of the measure which is set by the researcher to measures. Validity is determines whether the research actually measures that which it was proposed to measure or how truthful the research results are (Kumar, 2005). There is no ambiguity to say that validity is important principle of the research. Validity is apprehensive with the honesty of the result and finding that are generated from a part of

research. There are different type of the validity of research here we should be aware from these type like measurement validity, internal validity, external validity and ecological validity (Bryman and Bell, 2007).

2.6.1a Validity in this thesis

Authors have been in contact with the different responsible person in the company to keep the study on track. To collect the relevant and valid data from the company through telephonic and e-mail, responsible resource persons have been contacted. It was not possible for authors to personally visit the company office due to geographical difference. These resource persons were having the complete knowledge of the area of our study and they also provided us the valid information.

2.6.2 Reliability

Scale of regularity and stability of the application of the study schedule in excess of time is called the reliability. Aptitude of people often performs and behaves in different ways on different time and situation (Bryman and Bell, 2007). It means achieving the constant result from measuring; it doesn't mater that does it, if a study gives the same results when it is used to measure the same object, under the same procedures. And some time if the result is exact in new study that may be done by any one, as it was in the previous study then it will be called the high reliable scale (Graziano and Raulin, 2007).

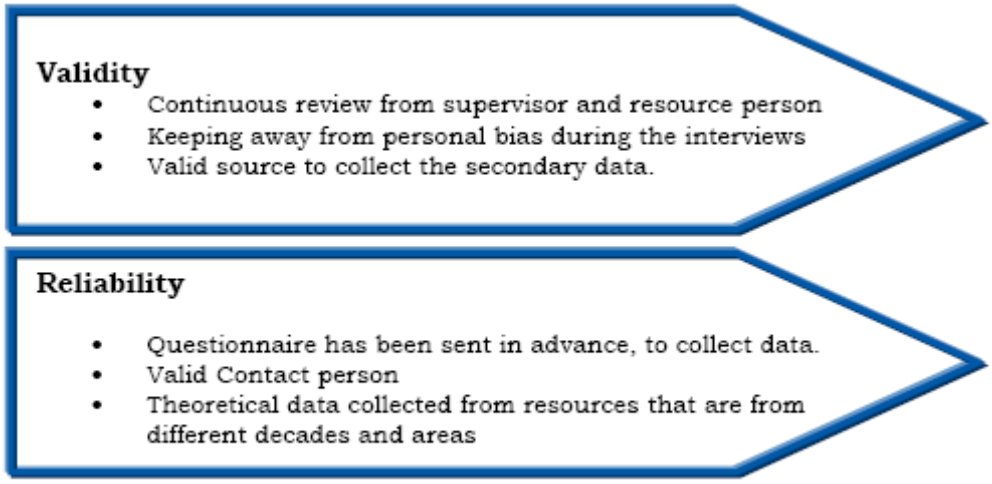
Reliability is a perception is easy to take hold of and however difficult to define, in general we call unreliable when we can not depend upon on it. There are many way to increase the reliability through the improvement of the research independency of the research (Aken *et al.*, 2007)

2.6.2a Reliability in this thesis

To ensure the reliability we have given proper attention on collecting the empirical data from the company resource person. We have received the answers of our questions in written form from two to three persons and then

we have compared them to check the reliability. To increase the reliability in the theoretical data we used the different authors from different continents.

Figure 2.3: Summary of Scientific credibility



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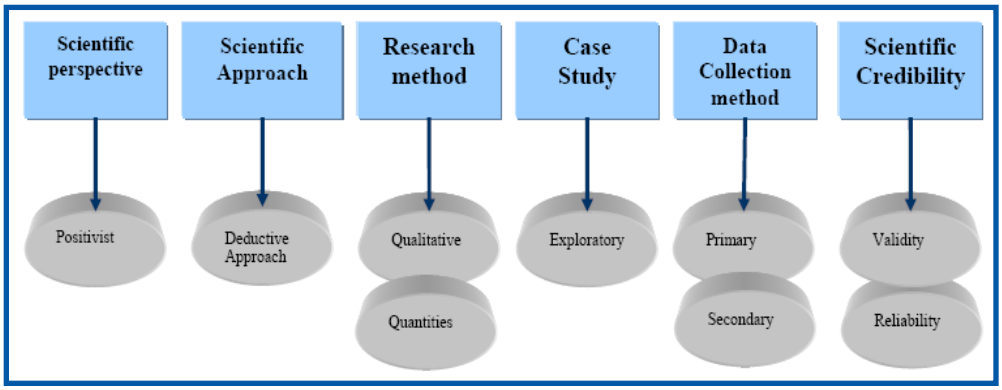
2.7 Summary of methodology

Below given figure is presenting the short summary of selection of methods which we have made for our thesis.

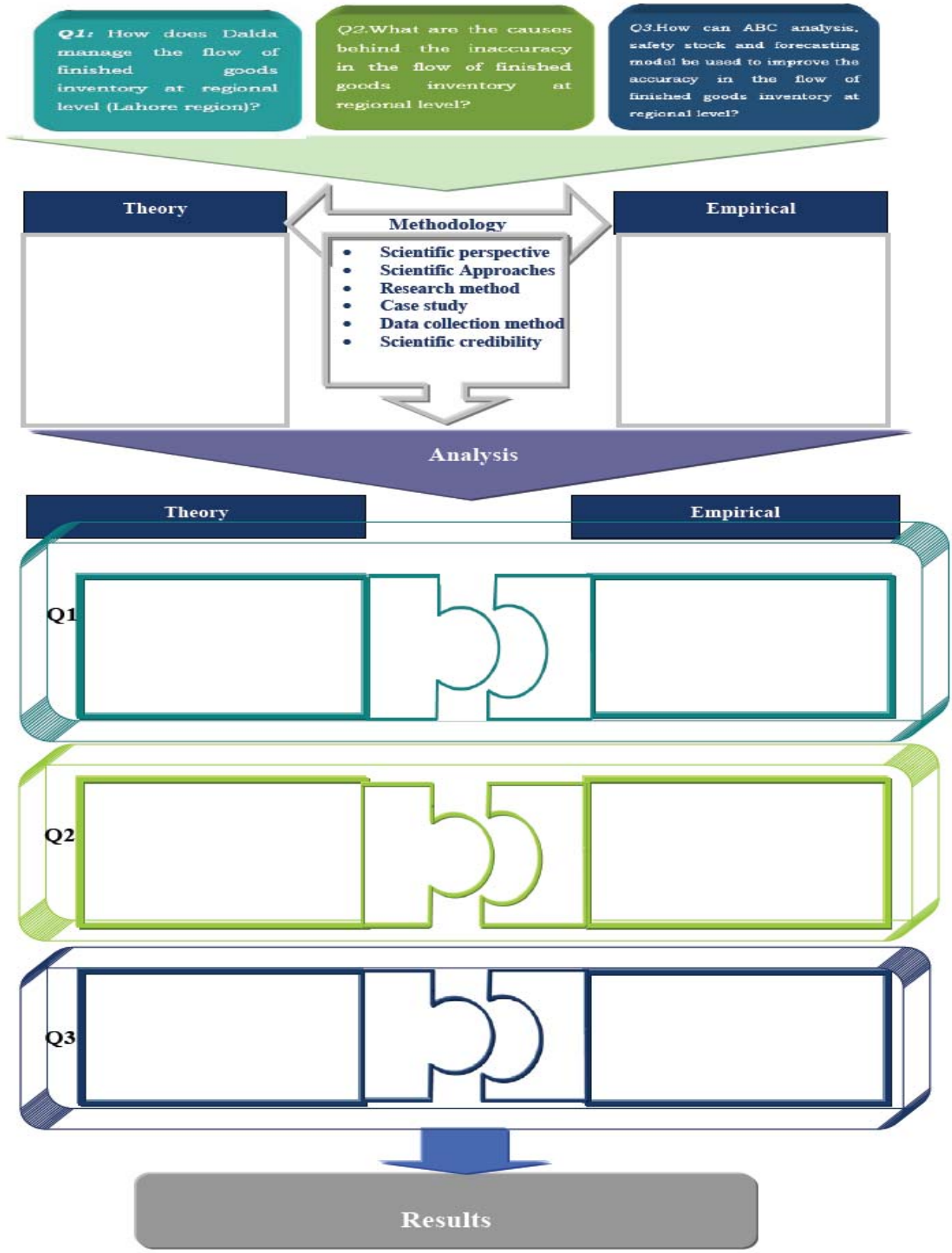
Figure 2.4: Summary of methodology chapter



Source: (Own)

2.8 Thesis model

Figure 2.5: Thesis Model (chapter 2)



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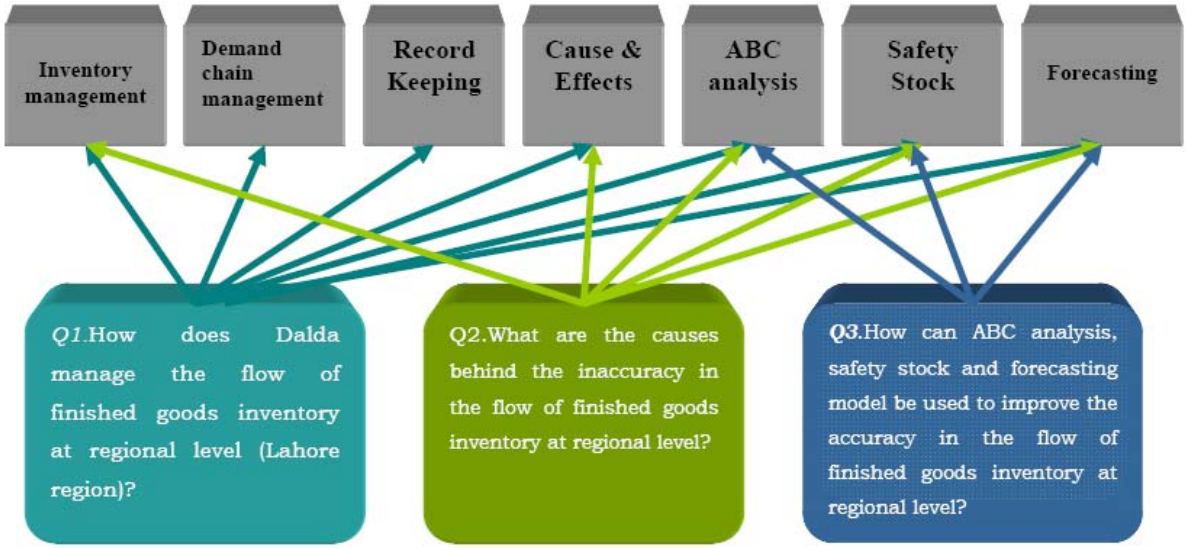
3. THEORY

The theory chapter will give the description of the inventory management, symptoms of poor inventory management, how to improve the flow of finished goods inventory management, demand based management. Explanation of ABC Analysis to classify the SKUs into different classes is also given. How to calculate the safety stock and forecasting is also the part of the theory chapter.

Following figure 3.1 describes all the theoretical framework regarding this thesis that also explains how each research question is related to the theory.

Figure3.1: Frame work of theory



Source: (Own)

3.1 Inventory management

It is the vital point to start our discussion and learn supply chain to understand the basic principle and concepts of inventory management (Robert, 2009). Every organization maintain inventory to run their operations, Inventory can be consist of raw material, work in process, supplies used in operations and finished goods (Muller, 2003).

Although, at the different level inventory perform multiple functions, but the most important and basic function of the inventory is to serving to customer (Toomey, 2003).

Organizations treat inventory as an activity which insure the availability of the items and products to the customer needs, on the other hand to co-ordinate the upstream and down stream function to meet the market demand. Inventory also enables the company to support customer service and distribution function in uncertainty, when purchasing and manufacturing of the items are not able to satisfy the demand (Wild, 2002).

When the customer service is used, it must clicks in our mind and thought comes as customer viewpoint and considers these causes like the availability of the product in the right quantity, at right time at right place (Toomey, 2003). Inventory must be held at the central distribution center in a certain level which is help full to achieve the company core objectives (Mentzer, 2004). Effectiveness of the inventory management is easy to access and calculate, normally inventory management assess through reviewing the ordering history of the each and every item (Wild, 2002).

3.1.1 Types of Inventory

There are primary categories of the inventory that fall in to general like raw material, finished goods and work in process inventory. Furthermore, inventory can be differentiating by its purpose to use (Muller, 2003).Because our area of study is related to the flow of finished goods inventory that's why we will discuss only finished goods inventory.

Finishes goods inventory includes completed product waiting to be sold to the customer, finished goods item are for sale while manufacturing companies tend to have less finished goods and more raw material and work in process (Muller, 2003). After manufacturing the goods, customer service handles issue concerning the movement of product out of finished goods inventory. Central planning ensure that sufficient finished goods are

available to meet incoming order from the customer (Simchi-Levi, 2003). Distribution centers must keep enough stock of finished goods inventory on hand to satisfy its daily demand (An and Fromm, 2005).The distributor is responsible for managing finished goods inventory at distribution centre. Even company manufacture the goods but the distributor could be a main partner in timely delivery of finished goods. (Manoj *et al.*, 2008).

3.1.2 Symptoms of Poor inventory Management

It is better, first to identify what which factors are creating the problem or hurdles in managing the inventory properly, and then it will be easy to identify where the opportunity exist for improvements. Fallowing are the some feature of poor inventory management. (Grant *et al.*, 2006).

- Increase in number of back-orders, point out that stock is low
- Low customer order fulfilment rate
- Huge number of order cancelled
- High quantity of obsolete items.
- Large variation in turnover of major items (Grant *et al.*, 2006).

3.1.3 Improving Inventory Management

In order to improve inventory management, company should be synchronization between the customer's demand and quantity of inventory (Mercado, 2008). Inventory in stock is a general business practice to protect against risk of unfulfilled customer demand. Now a days firms often find that holding inventory is costly so they try to push inventory on to someone else in the supply chain. But on the other hand companies hold the inventory to fulfill the uncertain demand in the shape of finished goods inventory (Chandra and Kumar, 2000). Inventory management can be improved by using the different skill like ABC analysis, Forecasting and safety stock (Grant *et al.*, 2006).

Aim of Inventory management should like that

- To attach the all joints in the distribution network.
- Correct and on time Information regarding the demand and supply at every point is better sign to reduce unnecessary stock of inventory in the network.
- In the distribution network the successful managing or having the superior "control of the flow of inventory is the proper focus of the inventory management not the management of the inventory at each location in the network" (Ross, 2000).
- To ensure the accuracy of the inventory during the distribution function of the finished goods.
- To make sure the target inventory according to customer demand, what service level should be achieved and how much the safety stock kept at floor?
- Accuracy in flow of finished goods is also seeks the replenishment of the inventory and optimal customer satisfaction (Ross, 2000).

By fulfilling the above stated aims of inventory management, these aims become the cause behind the accuracy in the flow of finished goods inventory otherwise it originates and become the causes that leads towards the inaccuracy in the flow of finished goods inventory and ultimately it will create some hurdles and problems in the flow of finished goods (Ross, 2000)

3.2 Cause-and-effect relationship

Cause-and-effect relationship refers to identify the problems. This relationship helps to determine why something happens as the result of something else happened and what are the reasons and causes behind the whole situation. In simple words it may also be stated that a relation ship between one variable and another in such a way if change in one variable also affects a change in other (Kerzner, 2009).

Cause-and-effect relationship also measures and identifies the causes and sub causes that effect the main problem. A significant quantity of analysis is often required to determine the specific and particular causes of the main bone of problem. A tool named as cause-and-effect diagram is usually used to identify possible causes of a specific problem (Kerzner, 2009).

3.2.1 Cause-and-effect or Ishikawa Diagram

When a problem has been recognized it is very important to understand from where the problem invent. A systematical and logical way of sorting out the problem can be used to identify the problem. The cause-and-effect diagram is used to discover the problem. This type of diagram is also called “Ishikawa diagram” because it was invented by Kaoru Ishikawa and also called “fishbone” diagram because of the way it looks. It graphically demonstrates the relationship between a given outcome and all other factors that can influence the outcome (Fredendall, 2001).

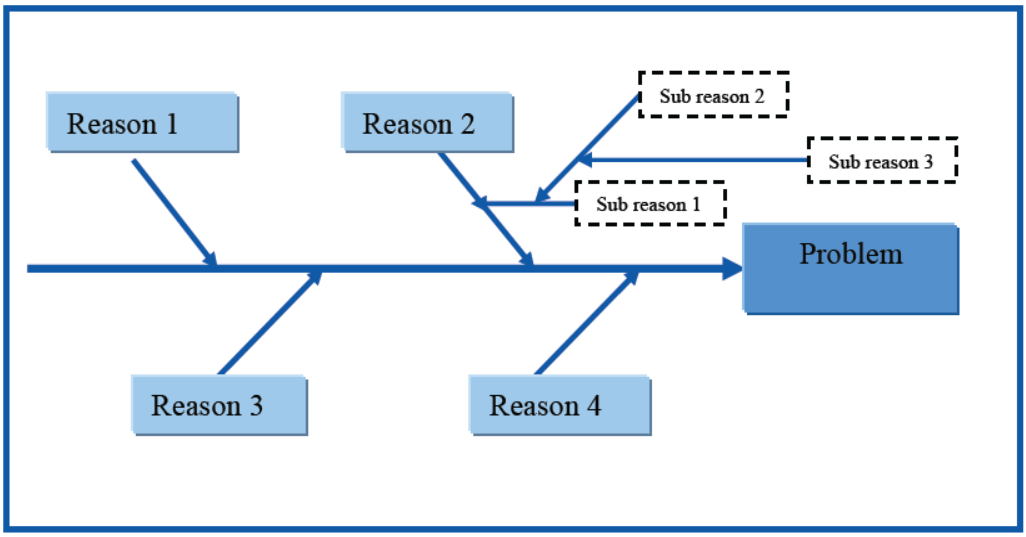
Cause-and-effect diagram is similar to a fish frame, with a problem placed at the head of the spine on the right hand side. Each bone of the fish frame represents an input of the process that is the dependable for the main problem. Fish bone diagram sensibly organizes inputs and allows the researcher for in-depth analysis of the problem (Gardner, 2004).

A cause-and-effect diagram is utilized to communicate the maximum possible causes to every one. It may be also possible to get the important ideas as many people as possible because every person has its unique counter thinking. In this way more people can be involved to solve the particular problem. The structure of the diagram helps team members to solve a problem in a systematic way (Fredendall, 2001).

While developing cause-and-effect diagram, following steps should be kept in mind: identify and clearly define the outcome or effect, identify the main causes that contributes to the effect those are the major reasons, for each major reasons identify other specific factors which may also be the causes of

the effect, identify increasingly more detailed levels of causes and continue to organizing them and at the end analyze the diagram for further investigation (www.balancedscorecard.org).

Figure 3.2: Structure of cause and effect diagram



Source:(Fredendall, 2001)

3.3 Demand chain management

Demand chain management refers to "the alignment of demand creation and demand fulfilment processes across functional, organizational and inter-organizational boundaries." Thus the process of demand creation consist and cover all the activities that considered to be necessary and important for creating demand and are closely related to marketing. Demand fulfilment process consists of all those activities that considered necessary to fulfil the demand and also closely related to supply chain management (Hilleton *et al.,* 2009).

A framework of demand change management may also be created on the basis of the three inter related elements: market, marketing and supply chain management. Marketing elements focus on demand creation towards market and SCM elements focus on demand fulfilment towards market. It is also very important that these elements of marketing and SCM are

coordinated through effective collaboration. The goal of DCM is to synchronize the demand creation and demand fulfilment process to gain competitive advantage by segregation delivery process as well as to develop synergy between marketing and supply chain management (Hilleton *et al.*, 2009).

DCM plays a very vital role in managing the supply chain activities among the firms. It also helps to integrate supply and demand management activities (Lee, 2001). However, this kind of fully developed DCM approach doesn't most likely exist today but some companies are on track to develop versions including their major processes (Hilleton *et al.*, 2009).

