SUPPLY CHAIN MANAGEMENT ISSUES IN AN ANCILLIARY ORGANISATION

By
SANJAY KUMAR
(11/ME/02)

A MAJOR PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF
THE DEGREE OF
MASTER OF ENGINEERING
IN
MECHANICAL ENGINEERING (PRODUCTION ENGINEERING)
(UNIVERSITY OF DELHI)

DELHI COLLEGE OF ENGINEERING
DELHI 110042

CERTIFICATE

This is to certify that the major project titled “Supply Chain Managements Issues in an Ancilliary Organisation: submitted by Sanjay Kumar (11/ME/02) in a bonafide record of work carried out under my supervision & guidance. The project matter contained herein has not been submitted to any other university or institute for the award of any Degree.

Dr. S. K. Garg

Professor

Department of Mechanical Engineering
DELHI COLLEGE OF ENGINEERING
DELHI-110042

Candidate's Declartion

I hereby declare that the project submitted tittled " Supply Chain Management Issues in an Ancilliary Organisation" partial fulfillment of the requirments for the award of the degree of Master of Engineering in Mechanical Engineering (Production Engineering is an authentic record of my own work carried out under the kind supervision & guidance of Dr. S.K. Garg, Professor Department of Mechanical Enginnering , Delhi College of Engineering, Delhi.

I have not submitted the matter to any other university or institute for the award of any degree.

Sanjay Kuamr
11/ME/02

This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Dr. S. K. Garg
Professor
Department of Mechanical Engineering
Delhi College of Engineering,
Delhi-110042 (India)

Acknowledgement

In this world of break-neck competition, supersonic pace and hectic schedule, the present work could not have seen the light of the day without support and help of a number of people. First of all I wish to thank my project guide - Prof. S.K. Garg , Mechanical Engineering Department, Delhi College of Engineering , not only for suggesting such an interesting topic to work on, but also for guiding the work and helping us to think objectively by giving his valuable assistance and also for the valuable effort on the behalf of imparting education and wonderful learning experience throughout the length of this project. I would also like thanking all my professors for all their contributions which can never be forgotten.

This report submission could not happen with out the all time support of Dr. Sanjay Jain, Director , Guru Premsukh Memorial College of Engineering, Delhi. Credit goes to all my colleagues specialy Mr. Rohit Arora & Mr. Sonu Malhotra. Also thanks goes to Mr. Kshitiz Sharma, Ms. Kanika, Ms. Divya for their valueable help.

Finally, I would lilke to express my love & thanks to my beloved wife & beloved daughters.

Sanjay Kumar
11/ME/2002

Executive Summary

In the current scenario of globalisation, it has become important to see single organization as a part of supply chain to add on value to the product to excel in their respective fields to create and sustain a competitive advantage over their competitors around the globe. Now supply chain & supply chain management issues have become more significant to the success of a firm. In Indian context, lot of efforts have been already done to cut excess cost & time out of production processes, but one front is still to be taken care of to gain competitive advantage & that is supply chain management which is integration & management of supply chain organizations and activities through cooperative organizational relationship, effective business processes & high levels of information sharing to create high performance value system that provides member organizations a suitable competitive advantage.

In the field of supply chain management, a lot of work has been done on high volume organizations or make to stock organization, but very less work has been done on supply chain management issues in an ancilliary organization. This project is an effort in the same direction. In this project an ancilliary organization called Bharat Precision Products situated at Rohtak (Haryana) is taken and detailed analysis of different supply chain management issues has been done. Bharat Precision Products is an ancilliary organization manufacturing specialized make to order nuts & bolts for automobile & tractors manufactures like HERO HONDA, HMT etc. Detailed analysis of upstream processes and elements, internal microlevel issues & down stream process has been done. Here purchasing issues, organization structure of the company, quality practices, invertory, layout, demand & supply patterns, lead time analysis of selected products, human resources, marketing issues including customers of Bharat Precision Proudcts, Product range has been dealt with the help of SWOT Analysis and SAP LAP Analysis.

During the study it is observed that the company should go for vertical & horizontal integration, implementation of group technology reduction in inventory level, implementation of scheduling and sequencing techniques and more use of IT to improve the performance of the company. The study has been limited upto the recommendation part only, Actions on these recommendation and the performance monitoring have not been dealt with. Implementation part maybe handled as

future work and corresponding performance feedback can be compared with the existing performance to judge the effectiveness of each recommendation.

CONTENTS

List of Tables

List of Figures

LIST OF ABBREVATIONS

BPP	BHARAT PRECISION PRODUCTS
CAL-	CALIBRATION
DSP	DESPATCH
FST	FINISHED GOODS STORE
HOD	HEAD OF DEPARTMENT
HRD	HUMAN RESOURCE DEVELOPMENT
JIT	JUST IN TIME
LO	LAYOUT
MKT	MARKETING
MNT	MAINTENANCE
MR	MANAGEMNT REPRESENTATIVE
PRD-	PRODUCTION DEPARTMENT
PROP	PROPRIETOR
PUR-	PURCHASE
QMD	QUALITY MANAGEMNT SYSTEM
R&D	RESEARCH & DEVELOPMENT
SC	SUPPLY CHAIN
SCM	SUPPLY CHAIN MANAGEMENT
STI-	STORE INCOMING
SYS-	SYSTEM
TRG-	TRAINING

GLOSSARY OF TERMS

Glossary

1. **Supply Chain** : A supply chain is the network of autonomous and semi autonomous business entities which are involved through upstream and downstream linkages in the different processes and activities that produce value in the form of physical products and services in the hands of the ultimate customers.

2. **Supply Chain Management**: Supply Chain Management is the integration and management of supply chain organizations and activities through cooperative organizational relationships, effective business processes and high levels of information sharing to create high performance value systems that provide member organizations a suitable competitive advantage.

3. **Flexible Manufacturing System** : A flexible manufacturing system is a highly automated group technology machine cell, consisting of a group of processing workstations, interconnected by an automated material handling and storage system, and controlled by a distributed computer system.

4. **Group Technology**: Group Technology is a manufacturing philosophy in which similar parts are identified and grouped together to take advantage of their similarities in design and production.

5. **Just In Time**: Just in time is a manufacturing philosophy, which aims at having the right part at precise time and in the right quantity to go into assembly.

6. **Productivity**: Productivity is the quotient obtained by dividing output by one of the factors of production.

CHAPTER 1

Introduction

1.1 Introduction

In today's highly competitive global market place the pressure on organization to find new ways to create & deliver value to customers grows ever stronger. The supply chain & supply chain management issues has become significant to the success of a firm. Now the question arises why the supply chain is so important to success. Because it is new frontier of business modern manufacturing has driven most of the excess cost & time out of the production process so there is little advantage to be gained on the shop floor but supply chains are still wasteful & error prone & they offer large opportunities for gaining competitive advantage. Supply chain management is an approach to create high performance value systems that provide a suitable competitive advantage by integrating & marketing supply chain organizations & activities through cooperative relationships effective business process & high levels of information sharing.

1.2 **Supply Chain**

A supply chain is the network of autonomous and semi autonomous business entities which are involved through upstream and downstream linkages in the different processes and activities that produce value in the form of physical products and services in the hands of the ultimate customers.

A supply chain consists of all parties involved, directly or indirectly in fulfilling a customer request. The supply chain includes manufacturers, suppliers, transporters, warehouses and customers. It provides the route through which the raw material is converted into finished good/services into the hands of the consumers. Supply chain covers the "flow of goods from suppliers through manufacturing and distribution chains to the end users". Within each organization such as manufacturers, the supply chain includes all functions involved in receiving and fulfilling a customer's request. These functions include, but are not limited to new product development, marketing, operations, distribution, finance and customer service.

A supply chain is dynamic and involves the constant flow of information, product and funds between different stages. Customer is an integral part of the supply chain. The primary purpose for the existence of any supply chain is to satisfy customers needs and in the process generating profits for itself.

The supply chain encompasses all organizations and activities associated with the flow and transformation of goods from the raw materials stage, through to the end user, as well as the associated information flows. Material and information flows both up and down the supply chain. (Handfield and Nichols, 2003)

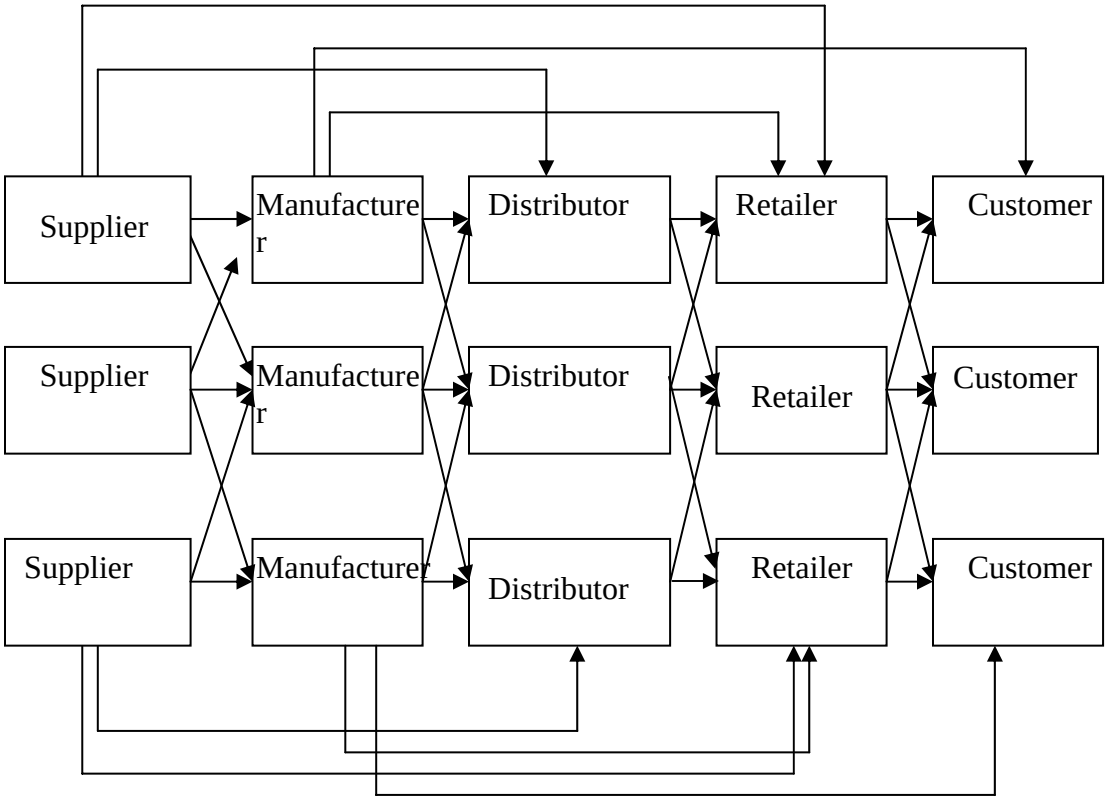


Figure 1.1 Supply Chain Stages (Chopra and Meindl, 2004)

1.3 Supply Chain Management (SCM)

Is the integration and management of supply chain organizations and activities through cooperative organizational relationships, effective business processes and high levels of information sharing to create high performance value systems that provide member organizations a suitable competitive advantage. (Hardfield and Nichols, 2003).

From the local firm's perspective, the supply chain includes upstream suppliers, internal functions, and downstream customers. A firm's internal functions include the different processes used in transforming the inputs provided by the supplier network.

In the case of an automotive company, this includes all of its parts manufacturing (e.g., stamping, power train and components) which are eventually brought together in actual automobiles. Coordinating and scheduling these internal flows is challenging, particularly in a large organization such as an automotive company. For example, order processing managers are responsible for translating customer requirements into actual orders, which are put into system.

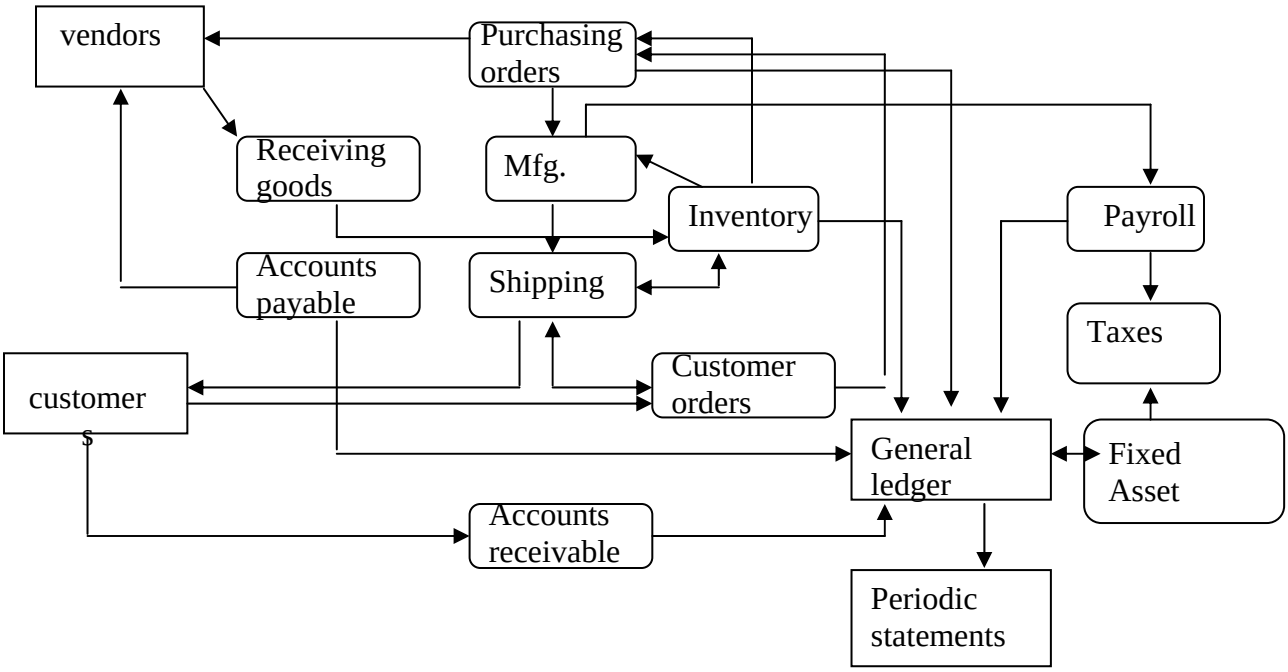


Figure 1.2 : Supply Chain Management Process, (Chopra and Meindl, 2004)

In the case of an automotive company, these individuals work primarily with the extensive dealer network to ensure that the right mixes of automobiles and service parts are available so that the dealers can meet the needs of the customers. Order processing may also involve extensive customer interaction, including quoting prices, discussing delivery dates and other shipment requirements, and after market service. Another important internal function is production scheduling, which translates orders into actual production tasks. This may involve

working with material requirements planning systems, scheduling work centers, employees, capacity planning and machine maintenance.

The second major part of supply chain management involves upstream external supply chain members. In order to manage the flow of materials between all of the upstream organizations in a supply chain, firms employ an array of personnel who ensure that the right materials arrive at the right location at the right time. The purchasing function serves as the critical interfacing interface with the upstream supplier. Purchasing managers are responsible for ensuring that:

1) The right members are selected.
2) Suppliers are meeting performance expectations.
3) Appropriate contractual mechanisms are applied.
4) An appropriate relationship is maintained with all the suppliers

They may also be responsible for driving improvement in the supply base and acting as liaisons between suppliers and other internal members. Material managers are responsible for planning, forecasting, and play an important role coordinating a wide range of activities. Materials managers play an important role coordinating a wide range of activities. Materials managers work closely with production schedulers to ensure that suppliers are able to deliver the materials on time to the required locations, and that they have some visibility regarding future requirements so that they can plan ahead of actual production and delivery dates.

Finally, a firm's external downstream supply chain encompasses all of the downstream organizations, processes and functions that the product passes through o its way to the end customer. In the case of an automotive company's distribution network, this includes its finished goods and pipeline inventory, warehouses, dealer network, and sales operations. This distribution channel is relatively small. (Hardfield and Nichols, 2003)

The concept of supply chain management is important as it provides a framework of information, materials and finance of the enterprise, right from the suppliers to the customers. The coordination elements of the supply chain includes:

- Procurement also known as Source
- Manufacturing also known as Make
- Logistics also known as Move
- Warehousing also known as Store

- Market also known as Sell

1.4 Objectives of the study

In the current scenario of economic labialisation & opening up of the Indian economy after 1991. It has become important to analyses single organization as a part of supply chain system to add on value to the product to excel in their respective fields to create & sustain a competitive advantage over their competitors around the globe. In the field of supply chain management a lot of work has been done on high volume organizations but of not much of work has been done on Ancillary organizations. Here is an effort in the same direction to explore different areas/issues involved in SCM practice in an ancillary organization with following objectives.

- To develop an understanding of supply chain & supply chain management.
- To Study different SCM Issue in an ancillary organization.
- To identify areas of strengths & weakness for selected ancillary organization.
- To explore new opportunities & win over the threads from external environment.
- To identity area for using IT in an ancillary organization.
- To explore potential means of improvements.
- To support the improvements from the analysis.

1.5 Scope of the study

The project has limited the scope of the study to the ancillary organization only as the scope of SCM is very large & lot of work has been already done on SCM practice in high volume organization so here SCM issues are dealt with selected to an ancillary organization only.

1.6 Methodology

There are many dimensions of SCM practices, which are qualitative, & quantitative in nature, so after defining objectives, extensive of literature reviewing has been done. The literature includes

- Journals on concerned areas.
- Book on Supply Chain Management
- Unpublished literature from different source.

After the review of the literature, case study of different SCM issues in BPP was done & data (both qualitative & qualitative in nature) was collected by

- Talking to senior level management representatives, Engineers, Workers of BPP
- Time Watch study.
- Questionnaires
- Telephonic discussion
- Observation
- Through schedules & records of BPP

After collection of data, analysis was done with the help of making certain tables (made from collected data after summarization) then generalization & interpolation took place, which then led to conclusion & suggestion.

1.7 Conclusions

In this chapter supply chain & supply chain management have been defined. The objectives & scope of the study (which is limited to the ancillary organization only) here been dealt with. To carry out this research suitable methodology (devised for it) is clearly specified. Now in next chapter we are going to see what literatures have been reviewed to make the basis of their research.

CHAPTER 2

Literature Review

2.1 Introduction

Extensive literature revised has been done which includes journals, books on different topics, and unpublished literature from different sources. Few of the important & relevant portions are here dealt with (Like different models related to SC, SC decision phases, process view , system view of SC, Mapping, performance, JIT Quality aspects etc.)

2.2. Different Models related to supply chain

2.1.1 Classification of Models

Business models come is a wide variety of forms, but most of them fall into one of the three broad categories.

- Conceptual models
- Mathematical models
- Simulation models

Conceptual Models use diagrams and description to represent a Business system. They can be created on whiteboards, computer screen, or the backs of envelopes, and they provide simple, familiar structures for reasoning about the business. Mathematical models represent a business in terms of formulas and procedures, and they are solved by evaluating those formulas or procedures under a particular set of assumptions. Simulation models use software objects to represent the components of a business and they are solved by running the model to see what happens when the objects interact with each other. Mathematical and simulation models are often referred to as formal models because they have strict forms and generate numerical predictions, in contrast to the informally of conceptual models.

2.2.2 Conceptual Models

The conceptual model is by far the simplest of the three types. This sort of model is basically a description of a business system and is usually expressed as some combination of diagrams and explanations. To a large extent, the format depends on the experience of the

modelers-those with the most training in modeling usually rely on detailed diagrams with formal notation to reduce ambiguity.

By contrast, those- with little or no training tend to express their models as verbal descriptions mixed with stories about how the business works-stories that can often be formalized as scenarios. Although generally less precise than diagrams, descriptions and scenarios often capture the nature of the business in a way that formal .I diagrams cannot. The best conceptual models are usually a mix of can -diagrams, descriptions, and scenarios.

Regardless of how you express a conceptual model the key is to find the right balance between precision and ease of communication. For systems analysts trained in the use of entity relationship (ER) diagramming, formal ER diagrams and detailed scenarios may be just the right tools. For managers who have never engaged in business modeling before, the right balance may be a combination of simple diagrams and informal explanations. But even with managers, some conventions are necessary to make the diagrams and explanations make sense. Otherwise the output of the process contains more myth than model.

The diagrams in this book generally follow the conventions of convergent engineering, a modeling technique I developed specifically to help managers formulate useful business models. In this approach, a business system consists of three basic kinds of objects

Organizations, processes and resources. Each of these objects plays a different role in the model, and the three relate to each other in ways that both constrain the model and make it more understandable at the business level. Briefly put, organizations own resources and execute processes; processes consume one set of resources and generate another set; and resources, are the source of all cost and value in the system. There is much more to the approach than this, of course but this one-sentence summary illustrates what I view as an appropriate level of formalism for managers, and it should make the illustrations more meaningful to you as well.

Conceptual models can be developed by individuals, but for systems that cross organizational boundaries, as supply chains inevitably do, the best approach is to assemble a team of representatives from all effective the groups involved and hammer out the model together. Many software tools have been designed to support this group design process, but low-tech tools are often the most effective. Personally, I have always got the best results from a combination of white- Board diagrams and 5 x 7 index cards. Each card represents one of the organizations, processes, or resources required for the model, and participants take turns role-

playing these objects as they inter-act in the operation of the business. The resulting process is highly engaging, often contentious, and always educational as participants discover that each has a radically different understanding of how. The business actually works. Once the group has assembled a consensus model out of its various conflicting perspectives, it has a solid foundation on which to build a better system

Although conceptual models form the basis for understanding systems they are of little value in prediction and control. It should be clear from the preceding chapter that even the simplest models can produce surprising interactions as soon as two or more components are hooked together, and our minds are simply not equipped to extrapolate the effects of these interactions. When we do try to puzzle out the behavior of a system, most of us tacitly assume that all the relations involved are linear. For reasons that psychologists are still teasing out, it is extremely difficult for us to extrapolate the behavior of nonlinear interactions, so we naturally tend to work within our limitations and oversimplify real-world relationships. Going beyond these limitations requires us to turn to more powerful kinds of models.

2.2.3 Mathematical Model

Remember those word problems you hated as a kid? They went mathematical something like this: If a boat moving upstream in a river flowing at models 2 miles an hour takes 4 hours to travel 3 miles, how many people were in the boat? These designed to teach you how to generate and apply mathematical models. And despite this early training, you do use mathematical models today. You just don't formally.

For examp1e, suppose your boss asks you how much it would cost to run batches of 1,000,2,000, or 3,000 audio CDs. You know that linear model it Costs $1,000 to set up the run and a dollar to make each CD once the run begins, so your total cost would be $1,000 plus $1 times the number of CDs, giving you $2,000, $3,000, and $4,000 for the three' quantities. In working up those numbers, you used one of the most common mathematical models in all of business-a linear, model. In effect, your model predicts a linear relation between cost and the number of CDs produce

Like all systems, mathematical models have inputs and outputs. In Models have the linear model the input is represented by inputs and the letter x and the output by y. As you twist the knob to vary the outputs value of x, the reading for y moves up the graph in a straight line. The other two quantities, labeled a and b, are called parameter. Calculating numerical solutions for

anything but the simplest of run mathematic- models can quickly become tedious, but this grunt work is almost always done by computers. The most common tool for mathematical modeling is a spreadsheet program such as Microsoft Excel.

Spreadsheets started as out tools for accountants, but their primary use today is in building business models. These models usually deal with financial flows, but the numbers can just as easily express the flow of supply or demand. For example, spreadsheets are often used to build demand forecasts but spreadsheets aren't the only tools for implementing mathematical models-many of the supply chain applications described in the next chapter use specialized mathematical models to perform their calculations.

Given the difficulty of building and using mathematical models, there has to be a good reason to use them, and there is. Unlike conceptual models, where the behavior of the model can be a subject of much debate, mathematical models are unambiguous; you plug in (the numbers as inputs and you get clear, quantitative results. That's a powerful advantage in dealing with complex systems in which behavior can often be hard to understand, much less predict.

There is, however, an even better reason for using mathematical models: In many situations, they can not only tell you what output you can expect from a given set of inputs, they can tell you what inputs to use in order to produce the best possible output. This remarkable ability, known as optimization, can be a tremendous tool for making decisions about how to run a supply chain. What optimization does is a lot like curve fitting, but instead of looking for parameter values that match a given set of outputs, optimization looks for values that produce the best outputs, and you get to tell it what constitutes "best." For example, you could model the way profit depends on both price and sales, including the interaction between the two, then solve the model mathematically to find the price that maximizes your profit.

In supply chain management, the most commonly used optimization technique is linear programming (LP). Linear programming is an extremely powerful management tool one that comes about as close to magic as anything in business. Linear programming can be done in Excel, using its built-in optimizer, but the really powerful LP optimizers are found in the supply chain design and it: planning tools described in the next chapter. Skilled modelers use these systems to construct models that include thousands of parameters, representing such factors as historical demand levels, plant and warehouse capacities, material and labor costs, transportation rates, and required service levels. They then run the models to discover the best mix of products

to build at each plant the most cost-effective sources for each customer region, and other optimal values.

There is a price to be paid for all this power: Linear programming makes some rather stamen simply assumptions about the real-world system. As the name linear programming suggests, one assumption is that all relations be of the well-behaved linear form, so all the true, rogues in the gallery are banished. But in situations where the assumptions come reasonably close to the reality, the optimizations provided by linear programming can be immensely valuable. There are also variants of linear programming that relax, some of these constraints. These alternatives usually take longer to computer

Solutions, but they are still guaranteed to produce optimal solutions.

