PRODUCTION PLANNING SYSTEMS AND OTOMATION OF PRODUCTION PLANNING IN AN ORDER BASED FACTORY

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We certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as thesis for the degree of Master of Science.

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ABSTRACT

Nowadays, namely on the threshold of 2000's, the need for becoming a society of automation as a result of contemporary developments in technology has changed the environment of industry and production with a large extend. This change will gain speed in accordance with the goal of further developments.

The field of computer is another sector, which is influenced by these developments. It has influenced all aspects of our life and facilitated many difficulties. The technology of changing has gained speed as a result of these advantages.

The computer technology has entered a rapid process of development. The uses of computers in industrial design and Production Planning as well as processes in industrial fields became widespread. Computer is one of most widespread means of Production process planning and controlling. Particularly, Production planning, cost and productivity analysis and Production and Quality Control are very important. The reason for their importance is their nature of being application decisions directing production and sometimes release decisions directing production decisions.

Production Planning studies are performed on a selective basis. The management decisions are established by comparing the concrete results of choices. Computer can arrange an application of this type rapidly and effectively.

This study consists of basic information about Production Planning, an analysis of auxiliary modules forming a resource for Production Planning and the program established in accordance with the aim of computerising this over the Client-Server

model. This study will show that the Systems making production for us have various approaches to charting for Production Planning problems. Thus, the other available successful approaches, the capacity of their plant and the planning solutions are described.

As a result, the possibility of obtaining the most available results rapidly by means of explanatory information for al stages and multiple choices of production.

ÖZET

İkibinli yıllara gireceğimiz şu sıralarda teknolojideki son gelişmelerin sonucu olan otomasyon ve bilgi toplumu olma gereksinimi endüstri ve üretim ortamını oldukça değiştirmiştir. Bu değişim teknolojinin daha da ilerileri gitme hedefi sonucu durağan olmayıp giderek artacaktır.

Bu ilerlemeden etkilenen bir diğer sektörde bilgisayar sektörüdür. Hayatımıza girişinden bu yana bütün alanlarda etkisini göstermiş , bir çok problemin çözümünde kolaylıklar getirmiştir. Bu faydalara bağlı olarak da değişim teknolojisi hız kazanmıştır.

Bilgisayar teknolojisi ülkemizde hızlı bir yayılma süreci içine girmiştir. Bilgisayarın endüstriyel konulardaki kullanımı yanı sıra çeşitli endüstrilerin tasarımı ve Üretim Planlama sürecinde de kullanılması yaygınlaşmıştır.Bilgisayar , Üretim sürecinin planlanması ve kontrolü yönünde kullanımı çok yaygın konularda biridir. Özellikle Üretim Planlaması , Maliyet ve Verimlilik Analizi , Üretim ve Kalite Kontrolü çok önemlidir. Bunları önemli kılan etken bu çalışmaların üretime yön veren uygulama karaları niteliğinde olmaları, bazı durumlarda ise yönetim kararlarını yönlendiren çıkış kararlarını oluşturmalarıdır.

Üretim Planlaması ile ilgili çalışmalar seçenekli olarak yapılır. Çeşitli seçeneklerin somut sonuçlarının kararlaştırılması ile yönetim kararları belirlenir. Bu tür bir uygulama bilgisayar yardımıyla hızlı ve etkin olarak düzenlenebilir.

Bu çalışma Üretim yapan sektörler için önemli olan Üretim Planlama temel bilgileri , Üretim Planlamaya kaynak oluşturan yardımcı modüllerin bir analizi ve bu analiz sonucunda Cient-Server model üzerinde bilgisayara yaptırılması için

oluşturulan programı içermektedir. Aynı zamanda bu çalışma sonucu bize Üretim yapan sistemlerin Üretimi Planlama problemleri için bir çok çizelge yaklaşımı olduğunuda gösterecektir. Bu yüzden de şu anda mevcut bulunan başarılı diğer yaklaşımların ve onların fabrika kapasitesi ve planlama çözümlerini açıklanmaya çalışılmıştır.

Bu sayede üretim için çok sayıda seçeneği, çözümleri ve her aşamada açıklayıcı bilgileri ile en uygun sonuçları en kısa zamanda elde etme olanağı sağlanmış ve bunların karşılaştırılması yapılmıştır.

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and My Grandfather İbrahim Amanlar

CHAPTER ONE

INTRODUCTION

Production Plan; A plan technique, should be established and applied in order to ensure that the production type and quantities are established within a period in accordance with the planning parameters and the organisational parameters limiting these parameters.

1.1 History of the Production Planning

New developments occurring throughout the world, particularly the achievements performed by some countries in the world's market and the attribution of these achievements to their superior production systems has altered the approaches of people to productions. From now on the production superiority is viewed as a competitive power and the production administrations find themselves in a crisp environment.

The growth of competition is observed in all fields of industry such as automotive, consumption products, electronic and white properties. From now on to sell the series products, but the possibility of competition may be realised by increasing the product varieties. The manager should develop new strategies in order to survive in this circumstance. The importance of series production technologies is substituted with the strategy of flexibility and shortening design and production periods. This process sophisticates the increasing product varieties, product developments and production management.

The production companies have to utilise computerised, flexible, productive and effective techniques. The first studies performed with that direction has been in the stock control software using Purchasing Policies [Allen, 1994] [Schuster, 1994].

Materials Requirement Planning (MRP) method has clarified the fact that the demand for a part must be considered in production. Materials Requirement Planning(MRP) has proposed a method, which comprises a simplification and backward charting in order to determine the demand for a part [Browne, 1988] [Sartori, 1988]. The Materials Requirement Planning (MRP) has developed with the direction of becoming a closed circuit production method with the attachment of modules in order to cope with the daily developments in the production. Afterwards, the Management Resource Planning (MRP2) has been established with the attachment of other administrative functions except production to this closed circuit system.

After the MRP, some new philosophies are developed such as Just In Time Production (JIT) and Optimised Production Technology (OPT). Various methods, which do not basically change MRP, but removes its deficiencies were proposed. However these method could never influence the central place of MRP in the production management [Browne, 1988] [Sartori, 1988] [Hastings, 1982] [Faaland, 1993] [Ptak, 1991] [Allen, 1994] [Yazgaç, 1996].

The developing data processing technology has revealed the ending capacity charting system. These systems could establish a detailed production chart in case that detailed information about physical and technological limits of production, work flows and the actual status of resources and production environment. These charts were used in the direction of production systems [French, 1982] [Taylor, 1995].

1.2 Production Planning and its Goal

The main goal of a production plant is to get the highest interest by producing huge quantities of a particular product with lowest costs with the condition of market demand continuity and the production quality to be fixed [Faaland,1993].

In order to achieve this goal;

- Maintaining and fully utilisation of materials and semi-finished products necessary for production.
- Optimised, rapid and smart utilisation of production machines.
- Effective utilisation of human resources required for the production.

In order to maintain these conditions and achieve the production goals, the Production Planning, constant controlling and reporting of production and quality should be ensured. However the Production Plan should be systematically prepared in accordance with actual data and must be applicable and consistent.

In a big enterprise the production is not performed with only one machine. According to production technology, there may be machine groups, which are arranged as per their production capacities, doing the same duty and working parallel, namely on tapes, as well as the several machines in queue. In a more sophisticated enterprise organisation the parallel machine groups are arranged in queue. In order for this process flow properly and constantly the Production Planning should be well established in the system.

It must be ensured that each division is arranged moderately and the type of production is planned and processed in compliance with organisation in order for the plant to run properly. Thus, the established Production Plan will utilise in accordance with its objective.

1.3. The Place of Production Planning in the General System

The production Planning is a component of Production Management System. There are some auxiliary functions, which should work with planning, required for the planning in the production management system. These functions can be listed as Definite and Expected Orders, Product and Resource Management, Production Requirements Management, Materials Management, Capacity Planning, Capacity Charting, Production Planning and Reporting.

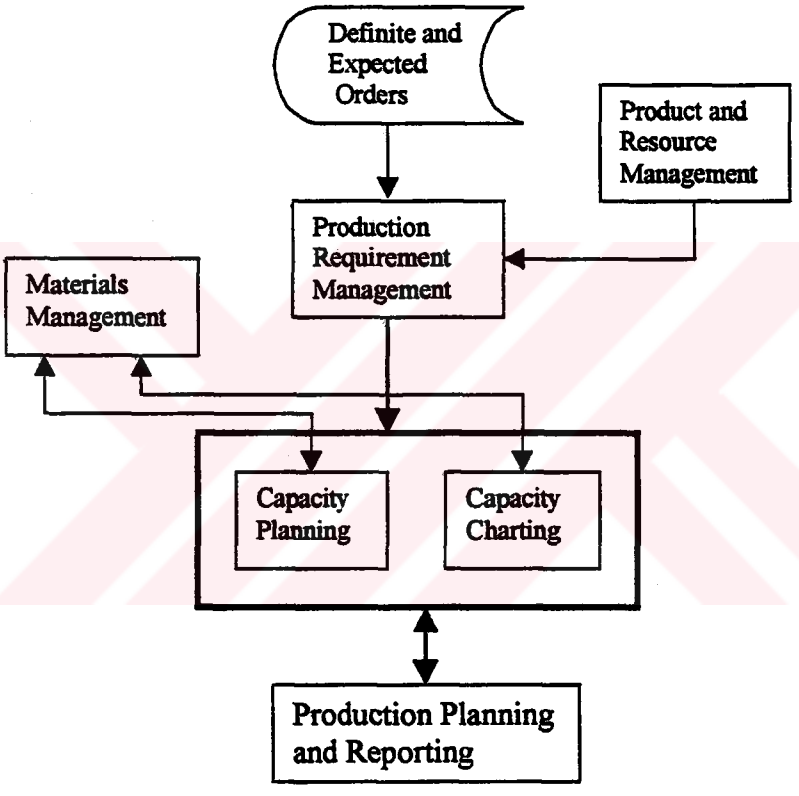


Figure 1.1. Production Management System.

The main objective in here is to solve the problems occurring in other defined modules. The main modules of the system and their interactions with each other are displayed.

1.3.1. Production Requirements Management

Production Requirements Management is deciding what and when to produce by considering definite orders, sales estimated and product stocks. The short and long period production commands are established in accordance with the product type. At this stage the decision pertinent to production route and other production parameters is established. The estimated orders are plotted with daily, weekly, and monthly basis and the Production Planning establishment is commenced. At this stage all the details pertinent to specific product routes are arranged.

1.3.2. Materials Management

Materials Management is required for the proper running of Monitoring of Material stocks, arrangement and maintenance of purchase plans and production plans.

This management comprises the Purchasing Planning, Stock Monitoring sub-systems. These systems produces exact results for material requirements.

1.3.3. Product and Resource Management

Product and Resource Management is required for the Product Tree Analysis, the establishment and maintenance processes and resources and Production Planning.

The data details alter during the period of planning activities of established in the plant. This depends on the delivery terms of order and the amount of order. Thus, a Capacity Planning System is required for the production. This system consists of two approaches using the data in its detail and running in integration. There are two approaches existed for planing; charting the capacity relevant for the product orders, details of which are identified, for the short term orders and establishment of capacity planning for the long term orders, details of which are not identified.

1.4. Planning Parameters

The Production Planning is a system, which has a harmonious construction and which is arranged in accordance with plant parameters pertinent to the intended production [Başer , 1978]. Thus, the identification of a production policy happens to be a prequisite of planning.

The accomplishment of Production policy may only be possible with the sales in compliance with the production. The sales may be ensured with the order in compliance with the production policy. In addition to this the capacity of the plant, product distribution, delivery terms should be considered and the flexibility of working periods should be increased in order to ensure that the orders are balanced.