3.4 Record keeping

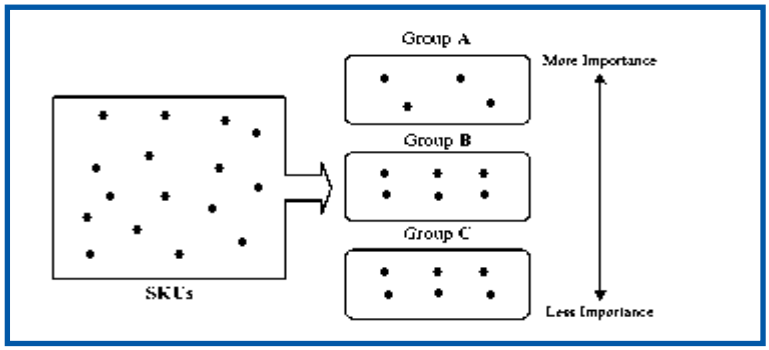
Every business should be able to respond rapidly according to dramatically changing conditions and expectations along a wide range of activities. A records and information programme provide a support to the organizations through out the whole life from conceptualization to operations. A business may also required timely access to records that has been created previously. Records and information management activities should also be closely synchronized along other activities of the organization (Shampson, 2002).

Record management concerns the management and collection of data in a well organized way which can be accessed latterly in a logical order. It also includes the interpretation and storage of information that are of primary importance. It includes containing of all the data that is needed by the organization as well as employees to take some decisions (Sumathi and Esakkirajan, 2007).

3.5 ABC Analysis in Inventory Management

ABC Analysis is an inventory management technique that is broadly used in categorizing the SKUs in different groups and ranks according to their importance in inventory management system. SKUs that are most important are ranked in group A and these are required huge attention from the management, the SKUs that are at least significance are fall into group C, and others belong to group B (Chen *et al.*, 2008).

Figure 3.3: An illustration of ABC analysis



Source: (Chen et al., 2008)

Every organization has many stock-keeping units (SKUs), the number can be easily reached to thousands. It seems very difficult to make separate policy for managing every SKU. Because some SKUs plays very key role and required huge attention. It is better that at first all SKUs should be divided in different groups and then every group could have different management policy. ABC analysis can be use to divide the SKUs in different groups. The classical ABC analysis is derived from the Italian economist Pareto, s famous study of the distribution of the national income in Italy, that about 80% wealth was owned by the 20% population (Chen *et al.*, 2008).

3.5.1 Single-criterion ABC Analysis

Single-criterion ABC analysis stands on one measurement that is based on annual dollar usage of SKUs. An ABC analysis provides the tools to classify the items that can have the large positive and negative impact on the

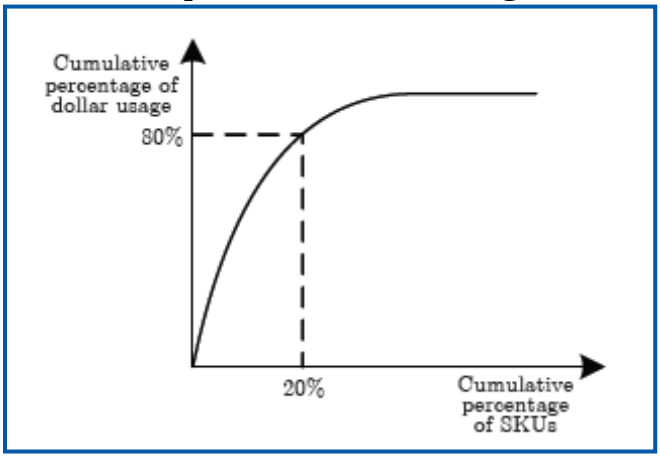
performance of the firm. A careful analysis of the order quantity and timing decision of A class items will force the management to improve the inventory management that is also similar for B and C. ABC analysis helps the management attention to focus on what is really important for them.
(Vollmann *et al.*, 2005).

Procedure for ABC analysis

Fallowing is the common process for conducting ABC analysis.

- First choose the criteria for classifying the SKUs, like annual dollar usage most widely used criteria.
- Second gathered the necessary information and calculate the annual dollar usage for each SKU.
- Third, organize all SKUs in to descending order of annual dollar usage.
- Fourth, calculate the cumulative percentage of SKUs and also corresponding cumulative percentage of annual dollar usage as shown in below figure 3.4

Figure 3.4: Example of the Dollar usage Distribution Curve



Source (Chen et al., 2008)

- Fifth, determine the door step of classification for every group and organize SKUs in to different groups according to predefined rules (Chen *et al.*, 2008).

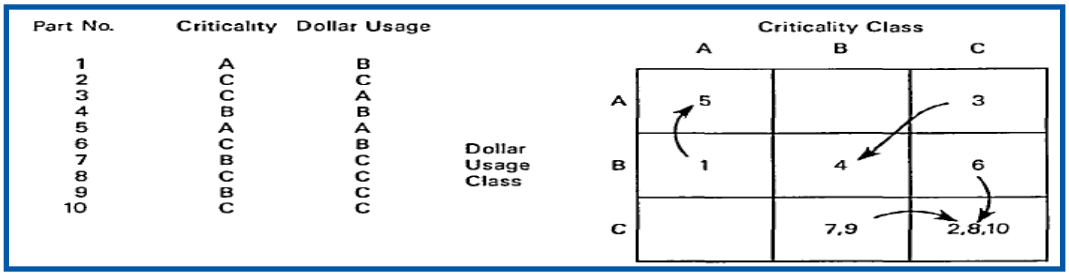
3.5.2 Multiple Criteria ABC analysis

For inventory classification, it is proved that an only dollar usage criterion is not sufficient to get the maximum benefits from this technique. There are many non-cost criteria's that are equally important in inventory management (Vollmann *et al.*, 2005). Such as lead time, inventory cost, scarcity, durability, order requirement, stock-ability, demand distribution. These criteria's are also important in inventory classification (Lung, 2006). Many approaches have been anticipated to carry the multiple criteria classification of SKUs (Chen *et al.*, 2008).

Joint criteria matrix

Flores and whybark's bi-criteria matrix approach was the first effort in multiple criteria classification (Chen *et al.*, 2008). In joint criteria matrix to classify the inventory, two criteria's are selected like dollar usage and criticality. First the items are classified in A, B and C category by using the selected measures (Benito and Whybark, 1985). And then model reclassify them in to three categories, AA, BB and CC, under the rules that is jointly determine by the dollar usage and new criterion. (Chen *et al.*, 2008) and then matrix given below is showing the both dimension and number of every cell, that are matching the both criteria.

Figure 3.5: Joint matrix



Source (Benito & Whybark, 1985)

Simple weighted linear optimization model

Lung, W. (2006) proposes a simple weighted linear optimization model to handle the multiple criteria inventory classification (MCIC) problem. Model initially transformed the measures to comparable base in a scale of 0-1. *i* is for items that are to be classified based on the criteria and criteria is defined as *j*. Measurement of the *i*th item under the *j*th criteria is denoted as y *ij*. Multiple measures would be converted to single score of an item. Fallowing is the model for transformation (Lung, 2006).

$$\frac{y_{ij} - \min_{i=1,2,\ldots,I}\{y_{ij}\}}{\max_{i=1,2,\ldots,I}\{y_{ij}\} - \min_{i=1,2,\ldots,I}\{y_{ij}\}}$$

Now after the transformation, multiple criteria inventory classification procedure, fallowing four steps are used to group the items in ABC classification.

- By using, I/j ∑ j k=1 Xik, j = 1,2,.....,j. to calculate the partial average.
- Then compare and locate the maximum amount among these partial averages, score of *s i* of the *ith* item.
- Then sort the s*i, s* in the descending order.
- At last group the items by the principle of ABC analysis.

Whole process is easy to implement on a common spreadsheet and decision makers can easily handle it without any special guidance (Lung, 2006).

3.6 Safety stock

Safety stock is important inventory technique and it provide the protection against uncertainty while it takes place from the internal process like production lead time and develop the synchronization among the unknown

customer demand and uncertain supplier lead time (Stadtler, 2008). Without keeping the safety stock, customer service suffers. Other reason to maintain the safety stock includes providing a safeguard against issues such as poor quality, production problem, transportation problem and avoid from losing sales. Safety stock is also important for customer retention. Sometime it also refers to as buffer stock (Mangan, 2008). It is not possible for a firm to carry inventory to fulfil all possible level of demand for every SKU. Companies expect higher customer service level and its parallel, the cost of inventory stock will be high. Safety stock can be determined by the several methods that shows how much inventory should be sufficient to fulfil the customer demand (Ross, 2004).

When a particular supply chain is facing demand uncertainties, stock outs can occur at all stages in the supply chain. A stock out may cause lost of sales, emergency shipments or loss of goodwill. Therefore, safety stock should be kept to increase the service level. Traditionally, safety stock is determined in advance based on models from inventory theories (Silver *et al.*, 1998).Safety stock level is an increasing function of the target service level, which we measure by the fill rate that is the long-run fraction of demand satisfied routinely from the shelf (Silver *et al.*, 1998). Based on the stored backorder quantities and the target service levels, safety stock levels can be determined. (Boulaksil *et al.*, 2009)

3.6.1 Safety stock calculation

In calculating safety stock levels it is necessary to consider the joint impact of demand and replenishment cycle variability. It can be accomplished by gathering statically valid samples of data on recent sales volume replenishment cycle and on hand inventory or buffer stock (Stock and Lambert, 2001).

To calculate the safety stock

- Determine the normal distribution demand and calculate mean on the base of that demand to determine the mean deviation from the history of demand.

- Next to calculate the Mean Absolute Deviation (MAD), divide absolute deviation by the numbers of period.

- Then multiplying the MAD with the value from the given below table 3.1 (that is the standard table) according to the desire service level that will be the value of safety stock (Ross, 2004).
-

The term desired service level that has been explained above concerns the situation at what extent the company wants to fulfil the demand of it customers. Generally when it is said that our service level would be 99%, it means 99% demand will be fulfil when it will occurs. It does not mean that 99% orders will be fulfilled during cycle. We can also say that in this way every order up to 99% would be fulfilled. It means that not out of hundred percent orders will be fulfilled during cycle (Nahmias, 2005). Most commonly used values of service level or stock out are given in below table 3.1

Table 3.1: Table of safety stock factor

service Level (w/o Stock out)	standard Deviation	Mean Absolute Deviation
50%	0.00	0.00
75%	0.67	0.84
80%	0.84	1.05
84.13%	1.00	1.25
85%	1.04	1.30
89.44%	1.25	1.56
90%	1.28	1.60
93.32%	1.50	1.88
94%	1.56	1.95
95%	1.65	2.06
96%	1.75	2.19
97%	1.88	2.35
98%	2.05	2.56
99%	2.33	2.91
99.5%	2.57	3.20
99.6%	2.65	3.31
99.7%	2.75	3.44
99.8%	2.88	3.60
99.9%	3.09	3.85
99.93%	3.20	4.00
99.99%	4.00	5.00

Source: (Ross, 2004)

3.7 Forecasting

Forecasting is required and essential in each and every decision that a manager takes. The managers can take appropriate, suitable and right decisions only if they have an idea of what will happen in future about the demand and consumption pattern of the goods. The top management also needs and takes some initiatives to assess the effects of its present decisions on the future so that the right decisions are made today to create a desired and favourable condition tomorrow. With the help of forecasting the companies can improve the quality of decisions concerning production procurement sale and demand. Definitely some amount can be minimized and thus the amount tied up in inventories can be reduced and causes avoid running of stock out, increase sales and improve profits (Ailawadi and Singh, 2005).

We have to keep in mind that a perfect forecast is usually impossible. Many forecasts in the business environment can not be predicted with certainty and surety. Therefore, instead of search and looking for the perfect forecast, it is more important and necessary to establish the practice of continual review and re-examine of forecasting technique (Jacobs *et al.,* 2009).

3.7.1 Approaches of forecasting

Broadly there are two approaches of forecasting (Ailawadi and Singh, 2005).

a) Top down approach

The top down approach of forecasting put down their views of the likely increase or decrease in overall sales volume. Under this approach stock of SKUs are allocated to each individual store according to the historical forecasting that is done by the top level management at the head office. This approach is helpful and useful where there are few variations and the expert personnel to make the forecast is placed in head office (Roland and Bee, 1999).

b) Bottom up approach

In the bottom up approach, managers at the lowest hierarchical level are asked to make a judgment and findings. This approach is decentralized since each and every personnel is developing forecasts individually and independently. This approach is more accurate because lower level manager knows better about his or her surroundings as compare to others. It also requires more detailed record keeping because each and every individual has his own values of forecasting (Roland and Bee, 1999).

3.7. 2 Types of forecasting

On the basis of above discussion about forecasting, forecasting can be classified into four basic types; qualitative, quantitative or time series analysis, causal relationships and simulation (Jacobs *et al.,* 2009).

3.7.2.1 Qualitative techniques of forecasting

Qualitative techniques are subjective or judgmental and are based on estimates and opinions (Jacobs *et al.,* 2009). Following are some of the types of qualitative techniques:

a) Grass roots

Grass roots forecasting builds the forecast by adding sequentially previous figure of forecasting from the bottom. It is supposed to that the person closest to the customer or end consumer of the product knows its future needs best relatively to others. Although it is not always true but in many cases it is a valid supposition of forecasting (Chase *et al.,* 2006).

b) Panel consensus

This technique refers to the method that penal of people from a variety of positions can develop a more reliable forecast than a narrower and lower level group. It is developed through open meetings with free exchange of ideas from all levels of management and individuals. The difficulty with this problem is that lower level employees are eliminated by higher level management (Chase *et al.*, 2006).

c) Delphi method

Delphi is a widely used forecasting technique for incorporating the knowledge of experts and professionals. It is essentially a method for achieving a structured interaction between carefully selected experts by means of questionnaire with controlled feed back. The aim is to avoid the weaknesses of the traditionally used techniques (Twiss, 1992).

3.7.2.2 Quantitative forecasting

Quantitative forecasting model try to predict the future based on past data. Terms such as short term, medium term and long term are used to refer forecasting in which context is being used. “Selection of forecasting model based on the following points: time horizon to forecast, data availability,

accuracy required, size of forecasting budget, availability of qualified personnel" (Chase *et al.,* 2006). Following are the techniques that come under the heading of quantitative forecasting; it is also referred as the time series analysis:

a) Simple moving average

Simple moving average is probably the simplest to develop method of forecasting in time series analysis. It develops forecasts on the basis of recent demand history and allows the forecaster for the removal of random effects. This method doesn't consider any seasonal, trend or business cycle that can influence on forecasting. This method simply averages a predetermined number of periods and uses this average as the demand for the next period. The disadvantage of this technique it forgets and doesn't consider the past (Coycle *et al.,* 2009).

The mathematical formula to calculate the simple moving average method is:

$$At = \text{Sum of last } n \text{ demand} / n \text{ (Coycle } et\ al.,\ 2009)$$

$$= D_t + D_{t-1} + D_{t-2} + \ldots\ldots D_{t-n+1}$$

Where

D_t = actual demand in period t

N = total number of periods in the average

At = average for period t

b) Weighted moving average

Weighted moving average method of forecasting is more accurate method as compare to simple moving average method of forecasting. In this method each calculation receives the equal weight. This method acts as a selecting a different weight for each value and then calculating a weighted average of the most recent n values as the forecast. The most recent observation receives the highest weight and thus the weight decreases for older data values (Williams and Shoesmith, 2010).

The formula for weighted moving average is given below:

$$F_t = w_1A_{t-1} + w_2A_{t-2} + \ldots\ldots + w_nA_{t-n}$$ (Jacobs *et al.,* 2009)

Where

W_1 = weight to be given to the actual occurrence for the period $t-1$

W_2 = weight to be given to the actual occurrence for the period $t-2$

W_n = weight to be given to the actual occurrence for the period $t-n$

n = total number of periods in the forecast

c) Exponential smoothing forecasting

Exponential smoothing uses a weighted average of past time series value as the forecast. It includes only one weight, the weight for the most recent observation. On the other hand the weights for the other data values are automatically calculated and get smaller as the observation move the further into the past (Anderson *et al.,* 2008).

It is forecasting technique that uses a weighted average of all past time series to forecast the value in a particular time span in next period. Following is the formula of exponential smoothing forecast (Stevenson, 2009)

$$F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$$

Where

F_t = forecast for period t

F_{t-1} = forecast for the previous period (i.e., period $t-1$)

α = smoothing constant

A_{t-1} = actual demand or sales for the previous period

The advantage of exponential smoothing forecast includes it allows "forecaster to assign weights to past historical data and present period data to reflect demand pattern such as trends and seasonality". This technique also requires least computer space to store data (Ross, 2004). The information and value after using the technique of exponential smoothing forecast can be used to forecast and predict demand in future more accurately (Chiulli, 1999). This technique can be implemented and performed routinely to develop many forecasts with relatively low cost in terms of data, computer time as well as labour (Yaffee and McGee, 1999).

The most recent values are more suggestive to predict the future as compare to others. Exponential smoothing technique of forecasting is being popular and acceptable due to some of the reasons like; surprisingly accurate, formulating is relatively easy, easy understanding of the model by user and little computation is required(Jacobs *et al.*, 2009).

Selecting the value of "α"

Here smoothing constant "α" demonstrates a percentage of the forecast error. "Quickness of forecast adjustment to error is determined by the smoothing constant α". As its value closer to zero the smoothing will be greater and as its value go beyond to zero the greater the responsiveness and less the smoothing. In fact the basic purpose of selecting the smoothing constant that balances the advantage of smoothing random changes along the advantages of responding to real change. Low value of "α" is being used when values tends to be stable and on the other hand high values are being used when values are changing dramatically (Stevenson 2009).

The value for the smoothing constant can be determined by two ways: nature of the product and sense of mangers what constitutes a good rate. Suppose if a firm produces products with a relatively stable demand the value of "α" can be small and if the firms producing products with high demand then value of "α" can be relatively high to give much importance to recent growth (Jacobs *et al.*, 2009).

3.7.2.3 Causal relationship forecasting

Causal forecasts are based on a statistical relationship between the dependent and one or more independent variables. There is no as such need of cause-and-effect relationship between the dependent and the independent variables. A statistical correlation alone is sufficient basis for prediction and forecasting. Causal model is generally constructed by finding variables that elaborates statistically changes in variable to be forecast (Wensveen, 2007).

According to Jacobs *et al.,* (2009) regression analysis, econometric models, leading indicators, and input output models also fall in the head of causal relationship forecasting technique.

3.7.2.4 Simulation model

Simulation model of forecasting is also called computer base forecasting. Simulation model refers to computer base forecasting, that allows the personnel of a firm to make forecast on the basis of some assumptions about the internal variables as well as external environment in the model. The forecaster may ask or develop the forecasting data by applying different assumptions on the model to predict the future (Chase *et al.,* 2006).