2.2.4 Simulation Model

As preceding paragraph suggests, much of the power of, mathematical models comes from distilling complex relation-ships down into relatively simple mathematical forms. For systems with known relationships that can be captured in equations, mathematical models are usually the best way to go. But sometimes the relations among components don't conform to simple equations. Alternatively, they may fit an equation just fine but there is no way of knowing what that equation might be. In such cases, simulation models are usually a better approach. Like a mathematical model a simulation is a special kind of system, with is, outputs, and parameters. The difference is that simulations bit more literal than mathematical models: They just try to the behavior of a system's components rather than distilling behavior down to an equation.

In essence, building a simulation consists of programming a number software objects to act out the roles of real-world objects, running the system to see how those objects interact with other under realistic business conditions. The objects represent customers and suppliers, orders and shipments, materials and products vehicles and container, and all the other elements of supply described in this book. In the program, these objects affect other just as they do in the real world: Customer objects create order objects and send them to supplier objects, which ship product objects using vehicle and container objects, and so on. In a good simulation, these objects are modeled at a fine level of detail. The more detailed and accurate the simulation, the more precise and label the predictions about supply chain performance.

As with mathematical models, simulations can be constructed using a variety of tools. A really simple simulation can be conducted with something as low-tech as index cards, with

people holding the cards and acting out the roles of the various objects. Simulations can also be expressed in software using conventional programming languages. However, the most cost-effective approach is usually to use a commercial simulation system. These stems include graphical tools for building models, automated routines for testing them under different conditions, and reporting tools for analyzing the results. Although general-purpose simulations are available and can be used, the best choice is a specialized tool built just for simulating supply chains. These dedicated simulation include prebuilt objects for all the usual supply chain elements allowing powerful simulations to be assembled and tested with minimum of effort.

Once you have constructed a simulation model you test it by running it. First, you initialize the objects in the system by setting their parameters to reflect real-world production capacities, shipment times, material and labor costs, retail prices, the like. You then start the simulator and feed it a sequence of inputs they would occur in real time, including shifting levels of dell seasonal variations in price, and so on. As the model runs, it generates outputs indicating the speed with which demand is satisfied, amount of inventory held at each facility, the total cost to operate the system, and other measures of supply chain performance. Up to this point, running a simulation model is a lot like running mathematical model: You set up the parameters, pass in the input and see That you get in the way of outputs. But simulations go there than most mathematical models in that they allow the parameters and inputs to vary about some average value rather than being locked down to a fixed value. It is possible to incorporate kind of variability into mathematical models, but in systems as I as supply chains, the computational power required is usually too great for these techniques to be of much value. Simulators, on the other hand, incorporate variability quite naturally adds importance because sales, shipments, prices, and countless other aspects of supply chains vary quite a bit in real-world supply chains, 's variability has a major impact on how the chains perform. It’s not just a matter of causing variability in the outputs, although 'certainly is one outcome. The more important concern about ability is how it affects the way you manage the chain.

As an example of this, consider a kind of variability that is especially problematical for supply chains: variability in demand. Imagine that you have a product-a particular kind of sofa, say-that is selling at a rite of 100 a week. You can simply use that value as a parameter the model, but that simplification glosses over a very important. Some weeks you sell more than 100, and some weeks you sell less. In any given week you have to be ready to handle the actual

sales for that week, not just the average sales, which means you need to maintain extra inventory to buffer variability in and how much inventory? It depends on how much variability in demand. How much inventory? It depends on how much variability in demand. How much Inventory? It depends on how much variability its you have. If your weekly sales vary quite bit, you need to be able to supply as many as 150 sofas a week to avoid running out. If you have only half this amount of variability, as shown in Case B, then 125 sofas will probably be enough. In either case, having just the average number of 100 sofas on hand pretty much guarantees that you will run out of' stock at least half the time. A model based only on average demand would not produce a viable business result.

The way models handle this sort of variability is by using distributions. If you take a large number of data points and plot the1otal number of times you get sales of each number of sofas, the result will be distributions of values the ones. The particular distribution shown follow a very common form, called the normal distribution, which has a mathematical formula with just two parameters: the mean which is the formal name for the numerical average, and the standard deviation, which is a measure of the variability. In Figurers' both distributions have a mean of 100, but the upper one has a standard deviation of 15, twice that of the lower figure. To capture his variability in weekly demand, then, you tell the model to use normal distribution and give it two parameters-the mean and the standard deviation-rather than just the mean. Given this richer input, the model can randomly vary the level of demand to reflect the way it varies in reality, producing a much more accurate simulation.

Adding variability to a simulation makes it more accurate, but it also complicated matters because the results of running the model now have a random element to them. If the output can vary each run a model you can't just run it once and take the results as definitive. Instead, you have to run it many times and average results to see how the model is most likely to behave realistic range of circumstances. This technique of running many times with random values is called the Monte Carlo Method, in recognition of the role that chance plays in the out-comes. It may sound tedious to do many runs and pool the results, by simulation tools handle all that automatically. The only real cost to the multiple runs is the time spent waiting for the results.

A Monte Carlo series provides a detailed look at how a supply chain , will perform under a single set of realistic business conditions. This may be sufficient to validate the results of mathematical modeling , but it doesn't do anything to improve those results. The way to at is to

vary the design in some systematic manner, running a Monte Carlo series on each variation and comparing the results. For example, you could seek the optimal level of safety stock under a of demand situations by simulating each level and comparing the results. Alternatively, you might want to compare the cost and benefits of varying the number of warehouses over a specified range.

Although simulations are better than mathematical models at ring the effects of variability, they aren't as good at finding) I solutions. The best you can do with a simulator is to vary the value of one or more parameters in a systematic way and I for the one that gives you the best fit. That can be tedious, but simulators support a technique called hill-climbing to accelerate the process. Rather than try out every possible value of a parameter, the simulator starts with a value provided as input, runs the model to determine how well it performs using that value, and then explores nearby values to see if it can improve on that performance. For example, if the parameter is initialized at a value of 30, the simulator would try out values just above and below 30, quickly discovering that only an increase' the value improved performance. Through a series such tests, would gradually home in on 50 as the best value.

2.2.5. Combining Models

The fact that three very different kinds of business models are begs the question of which one is best. The answer to that on depends on two things. The nature of the problem you are) to solve, and the kind of answers you are looking for. This section of the chapter offers a few suggestions about when .How to use each of the three kinds of model

This most important consideration is to apply each kind of model to ms it is best at solving. If your goal is to understand how the current supply chain works and explore ways to improve it, the may be a well-stated conceptual model. In fact, introducing mathematics or simulations can often do more harm than good by clouding the essential issues with irrelevant detail. If, on hand, the problem is one of choosing among a number of well-defined alternatives whose behavior can be stated in the form of equation, nothing can match the power of a mathematical the behavior of the chain can't be reduced to familiar, or if the problem at hand concerns the effects of variability performance, a simulation is usually the best choice.

Because the three kinds of models have complementary strengths, problems are best attacked with two or more models is on. Conceptual models are usually the best place to start require the least amount of training to use, and they indispensable in developing a shared

understanding of and its possible solutions. The best starting point is usually al model because it provides a quick way to identify the key information required for building a formal model. Once the formal model has been explored; the results can be mapped back to the conceptual model with appropriate modifications, to communicate the key insights to other managers.

If it isn't clear based on the problem which kind of formal mode use, consider using both. One option is to use a mathematical model to find an optimal solution, then use a simulation to make sure the results are robust across -the many kin variability that can affect the performance of the system. The other option is to use a simulator to get a better feel for how the supply chain works, then use the results to formulate a mathematical model suitable for optimization. The ideal is to move fluidly among all three kinds, using each to gain insights about the other until the best solution emerges.

All three kinds of models-including conceptual models-requires special training in order to use them effectively. Unfortunately, training in the use of models almost always focuses on one type the exclusion of others, or even on a single method within type. Systems analysts are commonly trained in the use of structured conceptual models such as entity-relationship diagram financial analysts and operations analysts are usually trained to mathematical models, and so on. In looking for specialists to he you in your own modeling efforts, it's important to find people are fluent in all three types. To paraphrase the old saying, if you hire someone who only has a hammer, all your problem will look like nails.

Regardless of who constructs your formal models, you should be careful about delegating conceptual models. At this level, the most important modelers in the company are you and your fellow managers. You are the ones with the firsthand knowledge of how the supply chain is constructed, the real-world experience in how well it’s working and the responsibility to make it work better. The best way to start any effort to model the supply chain is by gathering together the managers who make the chain work, bringing in a professional facilitator, and building a conceptual model. Once you have that model in hand, then you can bring in specialists to translate it into a formal model and analyze it in further details. (Taylor, 2004)

2.2.6. Steven Model Of Supply Chain Integration

Stevens (1989) and Stevens et al. (1995) have provided a simple model to understand supply chain integration. It involves transforming enterprise from an inward looking to a flexible

outward looking in an overall efficient manner. The transformation can be performed in an effective manner through a series of phrased steps. These steps involve the recognition of technological, organizational and attitudinal attributes. Integration of the supply chain is a four-stage process as given in Table 2.1

Stage 1	Base line	Understanding of material flow from purchasing to distribution
Stage 2	Functional Integration	Understanding the functionality of material management, manufacturing management and distribution
Stage 3	Internal Integration	Internal integration of material management, manufacturing management and distribution
Stage 4	External	Integration of suppliers, internal supply chain and customers

Table No. 2.1 Integration of supply chain in four stages, (Shankar Ravi, 2003)

There are two common approaches for evolving a supply- chain-management environment

(a) Internal Integration

- Integrated System (e.g., ERP solutions such as SAP R/3)
- Link functions such as purchasing, manufacturing, inventory, finance, marketing etc.
- Shared data and integrated processes

(b) Intera-firm Integration

- Interorganizational information system such as, extranet
- Link firm's system with external entities-suppliers, distributors, retailers etc.
- Shared data and integrated processes

2.2.7 Supply Chain Operations reference model (SCOR)

Successful supply chain management requires many decisions relating to the flow of information, product and funds. These decisions fall into three categories, or phase, depending on the frequency of each decision and the time frame over which a decision phase has an impact.

Metric Type	Outcomes	Diagnostic
Customer satisfaction **Quality**	**1.Perfect order fulfillment** **2.Customer satisfaction** **3.Product quality**	**1. Delivery to commit date** **2. Warranty costs, returns and allowances** **3. Customers inquiry response time**
Time	**4.Order fulfillment lead time**	**4. Source/Make cycle time.** **5. Supply chain response time** **6. Production plan achievement**
Costs	**5.Total supply chain costs**	**7. Value added productivity**
Assets	**6.Cash-to-cash cycle time** **7.Inventory days of supply** **8.Asset performance**	**8. Forecast accuracy** **9. Inventory obsolescence** **10. Capacity utilization**

Table 2.2. Supply chain council's integrated supply chain metric framework (Christopher, 2004)

2.2.8 Summary of SC Models :

Various models of SC have been proposed by the various authors.

Sl. No.	Models	Characteristics
1.	Conceptual models (Taylor, 2004)	➢ Is the simplest of all the models ➢ Uses diagrams and description to represent a business system ➢ Can be created on whiteboards, computer screens, or the back of envelopes ➢ Provide simple, familiar structures for reasoning about the business ➢ Organizations, processes, and resources. Each of these objects plays a different role in the model, and the three relate to each other in ways that both constrain

		the model and make it more understandable at the business level. ➢ Can be easily developed by individuals ➢ It forms the basis for understanding systems ➢ They are of little value in prediction and control.
2.	Mathematical models (Taylor, 2004)	➢ Represents a business in terms of formulas and procedures ➢ Solved by evaluating formulas and procedures under a set of assumptions ➢ Mathematic models may become tedious ➢ The most common tool for mathematical modeling is a spreadsheet ➢ These models usually deal with financial flows ➢ They are unambiguous. ➢ They are guaranteed to produce optimal solutions.
3.	Simulation models (Taylor, 2004)	➢ Use software objects to represent the components of business and they are solved by "running" the model to see what happens when the objects interact with each other ➢ Often referred to as formal models because they have strict forms and generate numerical predictions ➢ Can be created using a number of tools

		➢ The most cost effective approach is usually to use a commercial simulation system. ➢ Simulators incorporate variability quite naturally and this adds importance because sales, shipments, prices and countless other aspects of supply chains vary quite a bit in real world supply chains and this variability has a major impact on how the chains perform.
4.	Steven model of supply chain integration (Shankar, 2003)	➢ Provides a simple model to understand supply chain integration ➢ Involves transforming enterprise from an inward looking to a flexible outward looking ➢ The most common approaches used in this model are: • Internal integration • Intra-Integration
5.	Supply chain operations reference model (Christopher, 2004)	➢ Perfect order fulfillment ➢ Customer satisfaction ➢ Product quality ➢ Cash-to-cash cycle time ➢ Inventory days of supply ➢ Asset performance

Table 2.3 Summary of SC Models

2.3 Decision phases in a supply chain

Successful supply chain management requires many decisions relating to the flow of information, product and funds. These decisions fall into three categories, or phase, depending on the frequency of each decision and the time frame over which a decision phase has an impact.

Supply chain strategy or design:

During this phase, a company decides how to structure supply chain over the next several years. It decides what the chain's configuration will be, how resources will be allocated, and what processes each stage will perform. Strategic decision made includes the location and capacities of production and warehouse facilities, the production to be manufactured or stored at various locations, the modes of transportation to be made available along different shipping legs, and the type of information system to be utilized. A firm must ensure that the supply chain configuration supports its strategic objectives during this phase. Dell's decision regarding the location and capacity of its manufacturing facilities, warehouses and supply sources are all supply chain decision or strategic decisions. Supply chain decision are typically made for the long term (a matter of years) and are very expensive to alter on short notice. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the next few years.

1. Supply chain planning:

For decisions made during this phase, the time frame considered is a quarter to a year. Therefore, the supply chain's configuration determined in the strategic phase is fixed. This configuration establishes constraints within which planning must be done. Companies start the planning phase with a forecast for the coming year (or a comparable time frame) of demand in different markets planning includes decision regarding which markets will be supply from which locations, the subcontracting of manufacturing, the inventory policies to be followed, and the timing and size of marketing promotions. Dell's decisions regarding markets a given production facility will be supplied and target production quantity at a different location are classified as planning decision. Planning establishes parameters within which a supply chain will function over a specified period of time. In the planning phase, companies must include uncertainty in demand, exchange rates, and competition over this time horizon in their decisions. Given a shorter time horizon and better forecast than the design phase, companies in the planning phase

try to incorporate any flexibility built into the supply chain in the design phase and exploit it in optimize performance. As a result of the planning phase, companies define a set of operating policies that govern short-term operation.

1. Supply chain operation:

The time horizon here is weekly or daily, and during this phase companies make decisions regarding individual customer orders. At the operation level, supply chain configuration is considered fixed and planning policies are already defined. The goal of supply chain operations is to handle incoming customer orders in the best possible manner. During this phase, firm allocates inventory or production to individual orders. Set a date that an order is to be filled, generate pick lists at a warehouse, allocate an order to a particular shipping mode and shipment, set delivery schedules of trucks, and place replenishment orders. Because operational decisions are being made in the short term (minutes, hours or days), there is less uncertainty about demand information. Given the constraints established by the configuration and planning policies, the goal during the operation phase is to exploit the reduction of uncertainty and optimize performance.

The design, planning and operation of a supply chain have a strong impact on overall profitability and success. **(Chopra and Meindl, 2004)**

2.4 Process view of a supply chain

A supply chain is a sequence of processes and a flow that takes place within and between different stages and combines to fill a customer need for a product. There are two different ways to view the processes performed in a supply chain:

1. Cycle view:

The processes in a supply chain are divided into a series of cycle, each performed at the interface between two successive stages of a supply chain.

1. Push/pull view:

The processes in a supply chain are divided into two categories depending on whether they are executed in response to a customer order or in anticipation of customer orders. Pull processes are initiated by a customer order whereas push processes are initiated and performed in anticipation of customer orders.

Cycle view of supply chain processes

Given the five stages of a supply chain. all supply chain processes can be broken down into following four process cycles.

- Customer order cycle
- Replenishment cycle
- Manufacturing cycle
- Procurement cycle

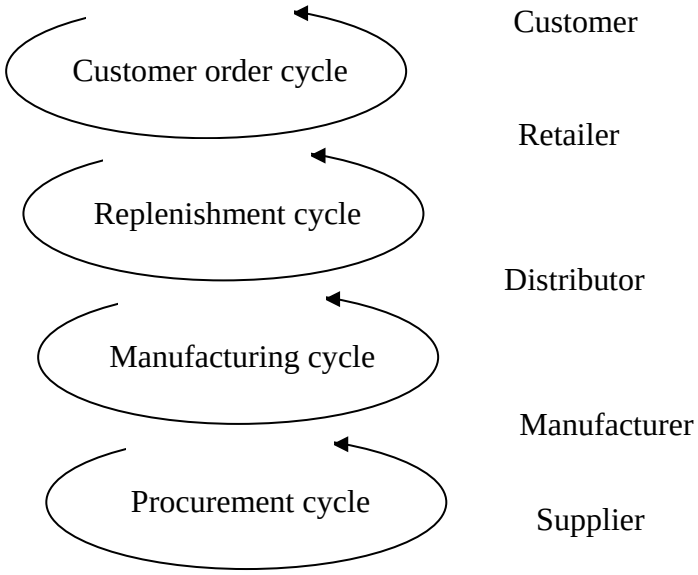


Figure 2.1 Supply Chain Process Cycles (Chopra & Meindl, 2004)

I in.

The five stages thus result in four supply chain process cycles. Not every supply chain will have all four cycles clearly separated. For example, a grocery supply chain in which a retailer stock finished-goods inventories and places replenishment orders which a distributor is likely to have all four cycles separated. Dell, in contrast, sells directly to customers, thus bypassing the retailer and distributor

A cycle view of supply chain is very useful when considering operational decisions because it clearly specifies the role and responsibilities of each member of the supply chain. The detailed process description of a supply chain in the cycle view forces a supply chain designer to consider the infrastructure required to support these processes. The cycle view is useful, for example, when setting up information system to support supply chain operations, as process ownership and objectives are clearly defined. We now describe the various supply chain in greater detail.

Customer order cycle

The customer order cycle occurs at the customer/ retailer interface and includes all processes directly involved in receiving and filling the customer's order. Typically the customer initiates this cycle at a retailer site and the cycle primarily involves filling customer demand. The retailer's interaction with the customer starts when the customer arrives or contact is initiated and ends when the customer receives the order. The processes involved in the customer order cycle are shown in figure 1.4 and include:

- Customer arrival
- Customer order entry
- Customer order fulfillment
- Customer order receiving

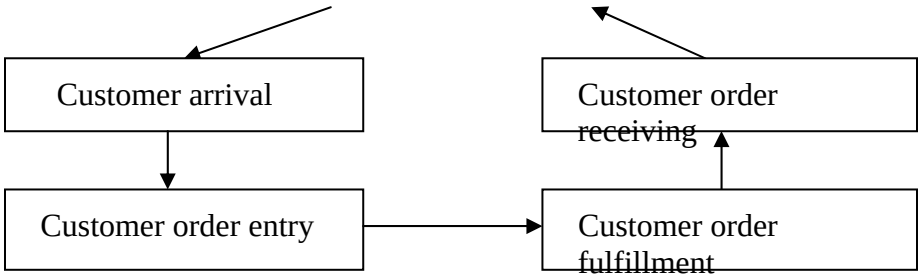


Figure 2.2 Customer Order Cycle (Chopra & Meindl, 2004)

Customer arrival

The term customer arrival refers to the customer's arrival at the location where he or she has access to his or her choices and makes a decision regarding a purchase. The starting point for any supply chain is arrival of a customer. Customer arrival can occur when

- The customer walks into a supermarket to make a purchase
- The customer calls a mail order telemarketing center
- The customer uses the web or an electronic link to a mail order firm

From the supply chain perspective, the key flow in this process is the customer's arrival. The goal is to facilitate the contact between the customer and the appropriate product so that the customer's arrival turns into a customer order. At a supermarket, facilitating a customer order may involve managing customer flows and product displays. At a telemarketing center, it may mean ensuring that customers do not have to wait on hold for too long. It may also mean having system in place so that sales representatives can answer customer queries in a way that turns calls

into orders. At a web site, a key system may be search capabilities with tools such as personalization that allow customers to quickly locate and view products that may interest them. The objective of the customer arrival process is to maximize the conversion of customer arrivals to customer orders.

Customer order

The term customer order entry refers to customers informing the retailer what products they want to purchase and the retailer allocating products to customers. At a supermarket, order entry may take the form of customers loading all items that they intend to purchase onto their carts. At a mail order firm's telemarketing center or web site, order entry may involve customers informing the retailer of the items and quantities they selected. The objective of the customer order entry process is to ensure that the order entry is quick, accurate and communicated to all other supply chain processes that are affected by it.

Customer order fulfillment during this process, the customer's order is filled and sent to the customer. At a supermarket, the customer performs this process. At a mail order firm this process generally includes picking the order from inventory, packaging it and shipping it to the customer. All inventories will need to be updated, which may result in the intention of replenishment cycle. In general, customer order fulfillment takes place from retailer inventory. In a build-to-order scenario, however, order fulfillment takes place directly from the manufacturer's production line. The objective of the customer order fulfillment process is to get the correct orders to customers by the promised due dates at the lowest possible cost.

Customer order receiving

During this process, the customer receives the order and takes ownership. Records of this receipt may be updated and payment completed. At a supermarket, receiving occurs at the checkout counter. For a mail order firm, receiving occurs when the product is delivered to the customer.

Replenishment

The replenishment cycle occurs at the retailer/distributor interface and includes all processes involved in replenishing retailer inventory. It is initiated when a retailer places an order to replenish inventories to meet future demand. A replenishment cycle may be triggered at a supermarket that is running out of stock of detergent or at a mail order firm that is low on stock of a particular shirt.

The replenishment cycle is similar to the customer order cycle except that the retailer is now the customer. The objective of the replenishment cycle is to replenish inventories at retailer at minimum cost while providing high product availability. The process involved in the replenishment cycle is shown in figure 1.5 and include:

- Retail order trigger
- Retail order entry
- Retail order receiving

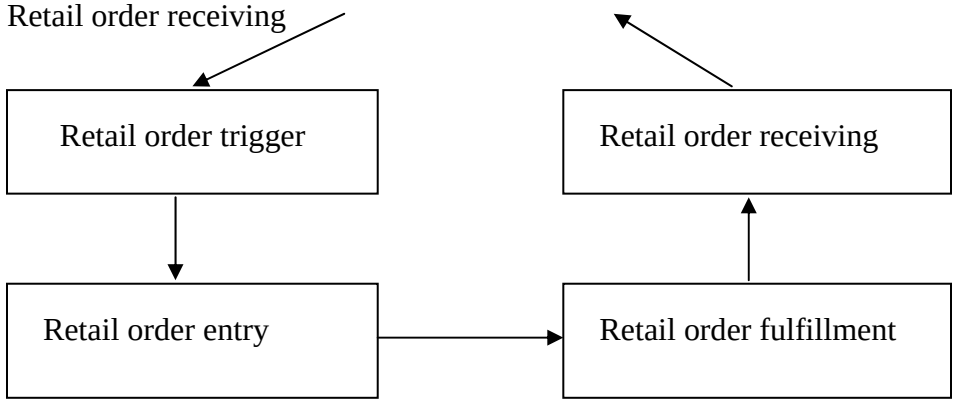


Figure 2.2 Replenishment Cycle (Chopra and Meindl, 2004)

Retail order trigger is as the retailer fills customer demand; inventory is depleted and must be replenished to meet future demand. A key activity the retailer performs during the replenishment cycle is to devise replenishment or ordering policy that triggers an order from the previous stage. The objective when setting replenishment orders triggers is to maximize profitability by ensuring economies of scale and balancing product availability and the cost of holding inventory. The outcome of the retail order trigger process is the generation of a replenishment order that is ready to be passed on to the distributor or manufacturer.

Retail order entry this process is similar to customer order at the retailer. The only difference is that the retailer is now customer placing the order that is conveyed to the distributor. This may be done electronically or by some medium. Inventory or production is then allocated to the retail order. The objective of the retail order entry process is that an order be entered accurately and conveyed quickly to all supply chain process affected by the order.

Retail order fulfillment this process is very similar to customer order fulfillment except that it takes place at the distributor. A key difference is the size of each order, as customer orders tend to be much smaller than replenishment orders. The objective of the retail order fulfillment is to get the replenishment order to the retailer on time while minimizing costs.

Retail order receiving once the replenishment order arrives at a retailer, the retailer must receive it physically and update all inventory records. This process involves product flow from the distributor to the retailer as well as information updates at the retailer and the flow of funds from the retailer to the distributor. The objective of the retail order receiving process is to update inventories and displays quickly and accurately at the lowest possible cost.

Manufacturing cycle

The manufacturing cycle typically occurs at the distributor/ manufacturer (retailer/ manufacturer) interface and includes all processes involved in replenishing distributor (or retailer) inventory. The manufacturing cycle is triggered by customer order (as in the case of dell), replenishment orders from a retailer or distributor (wal-mart ordering from p & g), or by the forecast of customer demand and current product availability in the manufacturer's finished-goods warehouse.