Thus, the planning parameters, which should be identified and effective before the establishment of production planning, which will be developed as a system, may be listed as below;

- Production policy
- Order status
- Capacity
- Working regime

1.5. Planning Technique

Production Plan; A plan technique, should be established and applied in order to ensure that the production type and quantities are established within a period in accordance with the planning parameters and the organisational parameters limiting these parameters. There are the components that explain below, affecting the selection and the relevant.

1.5.1. The Identification of a Production Policy

In a large company various products are produced and these products provides different rates of interest in accordance with market places. It is not the single way for the determination of generating policy for a specific period. The continuity of the demand is vital for the continuity of the benefit.

The Production Policy may be one of the following policies;

- Aiming of profitable production
- Realising the largest production
- Aiming of standard production and a harmonious combination of these policies.

1.5.2. Evaluation of Order Status

It will be useful with respect to planning technique to analyse order status separate from the following divisions:

- Total orders received at the beginning of plan period.
- Orders, which are transferred from the previous plan period.
- Expected orders during the period of plan.
- The remaining orders from the previous ones.

After the identification of order status, its prequisites; the product quantities will be determined in accordance with the delivery terms and their quantities within the period of planning are compared with production policy and capacities.

1.5.3. Working Regime

The working regime, which is identified as the working periods of workers and machines, will be useful in the identification of capacities of different divisions of the plant. Thus, working regime is an important part of the plan.

1.5.4. Plan Capacities

The production capacities, which is established by the mutual integration of worker and machine power and working regime, are one of the most parameters of a realistic production plan. However the capacity is not unchangeable. Thus, the production capacity may be identified exactly with a study, in which different factor are taken into consideration.

1.6. The Capacity Plan Algorithm

The capacity plan algorithm is established on the basis of operation instead of work basis. This means the non-commencing a different work until all the processes pertinent to the previous orders are finished.

The algorithm of this is as described below:

1-Back loading the works with a maximum capacity,

1-1 Arrange all the works according the following criterion;

1-1-1 Type of delivery (respectively daily, weekly and monthly)

1-1-2 Approximate to delivery (first, the nearest one to delivery)

1-1-3 Priority (First the one with highest priority)

1-2 Load each work with accurate capacities and determine launching and ending times for the operation.

2- Re-load the works, which foreground in back-loading, to the capacity straightly.

2-1 Arrange the foreground works as per the below criterions

2-1-1 Type of delivery (daily, weekly, monthly respectively)

2-1-2 Approximate to delivery (first, the one with nearest delivery term)

2-1-3 Priority (first, the one with highest priority)

1.7. Production Planning

The production is realised in accordance with an established plan. The main goal of production plan is to ensure that the product, which is planned for production, is finished in the specified quantity and periods.

The expression of Term (delivery terms) Planning is used for the plan including the commencing and finishing times of production in accordance with types of product and orders.

1.8. Terms Planning

A specific product may be produced in specific quantities and with different techniques. Also a specific type may influence the delivery terms of other types of products. And term plan should ensure that the orders are produced in the projected quantities and the capacity is utilised in the utmost level.

The term planning may be arranged with two different methods identified in accordance with types of orders. In case that the latest delivery terms of order is specified the relevant order is produced on time without surprassing the plant capacity. If only the quantities of orders are specified the planning is started form the commencement period of the program and from the first process and the orders are arranged separately in accordance with their arrival times.

The method of planning should ensure that the orders are distributed within the planning period properly. The established plan should also ensure that an important order performed in a sub-period is received.

CHAPTER TWO

CLIENT-SERVER COMPUTING MODEL

This chapter describes the Client-Server architecture and the requirements for Internet worked distributed systems in which servers will manage and share information with many other clients and servers.

In this chapter, basic Client-Server Model is analysed to designate the places of connection in the network area. The Client Server model's idea is to structure the operating system as a group of cooperating process, called servers, that offer services to the users, called Clients. The server and client machines normally all run the same microkernel, with both the clients and servers running as user processes. A machine may run a single process, or it may run multiple clients, servers, or a mixture of the two [Tanenbaum, 1992].

2.1. Client-Server Model

The server and client machines normally all run the same microkernel, with both the clients and servers running as user processes. A machine may run a single process, or it may run multiple clients, servers, or a mixture of the two.

To avoid the considerable overhead of the connection-oriented protocols such as OSI or TCP/IP, the Client-Server model usually based on a simple, connectionless Request/Reply Protocol. The Client sends a request message to the Server asking for some service. The Server does the work and returns the data requested.

The Client-Server model of computing has been widely accepted throughout the information technology industry. Despite this, there is no single definition of the Client-Server model that suits all implementations. Generally the server component maintains a centralised database and the necessary software components to maintain and search the database. The client component is responsible for interacting with the user and communicating with the server.

Most systems being developed today conform to the Client-Server model. The older host/terminal based systems designed and implemented over the last 20 years still play an important role in on-going operational environments. It seems inevitable that these systems will be eventually replaced by newer technologies based on the Client-Server model.

In the Client-Server model both the client and the server need to share some definitions that are size of array needed in the message, amount of the data, network address of the file server so that clients can send messages to it. It also contain Operation numbers so that the client and server on which code will show Read or Write, and so on. And the end Model needs to contain Result Code that often contains useful information. If the operation succeed, the value OK is used.

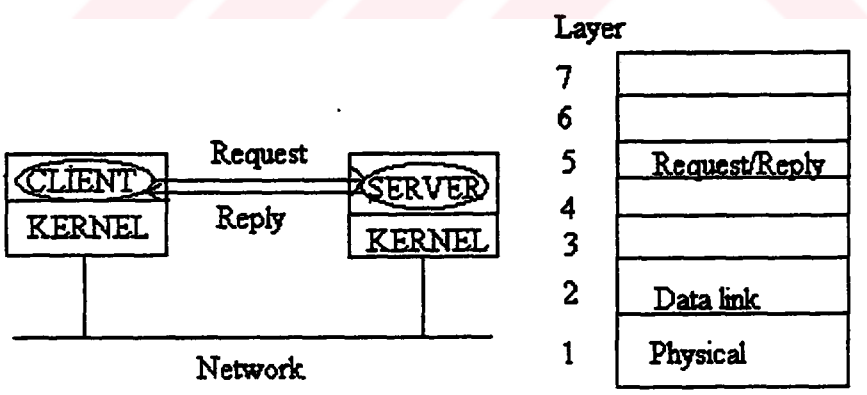


Figure 2.1. The Client-Server Model

2.1.1. Addressing of the Client-Server Model

Client must know the server's address in order to send a message. To do this we have the following methods for addressing processes:

1. Hardware machine.number into client code.
2. Let processes pick random addresses; locate them by broadcasting.
3. Put ASCII server names in clients; look them up at run time.

First addressing system is the file server has been assigned a numerical address. If it refers to a specific machine, the kernel use it as the hardware address for sending the packet to the server. If there is only one process running on this machine, the kernel will give the incoming message to this process.

An alternative addressing system sends messages to processes rather than to machines. To do this we use two part names. One part is machine number and the other is process number. The machine number is necessary for the kernel to get the message correctly to the proper machine, and the process number is used by the kernel on the machine to determine which process get this message. Nevertheless, machine.process is not transparent since the client is obviously aware of where the server is located.

Alternative addressing scheme uses machine.local_id instead of the machine.process. One process calls to tell the kernel that it wants to listen to local_id. Later, when a message comes in addressed to machine.local_id, the kernel knows which process to give the message to.

Another method for addressing process is to give own identifier from a large, sparse address space. The sender can broadcast its message containing the address of the destination process to the all machines on the network. All processes compare own local id with the address of the destination process will receive it. If it is suitable it send back a here I am message giving its network address. The sender uses this address.

Each of these has problems. The first one is not transparent, the second one generates extra load on the system, and the third one requires a centralized component, the name server.

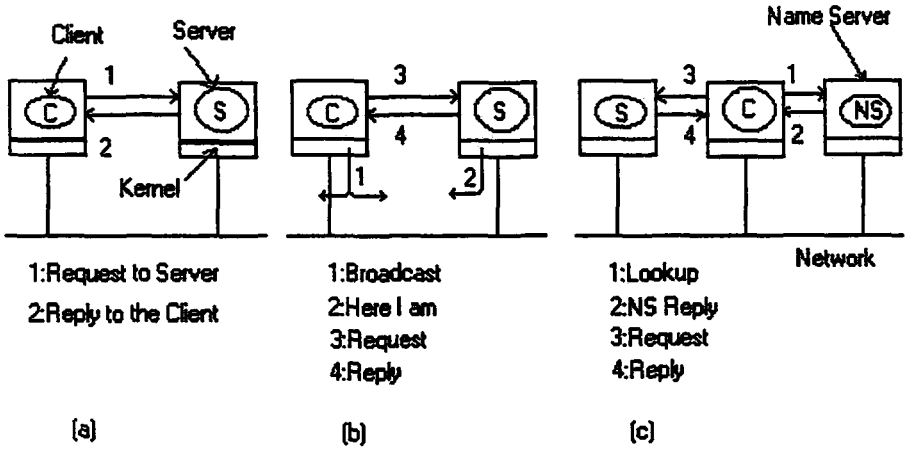


Figure 2.2. (a) Machine.process addressing. (b) Process addressing with broadcasting. (c) Address look up via a name server.

2.1.2. Blocking – Nonblocking Primitives of the Client-Server Model

Blocking Primitives means that while the message is being sent, the sending process is blocked, and the call to send is not executed until the message has been completely sent. The process remains suspended in receive until a message arrives. It does not maximize the parallelism, but it is simple to understand implement.

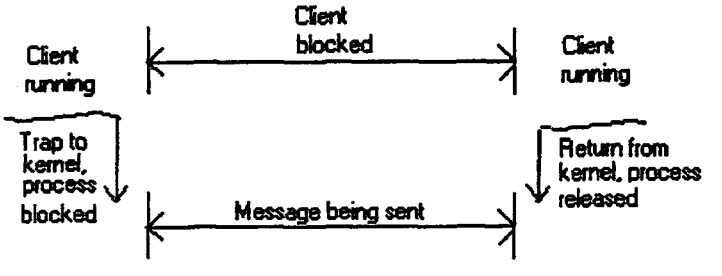


Figure 2.3. A Blocking send primitive.

An alternative to Blocking Primitives are Nonblocking Primitives. If send is nonblocking, it returns control to the caller, before the message is sent. The

advantage of this is that the sending process can continue computing in parallel with the message transmission.

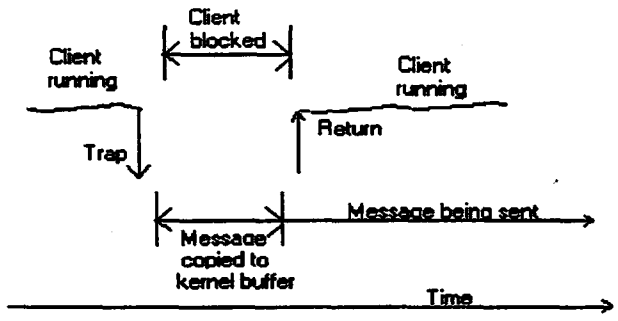


Figure 2.4. A Nonblocking send primitive.

2.1.3. Buffered–Unbuffered Primitives of the Client-Server Model

When the message comes in, The receiving kernel copies it to the buffer and unblocks the receiving process. This scheme works fine as long as the server calls receive before the client calls send. The problem arises when the send is done before the receive.

The second approach to dealing with this problem is to have the receiving kernel keep incoming messages around for a little while, just in case an appropriate receive is done shortly. Whenever an unwanted message arrives, a timer started. If the timer expires before a suitable receive happens, the message is discarded. A simple way of dealing with this buffer management is to define a new data structure called a mailbox. A process that is interested in receiving messages tells the kernel to create a mailbox for it. This technique is called buffered primitives.