3.8 Summary of theory chapter

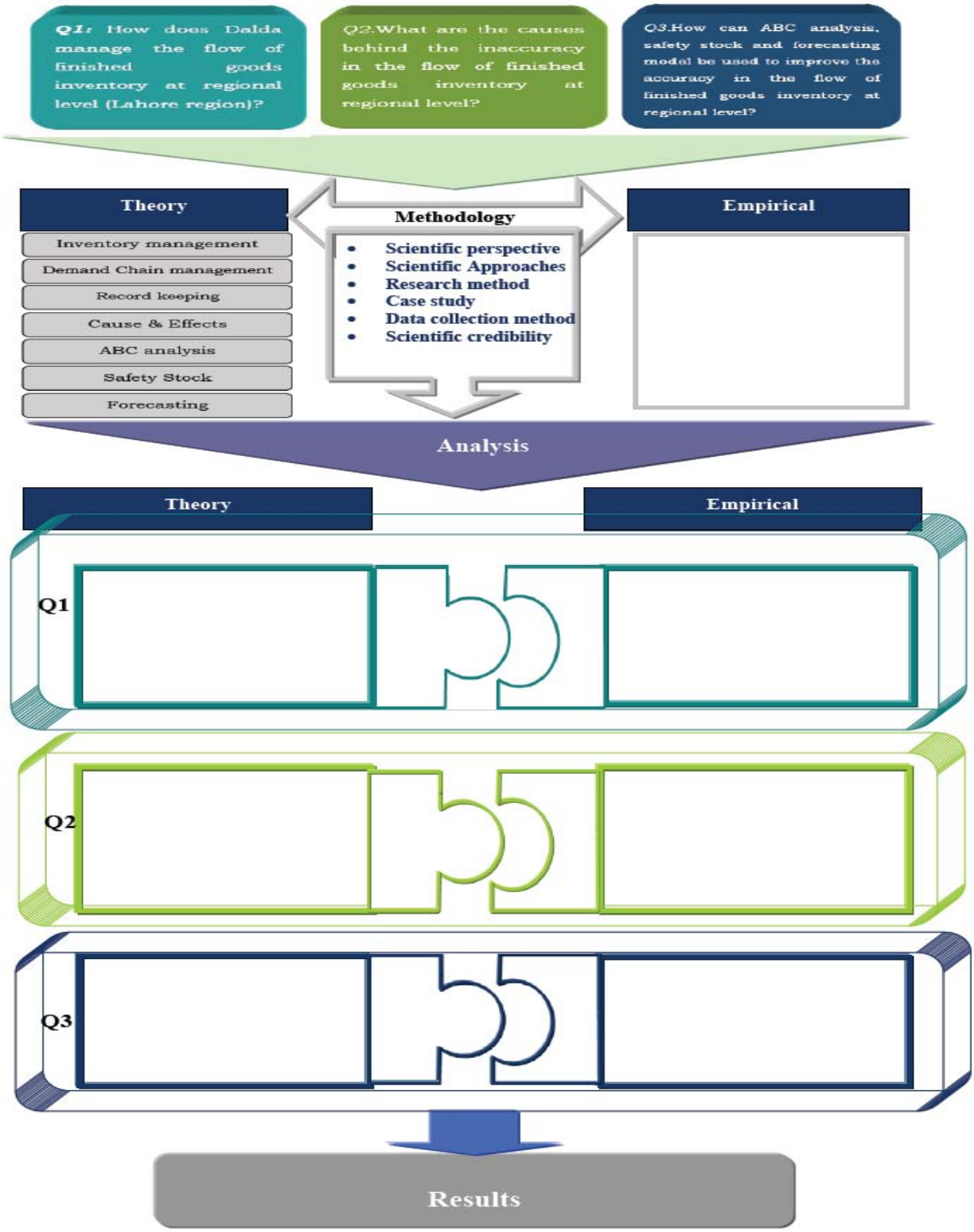
Figure 3.6: Summary of theory chapter

Inventory Management	The description of the inventory management that availability of the items and products to the customer needs to improve the flow of finished goods.
Demand Cain Management	It is about the knowing the demand of any product and then fulfill according to customer needs.
ABC Analysis	Explanation of ABC Analysis to classify the SKUs into different classes is also given
Safety Stock	Safety stock is important for the better flow of goods of goods; it helps in handle the unexpected events.
Forecasting	Its about the predicting, what future could be. Differents techniques of forcasting are used like qualitative and quantitative forecasting.

(Source: Own)

3.9 Thesis model

Figure 3.7: Model of thesis (chapter 3)



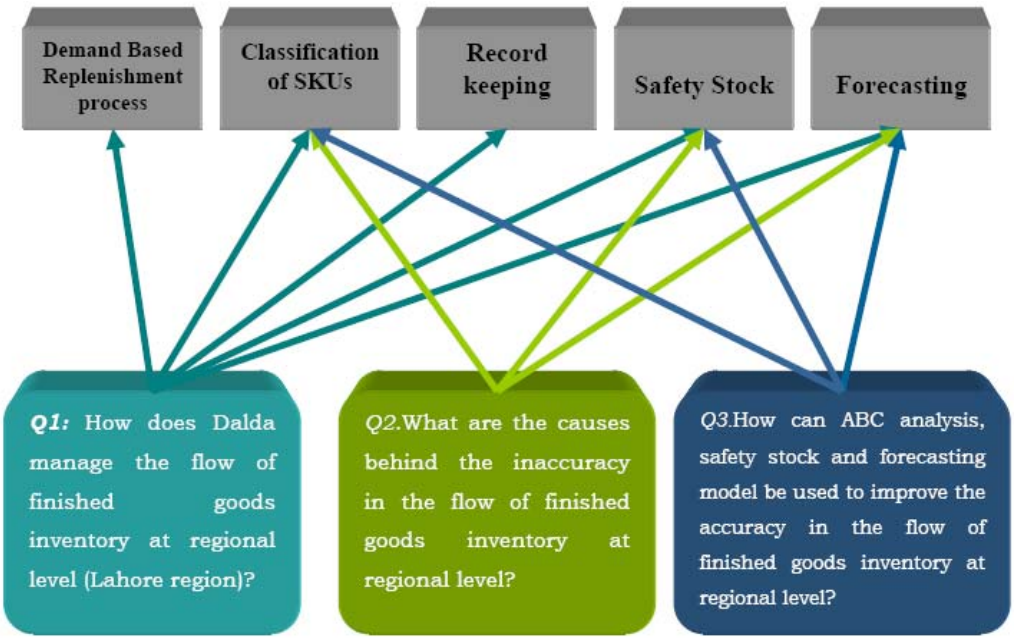
Source: (Own)

4. EMPIRICAL DATA

The following chapter presents the empirical data at regional level that we have collected from Dalda through questionnaire emails and telephonic conversation. First of all demand base replenishment is explained, in which we have stated complete process that a company is currently having. We have explained other processes that include how SKUs are classified, record keeping method of demand at regional level. At last, we have elaborated how at regional level forecasting is being done and how much they usually kept safety stock of each and every SKU. The sources for each collected data are not presented in this chapter.

Following figure 4.1 elaborates the empirical data that is presented in this chapter. It connects different parts of empirical data with appropriate research questions. The direction of arrows also tells that which research question is being addressed by particular empirical part.

Figure 4.1: Framework of the empirical Data



Source: (Own)

4.1 Demand base replenishment process

Receiving Demand

On the basis of the current process that is followed at regional level they receive the order in advance on weekly basis from agents in both ways formally through order sheet via territory sales officer and informally by phone call. Most of the orders take place from the agents through formal way like filling the order sheets that is developed on Microsoft excel. That sheet is called “order form”, in which each and every SKUs are clearly defined like how many particular SKUs are required in how much weights or how much quantity is required. According to concerned personnel at regional level, that is called Demand Based Replenishment process, when the demand of any SKUs will rise at regional level then it will be replenished by the required SKUs.

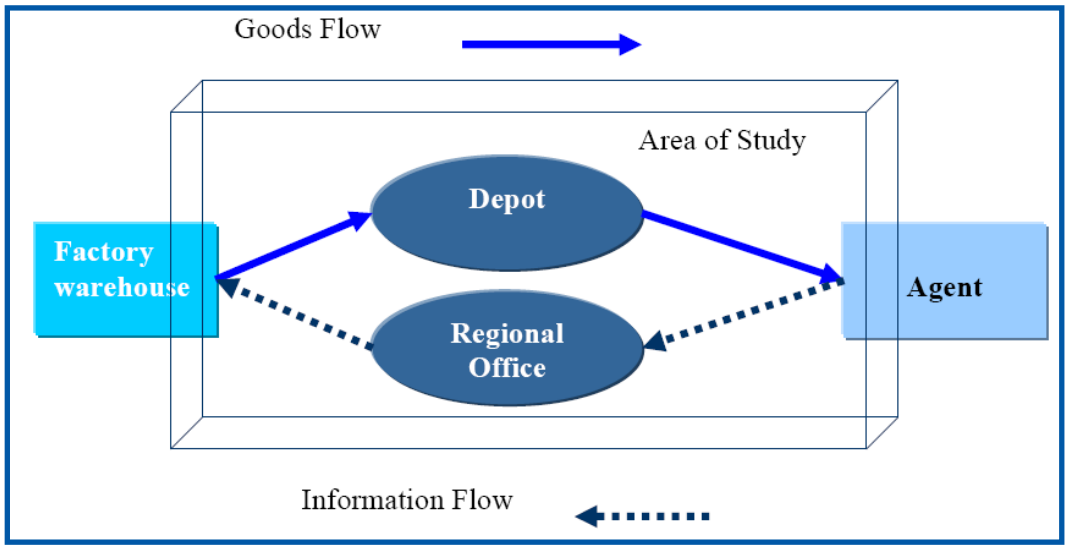
They don’t use any specific and particular software or any automatic system for managing the demand. The communication between agent and regional level takes place in the form of proper format, emails, as well as telephone. On the other hand the communication also takes place in the form of personal visit of responsible persons from the regional level like territory sales officers (TSO).

At regional level, they receive order about twice a week from Lahore region. Normally there are two days mentioned to receive the orders and demand from agents that are Monday and Tuesday. If the agent that is located out side of the Lahore (city) then the agent receives delivery from regional warehouse once a week on Monday because it is not affordable to receive order twice a week from the agents that is located outside of Lahore city and then to dispatch the order. The agents that are located outside of Lahore city, they usually have stock between 7 to 15 days that why they demand once a week.

Managing Demand

Excel sheets are being used to forward the order and demand to the factory warehouse. Then it is the duty of the factory warehouse and logistics department to manage the desired stock and send accurate stock to the proper region by using proper transportation and routing. They are having the transit period of one week. After receiving the delivery from the factory warehouse to the regional warehouse, required SKUs are delivered to the particular agent according to their specific requirement.

Figure 4.2: flow of information and goods



Source: (Own)

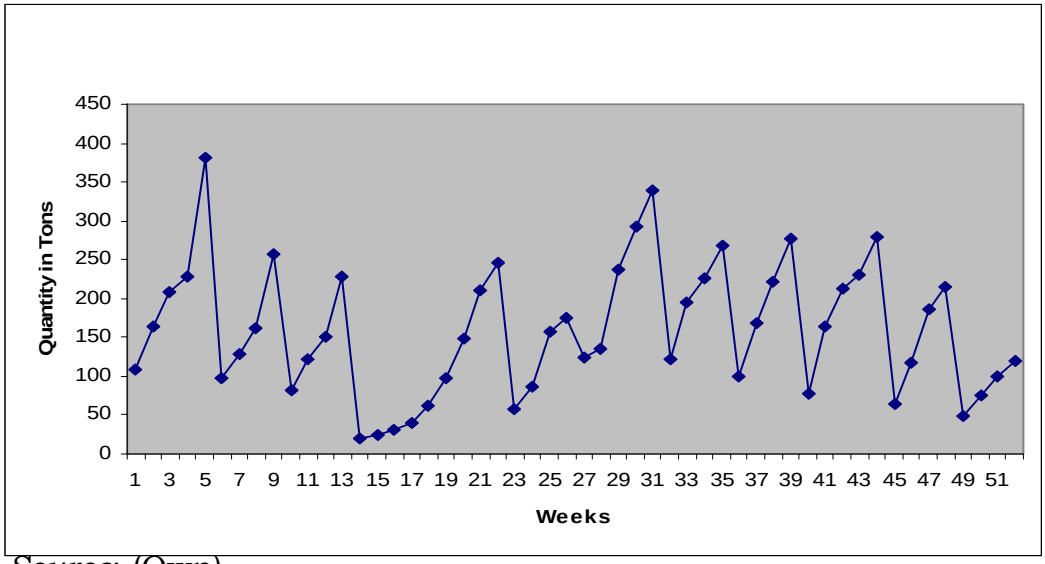
Fulfilment of Demand

If the regional office receives the order from agents up till 10 a.m. then they dispatch specific items to the particular agent at the same day. On the other hand if they receive the order after 10 a.m. then the order will be dispatched within 24 hours or next day.

According to concerned personnel at regional level, the whole week remains very busy and active. There are a lot of tasks and activities to manage the flow of finished goods inventory like receiving the orders from agents combine them and start to make the delivery arrangements to the particular

agents. If we talk about the dispatch pressure, the whole dispatch pressure and rush comes at the last day of week at Saturday. They dispatch all the demand and delivery at Saturday either that agent is based in Lahore city or outside of Lahore (Lahore region contains some areas that are the surroundings of the Lahore but comes under Lahore region). if the week has high flow in the whole month that is to be considered as the busiest week of the month. Normally the last week of every month is the busiest week of every month. This practice can also be seen in the below graph that is showing the week wise flow of finished goods at regional level. Some points are higher then the others that show the busiest period.

Figure 4.3: Weekly Flow of Finished goods at Lahore Region



Source: (Own)

At regional level they manage the flows of finished goods week wise and in whole year they consider 52 weeks. Some months like July, October, January and April are having five weeks a month.

Handling of emergency or special order

Normally there is no priority set by regional level to their agents in the context of dispatching orders. All the agents have the same equal level of receiving stock from regional warehouse. However, some time if an agent

request the regional office that stock is required early rather then the routine function then regional office makes some arrangements to deliver the stock as soon as possible.

4.2 Record keeping method

There is no as such record keeping criteria and process that is being used at regional level. An agent sends order to regional office and after delivery there is no any record keeping through which they can came to know that how much order they received. They keep the record of their delivered items like how many items they delivered in a particular week, month, and year to the particular agents. They have the record of invoices in which each and everything is clear like how many particular SKUs are delivered, in how much quantity, what is the total price of each and every SKU, what is the total price of the whole stock. Invoices are also kept in record that shows the particular order has been dispatched to the particular agent. Currently they are managing the 43 SKUs at regional level (Lahore region), some SKUs, like SKUs No. 11, 22, 25, 26, 27, & 29 they are pulling back due to zero sale volume and are not included in the calculation. The total distributed values in tones are given below in Table:

Table 4.1: Flow at Regional level in Ton

SKU #	Tons	SKU #	Tons
7	2 010,41	19	14,40
3	1 911,25	15	7,27
2	1 385,89	17	1,27
6	983,46	12	6,91
32	0,89	34	6,26
31	0,66	36	6,95
23	1,38	42	0,82
24	2,64	43	134,53
38	4,74	21	102,15
39	565,68	33	89,22
1	400,26	14	50,20
13	89,51	30	0,02
9	93,98	10	18,12
18	3,90	4	10,35
20	20,69	40	6,15
16	9,24	11	-
35	5,94	22	-
37	11,78	25	-
41	1,41	26	-
8	141,24	27	-
28	0,18	29	-
5	173,48		

Source: (Own)

Order fulfilment rate

When agent has placed the order to the regional level then operation manager makes some arrangements for the delivery to take place. Usually 80% orders has been executed too the agent according to the every agents particular demand of SKUs. Sometime it also happens that due to non availability of a specific SKU at regional level then they fulfil the demand of that agent of other ordered SKUs. This problem occurs because they don't have all SKUs according to their exact and accurate forecast demands as well as they also don't take consideration on safety stock calculations.

4.3 Classification of SKUs

They do not have any specific method to classify the items according to their importance through which they can came to know that which SKUs are most important on the basis of the distribution pattern.

4.4 Safety stock

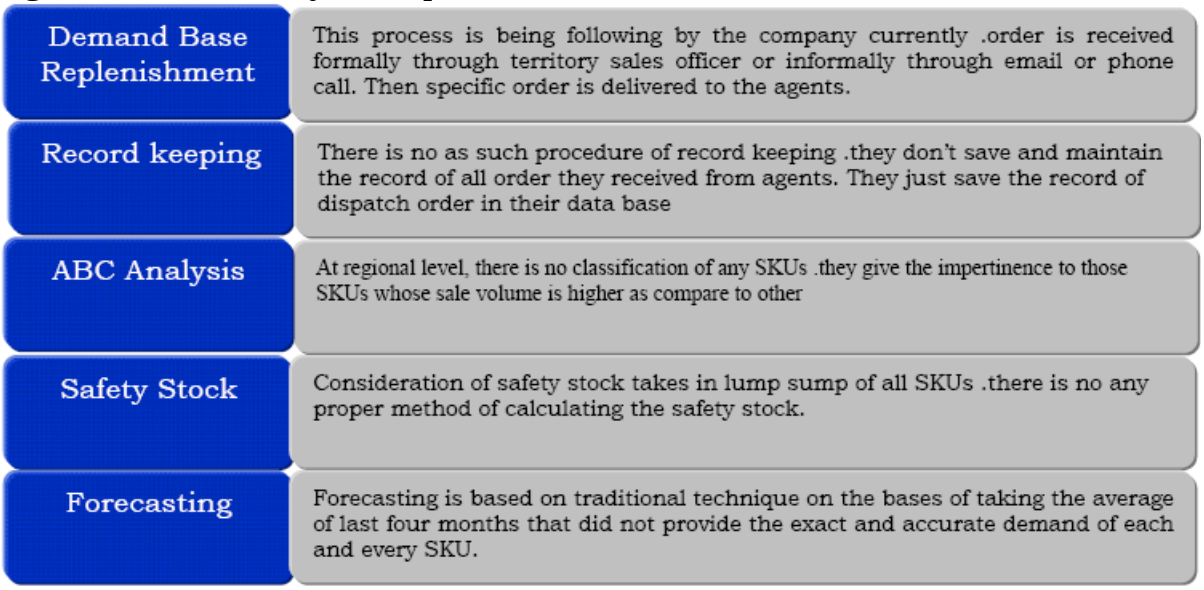
At regional level they do not follow any hard and fast rule of calculating the safety stock of any SKU. They just follow the pattern of having more inventories of frequently used SKUs. According to concerned personnel that stock is enough for seven days of demand. Only few SKUs that are having huge sales are to be considered to have more safety stock than others. Moreover at regional level they have total 150 ton safety stock of all SKUs and they don't have any particular criteria to manage and calculate the safety stock of each and every SKU. Due to this improper way the safety stock finish early, and then they send emergency delivery to agents after receiving new delivery from factory warehouse, to fulfil the order.

4.5 Forecasting

At regional level to forecast the future demand of each and every SKU on the basis of agent's actual sales, they just consider the past four month's sale volume and take the average of that available data. They just follow the conventional method of forecasting that has no any base and logic, based on assumptions and this method also doesn't consider any seasonal factor. After taking the past sales as average they calculate the values of forecasting about every SKU to make some decisions about production schedule.