One extreme in a manufacturing cycle is an integrated steel mill that collects orders that are similar enough to enable the manufacturer to produce in large quantities. In this case, the manufacturing cycle is reacting to customer demand (referred to as a pull process). Another extreme is a customer products firm that must produce in anticipation of demand. In this case the manufacturing cycle is anticipating customer demand (referred to as a push process). The process involved in the manufacturing cycle include the followings:

- Order arrival from the finished-goods warehouse, distributor, retailer or customer
- Production scheduling
- Manufacturing and shipping
- Receiving at the distributor, retailer, or customer

Order arrival during this process, a finished-goods warehouse or distributor sets a replenishment order trigger based on the forecast of future demand and current production inventories. The resulting order is then conveyed to the manufacturer. In some cases the customer or retailer may be ordering directly from the manufacturer. In other cases manufacturer may be producing to stock a finished-products warehouse. In the latter situation, the order is triggered based on product availability and a forecast of future demand. This process is similar to the retail order process in replenishment cycle.

Production scheduling this process is similar to the order entry process in the replenishment cycle where inventory is allocated to an order. During the production scheduling process, orders (or forecast orders) are allocated to a production plan. Given the desired production quantities for each product, the manufacturer must decide on to the precise production sequence. If there are multiple lines, the manufacturer must also decide which product to allocate to each line. The objective of the production scheduling process is to maximize the production of orders filled on time while keeping costs down.

Manufacturing and shipping this process is equivalent to the order fulfillment process described in the replenishment cycle. During the manufacturing phase of the process, the manufacturer produces to the production schedule. During the shipping phase of this process, the product is shipped to the customer, retailer, distributor or finished-product warehouse. The objective of the manufacturing and shipping process is to create and ship the product by the promised due date while meeting quality requirements and keeping costs down.

Receiving in this process, the product is received at the distributor, finished-goods warehouse, and retailer or customer and inventory records are updated. Other processes related to storage and fund transfers also take place.

Procurement cycle

The procurement cycle occurs at the manufacturer/supplier interface and includes all processes necessary to ensure that materials are available for manufacturing to occur according to schedule. During the procurement cycle, the manufacturer orders components from suppliers that replenish the component inventories. The relationship is quite similar to that between a distributor and manufacturer with one significant difference. Whereas retailer/distributor orders are triggered by uncertain customer demand, component orders can be determined precisely once the manufacturer has decided what the production schedule will

be. Component orders depend on the production schedule. Thus it is important that suppliers be linked to the manufacturer's production schedule. Of course, if a supplier's lead times are long, the supplier has to produce to forecast because the manufacturer's production schedule may not be fixed that far in advance. (Chopra & Meindl, 2004)

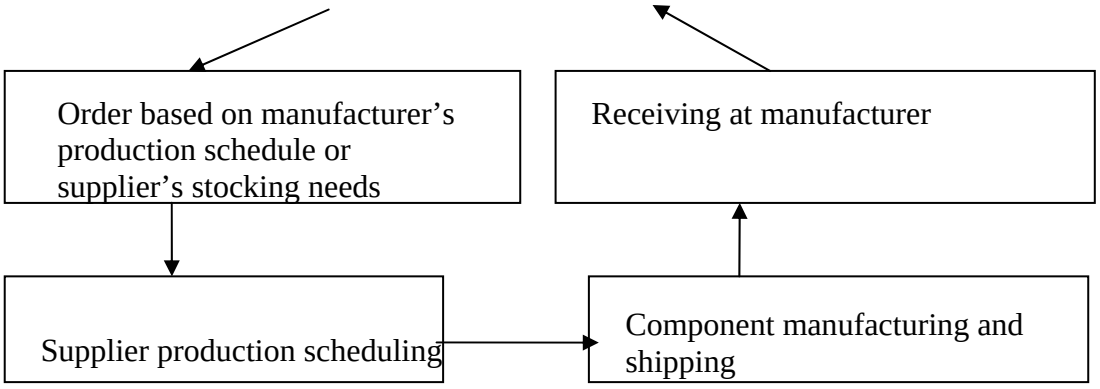


Figure 2.4 Procurement Cycle (Chopra and Meindl, 2004)

2.5 Push/ pull view of supply chain processes

All processes in a supply chain fall into one of two categories depending on the timing of their execution relative to end customer demand. With pull processes, execution is initiated in response to a customer order. With push processes, execution is initiated in anticipation of customer orders. Therefore, at the time of execution of pull process, customer demand is known with certainty whereas at the time of execution of a push process, demand is not known and must be forecast. Pull processes may also be referred to as reactive process because they react to customer demand. Push processes may also be referred to as speculative processes because they respond to speculated (or forecasted) rather than actual demand. The push/pull boundary in a supply chain separates push processes from pull processes. At dell, for example, the beginning of pc assembly represents the push/pull boundary. All processes before pc assembly are push processes and all processes after and including assembly are initiated in response to a customer order and are thus pull processes.

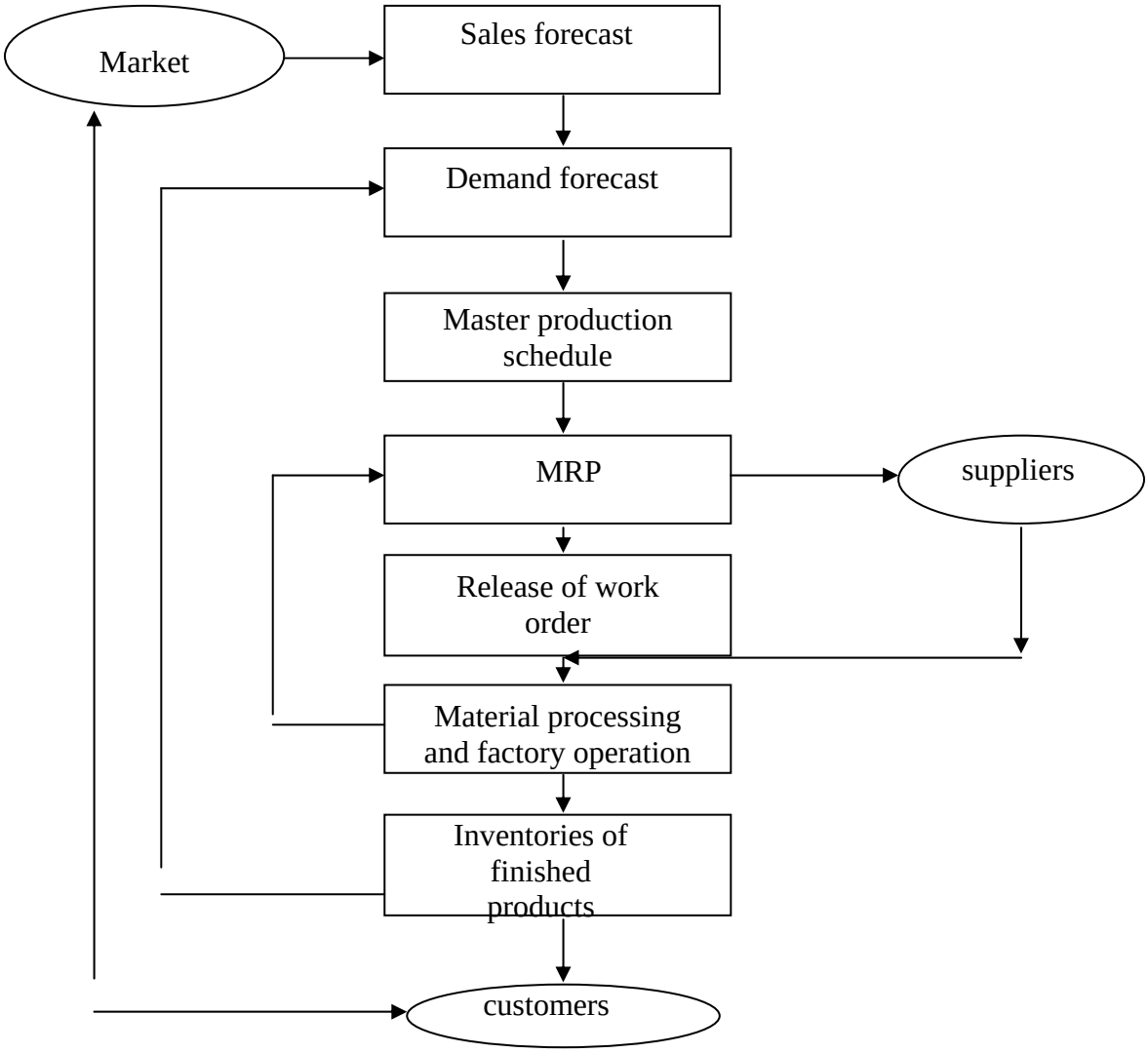


Figure No. 2.5 Material flow and building of schedule in a push system (Chopra and Meindl, 2004)

A push/pull view of the supply chain is very useful when considering strategic decisions relating to supply chain design. This view forces a more global consideration of supply chain processes as they relate to a customer order. Such a view may instance, result in a responsibility for certain processes being passed on to a different stage of the supply chain if making this transfer allows a push process to become a pull process.

(Chopra & Meindl, 2004)

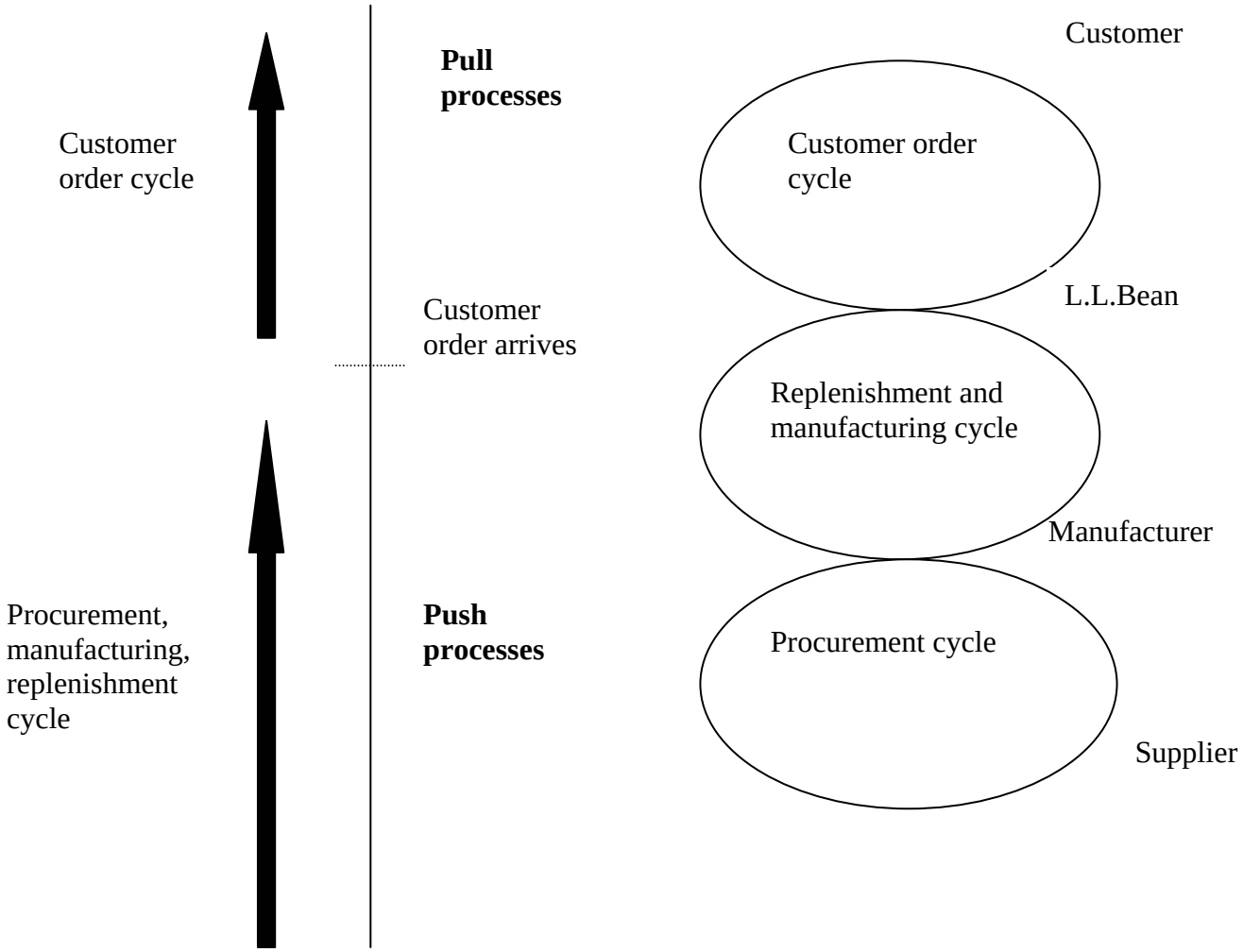


Figure No. 2.6 Push/Pull Processes For L.L.Beam Supply Chain, (Chopra & Meindl, 2004)

2.6 Mapping supply chain processes

Flowcharting supply chain processes are the first step towards understanding the opportunities that exist for improvements in productivity through reengineering those processes. A critical concept that underpins such reengineering opportunities is the idea of 'value-adding' time versus 'non value adding' time.

Very simply, value adding time is time spent doing something, which creates a benefit for which the customer is prepared to pay. Thus we could classify manufacturing as a value added activity as well as the physical movement of the product and the means of creating the exchange. The old adage 'the right product in the right place at the right time' summarizes the idea of

customer value adding activities. Thus any activity that contributes to the achievement of that goal could be classified as value adding.

On the other hand, non-value adding time is time spent on an activity whose elimination would lead to no reduction of benefit to the customer. Some non-value adding activities are necessary because of the current design of our processes but they still represent a cost and a minimized.

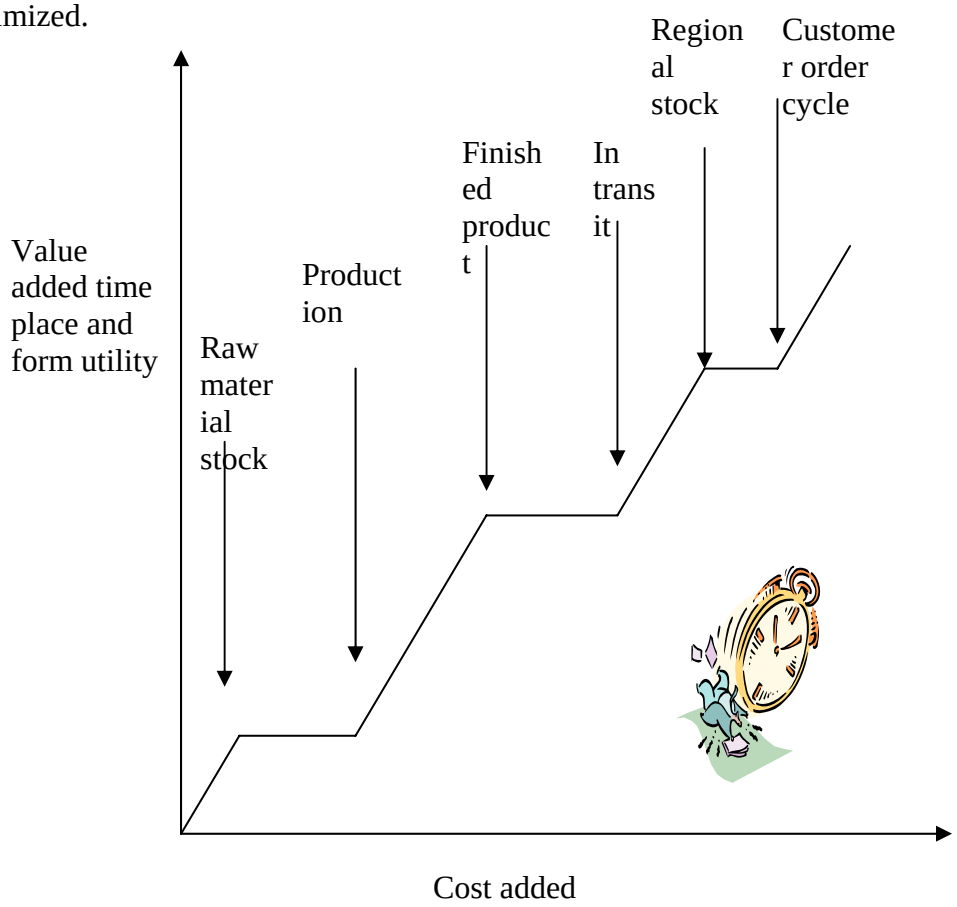


Figure No. 2.7 Which activities add cost and which add value? (Christopher, 2004)

The difference between value adding time and non-value adding time is crucial to an understanding of how logistics processes can be improved.

Once processes have been flowcharted the first step is to bring together the managers involved in those processes to debate and agree exactly which elements of the process can truly be described as value adding. Agreement may not easily be achieved as no one likes to admit that the activity they are responsible for does not actually add any value for customers.

The next step is to do a rough cut graph highlighting visually how much time is consumed in both non-value adding and value adding activities.

It will be shown from this example that most of the value is added early in the process and hence it is more expensive when held as inventory. Furthermore much of the flexibility is probably lost as the product is configured and/or packaged in specific forms early in that process Throughput efficiency in a supply chain be measured as:

$$\frac{\text{Value added time}}{\text{End to end pipeline time}} * 100.$$

Since this can be as low as 10%, meaning that most of the time spent in a supply chain is non-value adding time. To begin to make significant improvements in throughput efficiency first requires a detailed understanding of the processes and activities that together compromise the supply chain. A useful tool here is supply chain mapping.

A supply chain map is essentially a time-based representation of the processes and activities that are involved as the materials or products move through the chain. Simultaneously the map highlights the time that is consumed when those materials or products are simply standing still, i.e., as inventory.

In these maps, it is usual to distinguish between ‘horizontal’ time and ‘vertical’ time. Horizontal time is time spent in process. It could be in transit time, manufacturing or assembly time, time spent in production planning or processing and so on. It may not necessarily be time when customer value is being created but at least something is going on. The other type of time is vertical time, this is time when nothing is happening and hence the material or product is standing still as inventory. No value is being added during vertical time, only cost.

The labels ‘horizontal’ and ‘vertical’ refers to the maps themselves where the two axes reflect process time and time spent as static inventory respectively.

From this map it can be seen that horizontal time is 60 days. In other words the various processes of gathering materials, spinning, knitting, dyeing, finishing, sewing and so on take 60 days to complete from start to finish. This is important because horizontal time determines the time start to finish. This is important because horizontal time determines the time that it would take for the system to respond to an increase in demand. Hence, if there were to be a sustained

increase in demand it would take that long to 'ramp up' output to the new level. (Christopher Martin (2004))

2.7 Performance Of Supply Chain

It is important to judge the performance of supply chain so as to judge how well it is performing. This is important for two purposes. One, it gives idea regarding the current position. Secondly, it is helpful in identifying gaps for improvements. Beamon (1999) has identified three types of measures of performance: resources, output and flexibility. (Shankar, 2003)

2.8 Supply Chain As Systems (Taylor, 2004)

Integrating a supply chain requires assembling an ad hoc collection of facilities into a coherent than can function with a single purpose. In order to succeed in this effort, you need to know something about systems-how they are designed, how they work, and how they are controlled. In short, you need a little systems theory. This may sound like an abstract subject of limited relevance to your needs, but nothing could be further from the truth. As a manager, you deal with some of the most complex systems on earth every day, and your experience has already given you a basic under standing of how these systems work. The problem with this understanding is that it's already intuitive, making it hard to use in solving new problems. This chapter will help you hone those intuitions into powerful business design tools.

Business Cybernetics

1. A system is an assembly of components: In cybernetics, a system is viewed as an assembly of components that interact to produce collective behavior. The key insight of cybernetics is that there are common principles across all the different kinds of systems, principles that explain the behavior of each.
2. A system transforms inputs into outputs: One of the key contributions of cybernetics was the insight that all systems can be seen as transforming inputs into outputs. When systems are designed, they are usually designed to produce outputs that have greater immediate value than the inputs.
3. Systems may have controls and monitors: Natural systems are usually self-regulating, and attempts to control them often do more harm than good. Systems made by people, on the other hand, are designed to be controlled and monitored so that their

performance can be improved overtime. Control is achieved by regulating the flow of inputs, and monitoring involves measuring the regulating outputs.

4. Not all inputs are subject to control: Even in the best-designed systems, there are usually some inputs that can't be controlled by the people operating the system. Economists call these inputs extrinsic factors because, in contrast to intrinsic factors such as plant capacity etc. they originate from outside the boundaries of the system.
5. Monitoring outputs is a matter of selection: It may not be possible to measure every output of a system. Even if it is possible to measure every output, systems usually have so many outputs that it's not cost effective to measure them all. The preferred approach, then, is to measure the set of outputs that are most helpful in monitoring and controlling the system.
6. The first goal is understanding a system: Each manager in the chain is given the responsibility to maximize the outputs of the chain. That isn't going to happen without some shared understanding of how the settings affect the operation of the chain, together with some coordination of the changes to get their best overall performance.
7. Understanding permits prediction and control: Understanding provides the insights necessary to predict how a system will behave in response to changes to its inputs. Prediction allows to control the system by making the best combination of adjustments. (Fig. 4.2 pg 74)
8. Understanding is usually neglected: Of the three processes, understanding is the most important and yet the most neglected. Instead the emphasis is in the other direction: Control is the primary concern, prediction is invoked only as needed to improve control, and understanding is viewed as an incidental by-product rather than the prime mover of the sequence. This reversal of priorities may be necessary in the short run, but it is self-defeating in the long run.

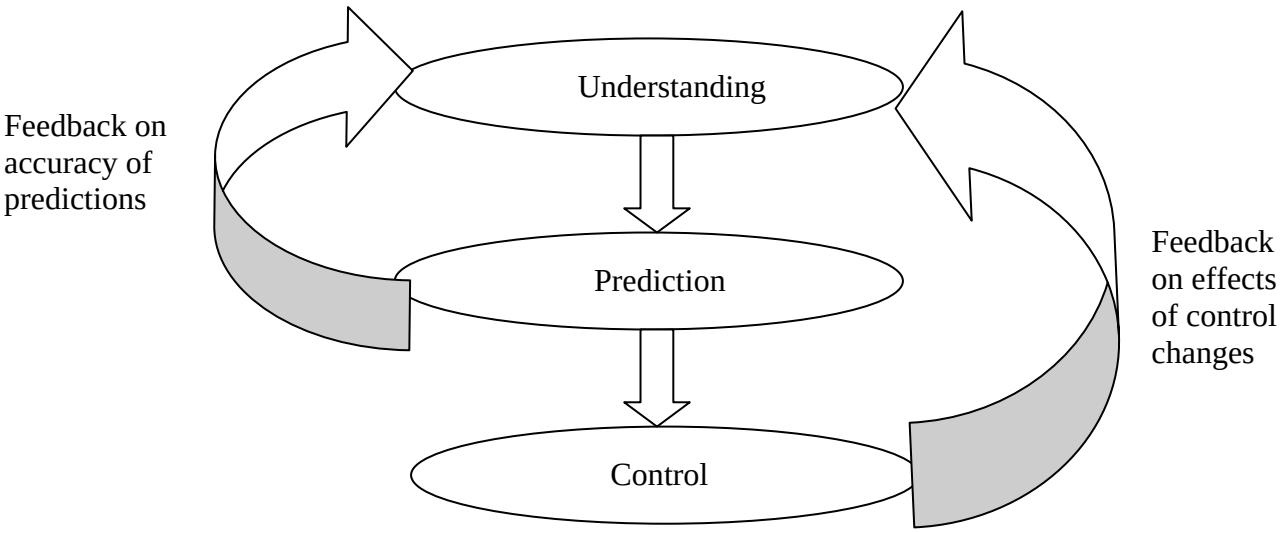


Fig 2.8 Understanding Production & Control (Taylor, 2004)

9. Some systems don't require understanding: Some systems are well designed that very little understanding is required to control them. In computer terms such systems are referred to as being user friendly, a state that remains an elusive goal for computers themselves.
10. Understanding is essential for supply chain: Supply chains are anything but user friendly. When it comes to systems of this level of complexity, understanding is not a luxury; it's a necessity.
11. Relations map inputs to outputs: The mapping of inputs to values on the outputs can take on a variety of different types, which range from the most straightforward to the truly bizarre.
12. The mapping can be viewed as a graph: As can be seen from the figure when the knob is turned from 0-100 the output goes from 20-80.

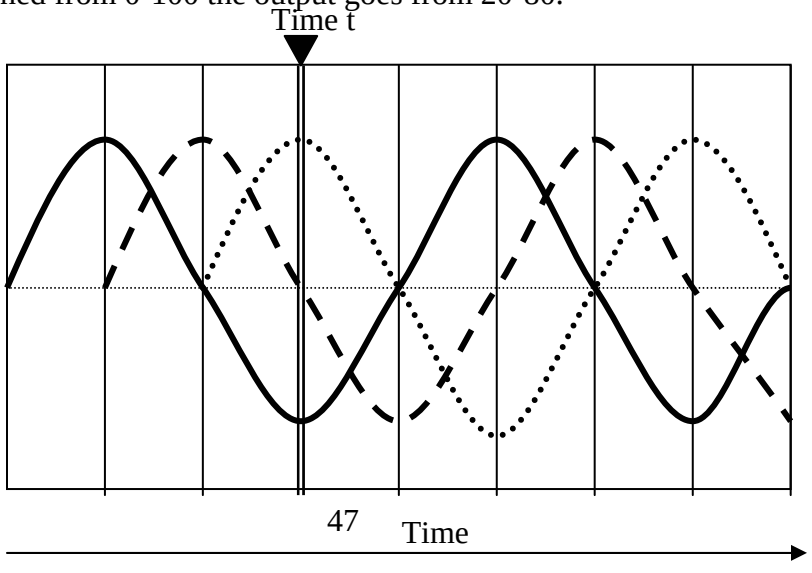


Fig 2.9 The Effects Of Delay (Taylor, 2004)

A Rougue Gallery of Relations

1. Relations come in many forms: This system is easy to understand and operate because the relation between the input and output is very simple. Unfortunately, relations in real world systems are rarely this simple.