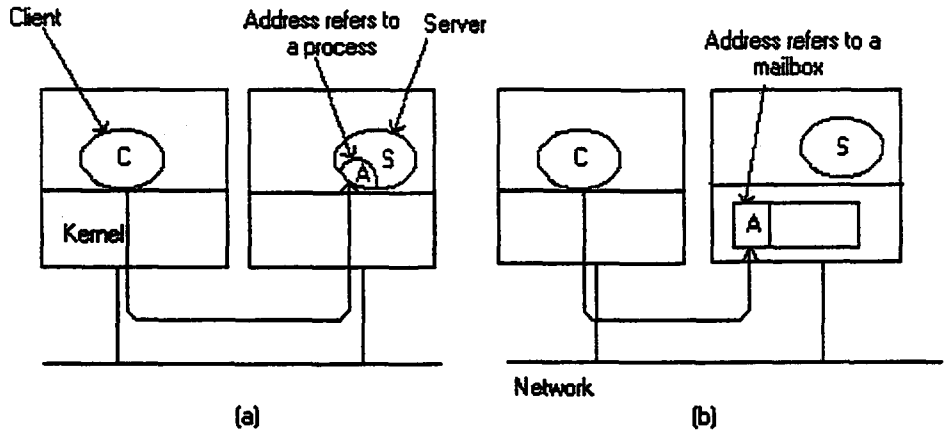


Figure 2.5. (a) Unbuffered message passing. (b) Buffered message passing.

2.1.4. Reliable–Unreliable Primitives of the Client-Server Model

When client sends a message, it is suspended until the message has been sent. However, when it is restarted, there is no guarantee that the message has been delivered. The message might have been lost.

There are three different approaches for solving this problem. The first one is just to redefine the semantics of send to be unreliable. Implementing reliable communication is up to the users.

The second approach is to require the kernel on the receiving machine to send an acknowledgment back to the kernel on the sending machine. The request from client to server is acknowledged by the server's kernel, the reply from the server back to the client is acknowledged by the client's kernel.

The third approach is that the client-server communication is a request from the client to the server followed by a reply from the server to the client. In this method, the client is blocked after sending a message.

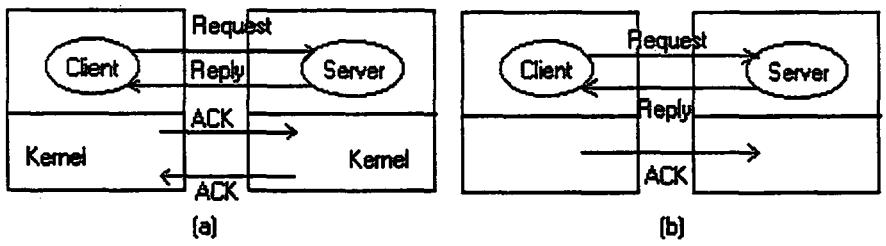


Figure 2.6. (a) Individually Acknowledged messages. (b) Reply being used as the ACK of the request.

2.2. Scope of the Client-Server Model

The traditional mainframe computing environment, in which all information and applications were centralised, is being replaced by distributed Client-Server computing in which data management, data processing and the presentation or "user interface" components may reside on different machines connected by a network.

The Client-Server architecture and the requirements for Internet worked distributed systems in which servers will manage and share information with many other clients and servers will be explain. This environment used for the system that often involves mission critical data and applications such as that found in the Financial Information System, Product Planning System etc. It will also include much smaller databases and applications that support departmental interactions in the system. The success of these systems in a distributed Client-Server environment will depend on the adherence to the architecture adopted by the system. The statement of Client-Server architecture does not preclude the deployment of systems and applications that do not meet the following guidelines. Many systems will be deployed within departments or workgroups that manage local information that is somehow unique or specific to a small group. These systems may use protocols and applications, which are not part of the architecture. In these cases, individual decisions must be made about the cost of development and support of non-standard systems and the potential migration problems if local information and applications become valuable system environment.

2.3. The Open System of the Client-Server

The first open system for networking also began to develop TCP/IP. Initially dismissed by many vendors, TCP/IP grew in popularity and displaced proprietary systems, especially in the academic environment, because of its portability, scalability, systems interpretability and cost effective means of networking a heterogeneous computing environment. The strategic value of open systems to the Application has been clearly demonstrated in the use of networking protocols and extends to all aspects of computing. The open systems movement has demonstrated that a completely proprietary systems environment is costly, limiting to users and detrimental to innovative new product development. The most effective Client-Server architecture will continue to build upon an open systems foundation and extend the goal of using open systems to include the entire suite of Client-Server software systems, including middleware and application standards.

2.4. Two-Tier to Three-Tier Client-Server Strategy

The two level model of Client-Server computing is based upon direct communication between only a client and a server with several variations on the level of processing required between them.

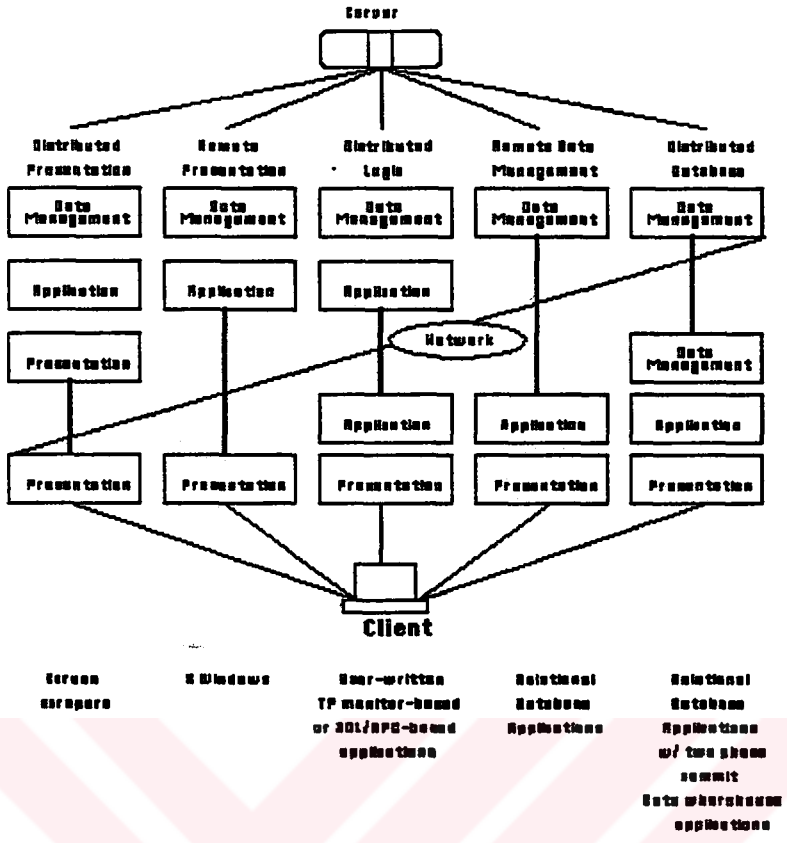


Figure 2.7. Communication between Client and Server

As distributed, Client-Server computing evolved, inefficiencies were found in the two-tiered model as applications development resulted in the redundant creation of some services, which also lead to incompatibility between systems. As a result, a new model has emerged; the three levels distributed logic model. This model minimises redundancy in applications development by providing a common framework for communication between Client-Server applications. For example, Client-Server applications throughout the Application must agree upon a common security procedure, login Ids and passwords, in order to securely share information. As the number of Client-Server applications increase, it is also important that people do not have to continually type in login Ids and passwords to complete each transaction. Enterprise wide servers, often called infrastructure servers, provide these common services in the three-tiered environment. New applications such as secure use of the World Wide Web and some Applications rely upon this three-tiered architecture.

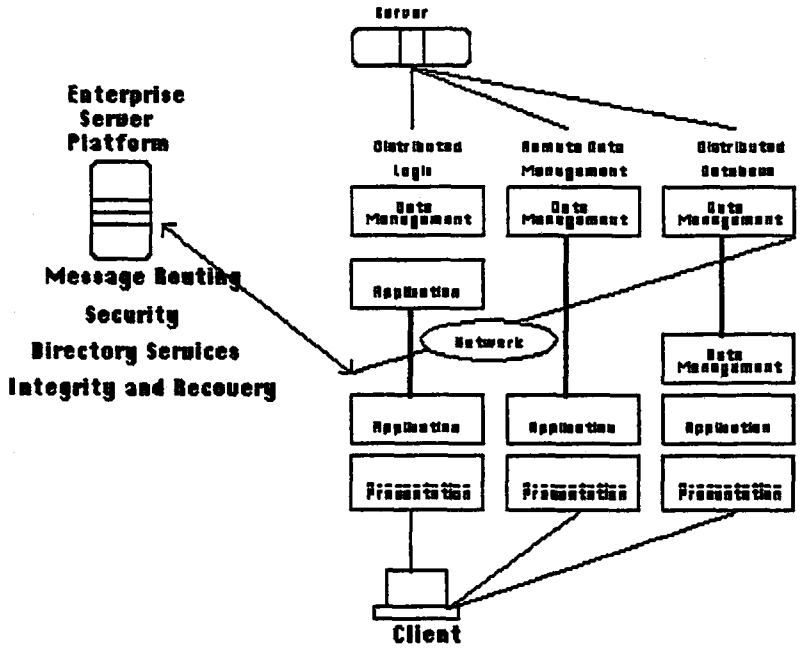


Figure 2.8. Three-Level Distributed Logic Model

2.5. Distributed System Management and Operations

Distributed computing creates an environment, which requires the analysis of using small groups of midsized to large servers. Each application will require an analysis of the tradeoffs but in general, large-scale applications, with widespread factory use, will benefit from a design that uses several smaller servers strategically placed throughout the network. This type of design can be used to eliminate single points of failure and optimise access, reliability, redundancy and network load balancing. Distributed computing support systems will be designed to optimise the tradeoffs and accommodate this change in systems design.

Open systems standards allow the choice of a server platform based upon functional specifications and the vendor software that meets them. Often, applications are developed to run under a particular operating system, which determines the choice of a proprietary platform. It is important to ensure that the platform supports open systems standards and is sized with enough capacity to handle the increasing processing and communications requirements in a distributed computing environment.

The development of Windows NT has generated a lot of discussion about its use as an enterprise wide server and its relationship to Unix servers. Current version of Windows NT provide limited implementations of open systems standards, and have a high reliance on console based management. Windows NT should be used primarily in small, localised, non-mission-critical applications. As this technology and provides utilities for efficient remote management, it should be re-evaluated for larger implementations.

2.6. Advantages of the Client-Server Model

Client-Server based systems are being implemented due to the advantages the architecture offers over other models. These include:

- First one is the simplicity. The client sends a request and gets an answer. The reply message serves as the acknowledgment to the request.
- Second one is efficiency. The protocol stack is shorter and thus more efficient. Assuming that all machines are identical, only three levels of protocol are needed.
- Due to this simple structure, the communication services provided by the kernel can be reduced to two system calls, one for sending messages and one for receiving them.
- Client software sends properly formatted search requests to the host Servers no longer need to process raw data into user friendly displays Client software can manipulate (sort/print/save) the search results locally.
- The net effect is that servers can be significantly smaller or serve larger populations of users. This translates into lower acquisition and maintenance costs for the organisation.
- Client-Server architecture can allow eliminating irrelevant messages overflowing between Client and database servers.
- It is an easy and inexpensive WWW connectivity for a financial institution to provide additional services to their customers.