4.6 Summary of theory chapter

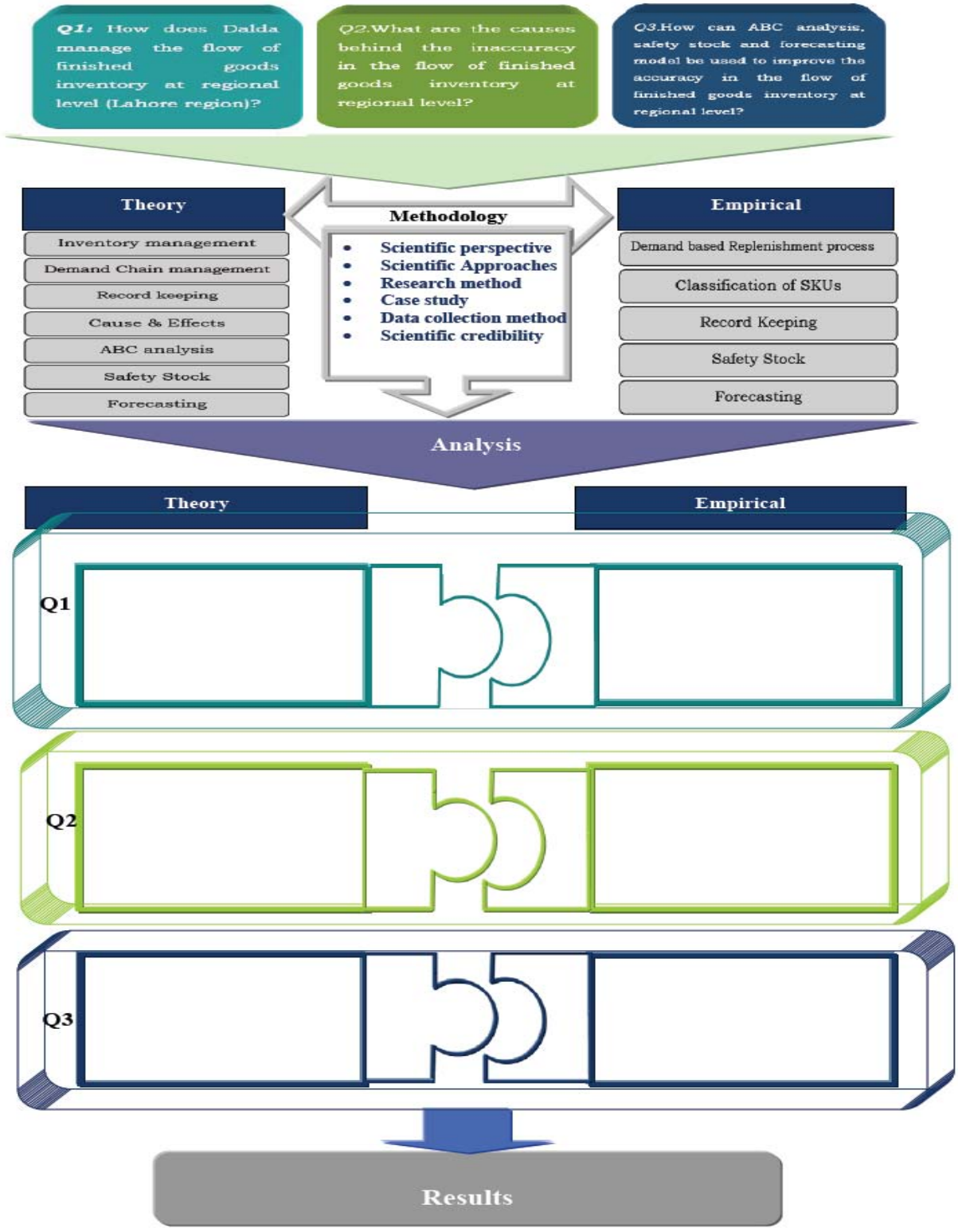
Figure 4.4: Summary of empirical data



Source: (Own)

4.7 Thesis model

Figure 4.5: Model of thesis (chapter 4)

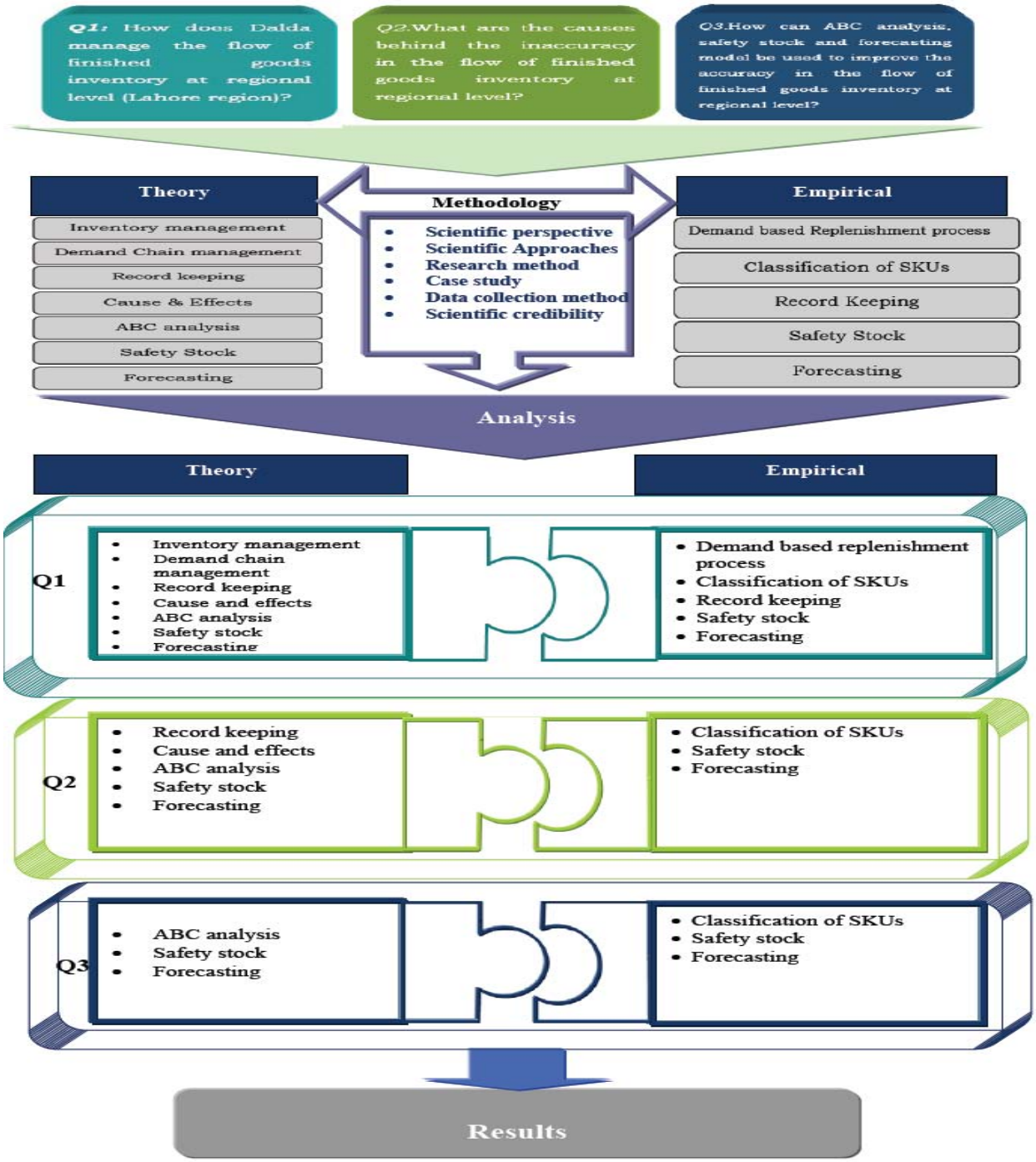


Source: (Own)

5. ANALYSIS

Analysis part of this thesis has been written after making comparison between theory and empirical data related to our problem discussion and research questions. It will also explain that how at regional level the accuracy in the flow of finished goods inventory can be increased.

Figure 5.1: Layout of analysis



Source :(Own)

The analysis of this research has been conducted on the basis of theoretical framework as well as empirical data presented in the previous chapter. More over the analysis of this research is planed according to the research questions. Connection of research questions with the theory and empirical is described in figure 5.1.

5.1 Research question 1

- ***How does Dalda food manage the flow of finished goods inventory at regional level (Lahore Region)?***

The analysis of this research question has been carried out on the basis of theory as well as empirical data provided by the company in empirical part of this thesis. Moreover, this research question will also describe concisely that how Dalda Foods manage the flow of finished goods inventory at regional level.

As stated in the theory by Lee (2001), demand chain management acts a very vital role in managing the supply chain activities. It also helps to integrate among all the channels of supply chain management. Close coordination with the consumer helps to find the right product at right place, when it is required. At regional level, we found that they receive the order from agents in advance on weekly basis in both ways formally through order sheet via territory sales officer and informally by phone call and e-mail. They receive the demand of their agents and forward it to factory warehouse and then the demand of agent is fulfilled. Due to this it seems that there is an integration or coordination between the agent, regional level and factory warehouse. They are not fallowing the whole process of demand chain management in true sense, it looks like that they are doing it just as formality. The advance demand does not show the true demand of agent.

According to Sumathi and Esakkirajan (2007), record management and record keeping refers to the management and collection of data and information in a well organized and planned way which can be accessed latterly to make some decisions. At regional level there is no as such record keeping process and procedure. They didn't maintain the record of that order and demand which they received from their particular agents. They just maintain the record of delivered SKUs to the agents. So, it means that they just uphold the record of their sales. At regional level they must have to build, the proper record keeping system and this record keeping system can help them in future for further decision making, evaluation and making long term strategic plans about production and ordering. It will also help the top management to know the demand pattern of the consumer as well as their agents that will help in making the accurate flow of finished goods at regional level.

Chen *et al.*, (2008), describes that ABC Analysis is inventory management technique that is broadly used to categorizing the SKUs in to different groups and ranks according to their importance to the inventory management. At regional level currently, there is no as such concept of classifying of SKUs on the basis of their importance. So we think that if they classify SKUs according to their importance then there will be more better and accurate flow of finished goods inventory at regional level.

As stated in theoretical framework by Stadtler (2008), safety stock is important inventory management technique that provides protection against uncertainty as well as it also covers ambiguity in inventory evaluation. If we talk about safety stock at regional level as we have also discussed it in our empirical part of the thesis, they just have over all 150 ton of safety stock. They are not calculating the safety stock of each and every SKUs. So, we think that it is better to calculate the safety stock of each and every SKU that will help them in fulfilling the complete demand of every agent.

According to Ailwadi and Singh (2005), managers can take appropriate and right decisions only if they have any idea of what will happen in future. With the help of using appropriate forecasting technique, the companies can improve the quality of decisions by keeping in mind the future demand. At regional level, they use improper technique of forecasting on the basis of the past four months average sales and this technique don't give the actual forecasting values of each and every SKU that is required by different agents. There should be appropriate technique of forecasting that exactly covers the accurate forecasting values for perfect flow of finished goods inventory at regional level.

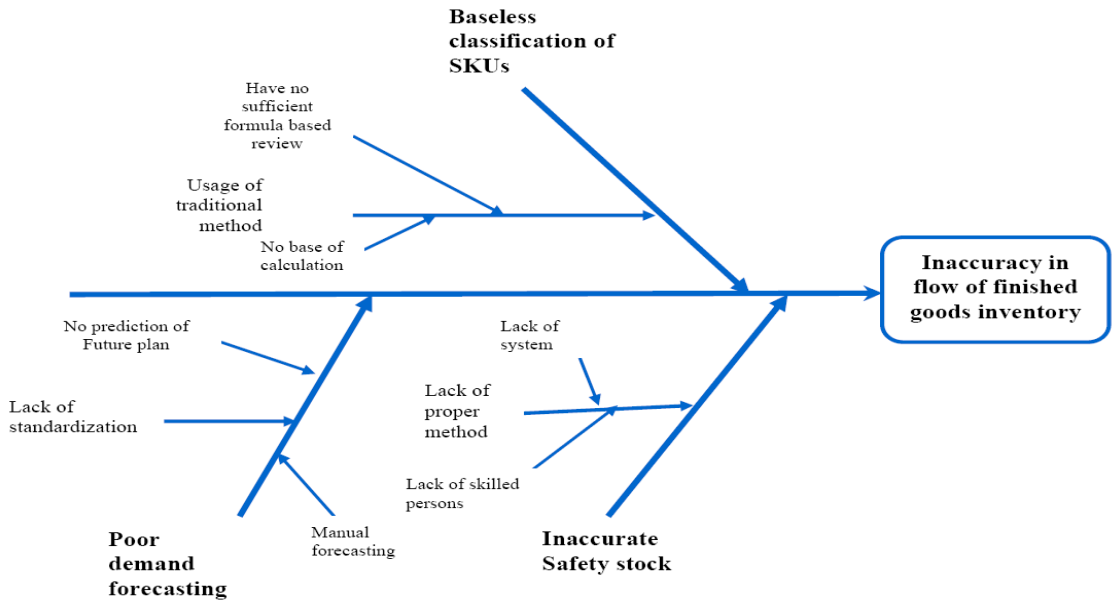
They are not following the complete principles of record keeping, safety stock, ABC analysis and forecasting according to the theory that has explained above. By not fallowing this inventory management techniques can become the cause behind the inaccuracy in the flow of finished goods inventory at regional level.

5.2 Research question 2

- ***What are the causes behind the inaccuracy in the flow of finished goods inventory at regional level?***

This research question will also be elaborated on the basis of theoretical framework and empirical data provided by the company. This research question will be addressed in two steps. At first we explained and sketched fish bone diagram after identifying the main reason and sub causes then we explained how these causes can be removed. Furthermore, we also described the causes behind the inaccurate flow of finished goods inventory.

Figure 5.2 : Fish Bone (cause & effect) diagram.



Source: (own)

According to Ross (2000), the core objective of inventory management is to ensuring accuracy of inventory during the distribution function of finished goods. While in our study we found that at regional level they are having the problem with accuracy of the finished goods inventory. Some time there is a shortage and some time there is an excess of inventory. By not having the accuracy in inventory is a cause of inefficiency in the flow of finished goods.

We agree with the Ross (2000), at regional level they should analyse, our inventory according to customer demand or not? How much safety stock they should have? Because currently at regional level their inventory is not according to customer demand and they are not having desired safety stock level. Answers of these questions are critical for improvement. This leads to the causes behind the inaccuracy in the flow of finished goods.

It is defined by Grant *et al.*, (2006), increase in number of back-orders, low stock and excess stock are the symptoms of the poor inventory management. In the context of explained theory we can say that at regional level they are having many orders in queue due to the shortage of required SKUs because

they are not able to fulfil the demand of agents. They are also not able to manage their stock according to variation in demand. These symptoms explain that there is poor inventory management at regional level that cause the inaccurate flow of finished goods.

5.2.1 Baseless Classification of SKUs

According to Chen *et al.,* (2008), ABC Analysis is an inventory management technique that is used in categorizing the SKUs in different groups according to their importance that leads to the accuracy in the flow.While in our study we found that at regional level they do not classify the SKUs by using the proper method or technique. They just differentiate some SKUs that are having high sales volume. They don't use any proper method for classification. They don't give special attention to important SKUs. That's way they are not able to manage the inventory according to the demand and ultimately it results the shortage of required SKUs or excess stock of important SKUs. This is the base less classification of SKUs, that is the cause to the inaccuracy in the flow of finished goods at regional level.

5.2.2 Inaccurate Safety Stock

Stadtler (2008), describes keeping accurate safety stock is important it provides the protection against uncertainty that helps in fulfilling the customer demand. But in our research we found that at regional level they are not paying the proper attention to calculate the safety stock in a proper way. They don't have the skilled persons, automatic systems or proper software that's way they are not able to find the accurate safety stock level. They have safety stock of some SKUs but they are not having safety stock of every SKU. This inaccurate safety stock is the cause that leads to the inaccuracy in the flow of finished goods at regional level.

Mangan (2008), explains without keeping the safety stock customer service suffers. Through empirical part we found that due to inaccurate safety stock, shortage of desired SKUs is a common fact. Due to this they are not able to fulfil the order of their customers and their customer service level suffers. Their order fulfilment rate is also low. Currently they are having the 80% order fulfilment rate. Many times it happens that they send the different SKUs instead of desired or ordered SKUs to customers. By not having the accurate safety stock at regional level is a cause that leads to inaccuracy in the flow of finished goods at regional level.

It is explained by Silver *et al.,* (1998), in the theory that stock out may cause lost of sales, emergency shipments, or loss of goodwill. Through empirical we came to know that they also dispatch the emergency delivery to the agent to fulfil the order. Obviously this gives the bad impression, that leads to bad-will and reduction in sale at regional level. Fulfilling the previous order after the due date is also the cause of inaccuracy in the flow of finished goods at regional level.

5.2.3 Poor Forecasting

According to bull (1993), forecasting is essential to handle the future in a better way but at region level as explained in empirical part they don't give any proper attention to forecasting. They are just using methods that are not effective.

As explained in the theory by Jacobs *et al.*, (2009) mainly qualitative, quantitative and simulation models are used for forecasting. After study the whole structure of the flow of finished goods we came to know that currently at regional level they are just following the technique of gross root that comes under the heading of qualitative technique of forecasting. Some value is added in the previous figure and thus forecasting is done on the basis of that previous values. This is being done at regional level by the operation manager.

As stated in the theory Jacobs *et al.*, (2009) describes simple moving average forecasts on the basis of recent demand history and allows the forecaster for the removal of random effects. At regional level, operation manager just consider the average sale of the past four months and consider that figure as forecasted value for the next period. It has also been explained well in the empirical part of this thesis. But the problem is that these two techniques of forecasting are not providing sufficient accuracy. This inaccurate or poor forecasting leads to the poor inventory management at regional level and become a cause behind the inaccuracy in the flow of finished goods inventory at regional level.

According to Roland and Bee (1999), top down approach of forecasting put down the views of top management of the expected increase or decrease in overall volume. On the basis of the empirical findings the same practice of forecasting is going on at regional level. Operation manager at regional level just follow the improper method of forecasting and on the basis of this forecasting they came to know about the demand pattern at regional level. Due to lack of proper technique of forecasting at regional level, they don't know about the exact demand of each SKU. Hence the problem of inaccuracy in the flow of finished goods occurs.

According to Ross (2000), correct and timely Information regarding the demand at every point is better indicator to reduce unnecessary stock of inventory in the network. At regional level they are not focussing on correct and accurate information because they are not able to forecast the exact demand of their agent. Information regarding the safety stock is not accurate that leads to an inaccurate stock of inventory. We think that this inaccurate information is the causes of disturbance in the flow of finished goods.

As above from different point of views we have explained the causes behind the inaccuracy in the flow of finished goods. Now we will explain how these causes can be removed.

5.3 Research question 3

- ***How can ABC analysis, safety stock and forecasting model be used to improve the accuracy in the flow of finished goods inventory at regional level?***

This research question will be carried out in three steps. in first step classification of all the SKUs will be done on the basis of both the methods traditional as well multifunctional criteria. Secondly, we will calculate safety stock according to the theory that has been discussed above on theory chapter. At the end we will calculate the forecasting values of each and every SKU on the basis of their actual demand. In fact this research question is the most vital part of the whole thesis that exactly shows the values to create smooth and accurate flow of finished goods inventory at regional level to manage finished goods inventory.

After combining empirical, theory and also by making cause and effect diagram we realize that there are many causes (that are explained in above analysis) behind the inaccuracy in the flow of finished goods inventory at regional level. According to Grant *et al.*, (2006) by using different techniques like ABC analysis, safety stock and forecasting, the accuracy in the flow of finished goods at regional level can be improved. Now we will use these techniques at regional level to correctly identify the important SKUs, for making reliable forecasting and accurate safety stock. These findings will remove the causes that are behind the inaccuracy in the flow of finished goods inventory.

5.3.1 ABC Analysis

5.3.1.1 ABC analysis based on traditional method

According to Chen *et al.*, (2008), ABC Analysis is an inventory management technique that is used in categorizing the SKUs into different groups according to their importance. That's why we implemented ABC analysis for categorising all SKUs that flows at regional level. First we will do with the single criterion approach that is Dollar based approach (we consider Rs nested of Dollars). Then we will use multiple criteria approach which is based on annual distributed units, average unit cost and annual distributed inventory in Rupees (currency where company operates). Then we will make a comparison because according to Vollmann *et al.*, (2005) for inventory classification it is proved that only dollar usage criteria are not sufficient to get the maximum benefits from this technique. There are many non cost criteria's that are equally important in inventory management.

Steeps for doing ABC analysis based on annual Dollar usage that are explained by the Chen *et al.*, (2008) are fallowed. First we have calculated the annual usage in units for every SKU at regional level for the year (2008-09). After this we calculated the annual Rupee usage by multiplying per unit cost with annual distributed units. Detail Calculation of the every SKU is given in appendix Table-7.1. Short description of one SKU is given below in table.

Table 5.1: Summary of annual distributed Units.

SKU #	Item Name	Annual distributed units	Unit Cost(Rs.)	Lea time (week)	Annual Distributed inventory in Rs.
SKU 1	Dalda Banaspati ghee 2.5 Kg Tin	160 090	34 955	1	55 959 460

Source: (Own)

After calculation of annual distributed inventory in Rs. We rank all SKUs according to the highest distributed values that are defined in appendix

Table-7.2. We also classify the SKUs in to three categories. Four SKUs are falling in A category (explained in below given table 4.1), and these four SKUs are containing the approximately 76% of the total distributed values. Eight SKUs are falling in B category, these SKUs are containing approximately 20% of total distributed values. 25 SKUs are falling in C category and these items are containing almost 4% of the total distributed value. That is given below table 5.2.

Table 5.2: Summary of Traditional ABC Analysis Method.

Summary of Tradditional ABC Analysis Method				
Category	SKUs No	% Of items in inventory	Rs. in the catagory	% in the Category
A	7, 3, 2, 6	10	856,215,883	75.91
B	1, 5, 8, 39, 43,21,9,13	20	231,688,657	20
C	,33,14,20,10,19,37,4,16,15,12,24,36,34, 35,40,18,38,32,31,41,17,23,42,28,30,	79	40,0964,12	4
Total	37	100	1,128,000,952	100.00

Note:
11,22,25,26,27,29 these SKUs numbers shwon Zero Sales value, company lift Back stock from distribution end.

Source: (Own)

5.3.1.2 ABC analysis based on multiple criteria

After doing ABC analysis according to traditional method that was based on annual Dollar usage. Now ABC analysis is done according to Lung (2006), which is called “proposed model” based on multiple criteria approach and it is also explained in theory. These criteria’s are annual distributed units, average unit cost and annual distributed inventory in Rupees. In this method three criteria’s that are explained above will be used to classify the SKUs in A, B and C category. According to this method first we have calculated the transformed values of all SKUs and of all criteria’s that is given below in the *Table No 5.3* by using the fallowing formula in Microsoft excel.

$$\text{Transformed Measures} = \frac{y_{ij} - min_{i=1,2,\ldots I}\{y_{ij}\}}{max_{i=1,2,\ldots I}\{y_{ij}\} \quad min_{i=1,2,\ldots I}\{y_{ij}\}}$$

For understanding lets calculate the transformed values of SKUs No 7 by one criteria.

i=1,2,3,……43(SKUs) j=1,2,3 (Criteria) ∑ x = J = 1

yi1=267385416 Min { yi1}=17136 M axi {yi1}= 267385416

267385416-17361 / 267385416-17361 => 1

You can see in the below given table 5.3, SKU No 7 is having the same answer 1 in fourth column. Same method is used to calculate rest transformed values, and these transformed values are between 0-1. Then we calculated the partial averages by using below given formula. For better under standing we elaborated SKUs No 7.

$$\text{Partial Average} = \frac{1}{j}\sum_{k=1}^{j} x_{ik} \text{ ,j = 1,2,3,……..}j.$$

1/ 1(Xi1) => 1/ 1(1) => 1

½(Xi1+Xi2) => ½(1+.07) => .53

1/ 3(Xi1+Xi2+Xi3) => 1/ 3(1+.07+.11)=> .39

You can see in below given table 5.3, SKU No. 7 is having 1, .53, .39 partial averages. Same method is used to calculate the rest of the values.