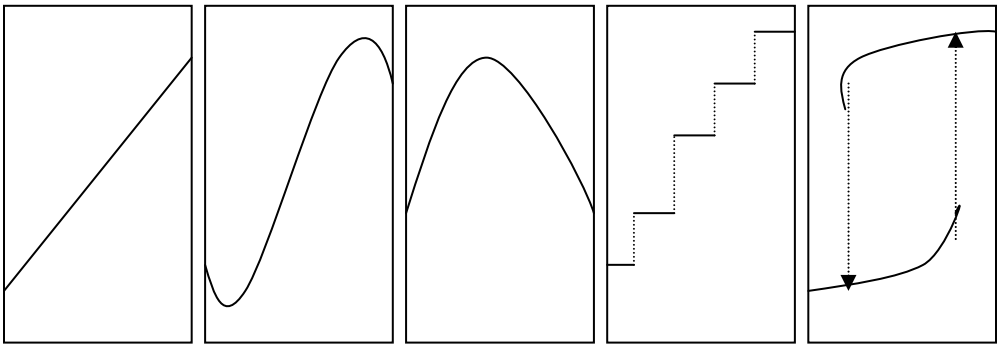


Fig 2.10 A Rougue Gallery of Relations , (Taylor, 2004)

All these relations are found in supply chain systems, and knowing which one you are dealing with when you are changing an input is essential to achieving good control.

1 Linear relations are straight lines: in a linear relation a straight line describes the mapping of inputs to outputs. This relation has every desirable quality and it is the best-behaved relation. Linear relations are easy to understand, easy to predict and above all easy to control because increasing the input by a constant amount always produce the same, constant increase in the output.

2 Monotonic relations always go up: The only restriction in the monotonic relation is that increasing the input never reduces the output. Beyond this, there are no guarantees regarding the shape of the curve.

3 Continuous relations change smoothly: The continuous relation is even less well behaved; the only guarantee with this relations that the output will rise or fall smoothly

with changes in input, without any sudden jumps. But the actual mapping can take any shape whatsoever.

4 Single-valued relations change abruptly: This type of relation is even harder to work with because even the smallest change in input can produce a huge leap in the output, with no smooth transition between successive levels.

5 Multi-valued relations can do anything: The multi valued is the worst case of rogues because it doesn't even promise to give you the same output for a given input. With this relation, a small change to the input can not only produce a sudden leap, it can shit the relation over to another curve altogether, so that reversing the change doesn't put things back the way they were.

6 We are biased towards their relations: We naturally assume that all the systems are linear in nature, and we are very bad at detecting and understanding any other kind of relation. Non-linear relationships are quite common in supply chains, so one will have to overcome his natural inclinations if mastering supply chain management is desired.

The Dynamics of Delay

1. Combinations produce new kinds of behavior
2. Delays take components out of phase
3. Phase shifts cause havoc in supply chain
4. Phase shifts are usually invisible
5. Distortions introduce further complications
6. Economies of scale distort signals
7. Demand amplification is one result

Feedback & Stability

1. Outputs can be fed back into inputs
2. Feedbacks comes in many forms
3. Positives feedback amplifies incoming signals
4. Negative feedback dampens signals
5. Positive feedback fuels growth
6. Negative feedback promotes stability
7. Feedback is vital to supply chains

8. All three flows benefit from feedback
9. Information is replacing inventory

2.9 Benefits Of Supply Chain Management (Shanker, 2003)

The most important benefits of supply chain management are:

- Reduced operating costs
- Improve responsiveness and reduce cycle time
- Improve customer service
- Simplify operations
- Improve quality
- Support significant volume growth
- Reduce capital basis/improved return on capital
- Effectively support a growing or diverse customer base
- Effectively offer a greater variety of products
- Focus on core competencies
- Integrated view of enterprise resources and constraints
- Improved channel efficiency by sharing information between suppliers and customers
- Reduced inventory levels and production costs.
- Extension of organizational control beyond firm boundaries
- ROI (return on investment): typically 10 times the cost of developing and implementing the system

2.10 Supply Chain Management Risks (Shankar, 2003)

- Poor implementation due to enlargement of scope
- Information access and security
- Supply chain interruptions
- Unidirectional loss of bargaining power
- Training and change management

- System maintenance
- Challenge of developing trust and managing interorganizational dependencies

2.11 Just In Time Production

Just in time is a manufacturing philosophy, which aims at having the right part at precise time and in the right quantity to go into assembly. Historically, JIT has generally been viewed as an inventory reduction technique which can be used to reduce continually the levels of inventory in a production process until stopped by some event. However the more appropriate view of JIT logistics role is that it should increase deliveries of purchased components to the points of use and ultimately, eliminate warehousing activities. The kanban method of triggering the movement of material should be sufficient to orchestrate the production process.((Burnham,J.M.(1987)),(Crawford,K.M. & Blackstone,J.H.(1988)),(Im,J.H. and Lee,S.M.(1989)))

PURPOSE OF JIT (Shankar, 2003)

The purpose of JIT is to produce and deliver finished goods just in time to be sold, sub assemblies just in time to be assemble into finished goods, fabricated parts just in time to go into final assemblies, and purchased materials just in time to be transformed into fabricated parts. The ultimate aim of JIT is to concentrate on lot less, repetitive manufacturing, with only one unit of work in progress and no stock of finished goods inventory.

The objective of JIT system is to encourage workforce to participate in the programmes relevant for work improvement; profits increased through cost reductions, inventory reductions and quality improvements. Thus, waste should be eliminated. This philosophy is based on two criteria's.

- JIT refers to the production and supply of required number of parts when needed and is called as JIT production system. If work in process inventories including parts and products are expected to decrease, this system is called stockless production system.

- Another criteria is Jidoka , i.e., when unusual events happen in production line, the worker in-charge stops the line and calls for help in removing the cause of trouble.

  JIT production system employs the pull system rather than the traditional system, push system. Pull system focuses on the end of the line and pulls work through the proceeding operation. Workers perform the required operation on the material/ work part, drawn from proceeding workstation at the necessary time with the use of a Kanban. Thus, working process inventory is minimized, and overproduction can be eliminated. In order to provide production information, two kinds of Kanban are used.
- Withdrawal
- Production order information

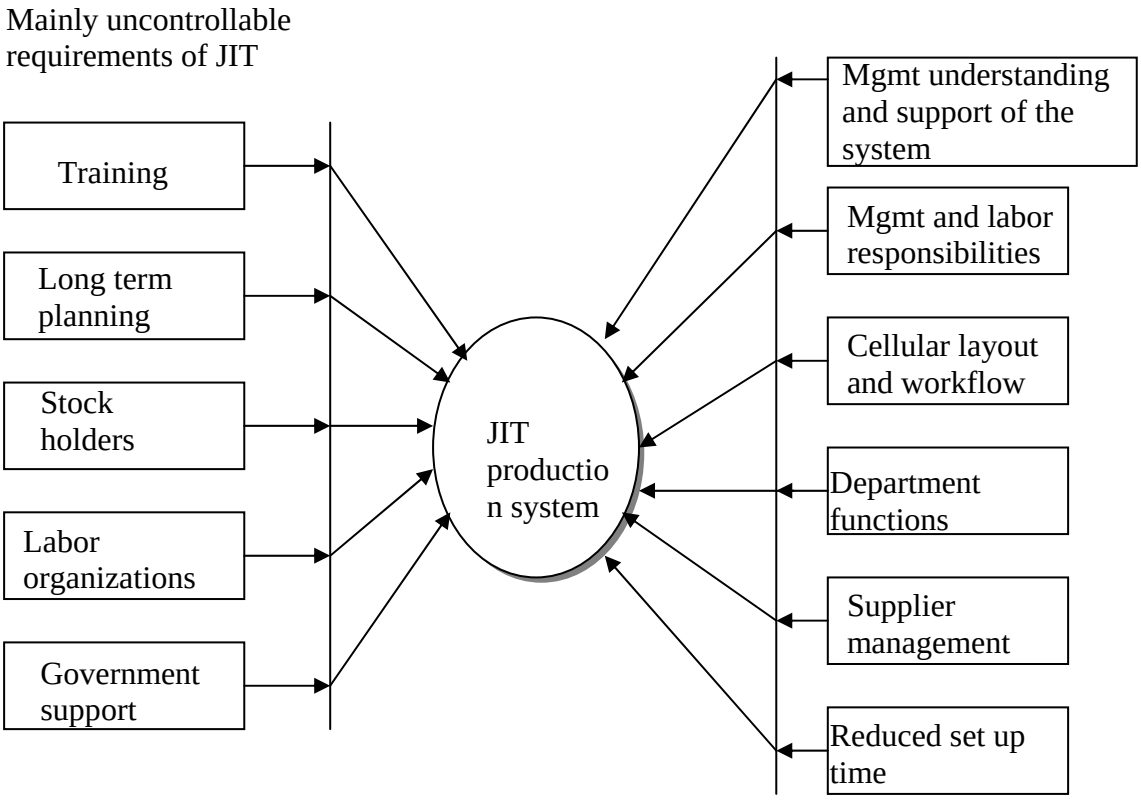


Figure 2.11 Some Requirements for implementing JIT (Shankar, 2003)

An Analogy To Jit (Shankar, 2003)

The benefits of reduced inventory are as follows:

- Saving in space for warehouse and work
- No tie up of money in ideal inventory leads to saving in working capital outlay of the firm.
- Ability to operate at low inventory level can happen only when the major productivity related problems are eliminated.
- Reduced inventory level, or for that matter other asset base is helpful in identifying other productivity levels such as scrap, WIP, quality, machine breakdown etc.

Lower Assest Level Leads of better utilization of resources.

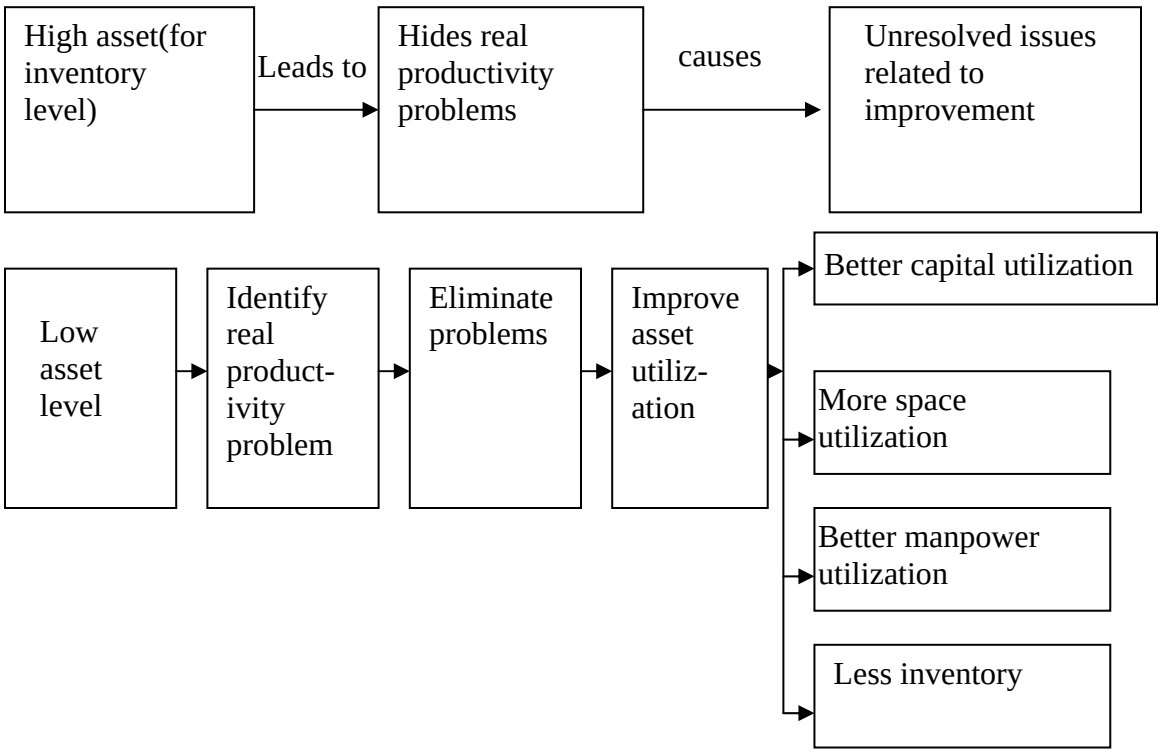


Figure 2.12 Lower asset level leads to higher utilization of resources (Shankar, 2003)

Requirements For Implementing Jit

Some of the requirements are controllable by the management,

while rest are uncontrollable. These are:

- Training
- Long term planning
- Stockholders
- Labor and union
- Government support
- Management support
- Management and labor responsibilities
- Cellular layout and work flow
- Department function
- Supplier management
- Reduction of set-up time

WALT GODDARD (1986) outlined some of the ways to reduce set up time:

- Standardize the external set up actions: replace adjustable gauges with permanent ones.
- Pull all probe and blow off hoses on one side of die
- Put a bench at side of press at the same level as the press opening to hold the next die
- Color code all hose connections: air, hydraulic, water etc.
- Use parallel operations-deliver all components to support die set up
- Design a quick locating system positioning pins and holes with quick fasteners.
- Standardize all die receptacles
- Add tonnage monitor on press to detect two pieces in die before damaging dies
- Involve tool and tie designers in set up reduction programs as all new designs incorporate quick change over concepts.
- Use two-way radio between set up and lift truck operator who removes and delivers dies.
- Photograph completed operation as a guide for set up man: location of tables, wrenches, baskets etc.

- Review material flow charts with reduced movements in mind.
- Make as many of the set up activities internal to the run time. That is to do as much of the set up as possible without shutting down the machine.
- Standardize All bolt sizes.
- Code parts on dispatch list for major and minor set ups to aid scheduling
- Standardization and use of common parts in the product will reduce the number of different parts required. If design engineering does not design a new part, no set up is required for it.

Characteristics Of Jit

- Ideal lot size in JIT is one piece
- Aims at driving all queues toward zero in order to:
  - ✓ Minimize inventory investment
  - ✓ Shorten production lead times and set up times
  - ✓ React faster to demand change
- Focused factory
- Cellular (GT) manufacturing system
- Uncover any quality problem and its control at source
- Total preventive maintenance
- Cross trained worker and worker flexibility
- Uniform work load
- Kanban cards
- Decentralization

Doctrines And Beliefs Of Jit

1. JIT pull system has several advantages and it should be and can be applied to all manufacturing and related processes
2. Offering the customers a variety of products and/or services and responding to their requirements with speed are the essential virtues of business.
3. Inventory reduction is important because inventories are a major cost component.

4. Holding inventories, particularly buffer stocks, is an evil
5. Reduce set up times to permit smaller batch sizes, thus reducing inventories and hence costs.
6. Smaller set up times and smaller batch sizes mean smaller inventories
7. If Just in Time is good for a company, it must be good for the suppliers
8. Since Jit is good for everybody, it should not be difficult to find JIT suppliers.
9. It is always good to have a few suppliers preferably have a sole supplier system for a group/category of items
10. What is good for the company is also good for the employees. (Garvin (1988))
11. Just in Time pull system leads to a significant improvement in quality performance, be it from the shop floor or from the supplier

((Chary (1992)) .(Natarajan (1990)) (Pannesi (1989)) .(Karmarkar (1989)) . (Moden (September 1981)) (Moden (August 1981)) . (Moden (May 1981)) (Ohno (1988)) (Moden (January 1981)) .(Ohno (1978)))

Benefits Of Jit

- Better quality
- Less work in process
- Less scrap
- Less blocked capital in the inventory
- Improved team work
- Less space requirement
- Improved team work
- Elimination of store and warehousing problems
- Improved productivity
- Higher work morale.

2.12 Organization Structure

Organization is the process of identifying and grouping work to be performed, defining and delegating responsibility and authority, and establishing relationships for the purpose of enabling people to work most effectively together in accomplishing objectives.

Organization is thus:

- A system
- Established structure
- People work and deal with each other in coordinate and cooperative way
- Grouping of work
- Established relationship for authority and delegation
- Attainment of common goal of the enterprise
- Internal structure of performance
- Definition of functional role of each personnel and outline of his responsibility for business performance
- A constituent of
    a) Division of labor
    b) Identification of the source of authority
    c) Establishment of enterprise relationship

Necessity of organization

The increasing size of the manufacturing plant, introduction of most complex methods of production, tough competition between the enterprise and labor problems has necessitated every factory to be well organized, in order to produce required quantity of the products of the required quality, at the required time with minimum production cost.

A well-designed organization structure with qualified personnel in all key positions achieves execution, coordination and control of all policies and functions of the firm.

A good organization is therefore necessary for the following reasons:

- Complexity of industry
- Growing competition
- Optimum utilization of resources
- Fixation of responsibility and authority
- Reduced labor problems
- Coordination and directing efforts
- Facilities administration
- Stimulates creativity

Characteristics/Essential features of organization

- Organization is a group of people, small or large.
- Group works under an executive leadership
- Organization is a tool of management
- It leads to division of responsibilities and work
- It defines and fixes the duties and responsibilities of employees
- It establishes a relationship between authority and responsibility

Types of organizations

The organization structure is a skeleton or a framework that divides the total activities into related groups, develops superior and subordinate relationship among the persons by prescribing the authorities.

The organization structure differs from industry to industry. The popular types of organization structures are:

(a) Line organization
(b) Functional organization
(c) Line and staff organization
(d) Committee organization

Line, Military or Scalar Organization

In this type of organization, the line of authority flows directly from top to bottom and the line of responsibility from bottom to top in the opposite direction. In line organization each department is subdivided into certain self-contained departments or sections. Each departmental head has complete control over his section and he is fully authorized to select his labor, staff, purchase of raw materials, stores and to get the standards of output etc. the responsibility of each departmental head is clearly defined. Each department works as a self-supporting unit.

Advantages

1. It is easy to establish and simple to understand.
2. The delegation of authorities and assignment of responsibilities are clear and precise.
3. Due to unity of command and unified control it is possible to maintain strict discipline.
4. It establishes clear-cut superior subordinate relationships
5. The entire management is in the hands of one individual

6. There is a clear channel of communication

8. The complete responsibility is in the hands of the heads and therefore effective coordination within the department is obtained.

9. It is flexible to expand or contract and stable.

Disadvantages

1. The success of the enterprise depends upon the caliber and ability of few departmental heads.

2.In this type of organization an individual executive is supposed to discharge different types of duties.

3.Departmental heads are overloaded with various routine jobs hence they cannot spare time for important managerial functions

4.In line organization too much authorities center around line executives.

5.Conflicting policies of different departments result in duplication of work.

6.It is limited to small concerns

7.Departments may work for their self-interest and may sacrifice the general interest of the enterprise.

8.As the departmental heads have the supreme authority there are chances of favourism.

9.Because of lack of specialization perhaps there may be more wastage of materials and man-hours.

Functional Organization

In this type of organization, the managerial activities are divided so that each head from the works manager down has few functions to perform as possible and is able to become specialist in these. Authority from top to down is delegated according to the function. Each specialist is supposed to give his functional advice to all other foreman and workers.

Advantages

1. Mental work has been separated from routine work.

2. Specialized and skilled supervisory attention is given to workers.

3. The narrow range of activities enables the functional expert to develop in depth understanding in his particular area of activity.

4. It is based on expert knowledge.

5. The work of subordinates is divided into standard parts

6. Wastage of materials is reduced.

7. This type of organization presents ample scope for the growth and development of business

8. It helps mass production by standardization and specialization

Disadvantages

1. It is difficult to maintain discipline

2.It is difficult for the top management to locate responsibility for the unsatisfactory work.

3.The spheres of authority tend to overlap and give rise to friction between the persons of equal rank.

4.There is a lack of coordination of functions and efforts.

5.High salary is paid to the experts employed. This increases the total cost of the job.

Line and Staff Organization

In this type of organization, the line heads are assisted by specialist staff. If the firm is of large size, managers cannot give careful attention to every aspect of management. They are busy with ordinary task of production and selling. Hence staff is deputed to do work of investigation, research, recording and advising to managers. Thus the staff brings specialization by assisting the line officers. The line maintains discipline and stability; staff provides experts information and helps to improve overall efficiency. Thus the staff are thinkers while the line are doers.

Advantages

1. It is a duplex organization, dividing the whole work into creative plan and action plan.

2. It is possible to maintain strict discipline.

3. It helps to make sound decisions.

4. There will be less wastage of material.

5. Quality of the product will be better.

Disadvantages

1.There is a risk of misunderstanding and misinterpretation.

2.The advice given by specialists may be ignored by the line heads.

3.The overhead cost of the product increases because of high salaried specialized staff.

Committee Organization

A committee is a formally organized group of individuals formed for the purpose of giving advice on certain problems, which cannot usually be solved by an individual. The committee members meet repeatedly, discuss, decide and recommend solution to certain problems of the organization.

Advantages

1. The decisions arrived are likely to be sounder
2. Coordination between different departments is effective.
3. Specialists can devote more time to important problems
4. It helps to adopt new ideas, new innovations, new schemes etc.
5. It promotes united actions and mutual understanding.
6. It encourages decentralization of authority.
7. Decisions taken are impersonal

Disadvantages

1. There is a delay in decision-making, it functions very slowly.
2. There may be a compromise to get a solution
3. Final decision may not be acceptable throughout the committee
4. The committee organization is relatively costly.
5. Committee decision is a group decision and no individual member can be held responsible for wrong decisions.

2.13 Quality

Quality is the customer's perception about the degree to which the product or service meets his/he expectations. Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy a given need.

Objectives Of Quality Control

The fundamental purpose of quality control is to maintain the quality standard of the manufactured items/products and at optimum cost. Some important quality control objectives are as follows:

- To decide about the standards of quality that is readily acceptable by the customer and economical to achieve and maintain.

- To carefully analyze and observe the extent of quality deviation in product/part/component from the predetermined standards
- To apply corrective measures to achieve the real goal of quality control
- To avoid as far as possible items reaching the customer which are of lower quality standard than considered acceptable
- To take different measures to improve the product quality or checking of quality from dropping below the designed level during manufacture.

Principles Of Quality Control

The principles of quality control which govern the manufacturing system are as follows:

- Under the present competitive manufacturing conditions quality of the goods being manufactured is a variable having upward trend
- The quality control increases the sales volume and decrease the cost of production, distribution and hence makes mass production economical.
- The conformance of finished products to the pre decided standards and specifications should be accomplished by using preventive measures instead of following corrective ones

ISO 9000

ISO 9000 is the International Organization of Standardization. ISO 9000 is a set of written standards, laying down a quality system.

ISO Series	Description
ISO 9000	It is considered as a road map for use of the other standards in the series. It defines the five key quality terms in the ISO terminology
ISO 9001	It specifies a model when two parties require the demonstration of a supplier's capability to design, produce, and install and service a product
ISO 9002	It specifies a model for quality assurance in production and installation
ISO 9003	It is model for quality assurance in final inspection and testing.
ISO 9004	It provides quality management guidelines for developing and implementing a quality system and in determining the extent to which every element is applicable

Table 2.4 Description of ISO 9000, Quality Systems (Shankar, 2003)

Prerequisites For Implementing Iso 9000 Quality System

For effectively implementing ISO 9000 quality systems, any organization must meet the following requirements:

- Development of quality awareness
- Imparting education and training to employees
- Introduction of motivation and incentive programs
- Development of measuring equipments laboratory
- Development of planning scheme for implementation
- To have firm commitment of top management to fully support the quality system with a strong will and faith to make it a success.

2.14 Layout

A plant layout is an arrangement of facilities and services in a plant. It outlines relationship between production centers and departments. Plant layout can be defined as an optimum arrangement of industrial facilities, including personnel equipments, storage space, material handling equipments and all other supporting services in an existing or proposed plants. Plant layout provides a broad framework within which production and many administrative activities have to take place.

Objectives of a good layout

A good layout is based on principles of flow—smooth flow of operations, flow of materials and people, so that manufacturing length and time can be shortened and inventory of material in process can be reduced. Similarly, it must be flexible and should anticipate future needs.

The main objectives of a good plant layout are:

- Integration of production centers
- Reduce material handling
- Effective utilization of available space
- Worker convenience and job satisfaction
- Flexibility
- Removal of bottlenecks
- Quick disposal of work

- Avoids industrial accidents

Importance of plant layout

- The layout determines the arrangement of facilities and services in the plant
- It outlines the nature of flow in the plant
- It determines the type of handling systems
- Machine utilization is partly determined
- It affects the amount of work in progress

Types of plant layout

1. Process layout

   It is also called functional or job lot layout. In a process layout all similar machines are grouped together. It is used in job and bath production and non-repetitive type of work.

2. Product or Line layout

   In this type the machines and auxiliary services are arranged in line according to the sequence of operations to be performed on the work. The raw material enters in line at one end, the operations are carried out in succession, in a smooth flow and the finished product is delivered at the other end of the line.

3. Mixed or Combined layout

   This is the combination of the process and line layouts. It incorporates the advantages of both the process layout and the line layout.