- Server Partition is the most cost-effective software technology bundling a number of cooperative application servers into a cluster in the same machine. Such cluster architecture allows different sets of application servers to share resources within the same machine. Growth in size and number of clusters can both be vertical and horizontal with a high degree of scalability.
- Another advantage is Vertical and Horizontal Scalability. Vertical is bundling of a number of cooperative servers into a single machine Horizontal is growth of cooperative servers extends across platforms horizontally.

CHAPTER THREE

PRODUCTION PLANNING SYSTEM IN AN ORDER BASED FACTORY

The general process flow in companies producing against orders is as described below:

1-The estimated and definite orders are received and transferred in the computers. The main aim of this process is to reveal the Estimated Production Plan for the next period.

2-The remaining orders from the previous production period is analysed and transferred to the next period.

3-The Production Planning Analysis is realised. The most important thing to be accomplished at this stage is the process of balancing the capacities of the lines in which the products to be produced are existed. The line capacities are evaluated and if necessary the previous production orders are re-calibrated. Then the lines are balanced again. This process is repeated until the lines are ready for production with full capacity.

4-The automatic Production receipt is constituted and the production process is commenced.

5-The semi-products and materials required for the production are to be identified after the production planning process. These components should be ready in the production lines before the commencement date of production. The Supply Planning department is responsible for the determination of the required materials between the production department and purchasing department and arrangement of a purchasing order form for the purchasing department.

6-The Purchasing Department should ensure that the materials are provided in the warehouses at the appropriate times for the purchase periods.

7-The finished products are maintained in the shipment warehouses in order to be dispatched at the date of delivery.

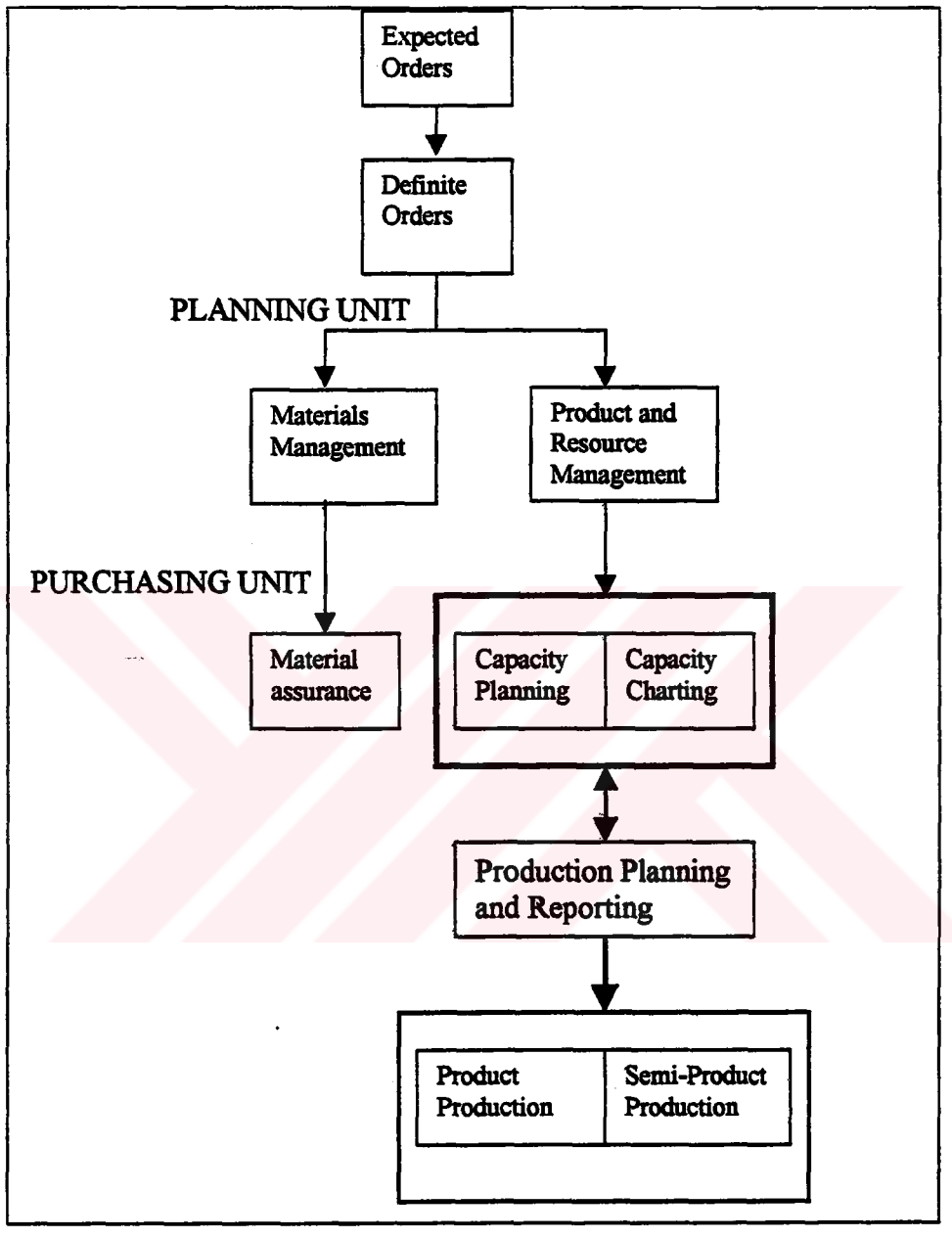


Figure 3.1. Main Structure of the Production Management System.

The main objective in here is to solve the problems occurring in other defined modules. The main modules of the system and their interactions with each other are displayed.

The general work and data flow is established in this way. The estimated orders are converted into definite orders by the Planning Unit in the system analysed. The Purchasing Department realises the purchasing processes of required raw materials in order to meet the requirements of the definite orders. The purchased raw material are transformed into semi-product in the production lines locate in internal and external production centres and into finished -product in the assembly lines. The Production Unit should ensure that the raw materials are transformed into semi-product and finished-product. The excessive products are maintained in the warehouses for non-ordered sales. In case that the complete orders are not met the previous processes are repeated for remaining orders.

3.1. Techniques of the Order

The estimated and definite orders are received and transferred in the computers. The main aim of this process is to reveal the Estimated Production Plan for the next period. To do this, User uses this Marketing System Menu is shown in Figure 3.2.

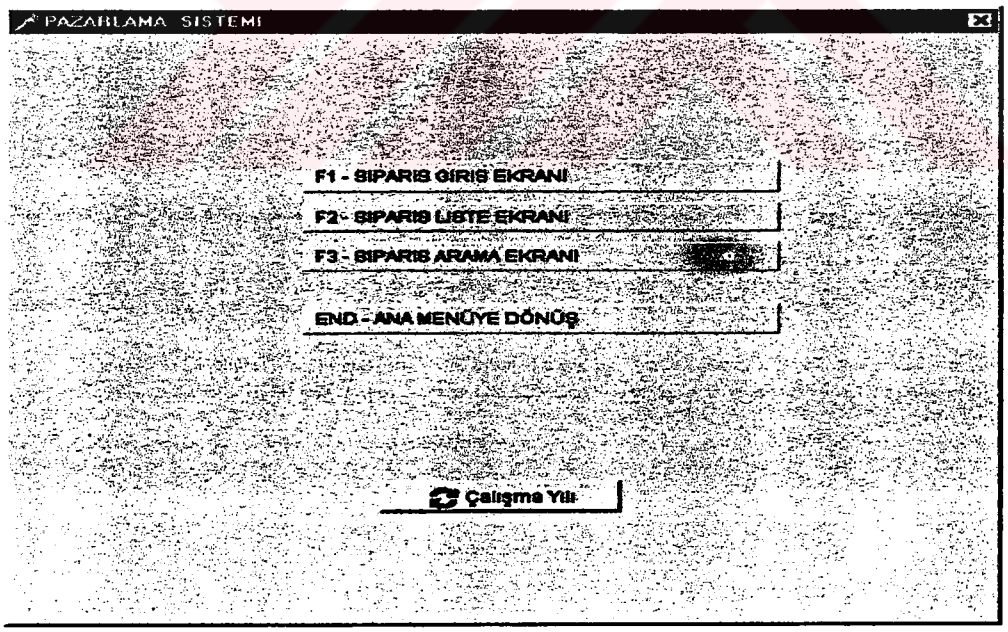


Figure 3.2. Marketing System Menu.

When the F1 button- Entering Order Screen is pushed the screen in which the Order Screen is shown in Figure 3.3 will be arranged.

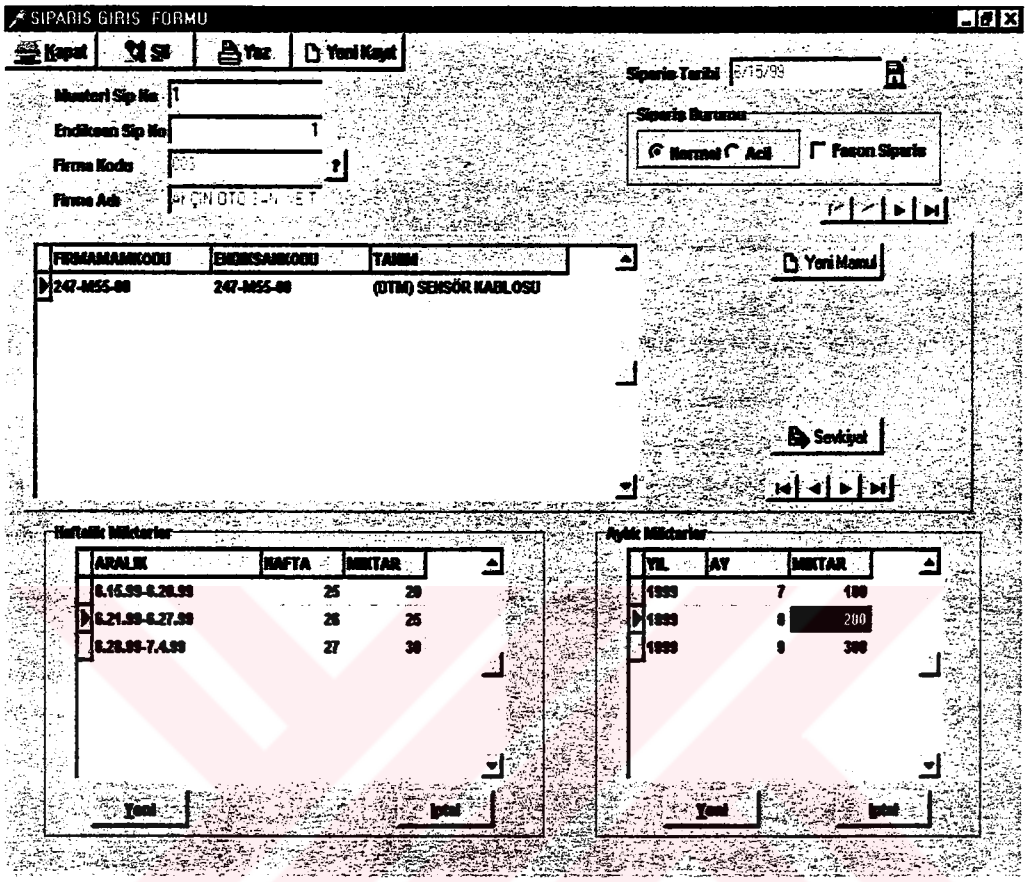


Figure 3.3. Order Entering Screen.

Because of the Factory Policy system takes order by using this screen. In this screeen User takes Order and it's Product amount in a weekly and mountly period. Mountly amount on the product can enter in this screen.Mount number must be determined after Order number. But weekly Amounts enter in a different screen. In this screen user calculates minimum 1 maximum 52 weeks if the user wants. Weeks number and their period of the day will be appear. These Weeks will be numbered after the Order Date. After the number process the user can enters the Product Amount in the proper week.