Table 5.3: ABC analysis by using multiple criteria approach

ABC Analysis By Using Multiple Critera Aproach Calculating Transformed Measure &Partial Averages SKU Wise Distributed Units (Sales) 2008- 2009 Lahore Region									
SKUs #	Anual Distributed Inventory in Rs	Average Unit Cost	Anuall Distributed Units	Anual Distributed Inventory in Rs (transformed) Xi1	Average unit Cost (transformed) Xi2	Average Distributed units (transformed) Xi3	Partial Average 1	2	3
7	267 385 461	133	210 047	1,00	0,07	0,11	**1,00**	0,53	0,39
3	256101470	134	1911205	0,96	0,07	1,00	**0,96**	0,51	0,68
2	188318239	679,42	277175	0,70	0,35	0,15	**0,70**	0,52	0,40
6	144410714	673,57	214396	0,54	0,35	0,11	**0,54**	0,44	0,33
39	71659488	114	628592	0,27	0,06	0,33	**0,27**	0,17	0,22
1	55959460	349,55	160090	0,21	0,18	0,08	**0,21**	0,20	0,16
5	24048490	346,54	69396	0,09	0,18	0,04	0,09	**0,14**	0,10
8	20992363	407,5	51515	0,08	0,21	0,03	0,08	**0,15**	0,11
43	17217677	115,2	149459	0,06	0,06	0,08	0,06	0,06	**0,07**
21	14785155	132,8	111334	0,06	0,07	0,06	0,06	**0,06**	0,06
9	14070056	616	22841	0,05	0,32	0,01	0,05	**0,19**	0,13
13	12955968	664	19512	0,05	0,34	0,01	0,05	**0,20**	0,13
33	11479833	115,8	99135	0,04	0,06	0,05	0,04	0,05	**0,05**
14	7266152	132,8	54715	0,03	0,07	0,03	0,03	**0,05**	0,04
20	3086776	616	5011	0,01	0,32	0,00	0,01	**0,16**	0,11
10	2639468	66,8	39513	0,01	0,03	0,02	0,01	**0,02**	0,02
19	2131225	407,5	5230	0,01	0,21	0,00	0,01	**0,11**	0,07
37	1539850	598	2575	0,01	0,31	0,00	0,01	**0,16**	0,11
4	1391136	67,4	20640	0,01	0,03	0,01	0,01	**0,02**	0,02
16	1378608	616	2238	0,01	0,32	0,00	0,01	**0,16**	0,11
15	1074170	407,5	2636	0,00	0,21	0,00	0,00	**0,11**	0,07
12	1044228	346	3018	0,00	0,18	0,00	0,00	**0,09**	0,06
24	955026	1322,75	722	0,00	0,68	0,00	0,00	**0,34**	0,23
36	944010	306	3085	0,00	0,16	0,00	0,00	**0,08**	0,05
34	865824	311	2784	0,00	0,16	0,00	0,00	**0,08**	0,06
35	800633	607	1319	0,00	0,31	0,00	0,00	**0,16**	0,11
40	778050	57	13650	0,00	0,03	0,01	0,00	**0,02**	0,01
18	598476	636	941	0,00	0,33	0,00	0,00	**0,17**	0,11
38	521892	1197	436	0,00	0,62	0,00	0,00	**0,31**	0,21
32	410326	1935,5	212	0,00	1,00	0,00	0,00	**0,50**	0,33
31	340005	1459,25	233	0,00	0,75	0,00	0,00	**0,38**	0,25
41	203236	596	341	0,00	0,31	0,00	0,00	**0,15**	0,10
17	201960	330	612	0,00	0,17	0,00	0,00	**0,09**	0,06
23	201000	1340	150	0,00	0,69	0,00	0,00	**0,35**	0,23
42	121600	304	400	0,00	0,16	0,00	0,00	**0,08**	0,05
28	105792	551	192	0,00	0,28	0,00	0,00	**0,14**	0,10
30	17136	158,67	108	0,00	0,08	0,00	0,00	**0,04**	0,03
Minimum	17135	57	108						
Maximum	267 385 461	1935,5	1911205						

Source: (Own)

After calculating the partial averages of every SKU from three mentioned criteria's, we compared and identified the maximum among three partial averages that is given in above table 5.3. Now we sort the score of partial averages in descending order and classify the SKUs in A, B and C, categories by fallowing the theory of Lung (2006). That is shown in below given table No. 5.4

Table 5.4: ABC classification by different models

ABC Classification by Different Models SKU Wise Diistributed Units(sales) 2008- 2009 Lahore Region						
SKUs #	Annual Distributed Inventory in Rs	Average Unit Cost	Annual Distributed Units	Scored by Multiple Creteria	ABC Classification	
					By multiple Criteria Approach	Tradditional Model
7	267 385 461	133	210 047	1	A	A
3	256101470	134	1911205	0,96	A	A
2	188318239	679,42	277175	0,7	A	A
6	144410714	673,57	214396	0,54	A	A
32	410326	1935,5	212	0,5	A	C
31	340005	1459,25	233	0,38	B	C
23	201000	1340	150	0,35	B	C
24	955026	1322,75	722	0,34	B	C
38	521892	1197	436	0,31	B	C
39	71659488	114	628592	0,27	B	B
1	55959460	349,55	160090	0,21	B	B
13	12955968	664	19512	0,20	B	B
9	14070056	616	22841	0,19	B	B
18	598476	636	941	0,17	C	C
20	3086776	616	5011	0,16	C	C
16	1378608	616	2238	0,16	C	C
35	800633	607	1319	0,16	C	C
37	1539850	598	2575	0,16	C	C
41	203236	596	341	0,15	C	C
8	20992363	407,5	51515	0,15	C	B
28	105792	551	192	0,14	C	C
5	24048490	346,54	69396	0,14	C	B
19	2131225	407,5	5230	0,11	C	C
15	1074170	407,5	2636	0,11	C	C
17	201960	330	612	0,09	C	C
12	1044228	346	3018	0,09	C	C
34	865824	311	2784	0,08	C	C
36	944010	306	3085	0,08	C	C
42	121600	304	400	0,08	C	C
43	17217677	115,2	149459	0,07	C	B
21	14785155	132,8	111334	0,06	C	B
33	11479833	115,8	99135	0,05	C	C
14	7266152	132,8	54715	0,05	C	C
30	17136	158,67	108	0,04	C	C
10	2639468	66,8	39513	0,02	C	C
4	1391136	67,4	20640	0,02	C	C
40	778050	57	13650	0,02	C	C
minimum	17135	57	108			
maximum	267 385 461	1935,5	1911205			

Source: (Own)

Summary of a multiple criteria approach is given below in table 5.5. According to multiple criteria approach there is little variation in the classification.

Table 5.5 Summary of Multiple Criteria ABC Analysis method

Summary of Multiple Criteria ABC analysis Method				
Category	SKUs No	% Of items in inventory	Rs. in the catagory	% in the Category
A	7, 3, 2, 6, 32	10	856 626 210	76
B	1,13,9,23,24,31,38,39,	20	156 662 895	14
C	4,5,8,10,12,14,15,16,17,18,19,20,21,28, 30,33,34,35,36,37,40,41,42,43	79	114 711 847	10
Total	37	100	1 128 000 952	100

Note:
11,22,25,26,27,29 these SKUs numbers shwon Zero Sales value, company lift Back stock from distribution end.

Source: (Own)

If we compare the traditional ABC analysis that is based on only one criteria, annual Rs. usage with the multiple criteria approach then out of 43 SKUs, 28 SKUs are at the same place. Nine SKUs are re-classified by using the multiple criteria approach. According to traditional approach there were only 4 SKUs in the category of A, but with multiple criteria approach one SKU has been added. Now SKU No. 32 is in class A. Now there are 5 SKUs in A class.

According to both traditional and multiple approach, 8 SKUs are in the B class But some SKUs, like 8,5,21,43, were in group B according to traditional method, but according to multiple approach they are now in C group. Some SKUs like 23,24,31,38 we in group C, but according to new approach these items are now ranked in group B.

In C group there were 24 items according to both criteria's but some SKUs like 2, 31, 23, 24, 38 were in C group but now they are in B group. There is a difference in the classification and according to Lung (2006), this difference in classification of the SKUs is due to the introduction of ranking in the criteria and the schemes of weights generation in scoring.

After conducting ABC analysis with both criteria, we selected the classification by the multiple criteria approach because in this aproach we used the three criteria's. It is also explained by Chen *et al.,* (2008) traditional approach is criticized due to its single criteria. There are also some other important attributes for classification and it would be more confident and strong classification if more attributes have been used.

According to Chen *et al.*, (2008) SKUs that are most important are ranked in group A and these are required the huge attention from the management. SKUs that are at least significance are fall in to group C and the SKUs that are of average importance belong to group B. we are also agree with the statement. In our study we found that items that are falling in the A class are very important because these items are contributing up to 76% of total amount and item B are contributing 14% and C are having very low proportion up to 10%.

We think that if management classify the SKUs at regional level by using the multiple criteria ABC Analysis approach as it is classified above then they will know that which SKUs are most important and which are the least important. So, the management will be more conscious about the management of the important SKUs that fall in A and B class. This is reliable method of classifying SKUs. SKUs will be classified correctly and it will remove the cause that leads to the inaccuracy in the flow of finished goods at regional level. It will also help in increasing accuracy in the flow of finished goods at regional level because important SKUs will be present at the regional warehouse and agents order will be fulfilled according to the requirement.

Now we will explain that how the cause of inaccurate safety stock can be removed. So, the problem of inaccuracy in flow of finished goods at regional level can be removed and accuracy could be improved.

5.3.2 Safety Stock analysis

Mangan (2008), also explain without keeping the accurate safety stock customer service suffers. In our study we found that at regional level they are not calculating the safety stock properly. That's why it creates problems for them to fulfil the customer demand and there customer service undergo.

Now we will identify the correct safety stock level for every SKU that flows at regional level by using the steps that are explained by the Ross (2004). First we calculate the mean absolute deviation for every SKU that is given in detail in excel sheets (Due to vast calculations it was not possible to include the table of MAD in this file).

In below given table 5.6 we have calculated the MAD for SKU No 7. we determine the normal distribution demand which is shown under the heading of (quantity SKUs 7), then we calculate mean on the base of that demand that is 39, and then we determine the mean deviation from the history of demand. That is shown in deviation Colum. Then to calculate the Mean Absolute Deviation (MAD), we divide absolute deviation by No. of periods which are 52 weeks. MAD is 16.2952 that can be seen in below given table.

Table 5.6: Calculation of mean absolute deviation

Calculation of Mean Absolute Deviation for SKUs No. 7							
Week	Quantity SKU 7	Average	Deviation	Week	Quantity SKU 7	Average	Deviation
1	23,53	39	15,47	27	24,2396	39	14,7604
2	35,295	39	3,705	28	26,4432	39	12,5568
3	44,707	39	5,707	29	46,2756	39	7,2756
4	49,413	39	10,413	30	57,2936	39	18,2936
5	82,355	39	43,355	31	66,108	39	27,108
6	22,16	39	16,84	32	36,333	39	2,667
7	29,55	39	9,45	33	58,1328	39	19,1328
8	36,93	39	2,07	34	67,8216	39	28,8216
9	59,09	39	20,09	35	79,9326	39	40,9326
10	17,18	39	21,82	36	27,3416	39	11,6584
11	25,77	39	13,23	37	46,2704	39	7,2704
12	31,9	39	7,1	38	60,9928	39	21,9928
13	47,86	39	8,86	39	75,7152	39	36,7152
14	5,2305	39	33,7695	40	15,2088	39	23,7912
15	6,657	39	32,343	41	32,3187	39	6,6813
16	8,559	39	30,441	42	41,8242	39	2,8242
17	10,461	39	28,539	43	45,6264	39	6,5264
18	16,6425	39	22,3575	44	55,1319	39	16,1319
19	27,7326	39	11,2674	45	17,4669	39	21,5331
20	41,5989	39	2,5989	46	31,758	39	7,242
21	59,427	39	20,427	47	50,8128	39	11,8128
22	69,3315	39	30,3315	48	58,7523	39	19,7523
23	12,2568	39	26,7432	49	18,9126	39	20,0874
24	18,3852	39	20,6148	50	29,7198	39	9,2802
25	33,7062	39	5,2938	51	39,1761	39	0,1761
26	37,7918	39	1,2082	52	47,2815	39	8,2815
					2010,41		847,3504

Total Deviation of 52 weeks =847,3504
Total Quantity of SKUs 7= 2010,41
MAD=Total Value of Deviation /Total peroid
MAD of sku 7 =847,3504/52 => 16,2952

Then after calculating the value of MAD, we multiply the MAD with the value from the given above Table 3.1 (that is standard table) according to the desire service level. Then this would be the value of safety stock for SKU No 7 that is 47.42 ton. That can be seen in below given Table No 5.7. Same method we have repeated for every SKU to calculate the value of safety stock by the method that is explained by Ross (2004).

There you will find that SKUs which are in A & B class their safety stock is calculated at the desire service level of 99% and the safety stock of SKUs that are in C class their safety stock is calculated at desire service level of 95%. Because according to Ross (2004), high desire service level means that SKUs are very important from customer perspective and safety stock should

meet every uncertainty. That's why; we calculate the safety stock of A and B class SKUs at 99%. Because these are 30% of total items and are contributing up to 90% in total flow of finished goods at regional level.

Table 5.7: Safety Stock Calculations

Safety Stock Calculation(Lead time 1Week) Week wise level of Safety Stock of SKU Lahore Region					
SKU No	Desire service level	Classification	Mean absolute Deviation	Standard Deviation Safety Factor	Safety Stock(Ton)
7	99%	A	16,295	2,91	47,42
3	99%	A	16,398	2,91	47,72
2	99%	A	11,719	2,91	34,10
6	99%	A	8,374	2,91	24,37
32	99%	A	0,017	2,91	0,05
31	99%	B	0,012	2,91	0,03
23	99%	B	0,044	2,91	0,13
24	99%	B	0,060	2,91	0,18
38	99%	B	0,134	2,91	0,39
39	99%	B	10,141	2,91	29,51
1	99%	B	3,787	2,91	11,02
13	99%	B	0,892	2,91	2,60
9	99%	B	0,933	2,91	2,72
18	95%	C	0,117	2,06	0,24
20	95%	C	0,247	2,06	0,51
16	95%	C	0,097	2,06	0,20
35	95%	C	0,169	2,06	0,35
37	95%	C	0,281	2,06	0,58
41	95%	C	0,034	2,06	0,07
8	95%	C	1,369	2,06	2,82
28	95%	C	0,008	2,06	0,02
5	95%	C	1,514	2,06	3,12
19	95%	C	0,215	2,06	0,44
15	95%	C	0,070	2,06	0,14
17	95%	C	0,049	2,06	0,10
12	95%	C	0,151	2,06	0,31
34	95%	C	0,163	2,06	0,34
36	95%	C	0,160	2,06	0,33
42	95%	C	0,020	2,06	0,04
43	95%	C	2,130	2,06	4,39
21	95%	C	1,731	2,06	3,57
33	95%	C	1,650	2,06	3,40
14	95%	C	0,596	2,06	1,23
30	95%	C	0,002	2,06	0,004
10	95%	C	0,575	2,06	1,18
4	95%	C	0,277	2,06	0,57
40	95%	C	0,178	2,06	0,37
Total Safety Stock in Ton					224,53

(Source own)

Now by using the theory that is explained by Rose (2004), the safety stock of every SKU has been calculated.

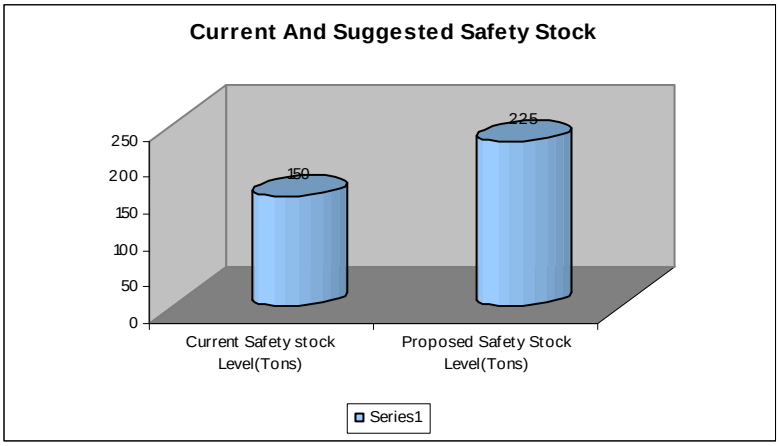
As Mangan (2008), explained in the theory that safety stock will provide safeguard against issues like delays in delivery from factory warehouse to regional warehouse, transportation problem, damaged stock during transportation. Now at regional level they will have accurate safety stock. That was the cause behind the inaccuracy in the flow of finished goods inventory at regional level. Now if any delay happens in delivery from factory or any transportation problem occurs, it would not affect the flow of finished goods because now they would have sufficient safety stock that will be able to meet the demand of agent. It will be only possible if they would have the correct quantity of safety stock. In this way it will help in increasing the accuracy in the flow of finished good inventory at regional level.

According to Silver *et al.*, (1998), stock outs that comes due to inaccurate safety stock can cause the lost of sales or good will. Now after calculating the accurate safety stocks this problem of stock out will be removed. Sufficient stock will be present at regional level to meet the customer demand. It will increase the accuracy in the flow of finished good to agent and it will save from loosing sales, and help in achieving the good will.

Comparison between current and suggested safety stock

If we see they are having 150 ton safety stock level and we found that they should have 225 ton that will fulfil their need of agents that is also shown in below given figure5.3. Having low safety stock then their requirement was the main reason behind the shortage of required SKUs.

Figure 5.3: Comparison of safety stock



Source: (Own)

Impact on carrying cost

After calculating of safety stock in a way that we have proposed to the company. You can see that there is clear difference of safety stock. As they have 150 ton of safety stock on weekly basis and we suggested 225 ton of safety stock. We have seen that safety stock has been increased with our suggested equation. Definitely it will also have some effect on inventory carrying cost. Although it is not our main focus of this thesis but we considered it just to have a look on inventory carrying cost.

Monczka, *et al.,* (2009) explained with the variation in safety stock the inventory carrying cost will also vary. At regional level we found that with the increase in the safety stock the inventory carrying cost will also increase. According to Monczka, *et al.* (2009) inventory caring cost can be calculated with fallowing formula.

Inventory carrying cost = average inventory in units * unit price * carrying cost

Where

Average inventory in units = 150 ton

Unit price = Rs. 562000(Per ton)

Unit price = Total price of every unit (Kg)/No. of SKUs

= 2418455/43 = 562

Because our units are in ton, that's way we will multiply 562 with 1000 that will be the value of unit price in ton (562*1000 = 562000 unit price).
Carrying cost = 19%.

By putting the above values in the equation

150* 562000*.19 => Rs16, 017,000 ($ 186244)

Now we found that inventory carrying cost with 150 ton is almost Rs. 16,017,000($ 186244). Now to calculate the inventory caring cost with an increase in safety stock we have used the above stated formula. Unit price and carrying cost will remain the same but the safety stock value will change. That will be the 225 ton.