4. Static or Fixed Position layout

   Static or fixed position layout is used when the product is too large or too heavy to move from one position to another and is consequently fixed in one place.

1.15 Conclusion

In this chapter literature on different related issue have been gone through to Map an understanding now we will take the detailed case study of BPP & analysis is done in the next chapter.

CHAPTER 3

SCM Issue for Ancillary Organisation

3.1 Introduction

In this chapter detailed analysis has been done of an ancillary organization situated at Rohtak in Haryana called Bharat precision products which is into customerised nut & bult manufacturing supplying to HMT, HEROHONDA & many more know names in Automobile sector and tractor sector. Different SCM issue related have been dealt with which are given below (a) company profile (b) SWOT Analysis upstream elements & process involved i.e. purchase processes & vendors from which purchase being done (c) Business process internal to company. A detailed analysis practices regarding production planning & control (PPC), Quality policy, Training & Development, Research & Development (R & D), Human Resources Development (HRD), Layout, Organization structure, Down stream elements & processes i.e. customers, then share in sales, sales increase compared to last years. Etc. (g) At conclusion with recommendations are made.

Supply chain management aims to reduce costs, risk and lead times associated with transactions thus improving value. There is limited research into supply chain management in the low-volume. Engineer to order (ETO) sector. This is in contrast to the extensive literature on the high volume sector particularly automotive & electronics (Lamming (1993), Nishiguchi (1994))

A business process approach to describing ETO companies help to identify the nature of relationships between customers and suppliers. These are particularly complex in ETO business, which are involved in many different types of supplier relationships. A systems modeling approach to representing this complexity is reported by McGovern (1998))

3.2 Brief Profile Of BPP

Bharat precision products came into existence in 1981 as a dream of three professionals out of which two were engineers and one was having commerce background. In the initial few years the performance of the company was not up to the mark because of the government policies of giving more emphasis on sports sector (because of asiad’82). But after that phase the

company picked up with the rich technical background, past experience and understanding of the market in due course.

Bharat precision products is into ETO manufacturing in automobile industry. The turnover of the company for the financial year 2003-2004 was 73 lacs (approx.) and the company is expecting an average growth of around 7% per annum.

3.2.1 Financial Aspects Of BPP

Financial management is an integral part of overall management. It is not totally independent area and draws heavily on related disciplines and fields of study. It is very important to analyze financial aspects of the company to judge current position, strongness of the company in financial terms, future prospects feasibility to take strategic decisions in short term and long term planning. The financial statement of the company is given are annexure AI-A2.

S. No.	Elements	Weight
1.	Fixed expenses • Bonus 0.010763 • Repair and maintenance 0.00717 • ESIC expenditure 0.00448 • EPF expenditure 0.01489 • Salary and wages 0.06103 • Gratuity 0.00174	0.100073
2.	Variable Expenses • Raw material/turn over 0.623519 • Consumable stores/turn over 0.024922 • Oil and lubricant/turn over 0.031257 • Diesel/turn over 0.012896 • Electric/turn over 0.029337 • Job work experience/turn over 0.10355	0.825481
3.	Gross profit	0.130423
4.	Opening balance minus closing balance	-0.056015
	Total	1.000000

Table 3.1 Cost Structure (2003-2004)

Analysis of Table 3.1:-

Variable expenses are dependent on production volume and they should be monitored. In above analysis raw material and job work experience are the major components and thus they should be monitored regularly.

Analysis of Financial Statement

1. Inventory turn over ratio	=	cost of goods sold/ average inventory
	=	7309613.12-953345.8/(9920501.6+1329932/2)
	=	5.64
Inventory holding period	=	12/5.64
	=	2.12 months

The ratio indicates how fast inventory is sold. A high ratio is good for liquidity while a low ratio signify that inventory does not sell fast. Since the inventory holding comes out to be 2 .1 months which in on higher side so JIT implementation should be carried out to decrease the inventory.

1. Current ratio = Current Asset/Current Liability = 3552091.24 / 1470395.17 = 2.4157

The ratio measures its short term solvency , it indicates the rupees of current assets available for each rupee of current liability. Higher the ratio larger the amount of rupees available. Hence, more the firm's ability to meet current obligations and greater is the safety of funds of short term creditors. Standard value of current ratio is 1.33 and for sound ratio it should be more than 1.33. Since our calculations show our ratio to be more than 1.33, therefore BPP is sound enough

2. Debt equity/ ratio = Debt/Equity = 1782379.8 / 964362.75 = 1.84825

This ratio reflects the relative claims of creditors and share holders against the assets of the firm. The value of debt equity ratio should not be more than 4 and hence above value is acceptable.

3. Gross profit turnover ratio = Gross profit/Turnover
=953345.84/7309613.12 = 0.130423

The calculations show that the ratio result comes out to be moderate.

4. Fixed asset equity ratio = Fixed Asset/Equity
= 635771.48 / 964362.75 = 0.65927

It should be less than 1 which is our present case.

5. Fixed asset debt ratio = Fixed asset/Debt
= 635771.48 / 1782379.8 = 0.35669

It should be around 0.5 and hence is okay.

3.3 SWOT Analysis

Importance Of SWOT Analysis

Hence, the firm should assess its internal strength as well as weaknesses, periodically by reviewing the business marketing, financial and organizational competence. The ACRONYM "SWOT" refers to a simple and effective method a firm can use to appraise in details its strength and weakness as well as the opportunities before it and the threat it faces.

The Goal Of Swot Analysis

The goal of SWOT analysis for a firm is to identify the strategy related factors that can have a major effect on it. However, all factors in such analysis are not of equal value, so the goal is to identify those critical factors that can have a major impact On the firm and build on vital strengths, correct glaring weaknesses, exploit significant Opportunity and void and counter the threats if any.

SWOT ANALYSIS OF BHARAT PRECISION PRODUCTS

(a) Strengths

(i) High technical expertise:

As BPP is there in specially manufactured fasteners sector, high technical expertise or know how is required to sustain in the market. That technical expertise is available with the expertise is available with the directors of the company. Two of the directors are engineers of 1970's.

(ii) High Quality No warranty claims

Customers have been claimed so far since from the beginning of the company. Also final rejection is approximately 2%after a rework of 3%.

(iii) General Purpose Equipments Available

Facilities available for production like machineries etc are of fairly good quality out of which most of them are branded one and to cover wide range of products asked by different automobile manufacturers (Tractors and car manufacturers).

(iv) Very Low production stoppages because

Of no power as genset is available as the answer of this problem with Bharat Precision Products and 100% machine utilization is approached by taking following decisions

S. No.	Reasons for Stoppages	Arrangements at BPP
1.	Maintenance and breakdown	Preventive maintenance schedule is followed strictly. In all preventive maintenance and breakdown maintenance time is 30 hrs. In one month in total for all machines.
2.	No power	Genset available
3.	No workers	Immediately recruitment is done if some workers leave the job.
4.	No materials	If no material is there then production schedule/sequence is changed and other items in queue are planned for production.

Table 3.2 Reason of Stoppages of production & arrangements at BPP

(v) Bharat Precision Products is the only

Vendor to the companies for the items that are dealing in currently.

(vi) Low overheads of the company so low manufacturing cost.

(b) Weakness

(i) Low labor incentives are given.

(ii) Technological advancement:

No CNC is used even for precision products. Use of CNC can be incorporated even to increase the product ranges.

(iii) MIS (Management Information System) or IT is used only in the account department and no centralized ERP software implementation is there which would increase the overall efficiency of the company.

(c) Opportunities

(i) There has been on an average a 7% overall growth in the company sales per annum.

(ii) There has been a prediction of manufacturing outsourcing by the multinational automobile companies. This prediction can be used effectively for the overall growth of the company and increase in its product range.

(iii) There has been predicted a high growth of the agricultural industry or the agricultural sector because of the use of new inventions and implementation of scientific methods in the fields. This would result in a more demand of the basic products of the company meant for the tractors and other automobiles.

(iv) There may be an overall economic growth of the company with the simultaneous growth of the automobile sector.

(v) Similar products may be added to the existing product range as it may increase to the overall growth of the company.

(vi) Export of the goods produced in the company to other parts of the world other than India. This will increase the production and profit and broaden the horizons of progress of the company.

(e) Threats

There is no specific general item made by BPP. The production depends upon the order of the customers. This may sometimes lead to bottlenecks in production.

(i) There are threats of increase in competition in terms of price and quality from other competitors in India as well as from outside the country.

(ii) There has been increase in production of nuts & bolts made up of new alloys and materials, which are relatively cheaper and somewhat stronger than the existing materials used by the company. Also the use of different types of plastics in place of nuts and bolts may hamper the overall growth of the company.

(iii) Since, India is now open to trade with different countries, there have been some companies from different parts of the world (e.g., China), which are feeding the market with very low priced goods having reasonable quality.

3.4 Supply Chain Of BPP

All the supply chains start from and end into the mother earth and so is the supply chain of BPP. The raw material i.e., Iron is extracted from the earth in the form of different ores such as haematite etc. this ore is then concentrated and extraction of iron is done from this ore in large blast furnaces. After this iron in the form of wrought iron is extracted. His wrought iron is then melted and put into moulds to take the form of iron bars or commonly known as black bars. These bars may go under deformation and may not be straight and dimensionally correct on cooling. Such rods cannot be used as it is for the manufacturing process. So these rods are passed from wire drawing or draw bench machine for dimensional correctivity and then through straightening machine for perfect alignment of rods. After these operations these bars are called as bright bars. These bright bars after forging act as the raw material for BPP. This raw material is worked upon i.e., all the machining process is done on these bars. The machining process

varies with the design of the product desired. After machining the final nuts and bolts are manufactured. These products are then sent inspection. The nuts and bolts which are O.K. are packed and dispatched to the customer but the ones which are rejected are again inspected. The ones that can be corrected are corrected and packed to be dispatched to the customer while the others are discarded. The customer uses the product as his use satisfies i.e., in different components assembly. After the use is over or the nut or bolt loses its life then they are collected as waste and discarded. These discarded items are again melted in a furnace and sent to mother earth.

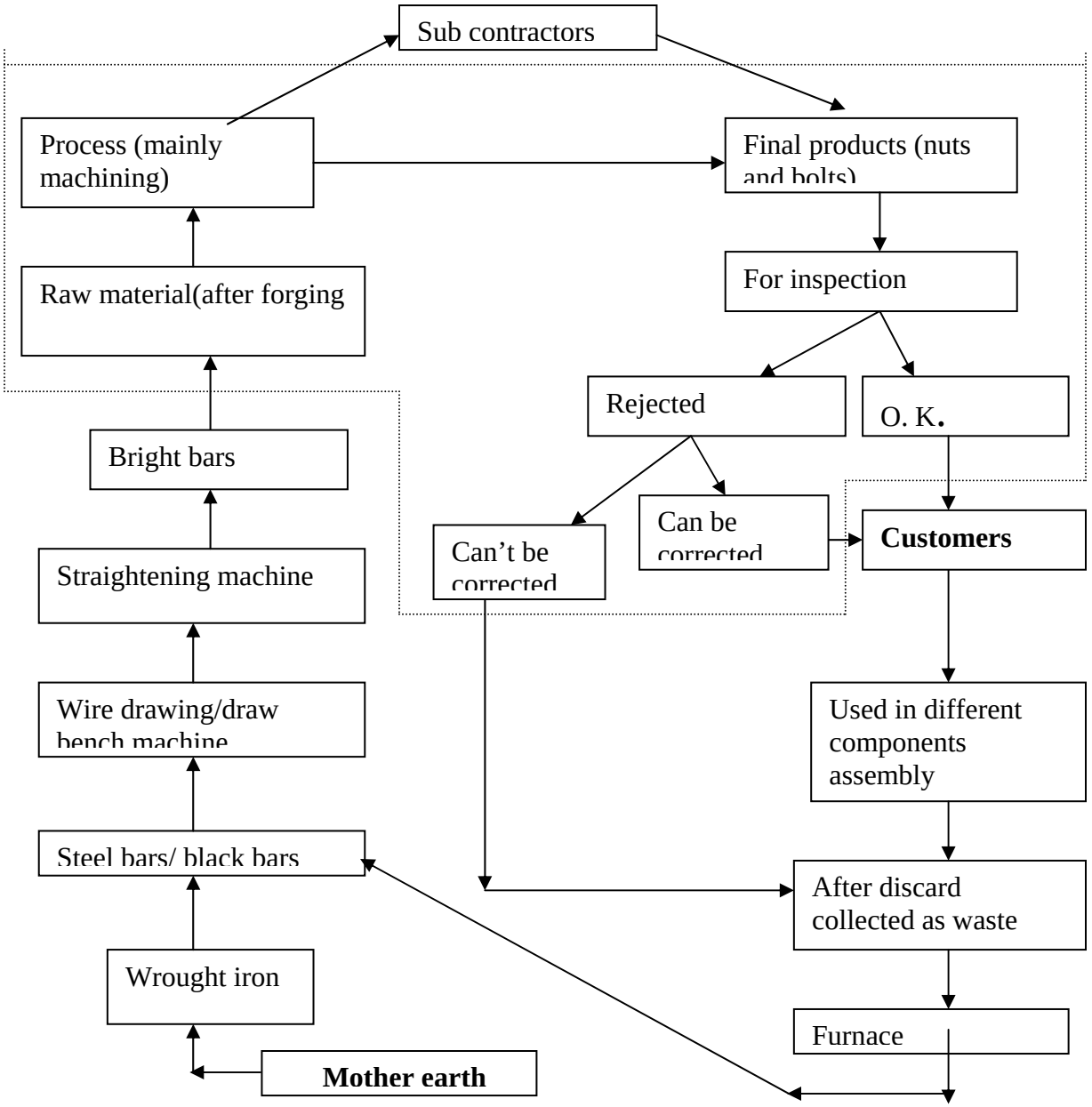


Figure 3.1 Supply chain of BPP (------- shows boundaries of BPP)

Internal QC processes

The raw material that enters the factory is first sent for inspection for the separation of deformed or weak raw material. The raw material is checked for quality of raw material, its size and finishing of raw material. The ones which are correct are recorded and coded but the ones rejected are sent back with the reason of rejection.

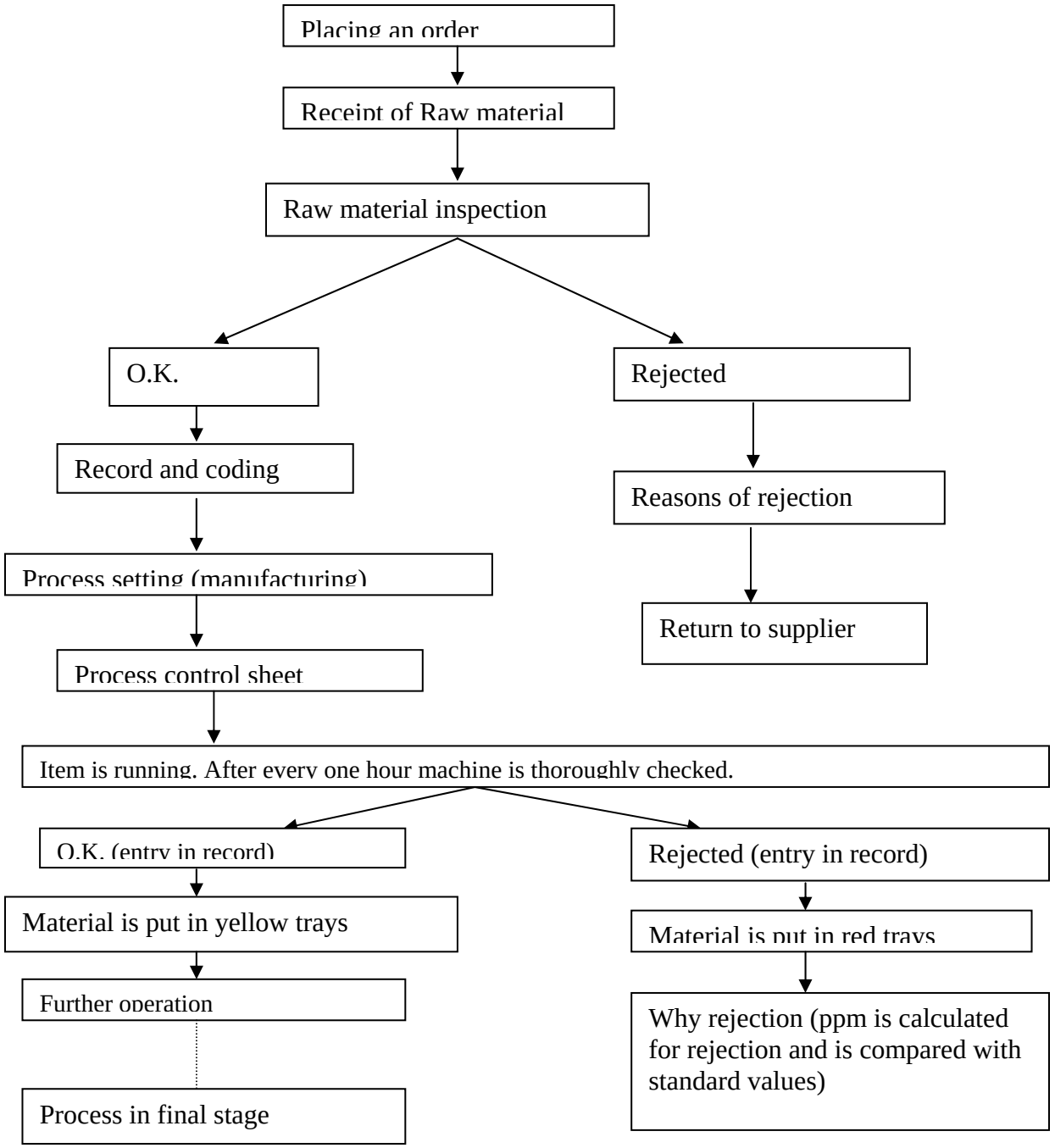


Fig 3.2 In process activities & record keeping in BPP

The correct raw material is worked upon i.e., all the machining process is done on these bars. The machining process varies with the design of the product desired. The whole manufacturing process is written or plotted on a process control sheet. This method helps as it will help in checking the sizes of initial setting and compare them with the ones on the drawing. This leads to accurate manufacturing. After the manufacturing quality testing of the product is done. This is done by running the product on the machine and after every one hour machine is thoroughly checked. The nuts and bolts, which are O.K., are put in yellow trays but the ones that are rejected are put in red trays and are again inspected. The ones that can be corrected are corrected and packed to be dispatched to the customer while the others are discarded. The reasons for rejection are stored and ppm is calculated for rejection and is compared with the standard values. The correct ones are packed and dispatched to the customer.

3.5 Purchasing

Purchasing Information

The purchasing information is provided in the purchase orders so that features are available to the sub contractors to meet the product specification. The following purchasing information is being provided to describe the product to be purchased where appropriate

(a) Requirements for approval of product, procedures, processes equipments.

(b) Quality management system requirements.

(c) Requirement for qualification of personnel.

The adequency of requirements is ensured prior to their communication to the supplier.

Purchasing Processes

- The company is maintaining a documented procedure for the purchase of product forms the subcontractors.
- Since the purchased product have the ultimate effect on the product realization therefore the type and extent of control applied to the supplier and purchased product which effects the quality of product realization.
- The selection of subcontractors and the criteria is defined. The subcontractors performance control is maintained and records are kept.
- The verification of purchased products is allowed for the customers.

The company has approved sub contractors from whom the products are purchased and the status of the vendor rating is communicated for improvements, if required in terms of quality/delivery.

3.6 Micro Elements & Activities: Internal To Bpp

3.6.1 Organization Structure Of The Company

In the company Bharat Precision Products the type of organization structure followed is functional organization. Each of the three directors of the company has a certain section of work under him. Each of them is authorized to give orders to workers. This set up permits the individual foreman, in charge of each function to specialize in it or the enterprise could employ specialists.

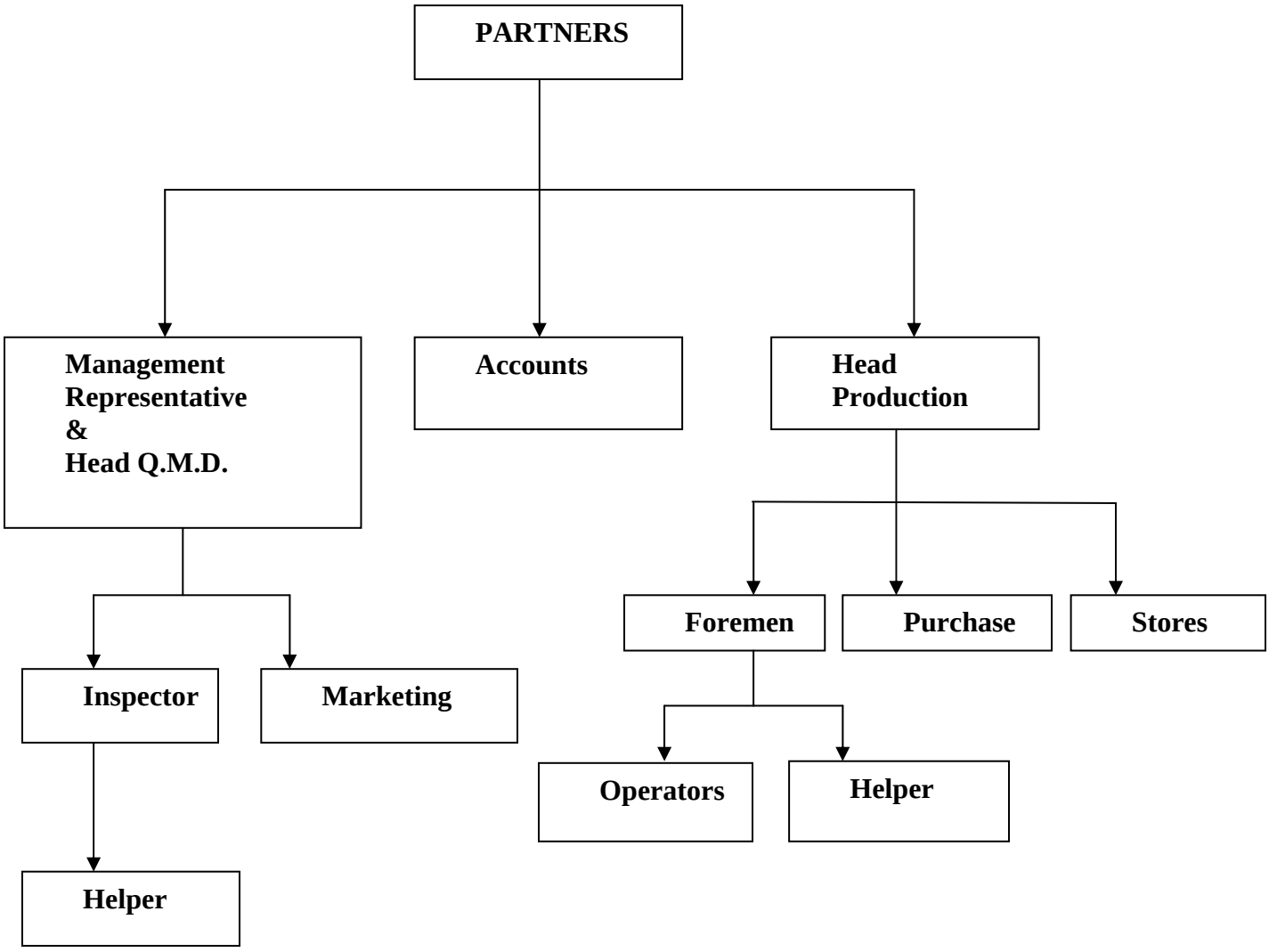


Fig 3.3. Organizational Structure of BPP

Advantages

1. Supports in depth skill development

2.Specialists free from administrative work

3.Simple decision network

4.Enforces efficient use of resources

5.Foster in depth skill specialization and development.

6. Better career progress

7. Coordination between functions is improved

8.Technical problem solving is of better quality

9.quality of work is better.

Disadvantages

1.Slow response time

2.Bottlenecks caused by sequential tasks

3.Decisions pile at top

4.Poor inter unit coordination

5.Stability paid for in less innovations

6.Restricted view of whole

7.Relatively poor communication across functional departments

8.Generally slow response to external changes

9.Delays due to decisions concentrated at top of hierarchy.

10.Difficult to pin point responsibility for problems.

3.6.2 Quality Practice In Bpp

Quality Policy

" Our Primary responsibility is to deliver maximum value to our customer inpursuance of this effort with our dedicated Team Work." We commit ourselves to the following quality objectives To maintain the leadership both in development and technology of precision turned parts by continual improvement in quality. To adhere in letter and sprit to the technical requirements and laid down systems which is essential for our products to be consistently. The first choice of our customer through inbuilt quality and on schedule delivery.