When the F2 button- List of the Order Screen is pushed the screen in which the List of the Order Screen will be arranged. User can see all Order that the user enters.

When the F3 button- Search for the Order Screen is pushed the screen in which the Search for the Order Screen will be arranged. Here all order will be search in the proper criteria.

ENDIKSAN SİPARİŞ FORMU

Firma Siparis No: 1	**Siparis Tarihi:** 6/15/99
Firma Kodu: 003	**Sipariş Durumu:** N **(N: Normal / A: Acil)**
Endiksan Siparis No: 1	**Sipariş Fason:** False
Firma Mamul Kodu: 247-M55-00	**Endiksan Mamul Kodu:** 247-M55-00

Hafta	Aralık	Miktar
25	6.15.99-6.20.99	20
26	6.21.99-6.27.99	25
27	6.28.99-7.4.99	30

Ay	Yıl	Miktar
7	1999	100
8	1999	200
9	1999	300

Table 3.1. Table of the Order Status

3.2. Planning System

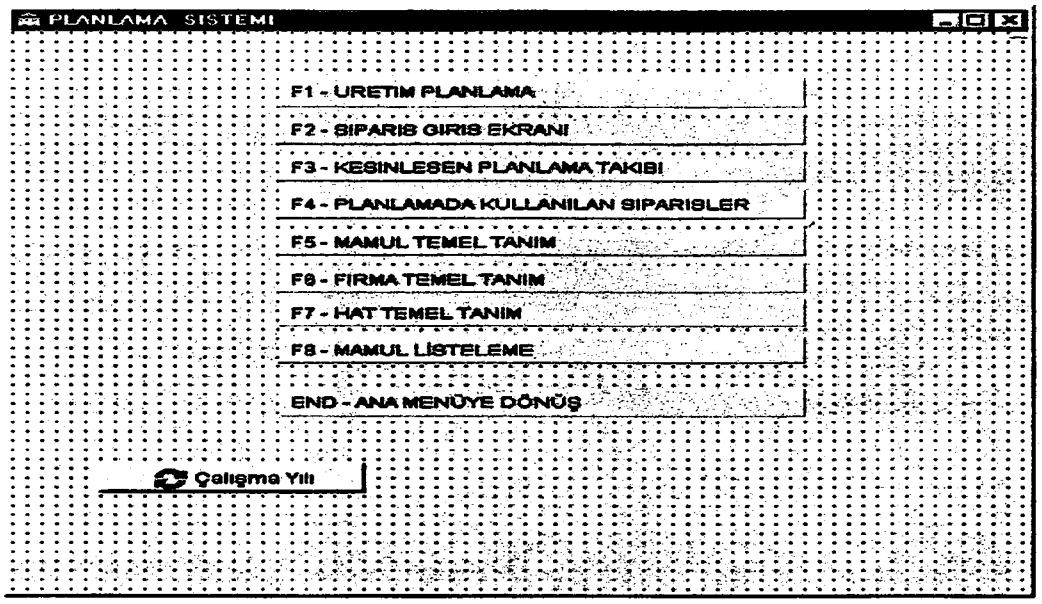


Figure 3.4. Planning System Main Menu.

The planning system menu is shown in Figure 3.4 may be used with F1 .. F8 buttons instead of mouse. This menu facilitates the transition to other required screens during the establishment of the Production Plan. And this has facilitated the data flow and accessibility within the whole system.

The production Plan is established on a monthly basis. Each new month displays a new planning period. The Planning Periods will be used for the identification of the amounts of product to be produced in the different weeks of the relevant month in accordance with the orders. In the first operation of Planning Process, the products to be produced and the quantities of weekly productions are demonstrated. Also the production lines are identified. The advantage of this will be experienced in the identification of line capacities.

After the establishment of the current monthly planning, the estimated order plans for the next 3 months is arranged. This process facilitates the evaluation of work density, line status and new orders.

Afterwards the daily status of the lines within the specific weeks are identified and planned on a daily basis. The aim of this process is to clarify the products and quantities of products to be produced production lines in the specific day. The detailed information will be given in the pertinent sections.

When the F1 button- Production Planning is shown in Figure 3.4 is pushed the screen in which the Production Planning is shown in Figure 3.5 will be arranged.

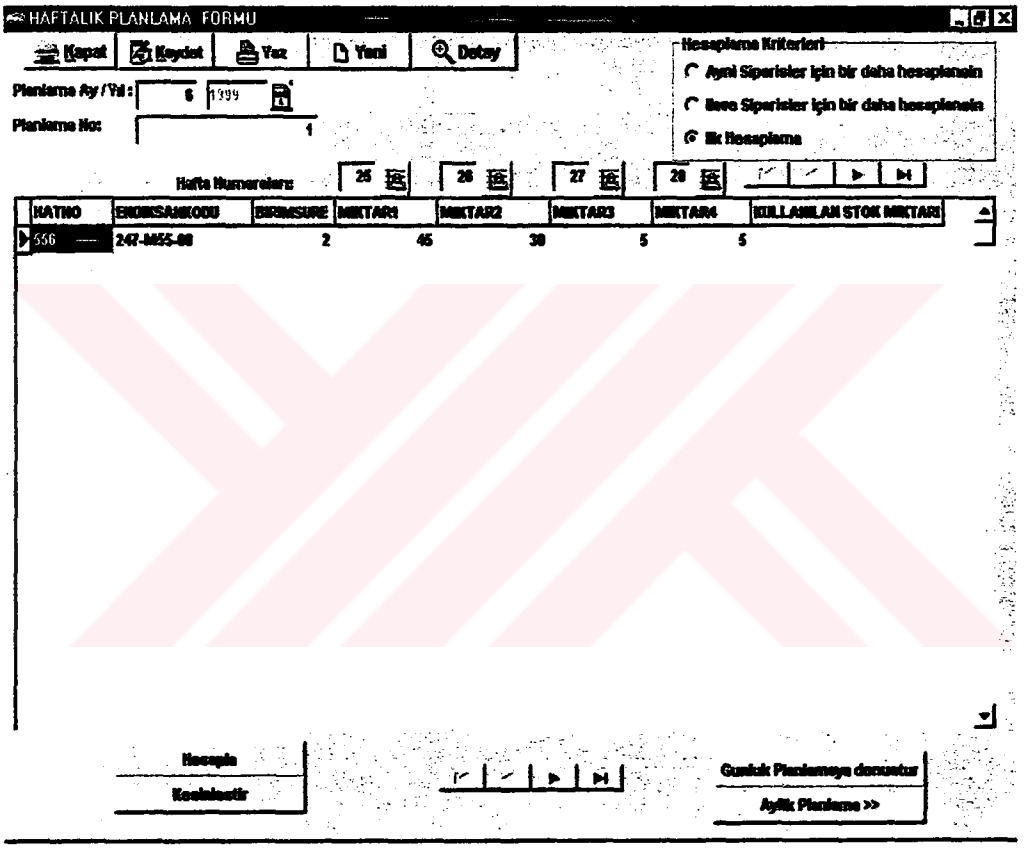


Figure 3.5. Production Planning Screen.

Various processes may be established on this screen.

1. The Production Plans of previous periods may be monitored when necessary. By this way, the number of commenced plans appropriate for the production are identified and desired modifications are performed over them and the re-planning process are applied for the new order, if available.
2. A production plan may be constructed for the orders in the specific periods.

3.2.1. The First Production Plan

The first process to perform is to identify the date and the number of weeks covered by the new plan by pushing the new button is shown in Figure 3.5. The reason for this is the arrangement of Production Plan on a monthly basis. Each month is a new planning period and contains different deficiencies.

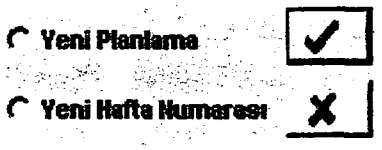


Figure 3.6. Panel of the New Operations.

When the New button is pushed, this panel is shown in Figure 3.6 will be displayed. At this stage the operator has two choices:

1. Can establish a new plan by selecting New Planning. The planning number is the number of month to be planned. This process does not enable the re-establishment of a current plan. It only enables us to change the week number of a current planning.
2. New Week Number; the week numbers of the planning in which covered weeks are entered improperly or incompletely.

The following screen is shown in Figure 3.7 will display for these processes.

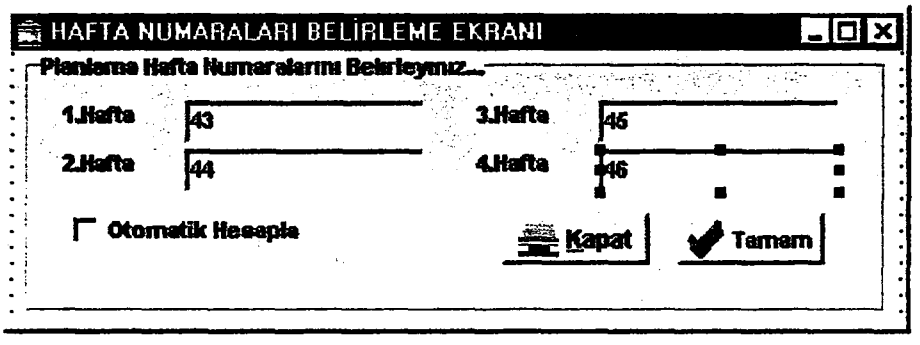


Figure 3.7. Determination of the Week Numbers Screen.

The numbers of the new month to be planned or the previously planned but the week numbers of which plans are selected on the screen. At this stage the other weeks may be automatically calculated if the operator determines the number of the first week and pushes on the automatic calculation soft-button. Or the operator may determine the numbers of 4 weeks.

Now the week and month number required for the planning is determined. If the Calculate button on the Production Planning screen is pushed after all these processes some data will be displayed. They are the total quantities of all orders that suitable this date, the Line Number of the product, which will be produced, and unit period of this product. (Automatically coming back from the Basic Data).

Planlama Haftalık ve Aylık Mamul Listesi — Tarih 6/30/99 11:39:46 AM

Planlama No: 1

Planlama Ay: 6

		Kesinleşmiş Planlama				Aylık Planlama		
Mamul No	Hat No	1.Hafta	2.Hafta	3.Hafta	4.Hafta	1.Ay	2.Ay	3.Ay
		25	26	27	28	7	8	9
247-M55-00	556	45	30	5	5	100	200	300

Table 3.2. Product Order Status

The used stock quantity column denotes the rate of materials used by the program for each product. If the products are currently available in the stocks a reduction in the quantity of the production will be necessary. Because the planned quantities are the quantities which should be produced.

On the Production Planning Screen is shown in Figure 3.5

- Re-calculate for the Same Orders is for the identification of modifications on the products and in the quantities of the products existed in current plan. When

the re-calculation of the same orders is selected and the calculation button is pushed the previous quantities is updated and new quantities are monitored.

- Re-calculation of Additional order is for identifies and displays the relevant quantities, if there is an order coming across to the weeks in a current plan. In order to perform this operation re-calculation should be selected for the Additional Orders and the calculate button should be pushed, then the new products will be displayed.
- The first calculation should be selected for first calculations. When the re-calculate button is pushed the currently ordered products and quantities will be displayed.

3.2.2. Weekly Capacity Plan for the Production Plan

The little buttons is shown in Figure 3.5 near the number of each week ensures the transition to the screen is shown in Figure 3.8 in which the lines used in the relevant week is balanced.