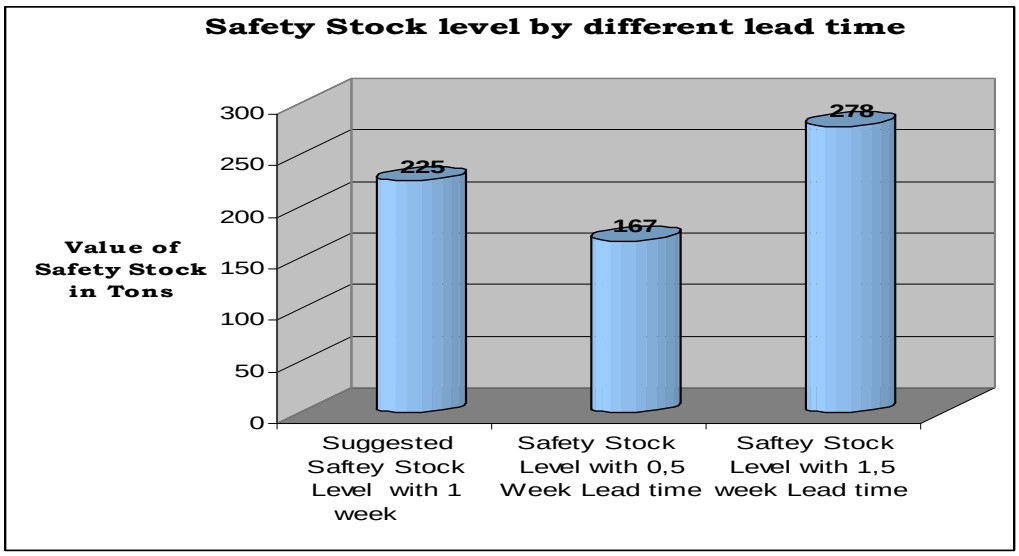
225*562000*.19=> Rs. 24025500($279, 367)

Now we can see that inventory carrying cost is increasing with an increase in the safety stock. Monczka, *et al.,* (2009) also explains that inventory caring cost will vary with the variation of safety stock. No we can also se from the above calculation at regional level with the variation in safety stock their inventory caring cost is increasing up to 50%.

Calculating Safety Stock with different Lead Time

After calculating the safety stock with one week lead time, we have calculated the safety stock with two different lead times to observe the variation. When we changed lead time with .5 week or we reduce it 50% from one week, than we found that 167 ton safety stock is suitable at regional level. With an increase in lead time up to 50%, that is 1.5 week we found that they should have 278 ton safety stock that will be suitable for them at regional level. Variation in safety stock by increasing or decreasing lead time can also be shown in below figure, 5.4. Detail calculation is also given in Appendix table-7.3 and table-7.4

Figure: 5.4.variation of safety stock level by different lead time.



Source: (Own)

We think that after calculating the safety stock of every SKU at regional level with proper methods will leads to the accurate safety stock. That will remove the inaccuracy in the flow of finished goods at regional level. Due to this accurate calculation stock will be present and order will be delivered to the agents according to their requirement and needs regarding the required SKUs. Ultimately it will increase the accuracy in the flow of finished goods inventory at regional level.

5.3.3 Forecasting analysis:

After analyzing the importance and review of literature about forecasting that covers all the aspects of forecasting and its technique. We recommend that they should use exponential smoothing technique of forecasting. According to Anderson *et al.*, (2008) exponential smoothing uses a weighted average of past and historical time series values as the forecast within a particular time span.

According to Stevenson (2009), following is the effective, reliable and easy to calculate forecasting value formula of exponential smoothing forecasting technique. We used this method to forecast the demand at regional level for the year (2008-09)

$$F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$$

Where

F_t = forecast for period t

F_{t-1} = forecast for the previous period (i.e., period $t-1$)

α = smoothing constant

A_{t-1} = actual demand or sales for the previous period

On the basis of the empirical data that is provided by the company, we have applied the above sated equation of exponential smoothing forecasting technique.

For better understand and explanation we calculate the forecasted value of the week 2 of SKU No.7 on the basis of the actual sale of week 1, then we apply the above stated equation in such a way:

$$F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$$

$$F_2 = 23.53 + 0.5 (35.295 - 23.53)$$

$$= 23.53 + 0.5 (11.765)$$

$$= 23.53 + 5.8825$$

$$F_2 = 29.4125$$

So, the forecasted value of the week 2 of SKU No. 7 is 29.41 ton of cooking oil. Rest of the values of forecasting of every SKUs throughout fifty two (52) is also being stated in appendix 5.

Explanation and justification to select the value of "a"

According to Stevenson (2009), As its value closer to zero the smoothing will be greater and as its value go beyond to zero the greater the responsiveness and less the smoothing. Low value of "α" is being used when values tends to be stable and on the other hand high values are being used when values are changing dramatically. Hence, on the basis of the above detail discussion about how to select the value of "α" we can say that as Dalda Foods is FMCG company that produce edible oil and have the vast demand of cooking oil in Pakistan as well as abroad. So, here we recommend the value of "α" as 0.5.

We applied the above stated formula after considering the value of smoothing constant on actual demand of fifty two weeks of each and every SKU to measure the most reliable forecasting values that would enable the management at regional level to manage the accurate flow of finished goods inventory at regional level. We have calculated the forecast values of all forty three (43) SKUs through out fifty two (52) weeks of the year 2008-09. Detail calculation is given in appendix table-7.5 and table-7.6

To view the quick and grasping look and to better understand the values of forecasting, we have also elaborated week wise forecasting in the following table No. 5.8 that shows the week wise forecasting. To check the proportion of every SKU you can have a look at appendix table-7.5 and table-7.6

Table: 5.8 Week wise forecasting at regional level.

Week wise forcasting at Regional Level Lahore Region			
Period	**Forcasting**	**Period**	**Forcasting**
Week 1	109,2	Week 27	139,1
Week 2	136,6	Week 28	137,2
Week 3	172,1	Week 29	187,0
Week 4	200,7	Week 30	240,0
Week 5	291,5	Week 31	289,1
Week 6	193,6	Week 32	201,6
Week 7	161,3	Week 33	198,0
Week 8	161,3	Week 34	212,5
Week 9	209,6	Week 35	240,0
Week 10	145,7	Week 36	169,9
Week 11	136,3	Week 37	169,5
Week 12	144,3	Week 38	196,0
Week 13	186,0	Week 39	236,1
Week 14	102,4	Week 40	156,6
Week 15	63,6	Week 41	160,2
Week 16	47,7	Week 42	186,1
Week 17	43,4	Week 43	208,7
Week 18	52,7	Week 44	244,1
Week 19	75,7	Week 45	154,2
Week 20	111,8	Week 46	135,5
Week 21	161,6	Week 47	161,2
Week 22	204,1	Week 48	188,6
Week 23	130,2	Week 49	118,0
Week 24	108,0	Week 50	96,7
Week 25	132,5	Week 51	98,0
Week 26	154,3	Week 52	109,0

Source: (Own)

To be familiar with the forecasting values of each and every SKU at regional level that is required throughout the year 2009-10 can be observed in the following table No. 5.9. This type of information at regional will help them to be more accurate and smooth flow of finished goods inventory because they would know in advance the demand of every SKU.

Table: 5.9 SKUs wise forecasting at regional level**.**

SKU Wise Forecasting at Regional Level Lahore Region			
SKU No.	Forecasting	SKU No.	Forecasting
7	1 992,3860	19	14,2497
3	1 914,5117	15	7,1829
2	1 390,0116	17	1,3189
6	984,1157	12	7,2310
32	0,9020	34	5,9087
31	0,6508	36	6,8153
23	1,1457	42	0,6374
24	2,8145	43	135,7314
38	4,7254	21	102,5646
39	575,6874	33	89,9958
1	400,1138	14	50,3370
13	89,3050	30	0,0457
9	94,7481	10	13,5713
18	3,9148	4	8,5095
20	20,7336	40	4,6490
16	9,1043	11	-
35	5,8765	22	-
37	11,1489	25	-
41	1,1352	26	-
8	142,4661	27	-
28	0,2479	29	-
5	174,3808		

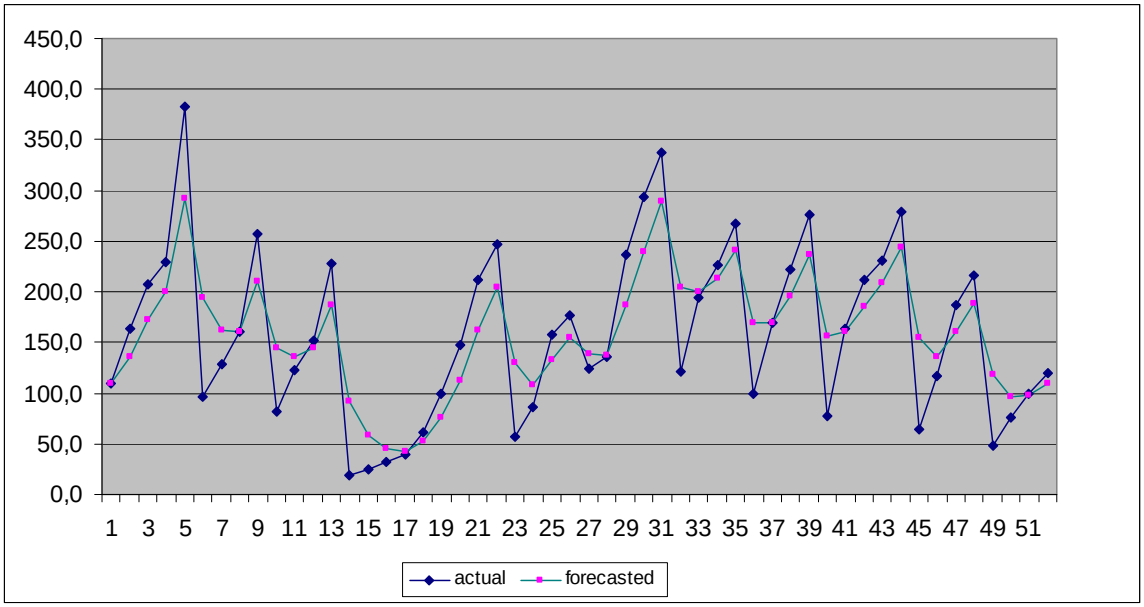
Source: (Own)

Comparison between actual demand and forecasted demand

Following graph shows the actual weekly sales of all SKUs and forecasted values of all SKUs on weekly basis by using the smoothing constant at 0.5. Actual graph is not fulfilling the demand of every agent and it usually happens at regional level that sometimes some of SKUs face shortage and some SKUs are in excess in stock. All this uncertainty happens due to poor

forecasting of demand that they couldn't able to seek by keeping in mind the future demand. It is clear from the graph that the forecasted values curve is more reliable that shows smooth and accurate flow of finished goods inventory at regional level. At the end we can say that if they use and follow the principles and technique of exponential smoothing forecast, flow of finished goods inventory will be more accurate that exactly fulfils the demand of every agent at regional level.

Figure 5.5 comparisons between actual and forecasted demand

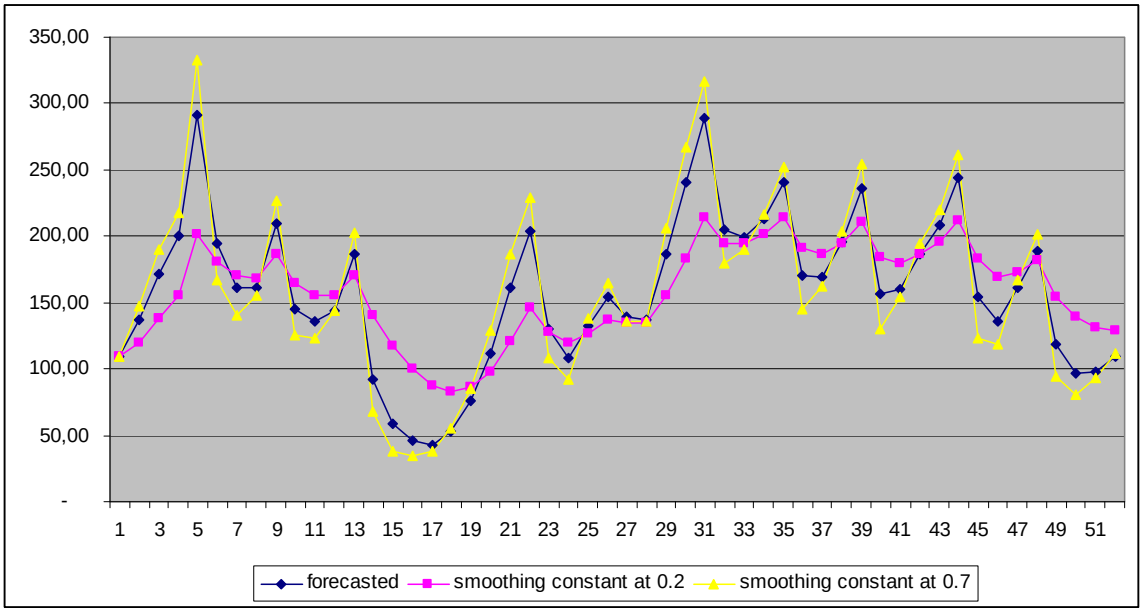


Source: (Own)

Forecasting by changing the value of smoothing constant "α"

Following graph shows the comparison between forecasted demand and changing the value of smoothing constant "α" 0.2 and 0.7 respectively. As we know that exponential smoothing technique of forecasting is based on actual and past historical data. So here we can see that if we increase the value of smoothing constant "α" like 0.7 then graph will move upward if we decrease the value of smoothing constant like 0.2 then this graph is relatively smoother. Here, we can conclude that forecasted values that we have calculated by using the value of smoothing constant 0.5 is the reliable values of forecasting that help out at regional level in order to be accurate flow of finished goods inventory.

Figure: 5.6 forecasting by changing the value of smoothing constant



Source: (Own)

According to bull (1993), forecasting is essential to handle the future in abetter way. If at regional level they perform forecasting as we have done above, it will help the management in handling the future in the better way.

Ross (2000), explains that Correct and at time Information regarding the demand is better thing to reduce unnecessary stock of inventory in the network and distribution channel. We agree with the writer and now at regional level by performing the correct forecasting as we have done above, they would be able to manage the stock according to requirement. With the help of this forecasting they can take the preventive measures to manage the ups and down in the demand of agents. By this way it will help the management at regional level to remove the causes of inaccuracy and ultimately it will increase the accuracy in the flow of finished goods inventory at regional level.

By this way using the ABC Analysis, safety stock and forecasting, the management at regional level can increase the accuracy in the flow of finished goods.

Note:

We have calculated the values of forecasting on Microsoft excel. While doing the calculations of forecasting on the basis of the actual demand, in actual demand there are some SKUs which have been returned to factory warehouse in some of the weeks due to zero sales of these SKUs. Moreover during calculation of forecasting some values also appeared in negative we considered them as "0".

6. RESULTS

In the fallowing chapter the convincing remarks of the research questions that have been derived after doing through analysis. Reflection about this thesis as well as future research is also the part of this chapter.

6.1 Conclusion

Research question 1:

- *How does Dalda manage the flow of finished goods inventory at regional level (Lahore region)?*

In chapter 4, empirical part of this thesis we explained in detail that how currently they are managing the flow of finished goods inventory at regional level. Flow of finished goods inventory in any organization concerns that how finished goods items can play an important role and how they can be reached accurately to end consumer to meet the customer demand. Flow of finished goods can not be accurate and smooth without the full participation of any channel. Every company has a lot of intermediate parties to reach the products to end consumer.

At regional level after receiving the order from agents through different mediums demand is being replenished and they called this system demand base replenishment system. At regional level record of demand is not being managed properly they just have the records of those orders that have been dispatched. There is no any proper classification of SKUs. Classification of SKUs is being done on the basis of most running and high sales volume SKUs. At regional level there is also no any proper method of calculating safety stock they just consider the safety stock as by keeping the high stock of most circulated SKUs. Currently they are having 150 ton of safety stock in which each and every SKU is included. Forecasting is also not being

practiced on organized basis. They take the average of past four month's sale and consider the forecasting of next period.

Currently finished goods inventory is not being managed in a proper way at regional level and this mismanagement leads towards a lot of causes behind the inaccuracy in the flow of finished goods inventory. These types of causes have been concluded in next step.

Research question 2:

- *What are the causes behind the inaccuracy in the flow of finished goods inventory at regional level?*

Cause-and-effect diagram is being used to identify the causes and sub causes behind the main reason and this type of technique is very common and helpful to identify the causes. We found that they don't classify or rank the SKUs according to their importance. This become the cause behind the inaccuracy in the flow of finished goods in such a way that management at regional level don't know exactly which SKUs are most important and need special attention. By having the inaccurate safety stock at regional level is another cause behind the inaccuracy in the flow of finished goods inventory at regional level because they don't have skilled persons as well as lack of proper system is also one of the cause behind the inaccurate safety stock. It leads to the shortage of the inventory and ultimately this shortage leads to the late delivery to the agents.

Inaccurate forecasting of the demand is also the cause behind the inaccuracy in the flow of finished goods inventory at regional level. Currently they just take the average of pat four weeks to do the forecasting of next week which is not reliable method. Due to this unreliable forecasting they don't know the exact demand of their agents and don't manage the inventory according to the demand.

These are the main causes behind the inaccuracy that obviously leads to the inaccurate flow of finished goods inventory at regional level. In next step we conclude that how these causes can be removed.

Research question 3:

- *How can ABC analysis, safety stock and forecasting model be used to improve the accuracy in the flow of finished goods inventory at regional level?*

If management classifies the SKUs at regional level by using the multiple criteria ABC Analysis approach as it is classified above, they will know that which SKUs are most important and which are the least important. So the management will be more conscious about the management of the important SKUs which fall in A and B class. Because in our study we found SKUs that are falling in A class are very important because these SKUs are contributing up to 76% of total amount. SKUs B are contributing 14% and C are having very low proportion up to 10%. This is the reliable method of classifying the SKUs and it will remove the cause that leads to the inaccuracy in the flow of finished goods at regional level. It will help in increasing accuracy in the flow of finished goods at regional level.

They should calculate safety stock at regional level with proper method and should consider every SKUs in calculation of safety stock in order to have accuracy in safety stock. Currently they keep 150 ton of safety stock for one week which is not sufficient. On the basis of our calculation, we suggest them to have 225 ton safety stock at regional level. We have also calculated safety stock by increasing and decreasing the lead time but one week suits good and our suggested figure is also higher then their current level of safety stock. Now if any delay happen in delivery from the factory or any transportation problem occurs, then it would not affect the flow of finished goods because they would have sufficient safety stock that will be able to meet the demand of agent. In this way it will help in increasing the accuracy

in the flow of finished good inventory at regional level and protect them against uncertainty of stock.

On the basis of theory related to forecasting from different authors, we can say that forecasting is a very effective tool to predict the future. We have done a deep analysis at regional level regarding forecasting to know how forecasting is being done to predict the future. We suggested to use exponential smoothing technique of forecasting on the basis of the advantages that is more feasible at regional level. By using the technique of exponential smoothing forecasting we can say that there is more reliable forecasting demand values that will help the management for more accurate flow of finished goods inventory. We have calculated the values of forecasting of all forty three (43) SKUs on the basis of actual demand through out the fifty two (52) weeks. Now there is more smooth and accurate flow of finished goods inventory and they will get better understanding to manage the flow of finished goods. In this way forecasting will help at regional level to be prepared for the challenging future.

6.2 Reflection

At the start of this thesis we were not completely aware of the extensive range of research subject and therefore not enough limitations were lay down. We have tried our best to make a deep study as possible but due to short span of time we have been forced to limit the scope. The empirical findings at regional level have to be included in an edited version.

The topic was difficult to elaborate and to test it empirically within a specific area of flow of finished goods inventory at regional level due to numeric calculations on the basis of some statistical formulas. It was also very difficult to collect empirical and quantitative data from Dalda Foods due to confidentiality and secrecy matters. However, most quantitative data received on some requests.

Another aspect we didn't deal with in this thesis is the generalization of the effects we were able to point out through our analysis. This could have boon done by generalizing the results obtained after study of accurate flow of finished goods inventory at regional level in Dalda Foods. As we have done our study only on one company we were not able to generalize the effects on any other company to observe the accurate and smooth flow of finished goods inventory. Despite of all these aspects we thought that our study will also help to other companies like FMCG (Fast Moving Consumer Goods) products as well as distribution companies. Mostly these types of companies have the same channel of distribution and the same inventory management techniques that we have used in our study can be applied for accurate flow of finished goods inventory.

Furthermore, the availability of literature, empirical data of Dalda Foods and time to time guidance from respected tutor, examiner as well as from opponents made it easy and interesting to solve the problem and to conduct the research.