Interface Relationship

P=PRIMARY RESPONSIBILITY **C= COMPLIMENTARY RESPONSIBILITY**

DEPTT. / ISOCLAUSE	Prop	MR	HEAD PROD	HEAD QMD
Management Reviews	P	P	C	P
Document & Data	C	P	C	C
Document Numbering	C	P	C	C
Prod. Identification & Trac	C	C	P	P
Control of Non Confirming Prod	P	P	C	C
Corrective & Prev Action	C	P	P	P
Control of Quality Control	C	P	P	P
Internal Quality Audit	P	P	P	P
Mont. & Meas of Processes	C	C	P	P
Quality Planning	C	P	P	P
Drawing Control	C	C	P	P
Preservation of Products	C	C	P	P
Contact Reviews	P	P	C	C
Control of Cust. Supp. Prod.	-	-	-	-
Handling Customer Comp.	C	P	C	P
Purchasing	C	C	P	C
Selection of Vendors	C	C	P	P
Vendor Perf. Control	C	C	P	P
Prod. Planning & Control	C	C	P	C
Process Control	C	C	P	C
Maintenance	C	C	P	C
Insp. & Test Incoming	C	C	C	P
Insp. & Test in process	C	C	P	C
Insp. & Test of final prod	C	C	C	P
Stores incoming	C	C	P	C
Pres. Hand & Store of F.P.	C	C	P	C
Training	C	P	C	P
Cont. of Monit & Meas Devi	C	C	C	P

Table 3.3 Interface Relationships at BPP

Quality Management System Planning

The quality planning of the products is carried out by implement the quality assurance system and by controlling the parameters of the products mentioned as here under.

Quality policy displayed in the company.

Set up of he organization in the company authority and responsibility stipulated for the different functions that have a bearing on the quality.

Identification of the process and product, verification, equipment and fixture skills and resources required for achieving the desired product quality.

Developing and acquiring quality control skills at the different stages.

Identification of measurement techniques that exceed present capability of the company, development and acquisition of the same.

Quality Assurance measures are systematically deployed in all relevant phase of manufacturing which are mentioned in the quality assurance procedures and work instructions. The specification of the work is based on the customer's standards. The processes are set up as per the requirements of the customer and established in house drawings and specification and monitoring is done by following inspection standards at appropriate stages of quality system.

The effectiveness of the system is assessed through a defined system of internal quality audits and corrective and preventive actions as required and monitoring the effectiveness of the system.

3.6.3 Product Realisation

So as to monitor the information related to the product realization and the customer perception to determine whether the organization is meeting the customer requirements.

Scope:

All activities in the organization.

Responsibility:

The proprietor, head prod, head qmd. are responsible for operation of this procedure.

Customer satisfication:-

The customer satisfaction of quality management system as one of the measurement of performance is being conducted in the company.

(a) The survey of customer satisfaction is conducted so as to know the gap between the customer satisfaction and our level.

(b) The customer satisfaction questionnaire will be prepared including the various aspects on the quality, Delivery documents are indicators.

(c) The questionnaire will be sent to the different customers and time data will be collected.

(d) After receiving the filled data from all the customer the analysis will be done by the cross-functional team to find the gap analysis and continual improvement. The projects will be identified to close the gaps and the release the satisfaction and the follow up action and review will be carried out once in a month.

3.6.4 Internal Audits: -

The internal audits are being conducted as per the intervals so as the ensure planned management systems instituted in the company are being followed and

(1) Confirms to the planned arrangements and as per the inter national quality managements standards.

(2) The same are effectively implemented the audits are being taken up taking in to the consideration the status of the processes and in continuation to the results of previous audits.

(3) The auditors are trained to carry out the internal audits and the same have been trained by the outside agency to carry out the audits.

(4) It is ensured that the followup action arising out of the audits are completed and the follow up activities are carried out to verify the corrective action carried out by the HOD'S of the deptts.

3.6.5 Monitoring and measurement of process :-

The suitable method as chosen as per the need to carry out the monitoring and the measurement of the manufacturing in the company.

The methods chosen can demonstrate the ability of the processes to achieve planned results. As and when the planned results are not achieved and deviation from the desired results takes place.

Monitoring And Measurement Of Products

At the appropriate stages of the products realization process. The verification of product is carried out by measurement and monitoring. The Acceptance criteria and the product to be released is identified is and the records are kept.

Monitoring And Measurement Of Product During Process

The product are verified during the various stages to manufacturing the conformance is verified as per the control plan, operational standard and the records are maintained. The Product is released form one stage to another after the product conformity is established.

Monitoring And Measurement Of Products At Final Stage

The Product at the final stage is released to the customer only after the product is the found conforming to the laid down quality check sheets are prepared including all the data to ensure the conformance.

In case the product required rework. The same is being taken up with the customer approval.

Control Of Non Conforming Product

A Procedure has been put in place for the non conformance observed at the various stages of manufactures.

Non conforming at any stage will be delete as per the following matrix.

Stage	Action Required	Rep.	Record
Incoming Stage	Segregation Return to Vendor on Deviation	Inspector M.R. M.R.	Yes
Inprocess Stage	Hold the material check 100% of the product till Previous inspection is revivified Of re-worked or deviation granted	Inspector	Yes

Final Stage	Segregate/Rework	Inspector	Yes
Customer End	Segregate/Rework	Inspector	Yes

Suspect Product : Suspect Products are in the under mentioned situations.

(1) Calibration of instrument and gauge not correct.

(2) Product produced between present and last stage of inspection.

(3) Customer complaint which includes the product lying in our works.

Analysis Of Data

(1) For company level data the areas will be defined on the basis of quality objectives. The company vision and results measureable.

(2) Data will be collected by the respective data which will be reviewed and analysis in the company.

(3) After collecting the data analysis will be done by cross-functional team so as the check whether they are meeting as per the laid down policy and objectives and also to know the present status.

(4) Priorities shall be sent for the targets for customer related properties.

Improvements

Continual Improvments

The Continual improvement will be facilitated through the

(a) Quality policy and objectives displayed.

(b) The internal quality audits conducted in the company.

(c) The data is collected and analysed so as to ascertain the status of the quality management system.

(d) Corrective and preventive actions taken the company and the extent of effectiveness of the action.

(e) The management reviews are carried out and the status of the continual improvement is reviewed.

Corrective Actions

A document procedure is in place to eliminate the causes and the non-conformity observations in the quality management system.

The procedure illustrates the corrective actions to be taken in the following events:

(1) Reviewing non-conformities in the system, which included customer complaints.

(2) So as to determine the causes of the non-conformities.

(3) To evaluate the need for the action to ensure closure of the non-conforming.

(4) The implementation action required.

(5) Records to be kept for the non-conformance.

(6) Actions to be discussed in the management's review meeting.

Preventive Actions

(1) To determine potential non-conformity, which will become major non-conformance in the due course if non-attendance to presently.

(2) To Evaluate so that the action then is enough to avoid reoccurrence of the non-conform.

(3) Determining and implementing needed.

(4) Record of the results to be monitored.

Preventive actions to be discussed in the review meeting.

3.6.6. QMS Procedure Input & Output

QMS PROCEDURES INPUT-OUTPUT						
DEPTT. ; MARKETING				DATE:		
PROCESS INPUT	PROCESS OUTPUT	PROCEDURE	CRITERION	CONTROL MEASURE	RESPONS-IBILITY	FREQUENCY
Looking for new customer	Increase in Customer	MKT-P-01	Increase in potential no of customer	By personnel visit increasing sales team	M.D.	After 3 months
Requirements of customer is consulted with Head QMD., Head production	Terms of production is finalized	MKT-P-01	Quality of product delivery time schedule	Negotiation/RE-Consideration	M.D/HEAD Production	As per Requirement
Contract Review is maintained	Knowing the existing status of ORG. with reference to customer	MKT-P-01	Customer Satisfaction	Document Reviewed	M.D.	After 5 months

Table No. 3.4 QMS procedures Input and Output for marketing department

QMS PROCEDURES INPUT-OUTPUT						
DEPTT. ; PERSONAL				DATE:		
PROCESS INPUT	PROCESS OUTPUT	PROCEDURE	CRITERION	CONTROL MEASURE	RESPONSIBILITY	FREQUENCY
List of employees	Description of total employees with their competency level & responsibility	TRG-P-01	Competency matrix for employees	Procedure & work instruction followed	M.D. & Concerned HOD	As per recruitment
Training Needs	Training requirements are generated or training programme	TRG-P-01	To be emprove for the next grade	Procedure followed & concern HOD	MR	Yearly
Training Calender	Description of training to be imparted schedule of training & the faculty Topic discussed Trainer & training	TRG-P-01	Training Needs	Procedure Followed	MR	Yearly
Individual TRG. Record	conducted internally or externally	TRG-P-01	Training Calender	As per the training procedure	MR	Yearly

Table No. 3.5 QMS procedures Input and Output for personal department

QMS PROCEDURES INPUT-OUTPUT						
DEPTT. ; QUALITY ASSURANCE				DATE :		
PROCESS INPUT	PROCESS OUTPUT	PROCEDURE	CRITERION	CONTROL MEASURE	RESPONSIBILITY	FREQUENCY
Incoming Insp. Report for raw material	Prepared at incoming stage	QMD-P-01	Purchase Order	Inprocess part performance	Inspector	PER LOT
Incoming Insp. Report	Preparing During Incoming of material	QMD-P-01	Process Control	Coming inspection history record	Inspector	PER LOT
Incoming Insp. History record	Updating with incoming material Filled during process	QMD-P-01 QMD-P-02	Vender Performance control Process Control	Vender Rating Quality control	Head QMD Inspector	Quaterly Process Wise
Inprocess Insp. Report	Preparing with each consignmet	QMD-P-05	Customer Drawing	Customer Satisfaction	Inspector	Lot Wise
Pre Despatch Insp. Report						

Table No. 3.6 QMS procedures Input and Output for quality assurance

QMS PROCEDURES INPUT-OUTPUT						
DEPTT. ; PRODUCTION				DATE:		
PROCESS INPUT	PROCESS OUTPUT	PROCEDURE	CRITERION	CONTROL MEASURE	RESPONSIBILITY	FREQUENCY
Daily production plan	Daily Planning	PRD-P-01	To meet the Schedule	Customer Satisfaction	Head Production	Daily
List of Machines	Update	MND-P-01	No. of machines with capacity	Daily Production Plan	Head Production	Whenever New M/C brought
Annual preventive maintenance Schedule	Update	MND-P-02	Less no, of breakdowns	Customer Satisfication	Head Production	Yearly
M/C Preventive maintenance history record	Update as per annual preventive maintenance schedule	MND-P-03	To Avoid the major breakdowns	Meet the annual desire Schedule target	Head Production	Yearly
M/C Breakdown maintenance History record	As per breakdown	MND-P-04	Efficiency	M/C preventive maintenance	Head Production	Yearly

Table No. 3.7 QMS procedures Input and Output for production department

QMS PROCEDURES INPUT-OUTPUT						
DEPTT. ; CALIBRATION				DATE:		
PROCESS INPUT	PROCESS OUTPUT	PROCEDURE	CRITERION	CONTROL MEASURE	RESPONSIBILITY	FREQUENCY
Master list of Instruments	Prepared	CAL-P-01	No. of inst. With range	Calibration Record	Head QMD	Whenever new inst. Produced
Record of approved external calibration agency	Prepared	CAL-P-01	Calibration Faculty	Desired Quality	Head QMD	With Effective Calibration agency With updation of master list of inst.
Individual inst. Calibration card.	Updating with master list of inst.	CAL-P-01	Desired quality performance	Maintain Desired Quality	Head QMD	Whenever new guage produced
List of Guages	Prepared	CAL-P-01	No. of gauges with range	Calibration Record	Head QMD	With the updation of gauge list
Gauge Calibration card	Updating with list of guages	CAL-P-01	Desired quality performance	Maintain Desired Quality	Head QMD	With the updation of gauge list

Table No. 3.8 QMS procedures Input and Output for calibration department

QMS PROCEDURES INPUT-OUTPUT						
DEPTT. ; PURCHASING				DATE:		
PROCESS INPUT	PROCESS OUTPUT	PROCEDURE	CRITERION	CONTROL MEASURE	RESPONSIBILITY	FREQUENCY
Approved Vender List	Total No. For approved vendors with their nature of job working	PUR-P-01	Vendor registration form	Procedure Followed	Head Purchase	2 Year
Purchase Order	Material acceptance criteria & commercial terms	PUR-P-01	Purchase requisitioning	Procedure Followed	Account Assitant	As per requirment
P.O. Register	Detail of purchase	PUR-P-01	Purchase order	Procedure Followed	Account Assitant	With the issue of P.O.
Stock Register	Total Stock in process with detail	PUR-P-01	Work order cum job work challen	Procedure Followed	Account Assitant	With the issue of P.O.
Vendor Registration Form	Infrastructure of vendor & their scope or working	PUR-P-02	Potential vendor who meets our job Requirements	Procedure Followed	Account Assitant	As per requirment
Vendor Updating Record	Present status of vendor's infrastructure	PUR-P-03	Personal Visit	Procedure Followed	M.D.	2 Years
Vendor Rating Card	Overall performance of vendor	PUR-P-03	Incoming inspection history record	Procedure Followed	Head QMD	Yearly or basis of monthly

Table No. 3.9 QMS procedures Input and Output for purchasing department

3.6.7 Inventory

Inventory means all the materials parts/components, in process or finished products, castings and consumable goods recorded on the ledgers of the organization and kept in its stocks for a period of time

Functions of Inventory

- Inventories serve as cushions and leas to better utilization of men and machine besides economy.
- Inventory provide production economies
- Inventory is a necessary evil for any enterprise
- Inventory results in the maintenance of smooth and efficient production flow
- Creation of motivational effect in decision making

Importance of Inventory

- Good consumer service can be provided and maintained in the organization
- Enables smooth and efficient production flow of goods/items
- Provides protection against uncertainties regarding demand and supply of materials and output
- Various production activities can be independently and economically performed
- Ensure better utilization of men, machines and materials
- With bulk purchases quantity discounts can be availed

Types of inventories

- Production inventory
- Work in progress inventory
- Finished goods inventory
- Operating and maintenance inventory
- Miscellaneous inventory

Reasons for holding inventory

- To create a buffer stock between the input and the output
- To ensure against delay in deliveries

- To allow for a possible increase in output if so required
- To ensure against scarcity of materials in the market
- To make use of quantity discounts
- To utilize to advantage price fluctuations

Types of inventory control systems

1. PERPETUAL INVENTORY CONTROL SYSTEM

It enables the manufacturer to know about the availability of these materials and stores without undergoing the cumbersome process of physical stock verification. Under this system, proper information with regard to receipt, issue and materials in hand is kept ready.

2. A.B.C. METHOD OF INVENTORY CONTROL

Under this method materials are classified under three categories in accordance with their respective values. This method is also called as 'stock control according to value method', 'selective value approach' and 'proportional parts value approach' etc.

INVENTORY DETAILS OF BPP

Factors	Description
Advance inventory	Approx 2 months
Frequency of ordering	About 1 week
Follow up report	Regular
Supervisor	Self
Cost%	50-60%
Time from ordering to supply	Approx 15 days
Suppliers	4 local, 2 from nearby region (e.g., Faridabad)
Safety stock	High
Value engineering effort and waste reduction emphasis	Less

Table 3.10 Inventory Details of BPP

3.6.8 Type Of Layout Used In Bharat Precision Products

The type of plant layout used in Bharat Precision Products is the process or job lot layout.

The different advantages and disadvantages of this type of layout are:

Advantages

1.There is flexibility in equipment or manpower allotment for specific tasks. Thus load distribution can be controlled easily.

2. Better equipment utilization

3. Comparatively low investment in machines is required

4. Each section can receive benefits of specialized supervision

5. The diversity of tasks offers a more interesting and satisfying occupation for the operator.

6. Varied degree of machine utilization may be achieved

7. High scope of expansion

8.Overhead cost is low

9. Maintenance of machines is easy

10.. There is low set up and maintenance cost

Disadvantages

1. There is a high degree of material handling

2. Large work in process is common

3. Workers are more skilled

4. Total cycle time is high

5. Inspection is more frequent which results in high supervision costs.

6. It is difficult to fix responsibility for a defect or a quality problem

7.The production planning and control is relatively difficult

6. Production planning and control systems become more complicated

3.6.9. Demands Supply & Lead Time Analysis

For this 3 products of Hero Honda had been selected & their demand & supply got analysed on month basis & week basis & it was found that demand is not completely met for every supply.

Table 3.11: Production schedule of Net Castle (2002-2003)

Month	Schedule (1st of every month)	I week	II week	III week	IV week	Total
April	25,000	3500(05.04.02)	4500(10.04.02)	4000(12.04.02) 6250(16.04.02) 5000(20.04.02) 15250	2250(25.04.02)	25500
May	40000	5000(08.05.02)	7000(14.05.02) 2000(16.05.02) 9000	8000(20.05.02) 2500(23.05.02) 10500	2000(24.05.02) 3500(27.05.02) 2900(28.05.02) 4000(35.052002) 12400	36900
June	35000	3000(05.06.02)	3250(06.06.02) 3750(10.06.202) 2000(12.06.02) 7750(12.06.02) 16750	2500(17.06.02) 3000(19.06.02) 5500	2950(24.06.02) 3500(28.06.02) 6450	31700
July	35000	5000(04.07.02) 4000(04.07.02) 1000(04.07.02) 10000	3250(11.07.02)	8000(13.07.02) 3250(18.07.02) 11250	4000(22.07.02) 3500(27.07.02) 7500	32000
August	35000	4000(01.08.02) 4000(03.08.02) 3750(07.08.02) 11750	4500(10.08.02) 4500(13.08.02) 9000	4250(19.08.02)	5550(24.08.02) 4250(27.08.02) 9800	34800
September	40000	2900(03.09.02) 6000(06.09.02) 8900	7000(10.09.02) 4000(16.09.02) 11000	5000(17.09.02) 5000(29.09.02) 10000	6000(27.09.02) 2900(27.09.02) 8900	38800
October	30000	4000(08.10.02)	4000(11.10.02) 2500(16.10.02) 6500	3000(19.10.02) 3000(21.10.02) 6000	6500(25.10.02) 4000(29.10.02) 10500	27000
November	40000	4500(07.11.02)	4500(14.11.02)	7000(15.11.02) 4500(21.11.02) 11500	5000(25.11.02) 4500(26.11.02) 6200(29.11.02) 15700	36200
December	40000	4000(05.12.02) 3750(06.12.02) 7750	4250(10.12.02) 5000(10.12.02) 5000(13.12.02) 14250	5500(17.12.02) 3000(18.12.02) 8500	5000(24.12.02)	35500
January	40000	5000(02.01.03) 4500(06.01.03) 9500	5000(11.01.03) 2750(15.01.03) 6000(15.01.03) 13750	5000(18.01.03) 3000(23.01.03) 8000	3900(24.01.03) 3250(29.01.03) 1000(30.01.03) 8150	39400
February	30000	700(01.02.03) 3900(08.02.03) 4600	2800(12.02.03) 2800(13.02.03) 5600	2000(18.02.03) 2000(19.02.03) 4000	850(24.02.03) 2500(25.02.03) 3350	17550
March	30000	1000(03.03.03) 3500(05.03.03) 3500(08.03.03) 8000	8000(12.03.03)	7500(21.03.03)	1900(24.03.03) 1700(25.03.03) 3600	27100

Table 3.12: Production schedule of Net Castle (2003-2004)

Month	Schedule(1st of every month)	I week	II week	III week	IV week	Total
April	35000	3750 (2.4.03) 3250(3.4.03) 3250(8.4.03) 10250	3500(11.04.03)	1950(16.04.03) 5000(19.04.03) 6950	2950(23.04.03) 5000)24.04.03) 3450(29.04.03) 11400	32100
May	35000	4000(03.05.03) 4650(07.05.03) 8650	1000(110.05.03) 4000(15.05.03) 5000	1000(16.05.03) 4000(17.05.03) 3000(20.05.03) 8000	4000(22.05.03) 3000(23.05.03) 5550(26.05.03) 11150	32800
June	44000	5475(05.06.03) 5150(06.06.03) 10625	5150(11.06.03) 5475(14.06.03) 10625	5475(18.06.03) 4750(21.06.03) 10225	2700(24.06.03) 2850(26.06.03) 5475(27.06.03) 11025	42500
July	40000	4325(06.07.03) 4750(08.07.03) 9075	4600(11.07.03) 5225(14.07.03) 9825	5000(18.07.03) 4750(22.07.03) 9750	500(22.07.03) 3500(24.07.03) 1300(28.07.03) 5200(28.07.03) 10000	38650
August	40000	4575(05.04.03) 4725(06.08.03) 9300	4125(11.08.03) 5625(16.08.03) 9750	3500(16.08.03) 5175(19.08.03) 8675	5200(23.08.03) 5175(27.08.03) 10375	38100
September	50000	5575(05.09.03) 5625(06.09.03) 11200	6125(10.09.03) 5625(13.09.03) 11750	6125(17.09.03) 5625(20.09.03) 11750	3750(24.09.03) 1825(26.09.03) 5625(27.09.03) 11200	45900
October	50000	6175(06.10.03) 5900(07.10.03) 12075	6175(14.10.03) 5900(15.10.03) 12075	7000(19.10.03) 7000(22.10.03) 14000	3750(24.10.03) 2250(20.10.03) 3000(29..10.03) 10000	48150
November	30000	3250(05.11.03) 4750(07.11.03) 8000	4750(10.11.03) 3250(13.11.03) 8000	3500(17.11.03) 2000(18.11.03) 1000(18..11.03) 4750(21.11.03) 11250	2250(25.11.03) 1500(28.11.03) 3750	31000
December	40000	1750(05.12.03) 3000(08.12.03) 3250(09.12..03) 8000	4750(12.12.03) 3000(15.12.03) 7750	2500(18.12.03) 1750(19.12.03) 4250	3750(22.12.03) 4250(23.12.03) 5000(25.12.03) 2500(26.12.03) 2500(27.12.03) 1000(30.12.03) 19000	39000
January	55000	5000(02.01.04) 6275(05.01.04) 5000(06.01.04) 16275	6350(12.01.04) 6375(14.01.04) 12725	4250(16.01.04) 2600(19.01.04) 6500(21.01.04) 13350	9850(28.01.04)	52200
February	60000	500(03.02.04) 6175(04.02.04) 6500(05.02.04) 13175	6500(10.02.04) 6175(11.02.04) 12675	7175(16.02.04) 6500(19.02.04) 13675	9300(23.02.04) 8400(26.02.04) 17700	57725
March	55000	5875(03.03.04) 5000(05.03.04) 10875	11500(12.03.04) 4400(15.03.04) 15900	5750(19.03.04) 7500(22.03.04) 13250	4250(26.03.04) 7750(29.03.04) 12000	52025

Table 3.13: Production schedule of Net rear Axle Sleeve (2002-2003)

Month	Schedule(1st of every month)	I week	II week	III week	IV week	Total
April	40000	3000(05.04.02) 1500(05.04.02) 4500	4500(10.04.02) 5000((12.04.02) 9500	5250(16.04.02) 5000((16.04.02) 4000(20.04.02) 14250	3750(25.04.02)_ 4500(29.04.02) 3000(30.04.02) 11250	39500
May	44000	10000(08.05.02)	10000(16.05.02)	12000(23.05.020	3250(24.05.02) 3050(27.05.02) 4600(28.05.02) 10900	42900
June	46000	7500(06.06.02)	4500(10.06.02) 7000(12.06.020 9800(12.06.02) 21300	3500(17.06.02) 3000(119.06.02) 6500	3000(20.06.02) 3000(20.06.02) 3800(28.06.02) 9800	45100
July	45000	10000(04.07.02) 10000(04.07.02) 20000	3250(11.07.02) 8000(13.07.02) 11250	6500(22.07.02)	5750(27.07.02)	43500
August	40000	4000(1.08.02) 10,200(03.08.02) 3000(7.08.02) 17200	6000(13.08.02)	3000(19.08.02)	10300(29.08.02)	36500
September	30000	8000(06.09.02)	7000(10.09.02)	6150(17.09.02)	4000(20.09.02)	25150
October	40000	3750(08.10.02) 6750(08.10.02) 10500	4500(11.10.02) 2000(13.10.02) 2200(16.10.020 8700	4000(19.10.02) 5000(212.10.02) 9000	6000(25.10.02) 4500(29.10.02) 10500	38700
November	45000	5000(08.11.02)	5000(15.11.02)	12000(25.11.02)	8250(26.11,02) 12950(29.11.02) 21250	43250
December	40000	6500(6.12.02)	9000(10.12.02) 3500(13.12.02) 12500	3500(17.12.02) 6250(18.12.02) 9750	3500(23.12.02) 6000(24.12.02) 9500	38250
January	40000	5000(2.01.03) 4500((6.1.03) 9500	4000(11.1.03) 3000(15.01.03) 7200((5.1.030 14200	7750(23.01.03)	7750(29.01.03)	39200
February	30000	4650(07.2.03)	4500(8.022.03) 2550(12.022.03) 4500(13.2.03) 11550	4750(19.02.03)	5850(25.02.03)	26800
March	40000	9000(05.03.03)	2500(08.03.03) 8000(12.03.03) 10500	4100(21.03.03) 2000(21.03.030 6100	9000(21.03.03) 1500(25.03.03) 10500	36100

Table 3.14 Production schedule of Net rear Axle Sleeve (2003-2004)