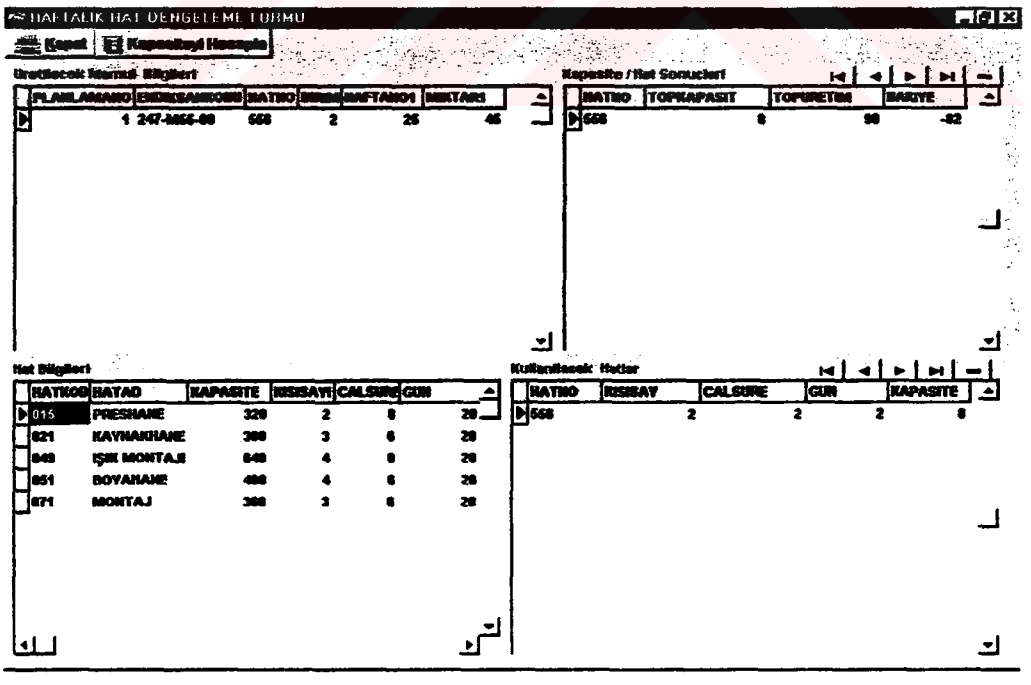


Figure 3.8. Weekly Line Capacity Planning Screen

In this screen is shown in Figure 3.8:

1. The Products and the quantities are displayed in the Products Data section. This is for the identification of the products having balanced lines.

2. All the internal lines and relevant data, which are specified previously for the Lines in accordance with the Basic Data, are displayed. These data;
   - Line code.
   - Line definition.
   - Previously specified maximum capacity.
   - Previously specified maximum employee number.
   - Previously specified maximum working days numbers.
   - Previously specified maximum working hours.

3. The lines required for the products to be produced in relevant week are displayed in the Operation Lines. The Working Period, Number of Days and Employees are automatically transferred from the Basic Data. And these data are subjected to following formula in order to determine the capacity;

   Line capacity=number of employees*number of days*working period

4. In the section of Capacity/Line Results the remainder between the total production including the total number of the products to be produced in the line and the line capacity is calculated in the form of + and -. The reason for this is the balancing of '-' remaining lines till it gives '+' or 0 remaining. The operation in order to ensure this is up to operator.
   - Increasing number of Working Days and Employees and extending of Working Period for the lines to be used, which are defined in the basic definitions before. The alteration in one of those parts will affect the capacity.
   - Another process to be performed may be the reduction of order quantities within the relevant month. The remainder will be changed since this operation will reduce the total amount of production.

If the Calculate the Capacity button is shown in Figure 3.8 is pushed after the modifications are performed New Capacity and Line Results will appear. This process is repeated until all the Lines display zero and optimum remainder.

3.2.3. Monthly Production and Capacity Plan

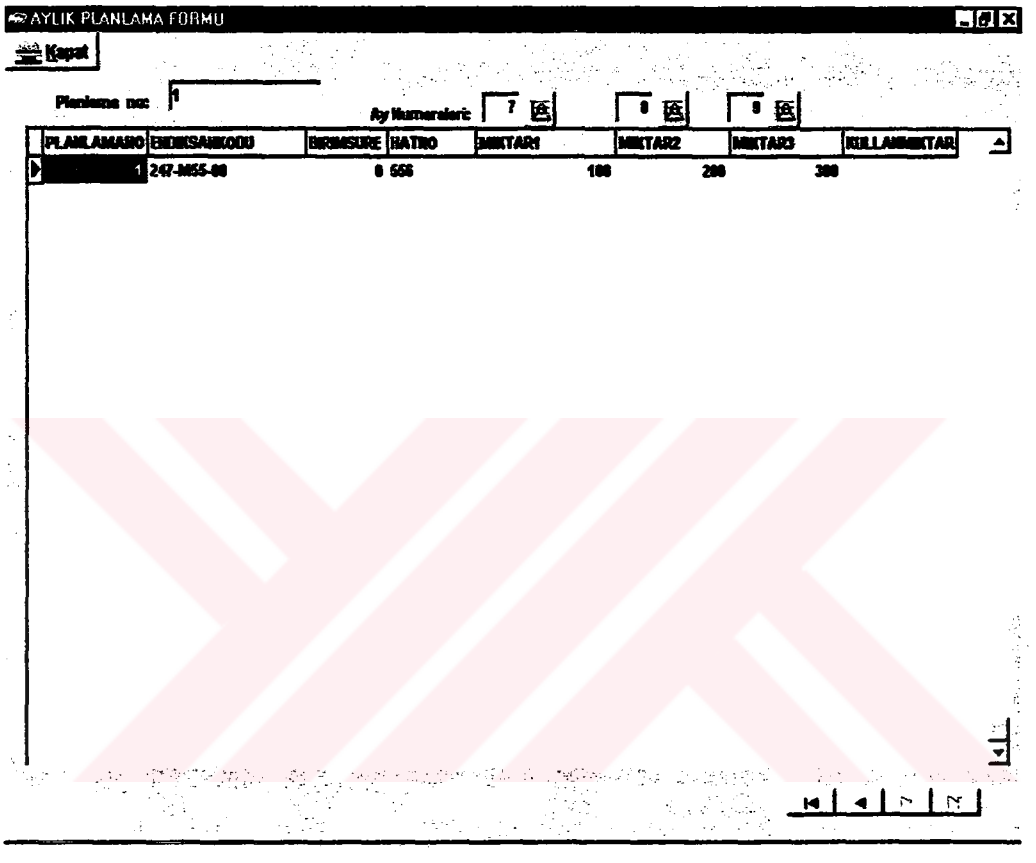


Figure 3.9. Monthly Production Plan Screen

If the Monthly Planning button is shown in Figure 3.5 in the Production planning Screen is pushed the total amount of products which are produced for orders within the last 3 months are displayed. The Little buttons is shown in Figure 3.9 near the Month Numbers provides the transition to the line-balancing screen. At this stage the monthly amounts and line capacities are compared. The aim is to identify the status of next period lines and searching for new orders or work for stock. After the establishment of the current monthly planning, the estimated order plans for the next

3 months is arranged. This process facilitates the evaluation of work density, line status and new orders.

3.2.4. Daily Production and Capacity Plan

The below panel is shown in Figure 3.10 will be displayed when the Daily Planning Button in the Production Planning screen is shown in Figure 3.5 is pushed.

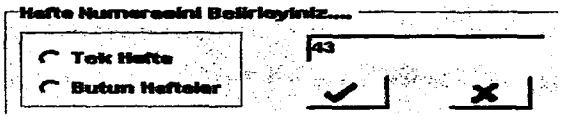


Figure 3.10. Definition of the Week Numbers for the Daily Plan

At this stage you can demonstrate the single week and all the weeks existed in the planning in a daily basis. This identifies the amount of daily production and enables operator to balance the capacity.

In case that the single week is desired the number must be affixed as described in the figure is shown in Figure 3.11. It is not necessary that the column be filled for each week.

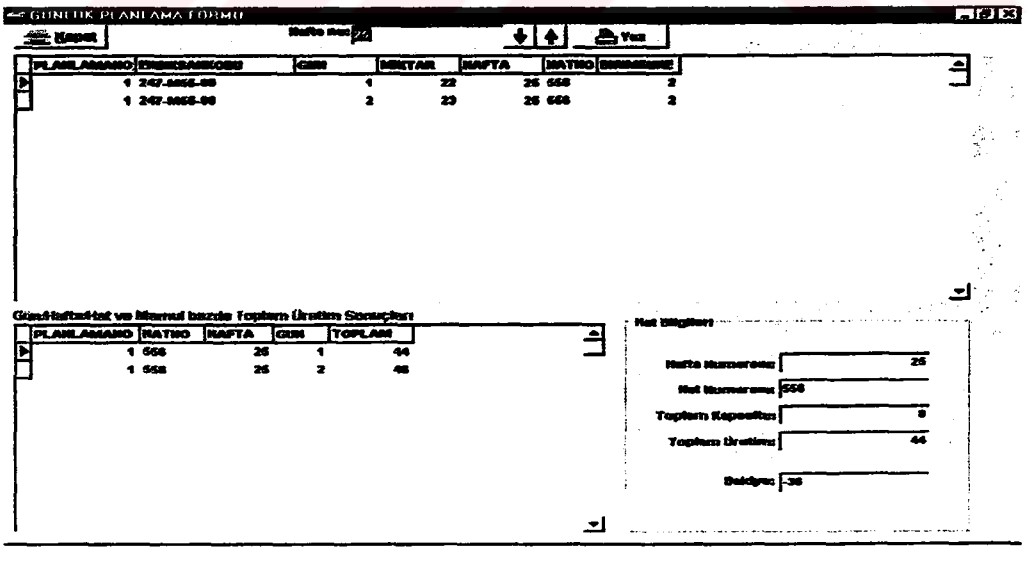


Figure 3.11. Daily Production Plan Screen

The weeks should be separated on the basis of data pertinent to number of working days for the stabilisation of the lines. If 5 is entered as the number of working days in the stabilisation of the lines, the Daily Planing is established over 5 days and the amount of product to be used on that line is distributed in accordance with this.

Daily Production Plan Screen is shown in Figure 3.11 is displayed at the end. At this stage the conformance of amounts of daily production to the Line Capacity.

The amounts of weekly and daily production over the same line on the Daily/Weekly/Line basis will be gathered and compared with the Total capacity in the Line Data and then the result is shown in Remainder Section.

The stabilisation of amounts should be performed in the remainder column. Because the Line Capacity is exceeded on the daily basis.

HAFTALIK ÜRETİM PLANI Tarih 6/30/99 11:39:04 AM

Üretim Planı No: 1
Üretim Planı Ay: 6
Üretim Planı Hafta No: 25

Mamul Kodu	1.Gun	2.Gun	3.Gun	4.Gun	5.Gun	6.Gun	7.Gun	8.Gun	9.Gun	10.Gun
247-M55-00	40	23	35	50	4	41	25	30	10	50

Table 3.3. Product Order Days of Proper Week

3.2.5. Increasing the Amount of the Production Plan

The aim of establishing this process is to be able to commence the production of a specific amount of the next month.

The rate of increase, which is identified in accordance with the classification of Companies, is reflected in the amounts. This process is shown in Figure 3.12 is accomplished with the identification of the rate of increase of each firm may and the distribution of this rate of increase on a weekly basis. The amounts will increase when the calculate button is shown in Figure 3.13 is pushed. In case of floats in the amounts as excessive and insufficient the added amounts may be foreground by pushing on the Change button.