6.3 Future research

In the following points further research subjects for Dalda Foods at regional level are presented:

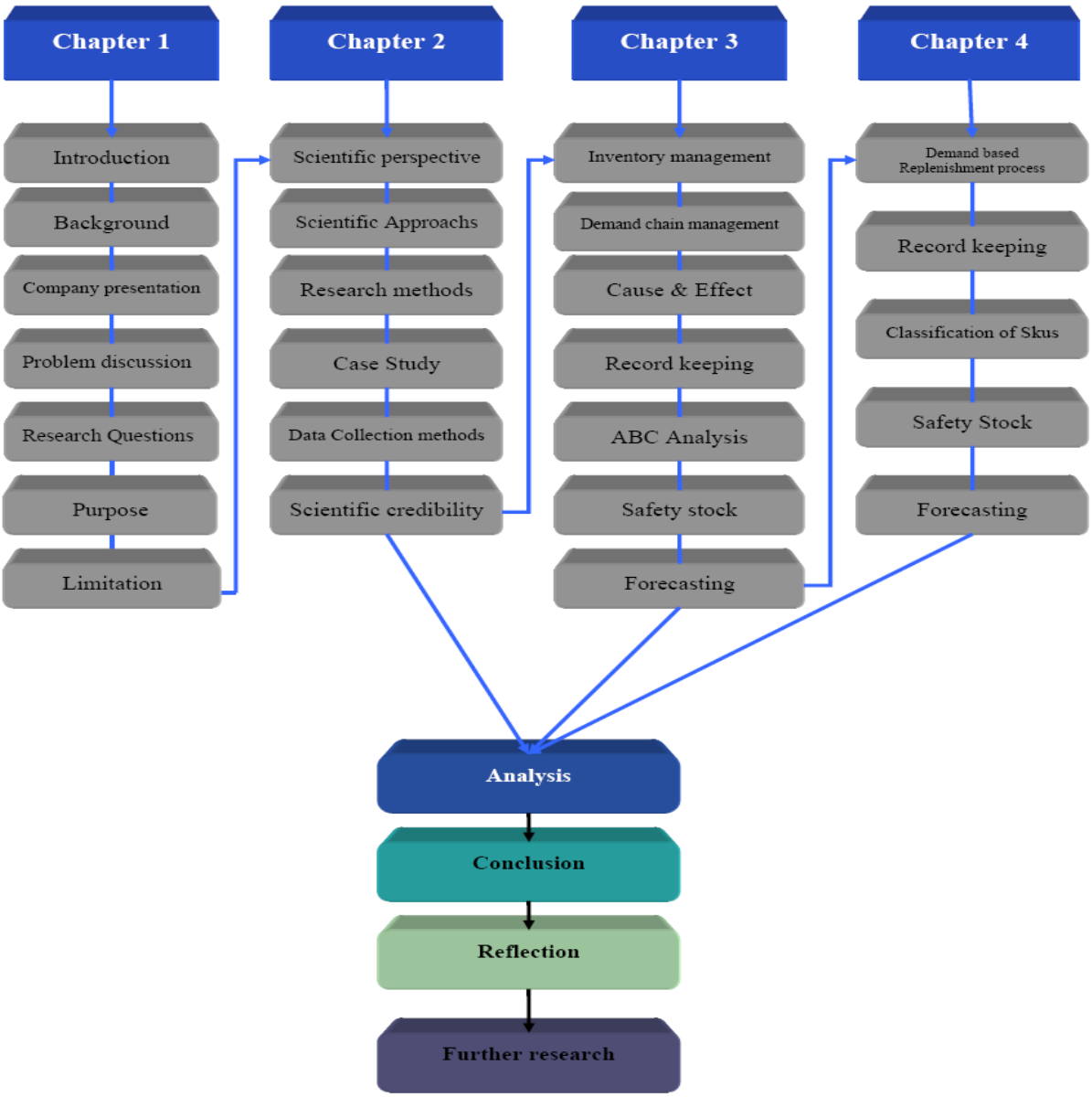
- A study of Distribution Requirement Planning (DRP) system can be done or implemented in order to more accurate and systematic replenishment inventory plan in a distribution network within Dalda Foods because our study can be used as a base to implement distribution Requirement Planning (DRP) system.

- A concept and system of collaborative, planning, forecasting and replenishment (CPFR) can also be implemented that will help Dalda foods at regional level to coordinate with agents more efficiently and effectively in this way agent can also play its role in order to planning as well as replenish the inventory.

7. APPENDICES

7.1 Appendix 1:

Layout of the whole thesis



7.2 Appendix 2:

Questionnaire

Q 1: How demand is being replenished after receiving demand from different agents?

_____

_____

Q 2: How the demand is fulfilled after receiving the demand from agents?

_____

_____

Q 3: How emergency orders are being treated at regional level that a agent placed?

_____

_____

Q 4: How regional manager at regional level receives the order from agents?

_____

_____

Q 5: In which proper format regional manager receives demand from agent?

_____

_____

Q 6: Can you send us the format of order form that you receive from agents?

_____

_____

Q 7: How many days it will take to deliver the order from regional office/warehouse to agent?

_____

_____

Q 8: How the agent communicate with the region and which medium is being used?

_____

_____

Q 9: How much orders the regional manger received in a day? Send us the complete information?

_____

_____

Q 10: How much orders at regional level received on weekly basis?

_____

_____

Q 11: Which are your busiest days in a week in order to dispatch the inventory to agents?

_____

_____

Q 12: How you combine all the demand from different agent that is received at regional level and how you send this demand to factory warehouse?

_____

_____

Q 13: What is the record keeping process of orders that received at regional level and how you forward it?

_____

_____

Q 14: How the record of orders is maintained at regional level?

_____

_____

Q 15: How many days it takes to complete the delivery process from regional level to particular agents?

_____

_____

Q 16: What is the order fulfilment rate at regional level? Either complete order has been processes according to agent's requirement or some part of the order?

_____

_____

Q 17: Have the regional manager set any performance measured dimension to deliver the order like order fulfilment or agents performance?

_____

_____

Q 18: Is there any priority level at regional level like if an agent that is financially strong and high sale as compared to other agents and the regional manager send him inventory on priority basis?

_____

_____

Q 19: At which days the operation manager receives the goods from factory warehouse and how it can be process to separate agent's particular demand?

_____

_____

Q 20: How do you calculate safety stock?

_____

_____

Q 21: Which method or technique you use usually for forecasting?

_____

_____

Q 22: What is the basis of forecasting?

_____

_____

Q 23: Did you consider any seasonal effect while forecasting?

_____

_____

Q 24: How safety stock of each and every SKU is being calculated at regional level?

_____

_____

Q 25: Did it ever happen that safety stock has finished?

_____

_____

Q 26: What is the lead time of inventory from regional level to agent?

_____

_____

7.3 Appendix 3:

Table-7.1: ABC analysis by traditional model

ABC Analysis by Traditional Model
SKU Wise Distributed Units (sales) 2008-2009
Lahore Region

SKUs #	Item Name	Total Distributed Units	Unit Price (Rs)	Lead Time (week)	Annual Usage (Rs)	Rank
1	Dalda Banas Pati 2.5 KG TIN	160090	349,55	1	55 959 460	6
2	Dalda Banas Pati 5 KG TIN	277175	679,42	1	188 318 239	3
3	Dalda Banas Pati Pouch 1KG	1911205	134,00	1	256 101 470	2
4	Dalda Banas Pati mini Pouch (500 GM)	20640	67,40	1	1 391 136	19
5	Dalda Cooking Oil 2.5 Ltr TIN	69396	346,54	1	24 048 490	7
6	Dalda Cooking Oil 5.0 Ltr TIN	214396	673,57	1	144 410 714	4
7	Dalda Cooking Oil Pouch 1 Ltr	2010417	133,00	1	267 385 461	1
8	Dalda Cooking Oil 3.0 Ltr Bottle(3 LTR X 6)	51515	407,50	1	20 992 363	8
9	Dalda Cooking Oil 4.5 Ltr Bottle (4.5 LTR)	22841	616,00	1	14 070 056	11
10	Dalda Cooking Oil Mini Pouch (500 ML)	39513	66,80	1	2 639 468	16
11	Dalda Cooking Oil 10.0 Ltr CAN	0	1 339,00	1	-	39
12	Planta Cooking Oil 2.5 Ltr TIN	3018	346,00	1	1 044 228	22
13	Planta Cooking Oil 5.0 Ltr TIN	19512	664,00	1	12 955 968	12
14	Planta Cooking Oil Pouch 1 LTR	54715	132,80	1	7 266 152	14
15	Planta Cooking Oil 3.0 LTR Bottle (3 LTR)	2636	407,50	1	1 074 170	21
16	Planta Cooking Oil 4.5 Ltr Bottle	2238	616,00	1	1 378 608	20
17	Dalda Canola 2.25 Round Tin	612	330,00	1	201 960	33
18	Dalda Canola 4.5 Round Tin	941	636,00	1	598 476	28
19	Dalda Canola 3.0 LTR Bottle	5230	407,50	1	2 131 225	17
20	Dalda Canola 4.5 LTR Bottle	5011	616,00	1	3 086 776	15
21	Dalda Canola Pouch 1 LTR	111334	132,80	1	14 785 155	10
22	Dalda Canola Oil 16 Ltr. Jerry Can	0	2 137,00	1	-	38
23	Dalda Canola Oil 10 Ltr. Jerry Can	150	1 340,00	1	201 000	34
24	Pomance Olive Oil 4 Ltr TIN	722	1 322,75	1	955 026	23
25	Pomance Olive Oil 3 Ltr TIN	0	1 018,50	1	-	40
26	Pomance Olive Oil 1 Ltr Bottle	0	352,67	1	-	41
27	Pomance Olive Oil 500 ML Bottle	0	211,58	1	-	43
28	Extra Virgin Oil 1 LTR Bottle	192	551,00	1	105 792	36
29	Extra Virgin Oil 500 ML Bottle	0	275,25	1	-	42
30	Extra Virgin Oil 250 ML Bottle	108	158,67	1	17 136	37
31	Extra Virgin Olive Oil 3 Ltr Tins	233	1 459,25	1	340 005	31
32	Extra Virgin Olive Oil 4 Ltr TIN	212	1 935,50	1	410 326	30
33	Manpasand Banaspati Pouch (0.9 KG)	99135	115,80	1	11 479 833	13
34	Manpasand Banaspati 2.25 KG JAR	2784	311,00	1	865 824	25
35	Manpasand Banaspati 4.5 KG JAR	1319	607,00	1	800 633	26
36	Manpasand Banaspati 2.25 KG TIN	3085	306,00	1	944 010	24
37	Manpasand Banaspati 4.5 KG TIN	2575	598,00	1	1 539 850	18
38	Manpasand Banaspati9 KG JAR	436	1 197,00	1	521 892	29
39	Manpasand Banaspati 0.9 KG	628592	114,00	1	71 659 488	5
40	Manpasand Banaspati 0.45 KG	13650	57,00	1	778 050	27
41	Manpasand Cooking Oil 4.5 LTR TIN	341	596,00	1	203 236	32
42	Manpasand Cooking Oil 2.25 TIN	400	304,00	1	121 600	35
43	Manpasand Cooking Oil Pouch (0.9 LTR)	149459	115,20	1	17 217 677	9

Source: (Own)

Table-7.2: Classification of SKUs by traditional model

Classification of SKUs by Traditional ABC Model
SKU wise Distributed Units (sales) 2008-2009
Lahore Region

SKUs No.	Value in Disanding Order	Cumulative Annual Usage	Annual Distributed Inventory %	Categary Assigned
7	267 385 461	267,385,461	23.70	A
3	265 101 470	523,486,931	46.41	A
2	188 318 239	711,805,170	63.10	A
6	144 410 714	856,215,883	75.91	A
39	71 659 488	927,875,371	82.26	B
1	55 959 460	983,834,831	87.22	B
5	24 048 490	1,007,883,321	89.35	B
8	20 992 363	1,028,875,684	91.21	B
43	17 217 677	1,046,093,361	92.74	B
21	14 785 155	1,060,878,516	94.05	B
9	14 070 056	1,074,948,572	95.30	B
13	12 955 968	1,087,904,540	96.45	B
33	11 479 833	1,099,384,373	97.46	C
14	7 266 152	1,106,650,525	98.11	C
20	3 086 776	1,109,737,301	98.38	C
10	2 639 468	1,112,376,769	98.61	C
19	2 131 225	1,114,507,994	98.80	C
37	1 539 850	1,116,047,844	98.94	C
4	1 391 136	1,117,438,980	99.06	C
16	1 378 608	1,118,817,588	99.19	C
15	1 074 170	1,119,891,758	99.28	C
12	1 044 228	1,120,935,986	99.37	C
24	955 026	1,121,891,012	99.46	C
36	944 010	1,122,835,022	99.54	C
34	865 824	1,123,700,846	99.62	C
35	800 633	1,124,501,479	99.69	C
40	778 050	1,125,279,529	99.76	C
18	598 476	1,125,878,005	99.81	C
38	521 892	1,126,399,897	99.86	C
32	410 326	1,126,810,223	99.89	C
31	340 005	1,127,150,228	99.92	C
41	203 236	1,127,353,464	99.94	C
17	201 960	1,127,555,424	99.96	C
23	201 000	1,127,756,424	99.98	C
42	1 216 100	1,127,878,024	99.99	C
28	105 792	1,127,983,816	100.00	C
30	17 136	1,128,000,952	100.00	C

Note: SKU# 11,22,25,26 27,29 show zero sales value these SKUs will not be consider in our calcuations.

Source: (Own)

Table-7.3: Safety stock calculation (Lead time 0.5 week)

Safety Stock Calculation (Lead time 0,5 week) Week wise level of safety stock of SKU Lahore Region					
SKU No	Desire service level	Classification	Mean absolute Deviation	Standard Deviation Safety Factor	Safety Stock(Ton)
7	99%	A	12,757	2,91	37,12
3	99%	A	11,767	2,91	34,24
2	99%	A	8,813	2,91	25,64
6	99%	A	6,169	2,91	17,95
32	99%	A	0,012	2,91	0,04
31	99%	B	0,010	2,91	0,03
23	99%	B	0,033	2,91	0,10
24	99%	B	0,043	2,91	0,13
38	99%	B	0,101	2,91	0,29
39	99%	B	7,310	2,91	21,27
1	99%	B	2,787	2,91	8,11
13	99%	B	0,688	2,91	2,00
9	99%	B	0,687	2,91	2,00
18	95%	C	0,089	2,06	0,18
20	95%	C	0,201	2,06	0,41
16	95%	C	0,073	2,06	0,15
35	95%	C	0,125	2,06	0,26
37	95%	C	0,204	2,06	0,42
41	95%	C	0,026	2,06	0,05
8	95%	C	1,048	2,06	2,16
28	95%	C	0,007	2,06	0,01
5	95%	C	1,187	2,06	2,44
19	95%	C	0,160	2,06	0,33
15	95%	C	0,050	2,06	0,10
17	95%	C	0,040	2,06	0,08
12	95%	C	0,113	2,06	0,23
34	95%	C	0,123	2,06	0,25
36	95%	C	0,117	2,06	0,24
42	95%	C	0,015	2,06	0,03
43	95%	C	1,569	2,06	3,23
21	95%	C	1,240	2,06	2,55
33	95%	C	1,179	2,06	2,43
14	95%	C	0,418	2,06	0,86
30	95%	C	0,002	2,06	0,004
10	95%	C	0,428	2,06	0,88
4	95%	C	0,203	2,06	0,42
40	95%	C	0,134	2,06	0,28
Total Safety Stock in Ton					166,95

Source: (Own)

Table-7.4: Safety stock calculation (Lead time 1.5 week)

Safety stock Calculation(Lead time 1,5 week) Week wise level of Safety Stock of SKU Lahore Region					
SKU No	Desire service level	Classification	Mean absolute Deviation	Standard Deviation Safety Factor	Safety Stock(Ton)
7	99%	A	21,007	2,91	61,13
3	99%	A	18,835	2,91	54,81
2	99%	A	14,450	2,91	42,05
6	99%	A	9,806	2,91	28,54
32	99%	A	0,021	2,91	0,06
31	99%	B	0,016	2,91	0,05
23	99%	B	0,055	2,91	0,16
24	99%	B	0,073	2,91	0,21
38	99%	B	0,169	2,91	0,49
39	99%	B	13,168	2,91	38,32
1	99%	B	4,416	2,91	12,85
13	99%	B	1,052	2,91	3,06
9	99%	B	1,138	2,91	3,31
18	95%	C	0,148	2,06	0,30
20	95%	C	0,331	2,06	0,68
16	95%	C	0,150	2,06	0,31
35	95%	C	0,211	2,06	0,43
37	95%	C	0,357	2,06	0,73
41	95%	C	0,043	2,06	0,09
8	95%	C	1,727	2,06	3,56
28	95%	C	0,008	2,06	0,02
5	95%	C	1,892	2,06	3,90
19	95%	C	0,272	2,06	0,56
15	95%	C	0,085	2,06	0,17
17	95%	C	0,057	2,06	0,12
12	95%	C	0,182	2,06	0,38
34	95%	C	0,204	2,06	0,42
36	95%	C	0,199	2,06	0,41
42	95%	C	0,025	2,06	0,05
43	95%	C	2,714	2,06	5,59
21	95%	C	2,260	2,06	4,66
33	95%	C	2,103	2,06	4,33
14	95%	C	0,734	2,06	1,51
30	95%	C	0,002	2,06	0,005
10	95%	C	0,723	2,06	1,49
4	95%	C	0,352	2,06	0,73
40	95%	C	0,221	2,06	0,45
Total Safety Stock in Ton					275,94

Source: (Own)

Table-7.5: week wise forecasting values of every SKU (1-2)