Month	Schedule(1st of every month)	I week	II week	III week	IV week	Total
April	42000	3750(2.4.03) 3250(3.04.03) 3000(8.04.03) 10000	3550(11.04.03) 2900(16.04.03) 6450	5000(19.04.03) 3350(23.04.03) 8000(24.04.03) 16350	7750(29.04.03)	40550
May	45000	3250(3.05.03) 4650(7.05.03) 7900	4100(10.05.03) 3000((15.05.03) 7100	10000(16.05.03) 2500(17.5.03) 9000(23.05.03) 21500	1850(26.05.03) 6350(27.05.03) 8200	44700
June	40000	5175(5.6.03) 4375(06.06.03) 9550	4375(11.6.03) 5175(14.6.03) 9550	5175(19.6.03) 4375(21.06.03) 9550	2000(26.06.03)	30650
July	50000	4000(6.7.03) 4700(8.7.03) 8700	4700(11.7.03) 4330(14.7.03) 9030	2500(18.7.03) 4160(22.7.03) 6660	6000(29.07.04) 4160(24.07.03) 8100(28.07.030 6000(29.07.03) 024260	48650
August	45000	7225(6.08.03)	3775(11.08.03)	6550(16.08.03) 4000(16.08.3) 4475(19.08.3) 15025	4000(23.08.03) 7000(26.08.030 5075(27.08.03) 16075	42100
September	51000	5000(4.9.030 5125(5.9.03) 5150(6.9.03) 15275	5875(10.09.03) 5150(13.09.03) 11025	4250(17.9.03) 5150(20.09.03) 9400	2500(24.09.03) 7025(26.09.03) 5100(27.09.03) 14625	50325
October	40000	11175(7.10.03)	5725(14.10.03)	7000(19.10.03)	7850(28.10.03) 4500(29.10.03) 12350	36250
November	30000	3750(5.11.03) 4750(7.11.03) 7500	2500(13.11.03)	1250(18.1.03) 5000(18.11.03) 2000(21.11.03) 8250	-	18250
December	42000	3500(3.12.03)	2500(9.12.03) 5000(12.12.03) 3750(15.12.03) 11250	2000(18.12.03) 1900(19.12.03) 3900	10250(26.12.03) 4250(27.12.03) 8000(30.12.03) 22550	41200
January	60000	5000(2.1.04) 11400(5.1.04) 16400	9500(9.1.04) 5275(12.1.04) 5850(14.1.04) 20625	3500(16.1.04) 1325(19.1.04) 3075(21.1.04) 7900	11625(28.1.04)	56550
February	55000	6000(3.2.04) 5700(4.2.04) 6025(5.02.04) 17725	11725(11.2.04)	1000(16.02.04) 5700(16.02.04) 6025(19.02.04) 12725	4000(23.02.04) 8425(26.02.040 12425	54600
March	55000	5425((3.3.04) 6200(5.03.04) 11625	4000(12.3.04) 6250(15.3.04) 10250	6750(19.3.04) 9500(22.3.04) 16250	6275(26.03.03) 4250(29.03.03) 5000(30.0.03) 15525	53650

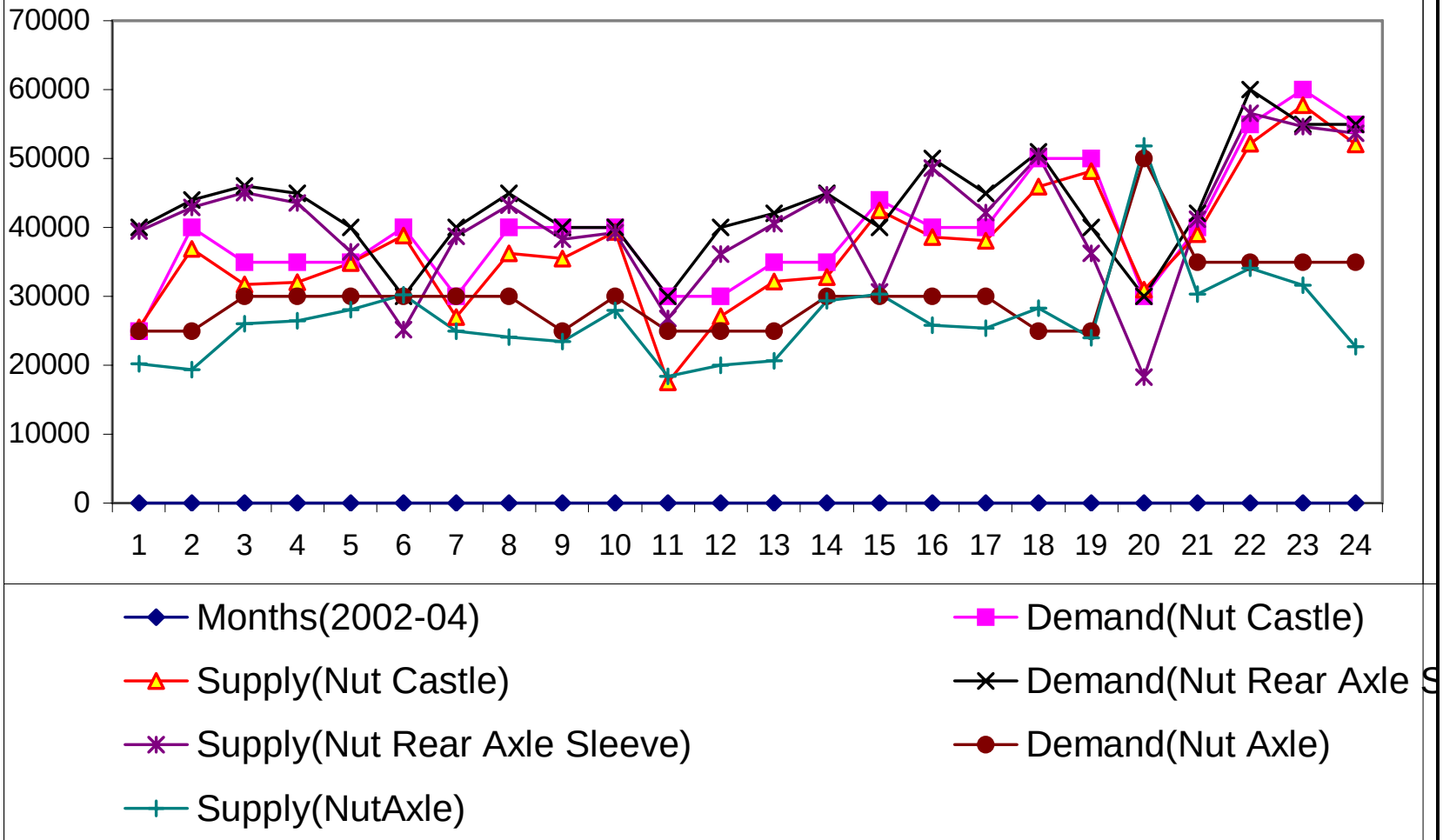
Table 3.15 Production schedule of Net Axle (2002-2003)

Month	Schedule (1st of every month)	I week	II week	III week	IV week	Total
April	25000	2700(5.04.02)	2000(10.4.02) 2000(12.04.02) 4000	3000(16.04.02) 2800(20.04.02) 2200(25.04.02) 8000	4000(29.04.02) 1550((30.04.020 5500	20250
May	25000	2000(08.05.02)	2400(14.5.02) 3000(16.5.02) 5400	3000(20.5.02) 2000(23.5.02) 5000	1400(24.05.02) 3000(28.05.02) 2600(30.05.02) 7000	19400
June	30000	2400(05.06.02) 3000(06.06.02) 5400	2400(10.0602) 1000(12.06.02) 4000(12.06.02) 7400	3200(17.06.02) 1600(19.06.02) 4800	2000(20.06.02) 2400(24.06.02) 4000(28.06.02) 8400	26000
July	30000	8000(04.07.02)	3200(11.07.02)	5600(13.07.02) 3200(18.07.02) 8800	3200(22.07.02) 3200(27.07.02) 6400	26400
August	30000	3200(1.08.02) 3700(03.08.02) 3200(07.08.02) 10100	3000(10.08.02) 4000(13.08.02) 7000	2350(19.08.02)	3200(24.08.02) 4000(27.08.02) 1400(29.08.02) 8600	28050
September	30000	3000(03.09.02) 5000(06.09.02) 8000	5000(10.09.02) 2400(16.09.02) 7400	4000(17.09.02) 3400(20.09.02) 7400	7400(27.09.02)	30200
October	30000	4000(08.10.02)	3500(11.10.02) 3000(16.10.02) 6500	3000(19.10.02) 3975(21.310.02) 6975	3025(25.10.02) 4500(29.10.02) 7525	25000
November	30000	3500(08.11.02)	4550(15.11.02)	600(19.11.02) 3500(21.11.02) 4100	4000(25.11.02) 2950(26.11.02) 5000(29.11.02) 11950	24100
December	25000	3000(05.12.02) 1600(06.12.02) 4600	3600(09.12.02) 500(10.12.02) 3400(13.12.02) 7500	2400(17.12.02) 4800(18.12.02) 7200	4150(24.12.02)	23450
January	30000	5000(02.01.03) 4000(06.01.03) 9000	3400(11.01.03) 2000(13.01.03) 500(15.01.03) 5900	3400(18.01.03) 2400(23.01.03) 5800	4500(24.01.03) 2800(29.01.03) 7300	28000
February	25000	2200(06.02.03) 700(07.02.03) 2900	3600(08.02.03) 2500(12.02.03) 1600(13.02.03) 7700	2000(18.02.03) 1600(19.02.03) 3600	1900(24.02.03) 2300(25.02.03) 4200	18400
March	25000	1000(03.03.03) 2700(05.03.03) 3700	2800(08.03.03) 3400(12.03.03) 6200	2750(21.03.03) 2000(21.03.03) 4750	3400(24.03.03) 1050(25.03.03) 900(28.03.03) 5350	20000

Table 3.16 Production schedule of Net Axle (2003-004)

Month	Schedule (1st of every month)	I week	II week	III week	IV week	Total
April	25000	3000(02.04.03) 2475(03.04.03) 2475(08.04.03) 7950	2550(11.04.03)	1500(16.04.03) 3600(19.04.03) 5100	2400(23.04.03) 3000(29.04.03) 5400	20600
May	30000	3000(03.05.03) 3650(07.05.03) 6650	3200(10.05.03) 1600(15.05.03) 1000(16.05.03) 5800	1200(17.05.03) 2600(20.05.03) 3800	2800(22.05.03) 2000(23.05.03) 2350(26.05.03) 2800(27.05.03) 3200(31.05.03) 13150	29400
June	30000	3975(05.06.03) 3600(06.06.03) 7575	3200(11.06.03) 3900(14.06.03) 7100	4050(18.06.03) 2000(21.06.03) 6050	2800(24.06.03) 2800(26.06.03) 3975(27.06.03) 9575	30300
July	30000	3075(06.07.03) 3875(08.07.03) 6950	3875(11.07.03) 3775(14.07.03) 7650	3875(18.07.03) 3425(24.07.03) 7300	3875(28.07.03)	25775
August	30000	3225(05.08.03) 3225(06.08.03) 6450	2875(11.08.03)	3325(16.08.03) 3050(18.08.03) 3325(19.08.03) 9700	3050(23.08.03) 3325(27.08.03) 6375	25400
September	25000	200(04.09.03) 3925(05.09.03) 3800(06.09.03) 7925	425(10.09.03) 3850(13.09.03) 4275	3880(17.093.03) 3800(20.09.03) 7680	3000(24.09.03) 1550(26.09.03) 3800(27.09.03) 8350	28230
October	25000	2000(06.10.03) 2800(07.10.03) 4800	3750(14.10.03)	2000(15.10.03) 2600(19.10.03) 4000(22.10.03) 8600	3000(24.10.03) 1800(28.10.03) 2000(29.10.03) 6800	23950
November	50000	3800(05.11.03) 4000(07.11.03) 7800	2600(10.11.03) 1700(13.11.03) 4300	3800(17.11.03) 2400(18.110.03) 500(18.11.03) 4000(21.11.03) 15200	3000(25.11.03) 2600(27.11.03) 3800(28.11.03) 3000(29.11.03) 12400	51800
December	35000	4000(03.12.03) 3550(05.12.03) 3000(08.12.03) 10550	3400(09.12.03) 3000(12.12.03) 3600(15.12.03) 10000	2200(08.12.03) 1050(19.12.03) 4400(23.12.03) 7650	2090(26.12.03)	30290
January	35000	3000(02.01.04) 8500(05.01.04) 11500	4000(12.01.04)	4500(14.01.04) 2400(16.01.04) 2125(19.01.04) 9025	4525(21.01.04) 5000(28.01.04) 9525	34050
February	35000	4350(04.02.04) 4575(05.02.04) 8925	4575(10.02.04) 4350(11.02.04) 8925	3000(14.02.04) 2600(19.02.04) 5600	2800(23.02.04) 5400(26.02.04) 8200	31650
March	35000	4125(03.03.04) 1890(05.03.04) 6015	3600(12.03.04) 2000(15.03.04) 5600	2800(19.03.04) 2300(22.03.04) 5100	4000(26.03.04) 2000(29.03.04) 6000	22715

Figure 3.4 Demand and Supply patterns for 3 products of Hero Honda



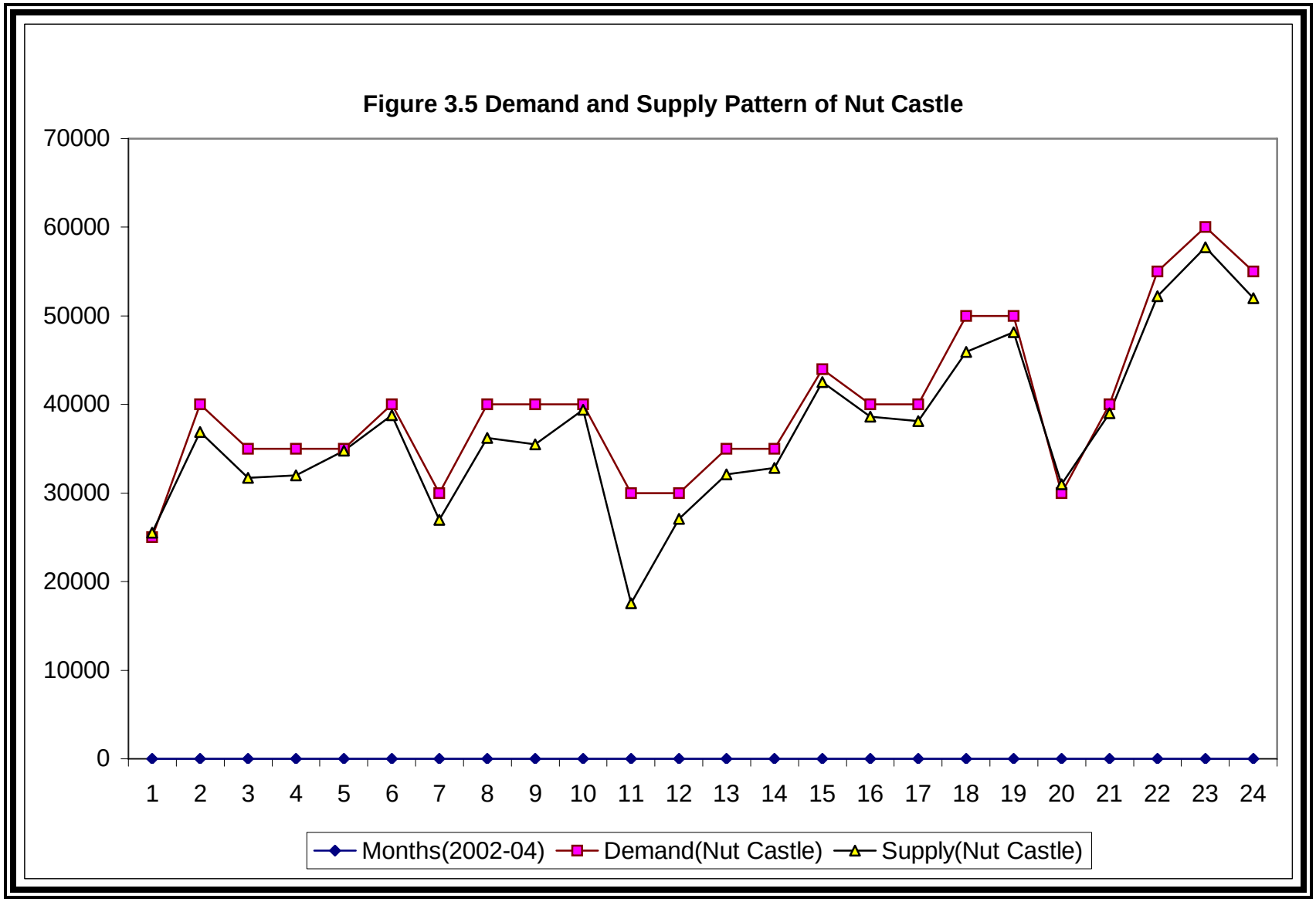


Figure 3.5 Demand and Supply Pattern of Nut Castle
70000
60000
50000
40000
30000
20000
10000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Months(2002-04)
Demand(Nut Castle)
Supply(Nut Castle)

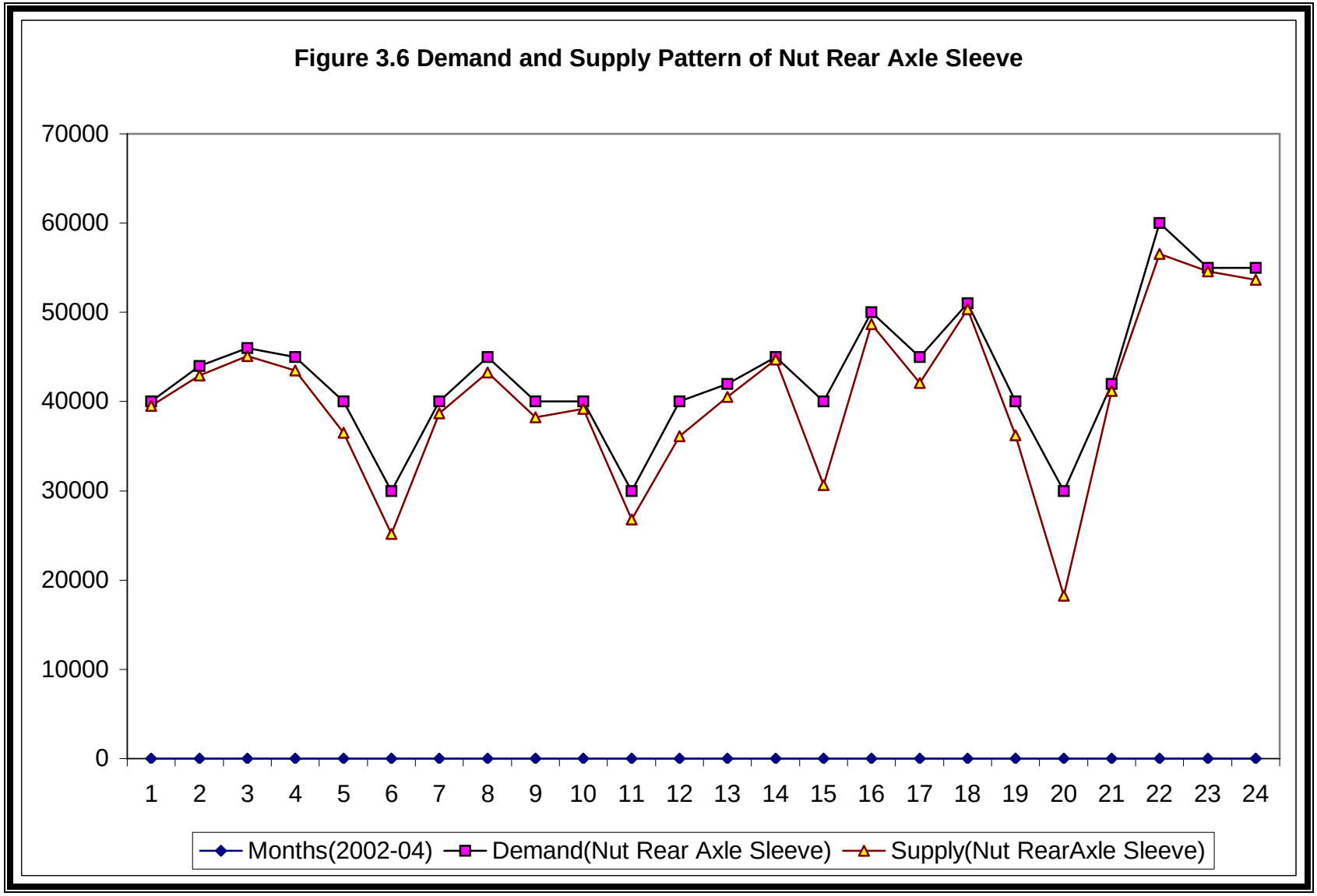


Figure 3.6 Demand and Supply Pattern of Nut Rear Axle Sleeve
70000
60000
50000
40000
30000
20000
10000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Months(2002-04)
Demand(Nut Rear Axle Sleeve)
Supply(Nut RearAxle Sleeve)

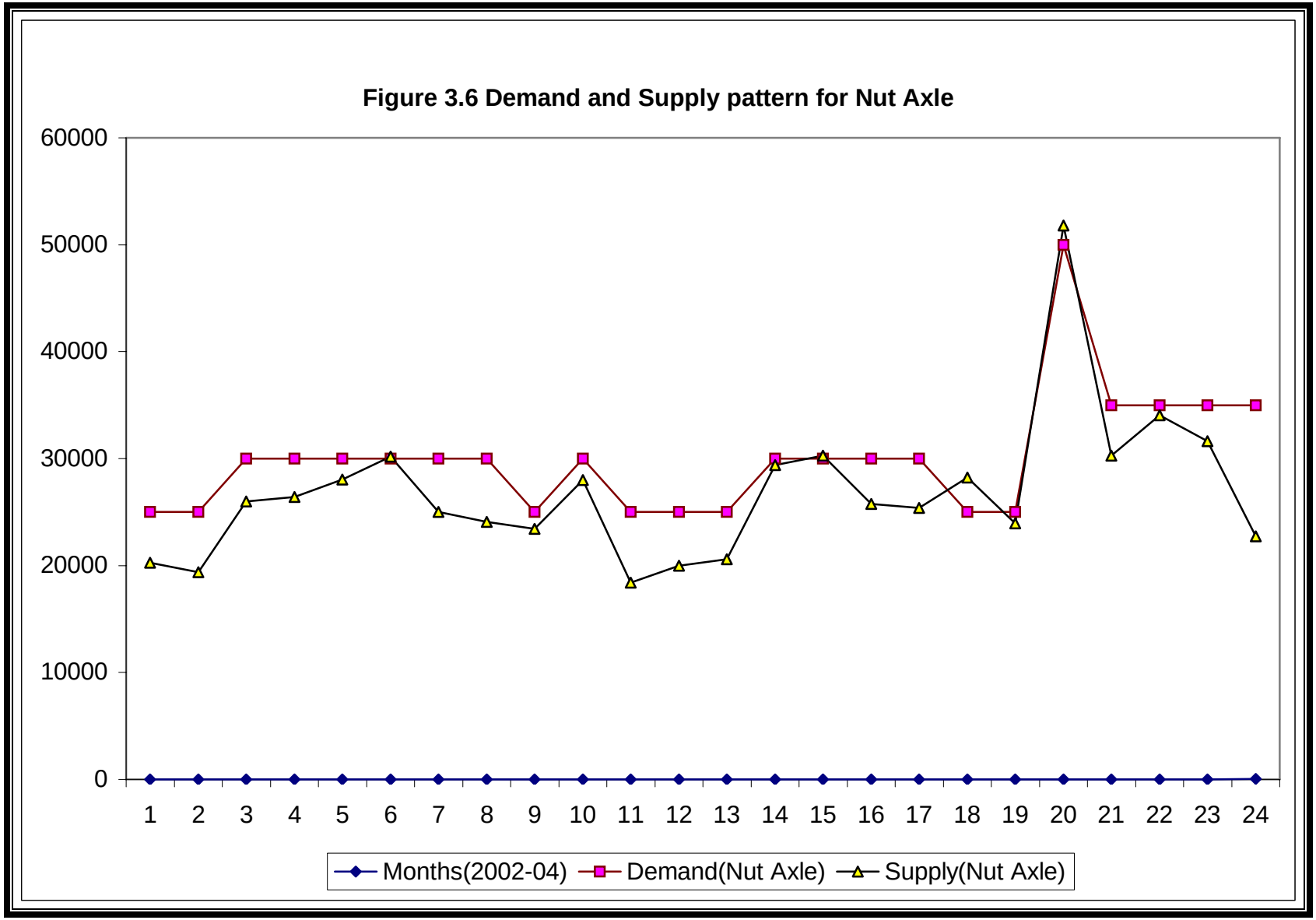


Figure 3.6 Demand and Supply pattern for Nut Axle
60000
50000
40000
30000
20000
10000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Months(2002-04)
Demand(Nut Axle)
Supply(Nut Axle)

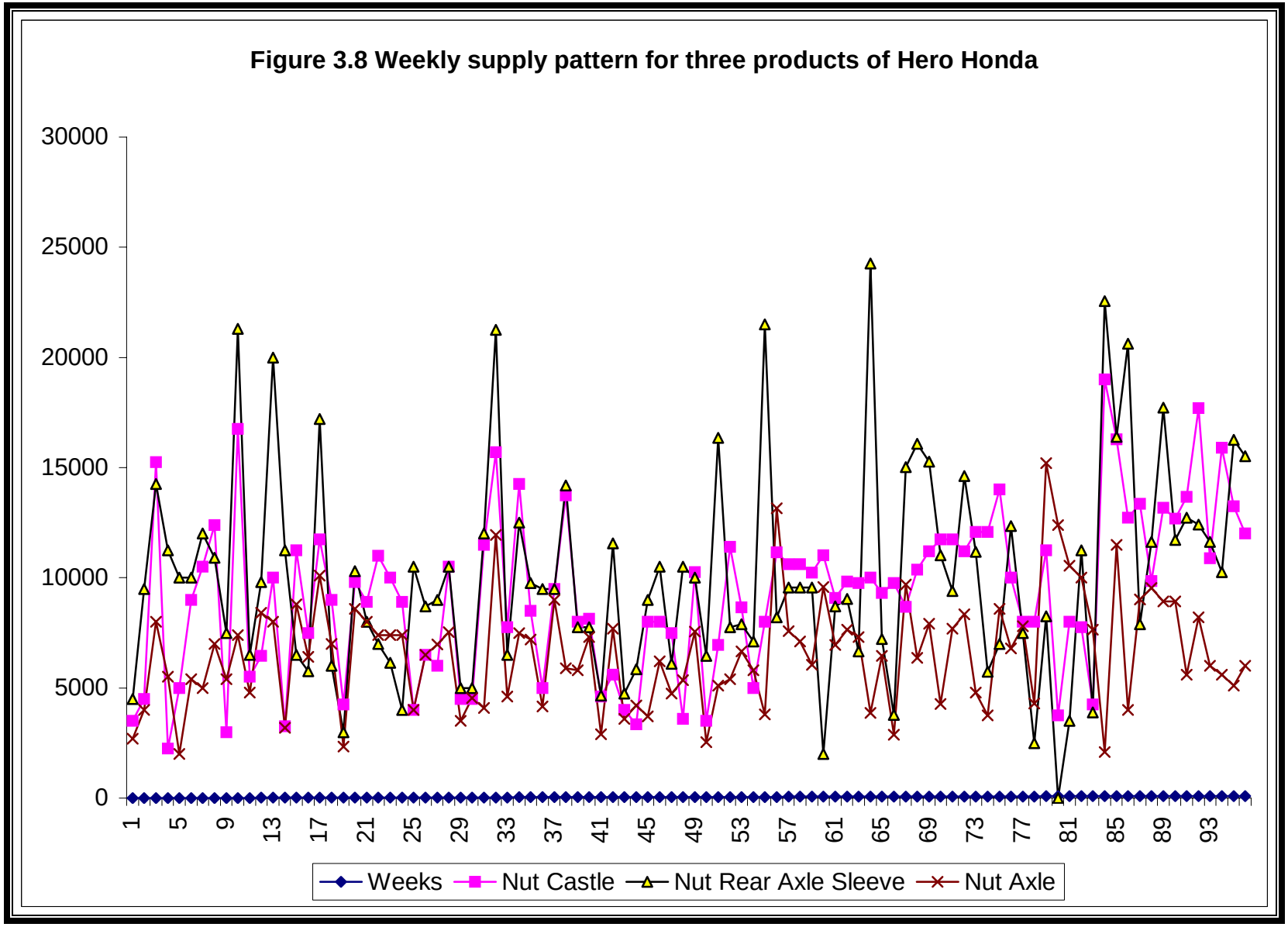


Figure 3.8 Weekly supply pattern for three products of Hero Honda
30000
25000
20000
15000
10000
5000
0
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
65
69
73
77
81
85
89
93
Weeks
Nut Castle
Nut Rear Axle Sleeve
Nut Axle

Products	Year 2002-03			Year 2003-04			Years 2002-04		
	Mean	**SD**	**COV**	**Mean**	**SD**	**COV**	**Mean**	**SD**	**COV**
Nut Castle	35000	5000	0.14285	44500	5404.47	0.12144	39750	5202.235	0.13087
Nut Rear Axle Sleeve	40000	5016.64	0.125416	46250	7959.53	0.1720	43125	6488.085	0.15044
Nut Axle	27916.67	2465.03	0.09	32083.33	6601.24	0.2057	30000	4333.135	0.1444

SD = Standard Deviation
COV = Coefficient of Variation

Table 3.17 Values of Mean, Standard Variation, Coefficient of Variation of 3 products

Above table suggest that the variation in Mean, Standard Deviation and Coefficient of Variation among 3 products and among two years (2002-04) is not much so planning of these 3 products can be done effectively in terms of raw material sequencing, scheduling and other activities.