The following screen appears when the Details Button on the Production Planning screen is shown in Figure 3.5 is pushed:

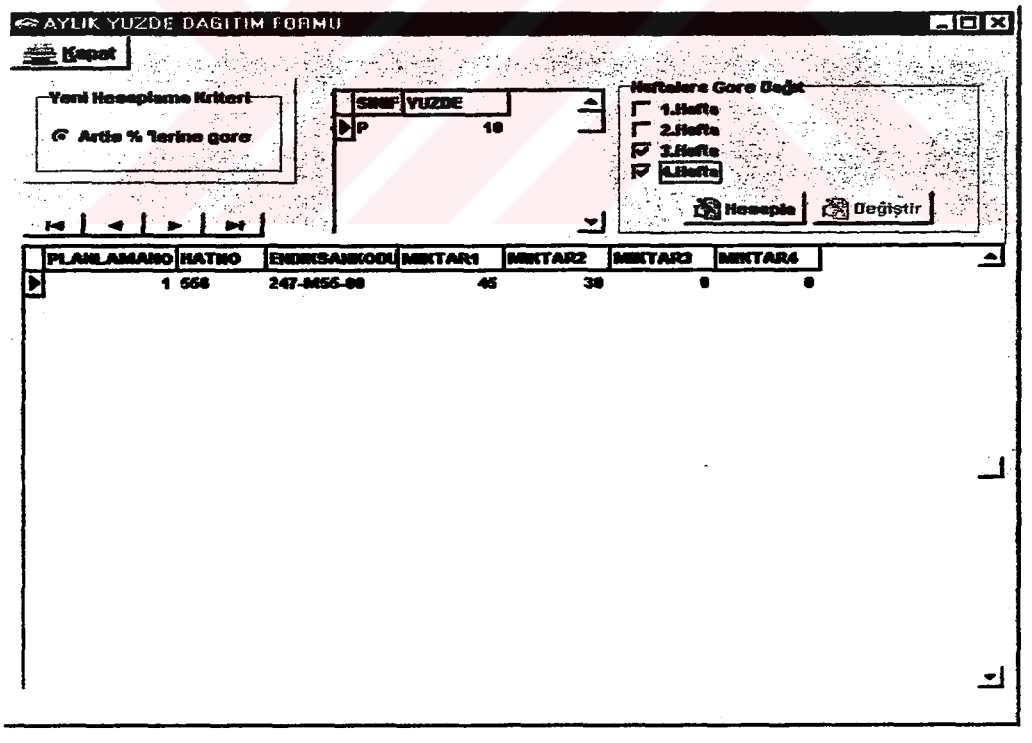


Figure 3.12. Before Increasing of the Product Amount

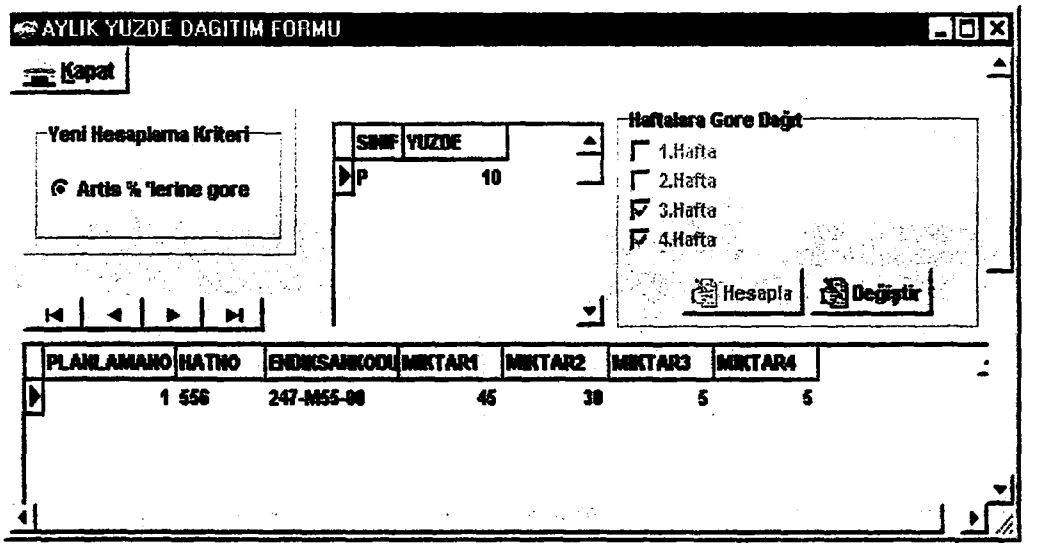


Figure 3.13. After Increasing of the Product Amount

3.2.6. Certain Production Plan

If all process is finished correctly the production plan is certained by the user. As the last operation the Planning is ready for the Supply Planning when the "Make Certain" button is shown in Figure 3.5 is pushed.

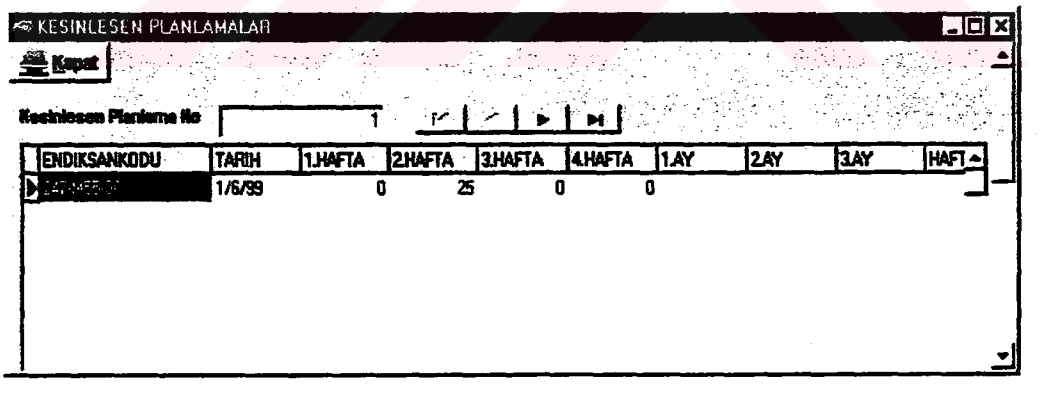


Figure 3.14. Certain Production Plan Screen

On the Planning System menu is shown in Figure 3.4 if the F3 button- Certain Production Plan is pushed the screen in which the Certain Production Plan is shown in Figure 3.14 will be arranged.

3.2.7. Production Plan Order Control

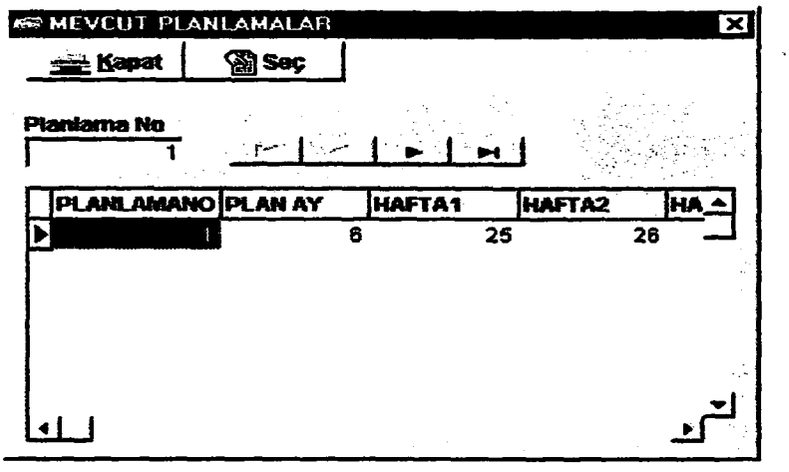


Figure 3.15. Existing Production Plan Screen

On the Planning System menu is shown in Figure 3.4 if the F4 button- Order of the Existing Production Plan is pushed the screen in which the Existing Production Plan is shown in Figure 3.15 will be arranged. First this screen will be appear because we must select the production number which we want to see the order of it. After this screen is shown in Figure 3.16 will be appear.

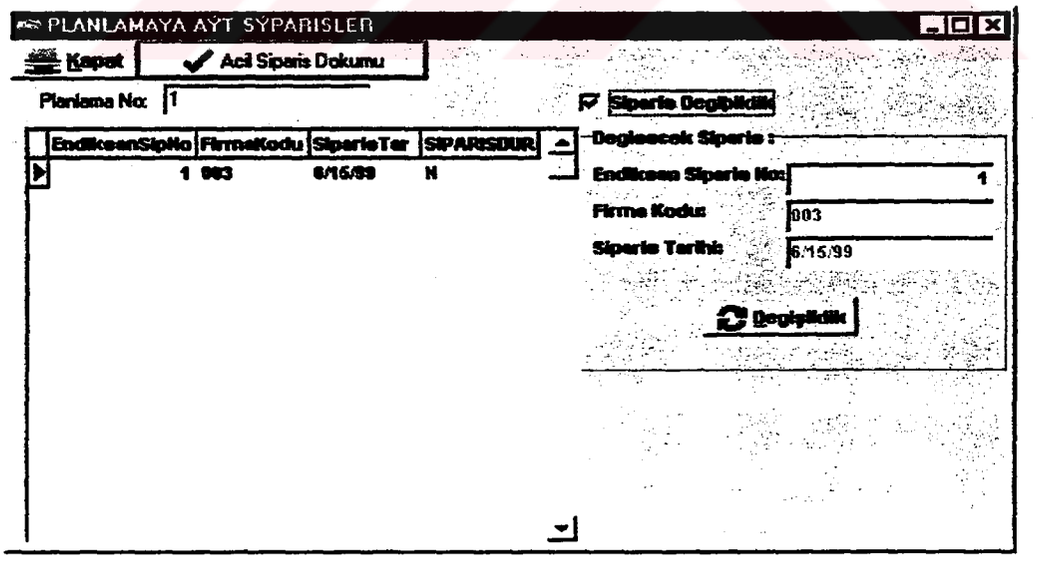


Figure 3.16. Order of the Determined Production Plan Screen

This Production Number may contain a lot of Orders. During the Production phase user can change some Orders information, which are Order Product Amount, Order Due Date, Order Condition, etc. User can select this Order Number in the Determined Production Screen easily and go this Order detail information Screen by pushing the Modification Button on the Determined Production Screen is shown in Figure 3.16.

3.2.8. Production Plan Product Control

On the Planning System menu is shown in Figure 3.4 if the F5 and F8 button is pushed the screen in which the Search for the Product Information is shown in Figure 3.17 will be arranged. First this screen will be appear because we must select the Product number which we want to see the order of it in the proper week.