Week Wise Forcasted Values of Every SKU Lahore Region																			
weeks	SKU 7	SKU 3	SKU 2	SLU 6	SkU 32	SKU 31	SKU 23	SKU 24	SKU 38	SKU 39	SKU 1	SKU 13	SKU 9	SKU 18	SKU 20	SKU 16	SKU 35	SKU 37	SKU 41
1	23,53	25,19	17,64	12,73	-	-	0,119	0,006	-	11,861	4,25	1,141	1,800	-	0,388	0,088	-	0,083	-
2	29,41	31,48	22,04	15,92	-	-	0,149	0,008	-	14,826	5,31	1,426	2,250	-	0,485	0,110	-	0,104	-
3	37,06	39,67	27,78	20,06	-	-	0,187	0,009	-	18,681	6,69	1,797	2,835	-	0,611	0,139	-	0,131	-
4	43,24	46,28	32,40	23,40	-	-	0,219	0,011	-	21,795	7,81	2,097	3,308	-	0,713	0,162	-	0,153	-
5	62,60	67,22	47,06	33,99	-	-	0,318	0,016	-	31,654	11,34	3,045	4,804	-	1,035	0,235	-	0,222	-
6	42,48	44,19	33,66	23,21	-	-	0,159	-	-	16,517	11,26	2,008	2,742	0,100	0,528	0,147	-	0,111	-
7	36,01	36,21	30,33	19,88	-	-	0,079	-	-	9,179	13,08	1,649	1,826	0,185	0,279	0,114	-	0,055	-
8	36,47	35,74	32,04	20,29	-	-	0,040	-	-	5,739	15,85	1,634	1,483	0,263	0,159	0,107	-	0,028	-
9	47,78	46,09	43,02	26,70	-	-	0,020	-	-	4,710	22,83	2,112	1,651	0,401	0,115	0,133	-	0,014	-
10	32,48	30,21	31,37	17,65	0,005	0,005	0,025		0,005	7,285	13,94	1,522	1,262	0,362	0,162	0,084	-	0,099	0,006
11	29,13	27,99	30,49	15,26	0,013	0,008	0,032	0,025	0,013	11,037	10,75	1,460	1,285	0,422	0,237	0,068	-	0,187	0,011
12	30,51	27,29	33,56	15,61	0,016	0,009	0,041	0,053	0,016	14,674	10,06	1,596	1,452	0,510	0,312	0,067	-	0,264	0,016
13	39,19	33,58	44,27	19,77	0,023	0,014	0,056	0,086	0,028	21,067	12,05	2,097	1,941	0,704	0,447	0,082	-	0,387	0,024
14	22,21	19,64	23,73	11,18	0,012	0,007	0,028	0,051	0,014	-	6,48	1,125	1,111	0,352	0,235	0,066	-	0,194	0,023
15	14,43	13,45	13,89	7,23	0,006	0,004	0,014	0,036	0,007	-	3,82	0,660	0,735	0,176	0,132	0,065	-	0,097	0,025
16	11,50	11,38	9,55	5,73	0,003	0,002	0,007	0,032	0,004	-	2,65	0,455	0,598	0,088	0,085	0,074	-	0,048	0,031
17	10,98	11,39	7,96	5,45	0,001	0,001	0,003	0,032	0,002	-	2,23	0,380	0,581	0,044	0,066	0,088	-	0,024	0,037
18	13,81	14,76	9,05	6,83	0,001	0,000	0,002	0,042	0,001	-	2,56	0,433	0,738	0,022	0,070	0,124	-	0,012	0,054
19	20,77	21,75	12,58	9,13	0,007	0,004	0,001	0,028	0,004	0,887	3,26	0,593	0,912	0,011	0,108	0,068	-	0,102	0,086
20	31,19	32,43	18,38	13,14	0,013	0,009	0,000	0,023	0,007	1,791	4,60	0,860	1,270	0,005	0,163	0,042	-	0,195	0,131
21	45,31	47,00	26,46	18,81	0,020	0,013	0,000	0,025	0,011	2,822	6,54	1,236	1,797	0,003	0,237	0,033	-	0,303	0,192
22	57,32	59,42	33,37	23,69	0,026	0,017	0,000	0,028	0,014	3,658	8,22	1,558	2,255	0,001	0,301	0,031	-	0,391	0,243
23	34,79	37,38	23,31	16,02	0,015	0,010	-	0,018	0,007	2,071	5,55	1,166	1,445	0,003	0,180	0,065	-	0,204	0,121
24	26,59	30,19	21,59	14,26	0,011	0,008	-	0,015	0,004	1,399	4,93	1,163	1,199	0,005	0,135	0,107	-	0,115	0,061
25	30,15	36,18	29,01	18,59	0,012	0,009	-	0,019	0,002	1,366	6,41	1,646	1,472	0,009	0,150	0,191	-	0,080	0,030
26	33,93	41,73	34,93	22,15	0,014	0,010	-	0,023	0,001	1,431	7,63	2,016	1,715	0,012	0,168	0,249	-	0,066	0,015
27	29,08	30,16	25,95	18,48	0,011	0,008	-	0,058	0,198	11,012	6,55	2,069	1,176	0,020	0,260	0,200	-	0,442	0,008
28	27,76	25,22	22,23	17,32	0,010	0,008	-	0,080	0,315	16,739	6,25	2,191	0,936	0,025	0,323	0,182	-	0,667	0,004
29	37,02	30,35	27,31	22,80	0,012	0,010	-	0,129	0,536	28,026	8,34	3,120	1,077	0,039	0,498	0,235	-	1,113	0,002
30	47,16	37,15	33,71	28,90	0,015	0,013	-	0,175	0,736	38,350	10,63	4,066	1,293	0,052	0,667	0,296	-	1,523	0,001
31	56,63	43,92	39,99	34,65	0,018	0,015	-	0,215	0,908	47,257	12,76	4,925	1,516	0,063	0,815	0,353	-	1,876	0,000
32	46,48	38,68	29,70	22,65	0,029	0,022	-	0,188	-	24,530	8,06	2,776	1,725	-	0,648	0,257	-	0,960	0,014
33	52,31	46,08	30,38	19,86	0,045	0,034	-	0,222	-	13,707	6,72	1,890	2,409	-	0,709	0,257	-	0,515	0,030
34	60,06	54,25	33,31	19,88	0,059	0,043	-	0,261	-	8,536	6,50	1,530	3,009	-	0,804	0,278	-	0,298	0,042
35	70,00	63,90	38,00	21,67	0,072	0,053	-	0,307	-	6,252	6,94	1,455	3,631	-	0,932	0,316	-	0,197	0,052
36	48,67	43,83	26,52	16,86	0,041	0,030	-	0,159	0,060	7,323	5,52	1,052	2,349	-	0,625	0,212	0,21	0,108	0,027
37	47,47	42,01	25,98	18,64	0,028	0,022	-	0,090	0,105	10,756	6,23	1,076	2,078	-	0,582	0,199	0,46	0,069	0,016
38	54,23	47,50	29,76	22,77	0,024	0,020	-	0,058	0,151	14,747	7,69	1,263	2,229	-	0,646	0,221	0,70	0,055	0,011
39	64,97	56,64	35,70	28,09	0,025	0,021	-	0,045	0,198	18,998	9,53	1,532	2,592	-	0,764	0,262	0,93	0,053	0,009
40	40,09	37,94	23,29	19,21	0,012	0,010	-	0,025	0,113	12,047	6,67	1,324	1,832	-	0,456	0,200	0,50	0,026	0,005
41	36,20	39,41	23,21	20,58	0,006	0,005	-	0,019	0,087	11,439	7,38	1,848	2,054	-	0,412	0,248	0,33	0,013	0,002
42	39,01	46,15	26,56	24,49	0,003	0,003	-	0,017	0,083	12,728	8,93	2,458	2,500	-	0,437	0,315	0,26	0,007	0,001
43	42,32	51,93	29,60	27,74	0,002	0,001	-	0,017	0,085	14,009	10,18	2,903	2,887	-	0,470	0,366	0,24	0,003	0,001
44	48,73	60,83	34,52	32,59	0,001	0,001	-	0,019	0,095	16,242	12,00	3,474	3,370	-	0,540	0,435	0,25	0,002	0,000
45	33,10	37,75	22,95	20,28	0,014	0,011	-	0,013	0,047	9,259	7,19	2,011	2,022	-	0,342	0,250	0,22	0,016	0,005
46	32,43	32,20	21,82	17,37	0,032	0,024	-	0,012	0,024	6,697	5,76	1,504	1,623	-	0,303	0,183	0,28	0,035	0,010
47	41,62	37,43	27,46	20,27	0,056	0,043	-	0,016	0,012	6,657	6,34	1,549	1,791	-	0,363	0,184	0,41	0,061	0,018
48	50,19	43,38	32,86	23,52	0,074	0,056	-	0,019	0,006	7,155	7,17	1,696	2,027	-	0,426	0,199	0,52	0,080	0,024
49	34,55	27,49	19,26	14,38	0,039	0,030	-	0,012	0,006	3,924	4,56	1,154	1,237	-	0,291	0,151	0,27	0,040	0,012
50	32,13	22,86	14,07	11,30	0,023	0,017	-	0,009	0,009	2,506	3,81	1,058	0,969	-	0,269	0,157	0,15	0,020	0,006
51	35,66	23,44	12,89	11,07	0,016	0,011	-	0,009	0,012	1,971	3,92	1,162	0,947	-	0,297	0,186	0,09	0,010	0,003
52	41,47	26,21	13,51	12,08	0,013	0,009	-	0,010	0,015	1,852	4,40	1,346	1,032	-	0,344	0,222	0,06	0,005	0,001
SKU wise Total	1 992,4	1 915	1 390,0	984,12	0,877	0,651	1,499	2,771	3,940	557,178	400,11	89,305	94,748	3,877	20,734	9,104	5,88	11,858	1,409

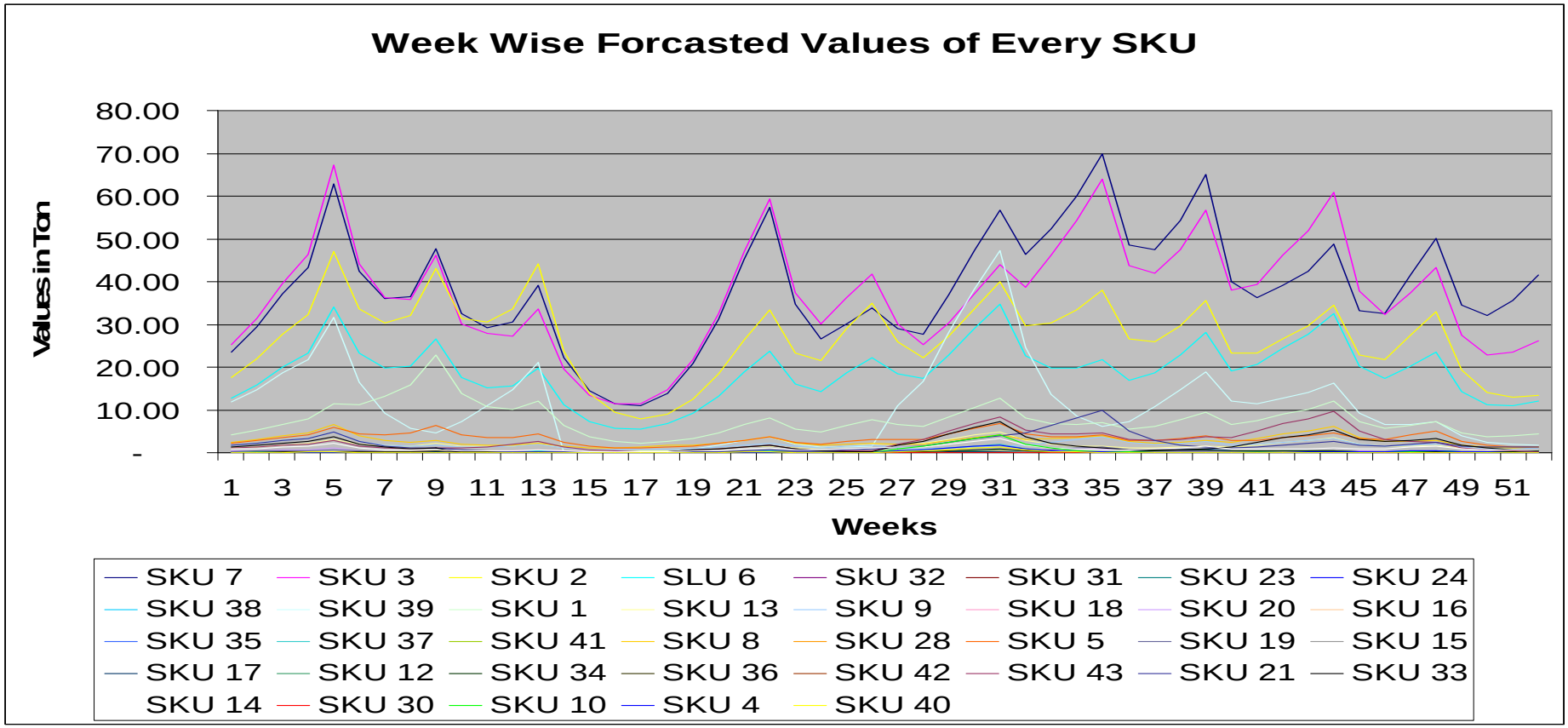
Source: (Own)

Table-7.6: week wise forecasting values of every SKU (2-2)

Week Wise Forcasted Values of Every SKU Lahore Region																			
weeks	SKU 8	SKU 28	SKU 5	SKU 19	SKU 15	SKU 17	SKU 12	SKU 34	SKU 36	SKU 42	SKU 43	SKU 21	SKU 33	SKU 14	SKU 30	SKU 10	SKU 4	SKU 40	Week Wise total
1	2,500	-	2,230	0,271	0,088	-	0,107	-	0,073	-	1,050	1,836	1,409	0,79	-	-	-	0,068	109,24
2	3,125	-	2,788	0,339	0,110	-	0,134	-	0,091	-	1,313	2,295	1,761	0,99	-	-	-	0,085	147,48
3	3,938	-	3,512	0,427	0,139	-	0,169	-	0,115	-	1,654	2,892	2,219	1,24	-	-	-	0,107	189,54
4	4,594	-	4,090	0,498	0,162	-	0,197	-	0,134	-	1,929	3,374	2,589	1,45	-	-	-	0,125	217,45
5	6,672	-	5,948	0,723	0,235	-	0,286	-	0,195	-	2,802	4,900	3,760	2,10	-	-	-	0,181	332,88
6	3,976	-	4,484	0,412	0,147	0,040	-	-	0,202	-	1,616	2,675	2,080	1,18	-	-	-	0,091	167,51
7	2,843	-	4,257	0,271	0,114	0,070	-	-	0,236	-	1,098	1,637	1,305	0,76	-	-	-	0,045	140,57
8	2,491	-	4,643	0,220	0,107	0,100	-	-	0,288	-	0,909	1,194	0,983	0,60	-	-	-	0,023	155,08
9	2,956	-	6,347	0,240	0,138	0,155	-	-	0,419	-	1,035	1,192	1,021	0,64	-	-	-	0,011	227,17
10	1,953	-	4,103	0,178	0,087	0,096	-	-	0,228	0,003	1,096	0,644	-	0,48	-	-	0,004	0,006	125,25
11	1,690	-	3,446	0,176	0,070	0,077	-	-	0,141	0,006	1,416	0,395	-	0,48	-	-	0,007	0,003	123,69
12	1,727	-	3,449	0,196	0,067	0,073	-	-	0,104	0,008	1,963	0,287	-	0,54	-	-	0,010	0,001	143,71
13	2,188	-	4,314	0,260	0,082	0,089	-	-	0,103	0,012	2,594	0,278	-	0,72	-	-	0,015	0,001	203,03
14	1,444	-	2,414	0,139	0,059	0,045	0,007	-	0,051	0,012	1,343	0,152	-	0,39	0,000	-	0,007	0,000	67,39
15	1,167	-	1,534	0,082	0,053	0,022	0,017	-	0,026	0,014	0,730	0,092	0,004	0,24	0,001	-	0,004	0,000	37,80
16	1,156	-	1,187	0,056	0,056	0,011	0,027	-	0,013	0,017	0,439	0,067	0,104	0,18	0,001	-	0,002	-	33,98
17	1,278	0,002	1,107	0,047	0,064	0,006	0,035	-	0,006	0,020	0,311	0,059	0,176	0,16	0,002	-	0,001	-	37,87
18	1,752	0,004	1,371	0,053	0,090	0,003	0,053	-	0,003	0,029	0,301	0,070	0,286	0,19	0,003	-	0,000	-	55,38
19	1,741	0,004	1,565	0,099	0,057	0,001	0,061	-	0,054	0,037	0,580	0,180	0,566	0,34	0,001	0,018	0,020	0,036	85,43
20	2,168	0,004	2,103	0,159	0,046	0,001	0,082	-	0,106	0,052	0,935	0,309	0,917	0,53	0,001	0,035	0,039	0,073	129,18
21	2,938	0,005	2,937	0,235	0,049	0,000	0,114	-	0,165	0,074	1,388	0,466	1,365	0,78	0,000	0,055	0,062	0,114	186,68
22	3,632	0,006	3,668	0,300	0,054	0,000	0,143	-	0,214	0,093	1,769	0,597	1,739	0,99	0,000	0,071	0,080	0,148	228,59
23	2,203	0,003	2,412	0,185	0,054	0,001	0,085	-	0,107	0,047	0,932	0,450	0,891	0,71	-	0,040	0,045	0,074	108,56
24	1,682	0,001	2,074	0,145	0,068	0,002	0,063	-	0,053	0,023	0,537	0,452	0,478	0,68	-	0,026	0,030	0,037	92,54
25	1,905	0,001	2,628	0,168	0,108	0,005	0,070	-	0,027	0,012	0,399	0,642	0,298	0,94	-	0,025	0,028	0,019	137,71
26	2,146	0,000	3,097	0,191	0,137	0,006	0,077	-	0,013	0,006	0,346	0,787	0,216	1,14	-	0,025	0,029	0,009	164,59
27	1,992	0,002	3,007	0,096	0,115	0,047	0,181	-	0,205	0,003	1,990	1,255	1,699	1,28	0,001	0,918	0,419	0,277	136,19
28	1,999	0,003	3,095	0,048	0,108	0,071	0,246	-	0,318	0,001	2,977	1,567	2,584	1,41	0,001	1,447	0,650	0,435	135,56
29	2,754	0,005	4,332	0,024	0,142	0,120	0,395	-	0,537	0,001	4,958	2,428	4,329	2,06	0,001	2,453	1,097	0,737	206,40
30	3,549	0,006	5,614	0,012	0,180	0,164	0,534	-	0,737	0,000	6,774	3,250	5,924	2,71	0,002	3,368	1,504	1,012	267,11
31	4,281	0,008	6,785	0,006	0,216	0,202	0,656	-	0,908	0,000	8,343	3,974	7,300	3,29	0,003	4,154	1,854	1,249	316,89
32	3,151	0,016	4,412	0,352	0,170	-	0,336	-	0,459	0,004	5,312	4,598	3,832	1,77	0,004	2,077	0,927	0,624	180,07
33	3,192	0,027	3,837	0,735	0,185	-	0,181	-	0,237	0,008	4,480	6,478	2,208	1,09	0,007	1,039	0,464	0,312	190,16
34	3,482	0,036	3,821	1,020	0,209	-	0,106	-	0,127	0,011	4,368	8,114	1,444	0,78	0,009	0,519	0,232	0,156	215,88
35	3,963	0,044	4,153	1,279	0,241	-	0,071	-	0,073	0,014	4,692	9,802	1,123	0,67	0,011	0,260	0,116	0,078	251,98
36	2,553	0,023	2,925	0,712	0,172	-	0,043	0,172	0,042	0,008	3,126	5,053	0,738	0,67	0,006	0,130	0,066	0,039	145,41
37	2,243	0,013	2,899	0,479	0,173	-	0,033	0,376	0,031	0,005	2,883	2,784	0,668	0,89	0,003	0,065	0,048	0,020	161,79
38	2,396	0,008	3,343	0,402	0,201	-	0,033	0,571	0,029	0,004	3,181	1,731	0,729	1,18	0,001	0,032	0,043	0,010	204,30
39	2,780	0,006	4,022	0,403	0,243	-	0,036	0,761	0,031	0,004	3,751	1,287	0,854	1,50	0,001	0,016	0,045	0,005	254,65
40	2,379	0,003	2,749	0,264	0,171	-	0,105	0,446	0,015	0,002	3,421	1,055	1,264	0,91	0,000	0,008	0,048	0,002	130,36
41	3,290	0,001	2,943	0,266	0,191	-	0,237	0,362	0,008	0,001	4,996	1,401	2,411	0,79	0,000	0,004	0,077	0,001	153,79
42	4,363	0,001	3,501	0,305	0,232	-	0,357	0,362	0,004	0,000	6,749	1,831	3,508	0,83	-	0,002	0,108	0,001	194,55
43	5,147	0,000	3,964	0,341	0,265	-	0,439	0,378	0,002	0,000	8,013	2,149	4,266	0,88	-	0,001	0,130	0,000	220,27
44	6,156	0,000	4,657	0,398	0,312	-	0,534	0,427	0,001	0,000	9,611	2,565	5,168	1,01	-	0,001	0,156	0,000	261,71
45	3,528	0,002	3,194	0,213	0,184	-	0,289	0,257	0,005	0,016	5,136	1,707	3,139	0,78	-	0,073	0,168	-	123,47
46	2,582	0,005	3,170	0,131	0,142	-	0,183	0,209	0,012	0,037	3,169	1,624	2,580	0,90	-	0,170	0,247	-	118,78
47	2,600	0,009	4,102	0,106	0,151	-	0,154	0,232	0,020	0,065	2,546	2,046	2,906	1,26	-	0,298	0,384	-	166,42
48	2,813	0,012	4,961	0,099	0,168	-	0,149	0,264	0,027	0,086	2,385	2,449	3,321	1,56	-	0,395	0,494	-	201,15
49	1,678	-	2,728	0,106	0,125	-	0,079	0,215	0,013	0,043	1,207	1,538	1,766	0,92	-	0,197	0,261	-	93,92
50	1,264	-	1,754	0,142	0,126	-	0,047	0,237	0,007	0,022	0,627	1,260	1,048	0,67	-	0,099	0,152	-	80,93
51	1,193	-	1,390	0,189	0,147	-	0,034	0,290	0,003	0,011	0,344	1,278	0,741	0,62	-	0,049	0,105	-	93,83
52	1,274	-	1,315	0,236	0,175	-	0,029	0,351	0,002		0,209	1,421	0,633	0,65	-	0,025	0,088	-	112,08
SKU wise Total	142,466	0,259	174,381	14,435	7,183	1,408	7,214	5,909	7,021	0,809	135,731	102,565	90,351	50,34	0,059	18,095	10,262	6,218	

Source: (Own)

Figure-7.1 : Week wise forecasted graph of every SKU



Source:(Own)

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