Lead Time Analysis

Item	Avg. Cycle Time/Item	Avg. Lead Time (For avg. lot size)
Nut Castle	2.79 min.	79 days (10000)
Nut Rear Axle Sleeve	1.44 min.	42 days (10000)
Nut Axle	3.78 min.	64 days(7500)

Table 3.18 – Calculation of Lead Time and Cycle Time

As suggested from the calculation done in the table above the difference between Avg. Lead Time and Avg. Cycle Time has to be reduced to a minimum value by cutting down non productive time.

3.6.10 Use Of IT In BPP

Information technology and the supply chain

Information is crucial to the performance of a supply chain because it provides the basis upon which supply chain managers the basis upon which supply chain managers make decisions. Information technology consists of the tools used to gain awareness of information, analyze the

information, and act on it improve the performance of the supply chain. Without information, a manager will not know what customers want, how much inventory is in stock, and when more products should be produced and shipped.

Given the role of information in a supply chain's success, managers must understand how information is gathered and analyzed. This is where IT comes into play. IT consists of the hardware and software throughout a supply chain that gather, analyze, and act on information. Using IT systems to capture and analyze information can have a significant impact on a firm's performance. Information is the key to the success of a supply chain because it enables management to make decisions over a broad scope that crosses both functions and companies.

Information must have the following characteristics to be useful when making supply chain decisions:

- Information must be accurate
- Information must be accessible in a timely manner
- Information must be of the right kind

Information is used when making a wide variety of decisions about inventories, transportation, and facilities within a supply chain:

- Inventory:

Setting optimal inventory policies requires information that includes demand patterns, cost of carrying inventory, costs of stocking out, and costs of ordering.

- Transportation:

Deciding on transportation networks, routings, modes, shipments and vendors requires information including costs, customer locations and shipment sizes to make good decisions.

- Facility

Determining the location, capacity, and schedules of a facility

USE OF MIS, IT IN BPP

There has not been a much use of information technology in Bharat Precision Products. The only field where the application of software is done is in the accounts department for the maintenance of accounts and continuous review of it.

3.6.11 Human Resources

The human resources are displayed after selection in terms of academic qualification and on the job competency. Fresh employees are trained for the job after deployment.

(a) A core competency of the job requirement is determined and accordingly the training is imparted so that the competency to produce quality jobs is ensured.
(b) The on the job training and system are taken as training concept so that the needs are satisfied.
(c) The effectiveness of the training is evaluated and if required the training method is modified to suit the requirements.
(d) The personnel's are given input so that the quality objectives are followed for the quality requirements.
(e) The records are kept of the education and training conducted.
(f) The employees are aware regarding the relevance and importance of the activities being conducted by them.

3.6.12 Formats used in BPP

a. Drawing control Format
b. Incoming material
c. Master Ready Documents
d. List of employees
e. Training calendar and other training formats
f. Request for change in a document
g. Customer complaint
h. Corrective and preventive action report
i. Master list of JIGS/FIXTURES?GUAGES and calibration records
j. Master list of measuring instruments
k. Packing detail
l. Inspection report
m. Improper inspection report
n. Approved vendor list
o. Supplier quality assurance report

p. Vendor rating format

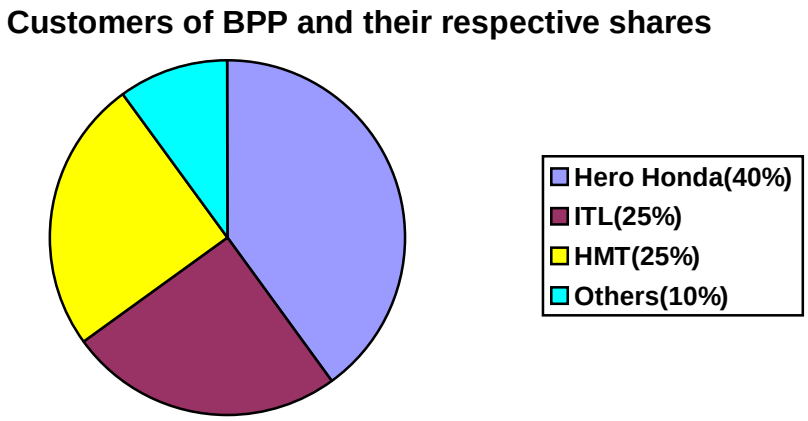
3.7 Downstream Elements & related activities

3.7.1 Main customers of Bharat Precision Products

Bharat precision products has established a status in the vendors list of many main players of automobile industry for very specialized engineer to order manufactured nut bolt items.

The list of customers includes tractors and automobile manufacturers like:

1) Hero Honda (40%)
2) HMT (heavy machine tools)(25%)
3) ITL (international tractors limited)(25%)
4) Other companies (10%)



3.7. Figure 3.9 Customers of BPP & their respective shares

As compared to the last year sales following increase in sales (in percentage) have been noticed:

	Customer name	Approx. Increase in sales as compared to last year sales
1.	Hero Honda	10%
2.	ITL	7%
3.	HMT	4%
4.	Others	3%

Table 3.19 Increasing Sale as compared to last sale

3.7.3 Product range

1. Hero Honda

Serial number	Item name	Avg. Demand in numbers per month (approx)
1.	Nut axle	30,000
2.	Rear axle	60,000
3.	Nut castle	64,000

Table 3.20 Product Range of Hero Honda with monthly demand

2 HMT

Serial number	Item name	Avg. Demand in numbers per month (approx)
1.	Pipe unit bolt	1200
2.	Plug screw	1200
3.	Hex bolt	1600
4.	Valve gear bolt	2200
5.	Plug 16	4000
6.	Hex plug screw	2400
7.	Plug screw 18	1000
8.	Union	2100
9.	Centering guide	600
10.	Double connection	500
11.	Plug screw	400
12.	Plug return line	1500
13.	Hex bolt	4000
14.	Connection	1000
15.	Plug screw	1000
16.	Nipple	1600
17.	Castle nut	1000
18.	Benow bolt	500

19.	Pin 19 dia	3000
20.	Pin 8 dia	2000
21.	Adjusting screw	6000
22.	Hex bolt 12x55	3000
23.	Hex bolt 10x60	1000
24.	Cylindrical pin 8 dia	3200
25.	Washer	8000
26.	Plg m12x12	800

Table 3.21 Product Range of HMT with monthly demand

3 ITL

Serial number	Item name	Avg. Demand in numbers per month (approx)
1.	Nut m8	6000
2.	Plug screw	5000
3.	Plug with groove	1000
4.	Oil channel plug	1400
5.	Plug return line	1650
6.	V.g. Bolt	1800
7.	Benzo bolt	1200
8.	Nut	2000
9.	Pin 10 dia	5000
10.	Pin 8 dia	5500
11.	Nut m14	10,000
12.	Support stud	3000
13.	Adjusting screw	13000
14.	Screw nut	11000

Table 3.22 Product Range of ITL with monthly demand

3.7.4 Other players in the market

companies dealing in standard fasteners

Serial number	Companies dealing in the standard fastener	Turn over(approx)
1.	LPS, Rohtak	100 crores
2.	Syndrom fasteners	150 crores

Table 3. 23 Turnover of companies dealing in standard fastener

Companies dealing in non standard fasteners

Serial number	Companies dealing in the ETO fastener	Turn over (approx)
1.	Reiko auto (Gurgaon)	500 crores
2.	Sohna steering (Gurgaon)	300 crores
3.	Tight well fasteners (Rohtak)	80 crores
4.	Rohtas auto industry	70 crores

Table 3.24 Turnover of companies dealing in non-standard fastener

3.8 Conclusions and recommendations

After analyzing all related SCM issues in BPP, being an ancillary organization, it has been recognized as an engineer to order manufacturing unit , “Operational Excellence” is the keyword for success (Handfield Robert B & Nichols Ernest L(2003)). Further following conclusions and recommendations have been made:

1. Raw material contributes major part of turn over which is coming out to be 62.35%. so effective purchasing system should be developed. BPP must explore new vendors to have cost effectiveness. At the same time wastages in terms of scrap etc should be minimized.

2. Job work is constituting 10.35% so efforts should be made to make it a part of turn over by vertical integration.
3. After going through other aspects of financial analysis fund positions are quite strong so decisions should be taken to expand the business by exploring new markets and customer by adding similar products to the product mix.
4. The demand analysis suggests that demands are not met completely. So measures to be taken to do so.
5. Mean, standard deviation and coefficient of variations of demands of three main products of Hero Honda have been calculated and tabulated.
6. The variation in monthly demand for three products of Hero Honda which has the maximum share in turnover of BPP is not significant so, group technology concept must be introduced for similar products to avail the benefits of group technology.

CHAPTER 4

SAP LAP Analysis and SMEs prospective in SCM

4.1 SAP LAP Analysis

SAP LAP Analysis is a technique of analyzing conditions of an organization and to see scope of improvements in related issues and then judging the effectiveness of each improvement by actually implementing them. The main objective of this analysis is continuous improvements. SAP LAP analysis stands for situation, actors, processes, learning, actions and performance analysis. First of all conditions of the organization are analyzed with the help of different situations of the company in Global & Indian market. All the elements (parties & individuals) taking part in different related processes outside the company as well as internal to the company are termed as actors. Then process are analysied in detail which includes different issues like inventory, purchasing , layout, marketing, company culture & environment etc. Based on the processes analysis, learnings are drawn for cost cutting, are more efficient & effective processes & systems. Implementation of learning is termed as action. Then based on these actions, performance is judged in terms of profits (Tengible & Intengible).

4.1.1 Situations

Strengths • High Technical Expertise • High Quality • General Purpose Equipments for wide range of products • Very low production stoppages • Only vendor of the companies for the items dealing in • Low overheads	**Weaknesses** • Low labour incentives • No CNC machines • Low use of IT in the company
Opportunities • 7% overall growth in sales per annum • Manufacturing outsourcing by multinational automobile companies • Predictive high growth of agriculture industry	**Threats** • Increase in competition • Alternative material manufacturing nuts & bolts • Open trade with countries like China, which is feeding the market by low price goals

Table 4.1 Situations of BPP in SAP LAP Analysis

4.1.2 Actors

- BPP
- Suppliers
- Customers
- Sub contactors
- Govt. agencies
- Transporters
- Competitors

4.1.3 Processes

- Upstream activity (purchasing) includes dealing with different vendors, which are already identified & certified. Frequency & lot size is not systematically determined with any of inventory model & techniques. Inventory holding time is 2.1.2 months and JIT implementation is not there.
- Process layout is being followed
- Preventive maintenance schedule is strictly followed. Breakdown maintenance as and when required
- Machine utilization is fairly satisfactory
- BPP is ISO 9001 certified so quality procedures are properly followed as well as documentation is done regularly but further analysis and corrective actions should be emphasized.
- Sequences and scheduling is not done by proper analysis
- Demand is not completely met for three products of Hero Honda which were analyzed in our study
- Use of IT is only there in Accounts Department
- List of customer includes mainly Hero Honda, HMT, and ITL etc. where HMT is having 40% share in BPP sales. The company deals in specially ordered fasteners by the customers

4.1.4 Learning

Vertical/Horizontal integration – as job work is 10.35% they must go for vertical integration to enjoy profits out of that. The position of BPP is financially very strong suggested by current ratio, which is 2.4. The company shows go for horizontal integration and new products may be added to the existing product range and expansion of the company must be looked forward.

Implementation of group technology – Similar type of products must be grouped together to have the benefits of group technology, as demand of products by customers like Hero Honda is consistent suggested by average coefficient of variation, which is 0.1387 for Nut Castle, 0.15044 for Nut Rear Axle Sleeve and 0.1444 for Nut Axle.

Purchase policy – must be modified an inventory must be reduced as the inventory holding period suggested by financial statements for the year 2003-04 is 2.12 months which is on higher side use of different software available may be used. Right now based on current month demand next month inventory is ordered.

Production Planning and Control (PPC) - Suitable PPC techniques must be implemented right now scheduling and sequencing is done without any systematic analysis i.e. haphazardly this will be easily scheduled and sequenced after implantation of group technology for similar type of products. Purchasing should be done very carefully as raw material constitutes 62.35% of sales & effective purchasing system should be developed and BPP must explore new vendors to have cost effectiveness.

Use of IT - in overall planning, decision making, implementation, control, documentation and analysis must be encouraged

4.1.5 Actions and Performance

Above learning may be implemented & their performances can be analyzed further, which is not done during the duration of this project

4.2 SME Perspective in SCM

Introduction

Customers demand products customized to their individual needs forcing companies to go in for ‘mass customization’. Product life cycles are shortening. New technologies allow product sophistication undreamed of earlier. Inevitably manufacturing is becoming a more globally

organized business and dominated by large international companies. Ths need not spell disaster for the suppliers because it is difficult to manage effectively the resources needed to design and manufacture such products for any one company. Thus, the large final assemblers in the value chain(Porter (1985), Lindeberg and Trygg(1991)) are concentrating on those activities which center around their core competencies (Prahalad and Hamel (1990)) and out source the rest from other members in the supply chain, providing opportunities for small and large suppliers to fill the product gaps so created.

The supply chain leaders are integrating (Stevens (1989)) or 'business process reengineering' (Evans et al (1994)) theirsupply chains into 'virtual' corporations (Johansson et al (1993)). Lamming (1993) and others have called this integrated supply chain model as the 'partnership model'

Supply Chain Trends

Johansson et al (1993) see 'virtuality', in which all business in a supply chain function as virtually one entity, as the means to gain competitive advantage. Lamming(1993), Presutti Jr.(1992) and Lyoris et al(1990) have all contributed towards understanding the supplier partnerships that underpin the 'virtual' corporation.

1. Suppliers would have fewer customers and closer collaborative, long term relationships with them.
2. Partnerships and narrowing supplier base would make it difficult for a supplier to break into other supply chains
3. They would identify their core competencies and leverage them to retain and expand their business.
4. Manufacturing improvements would be needed to meet JIT, quality requirements.
5. Improvements in design capability would be called for.

Analysis of supply chains

Customers have used techniques like supplier appraisal or supplier positioning tool (Gregory 1986, Thompson 1990) as the means to select/ drop suppliers and identify improvement opportunities and enter partnership agreements with suppliers. The concept of 'virtuality' (Johansson et al (1993)) is viewed from the perspective of the supply chain 'leader' who is

usually the strongest member of the supply chain—the final retailer in a consumer non durable supply chain.

"What does 'virtually' mean for a small supplier who is at the bottom of the supply chain?" Should the small supplier wait to be told of how he fits in the new scheme of things or can he proactively plan his course of action which not only distances him from his competitors but also ensures growth in value added in the supplier's business?

'Supply opportunity analysis technique' is a new 'upward loohing' tool which moves away from a reactive to a proactive mode by taking the suppliers' perspective, and which could be used by a supplier to classify the various supply chains and help identify those supply chains which offer high growth potential for the supplier's business.

Model of supply opportunity analysis technique(SOAT)

This approach from a supplier's perspective has four parts:

- Supply chain strategy and structure
- Supply chain characteristics
- Supplier's core competencies
- Existing and potential competitors

Supply chain strategy and structure

It deals with the following areas

- Final product/market characteristics
- Suppliers product's characteristics, includind the manner of its use by the customer
- Potential for increased value addition for the supplier's product and the competency/skills required
- Current supply chain structure

Supply chain characteristics

- Partnerships/ relationship
- Long/medium term planning
- Deliveries

- Quality
- Costing/pricing
- Product development
- Information sharing modes

Supplier’s core competencies

- Current core competencies
- Skills which can be developed

Existing and potential competitors

- Existing competitors
- Potential suppliers to the supply chain under analysis

CHAPTER 5

Conclusion

5.1 Conclusion of case study of BPP

The aim of the study is to study & analyze different supply chain management issues in an ancilliary organization called Bharat decision products situated at industrial area Rohtak which is into the manufacturing of specially engineered to order fasteners and their customers are Hero Honda, HMT and ITL etc. The financial position of the company is very string as analyzed from the case study following are the conclusion and recommendations obtained from our study

1 *Vertical/Horizontal integration* – as job work is 10.35% they must go for vertical integration to enjoy profits out of that. The position of BPP is financially very strong suggested by current ratio, which is 2.4. The company shows go for horizontal integration and new products may be added to the existing product range and expansion of the company must be looked forward.

2 *Implementation of group technology* – Similar type of products must be grouped together to have the benefits of group technology, as demand of products by customers like Hero Honda is consistent suggested by average coefficient of variation, which is 0.1387 for Nut Castle, 0.15044 for Nut Rear Axle Sleeve and 0.1444 for Nut Axle.

3 *Purchase policy* – must be modified an inventory must be reduced as the inventory holding period suggested by financial statements for the year 2003-04 is 2.12 months which is on higher side use of different software available may be used. Right now based on current month demand next month inventory is ordered.

4 *Production Planning and Control (PPC)* - Suitable PPC techniques must be implemented right now scheduling and sequencing is done without any systematic analysis i.e. haphazardly this will be easily scheduled and sequenced after implantation of group technology for similar type of products. Purchasing should be done very carefully as raw material constitutes 62.35% of sales & effective purchasing system should be developed and BPP must explore new vendors to have cost effectiveness.

5 *Use of IT* - in overall planning, decision-making, implementation, control, documentation and analysis must be encouraged

5.2 Limitation

The study has been limited till the recommendation part only, actions on these recommendation and then monitoring the performance have not been dealt with.

5.3 Scope of future work

Based on the recommendation made after the analysis implementation part may be handled as future work and corresponding performance can be judged to see the effectiveness of each recommendation.

References

1. Bhatacharya AK, Coleman JL & Brace G, (1995), Repositioning the supplier: an SME Perspective; Production, Planning & Control, Vol 6, No. 3, pp-218-226

2. Burnham, J.M.,(1987), Some conclusions about JIT manufacturing, Prodcution and Industry Management Journal, Vol 28, No. 3 PP7-10

3. Chopra , (2004),Supply Chain Management , Pearson Education PP 7-15

4. Christopher , (2004), Logistics and supply chain management , Pearson Education PP 110-116

5. Dutta A K , (2003), Materials Management – Procedures text and cases , PHI Pvt Ltd. PP 241-244

6. Gopal Krishnan P & Sundraresan M, (2002), Materials Management – An
7. Integrated Approach , PHI Pvt Ltd. PP 254-259

8. Gandhi JC, (1993), Marketing – A Managerial Introduction , Tata Mc Graw
9. Hills PP 8-25

10. Hand Field Robert B & Nichols Ernest, (2003), Supply Chain redesign, Pearson
11. Education PP 8-11

12. Kolter Philip, (1994), Marketing Management, PHI pvt Ltd PP 70 – 75

13. Shankar Ravi, (2003), Industrial Engineering and Management , Galgotia Publications Pvt Ltd. PP 319-349

14. Taylor David A, (2004), Supply Chain- A Managers Guide, Pearson Education PP 71-109

15. Babu,& Venkumar & Sankar, (2003), “Flexible Manufacturing System-An intergrated approach to automate production operation”, in Indian Foundary Journal, PP49-52

16. Alexendar & Young (1996), Strategic outsourcing, Long Range Planning, PP116-119

17. Clark K. (1989), Project scope and project performance; The Effects of Parts Strategy & Supplier Involvement on Product Development Management Science 35(10), PP1247-1263

18. Clark K., (1991), Product development performance strategy, Organisation & Mangement in the world auto inductsry, Harvard Buisness School Press

19. Erikkson A.K., Hakansson H. (1993), Getting innovations out of supplier networks, Journal of Buisness-to-Buisness Marketing, PP 3-34

20. Puto (1985), Risk handling strategies in industrial vendor selection decisions, Journal of Marketing, PP 89-98

21. Hicks, Mcgovern & Earl, (2000), Supply Chain Management: A Strategy Issue in Engineer to order manufacturing, International journal of production economics, pp 179-190

22. Choon Tan, Liman (2002), Supply Chain Management: A Strategic Perspective, Internatuional Journal of Operations & Production Management, Vol. 22, No.6, PP614-631

23. Croom, Romano & Giammakis, (2000), Supply Chain Management: An analytical framework for critical literature review, Europeon Journal of Purchasing & Supply management, PP67-83

24. Boyer (1987), Labour flexibility: Many forms, uncertain effects, Labour and society, PP 107-129

25. Spekman(1994), At last purchasing is becoming strategic, Long range planning, PP 76-84

26. Vaughan (1996), Innovating to compete, supply management, PP 46-47

27. Harland, (1996), Supply Chain Management: Relationships, Chains & Networks, British Journal of Management, PP63-80

28. Hakanson, (1987), Product Development in Industrial Technologist Development: A Network Approach

29. Brensen (1996) " Oganizational perspective on changing buyer-supplier relatonships"PP121-146

30. P.Turnbull (1990), Prospects for employment and organization, Buyer Supplier relations in UK automotive industry, PP15-20

31. Rainnie A., (1991) "Just in time, Subcontracting and the small firm work", PP353-375

32. Newman, (1988), Single Source Qualification, Journal of Purchasing and Material Management, PP10-17

33. Crawford, Blackstone, Cox, (1988), A Study of JIT Implementation and Operating problems, International Journal of Production Research, Vol 26, no. 9, 1988, PP 1561-1568

34. Im (1989), Implementations of Just in time Systems in US Manufacturing Firms, International Journal of Operations & Production Management, Vol 9 No. 1, PP5-13

35. Skinner, (1974), The focused factory, Harvard Buisness Review 52 (3), PP113-121

36. Hill, (1986), Manufacturing Strategy, Macmilan Education Ltd. , London PP44-52

37. Quinn, Hilmer, Strategic outsourcing, Sloan Management Review, 35(4) PP43-55

38. Bertrand, Muntslag, (1993), Prodcution control in engineer to order firms, International Journal of Prodcution Economics, PP19-26