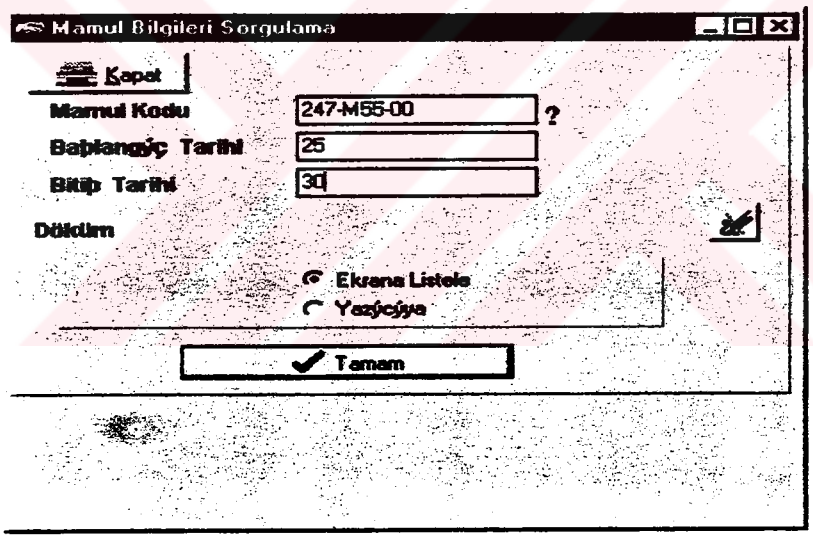


Figure 3.17. Search for the Product Information

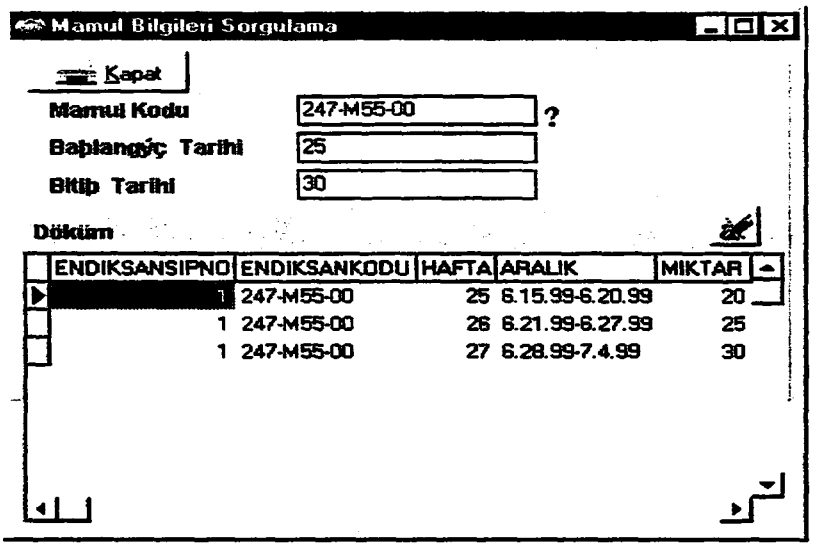


Figure 3.18. List for the Product's Weekly Amount

This is shown in Figure 3.18 gives some information to the user, which are product's amounts, product's production dates and etc.

Endiksan Mamul Sipariş Durumu 6/30/99 11:43:34 AM

Mamul Kodu : 247-M55-00

Sipariş Numarası	Hafta Numarası	Tarih Aralığı	Miktar
1	25	6.15.99-6.20.99	200
1	26	6.21.99-6.27.99	250
1	27	6.28.99-7.4.99	300

Table 3.4. Product Order Weekly Status

3.3. Terms Planning

A specific product may be produced in specific quantities and with different techniques. Also a specific type may influence the delivery terms of other types of products.

The term planning may be arranged with two different methods identified in accordance with types of orders. In case that the latest delivery terms of order is specified the relevant order is produced on time without surprassing the plant capacity. If only the quantities of orders are specified the planning is started form the commencement period of the program and from the first process and the orders are arranged separately in accordance with their arrival times.

If the Production Plan is certained that means that it's Term Plan can do by the user. To do this user must select Terms Plan in this menu is shown in Figure 3.19:

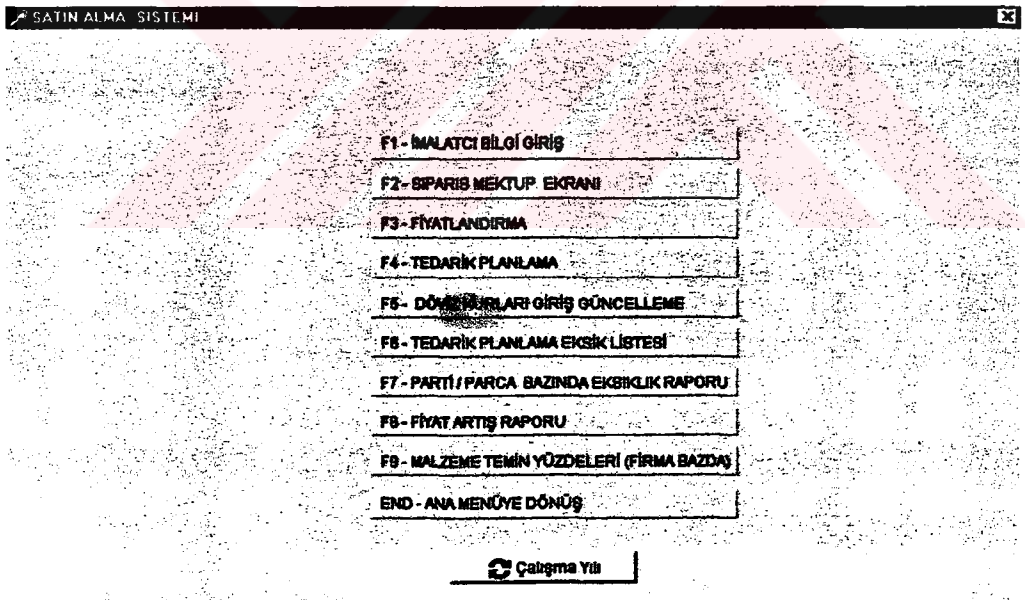


Figure 3.19. Purchasing System Menu

On the Purchasing System menu is shown in Figure 3.19 if the F4 button is pushed the screen in which the Term Plan is shown in Figure 3.20 for the Product will be arranged. In this screen must select the Production Number which we want to do Terms Plan.

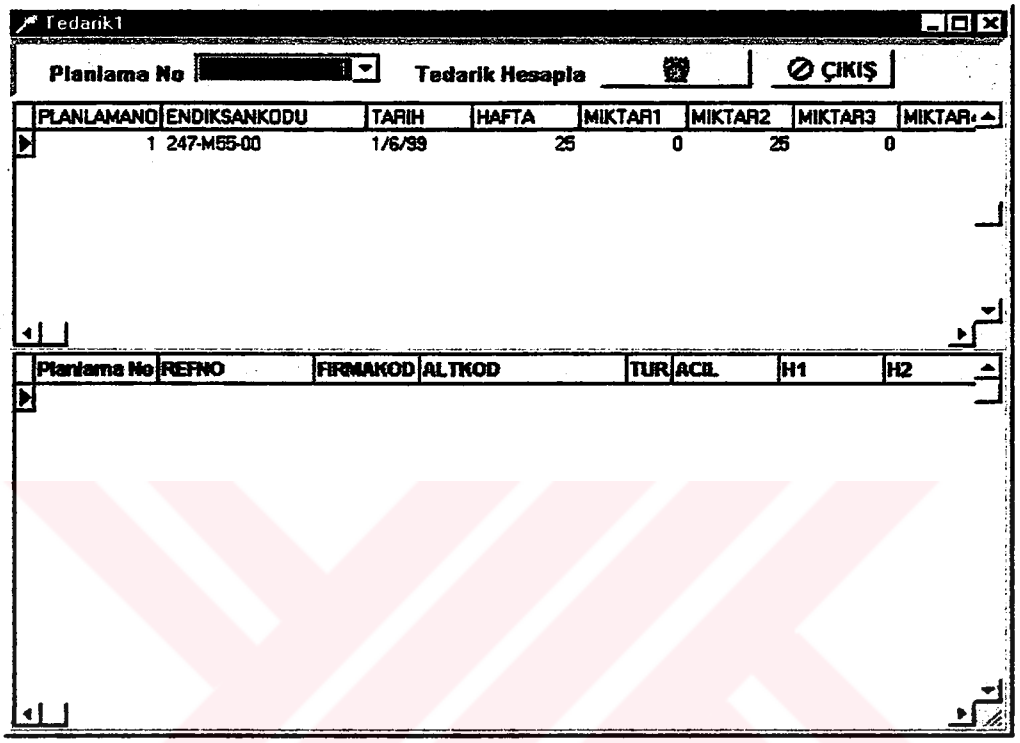


Figure 3.20. Term Plan Screen

If the Term Calculation is selected this result will be appear in this screen. And term plan should ensure that the orders are produced in the projected quantities and the capacity is utilised in the utmost level.

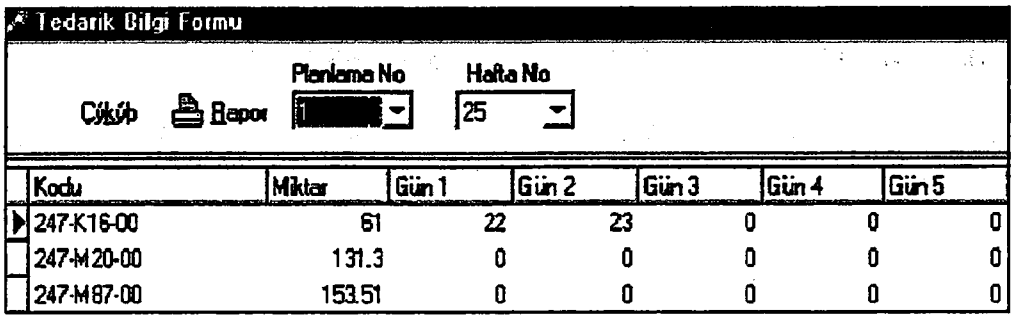


Figure 3.21. Term Plan Information

CHAPTER FOUR

DIFFERENT PRODUCTION PLANNING TECHNIQUES

These systems are about production planning but all of them have different approaches in this sector.

The Factory Vision makes production planning by using some special tools like Machine Interface Unit (MIU). Mixed Model Schedular (MMS) use Finite Capacity Planning in their Production Planning. SAP has a lot of tools empower companies of all sizes and all industry sectors to respond quickly and to dynamic market conditions, helping businesses achieve and maintain a competitive advantage.

This chapter contain three different production planning program in detail. And it also answer some question which are about production management, What kind of production management system prefers, their production planning approaches, etc.

4.1. Production Planning in The Factory Vision

The Factory Vision, works in factory, which is make consecutive production and it is a kind of system for the followings:

- to follow the production in the real time
- to report the production in the real time
- to explain and maintain the production in the real time.

The Factory Vision gives the possibility to vision the production of the factory which is already contiuning according to the Factory Vision's own definitions.To do this definitions it is necessary to define basic units of the factory lines, machines, products, product trees, operators and etc. by using the Factory Vision Machines are categorized in the Factory Vision according to logical and functional units. While in logical category the type of the machine is important, in functional category the type of product which is produced by the machine is important. According to the product of the machine it is necessary to define the work center.In the Factory Vision the work center is the group of the machines that works to produce the same product (Production line) [Datem, 1998].

The Factory Vision is a supporting system to vision, direct and report the production in a factory which makes consecutive production. The Factory Vision is especially important for a factory which has the target of computer supported production.

The main principle of the Factory Vision is collect and record the all data on the machines of the factory that contain this data for describing the Production. The operation of collecting data is belongs to the Machine Interface Unit (MIU) that takes and gives the data with analogy and digitaly. Beside this MIU takes and gives information which are production 's amount, state of the machine and the system's caution to the clients about the production.

Also Clients can define the machine's error that is under their control, and reason of the errors by writing error code and can enter amount and reason of the wastage to the system with the help of MIU.

4.1.1. The Services of The Factory Vision

- The Factory Vision gives computer supported production visioning and data collection.
- To decrease the possible errors coming from manuel functions the Factory Vision gives the computer supported possibilities for increasing the performance of employees and general works.
- The Factory Vision ensures to vision production orders on the base of work centers and machines.
- By using statistical estimations based on past productions,it helps material requirement and production time planning.
- Based on reports prepared with real time collected data , qualified personnel can make real decisions to increase the performance.
- The Factory Vision records the errors of machines and by this way it can be understood that how much resources are lost because of these errors.
- With the help of error frequency and error distribution reports, the Factory Vision helps to take precautions for increasing productivity.
- It gives information about operators like the capacity of an operator and what kinds of errors take how much time of operator to solve.
- It gives the real vision of the scrap proportions.

4.1.2. Hardware Requirement of the Factory Vision

There are three units like Machine Interface Unit (MIU), Master Station, the Factory Vision server and Clients. MIU is a unit that has a direct connection with machines. Master station is the computer on which a data collection module of the Factory Vision is running. These Master Stations takes information from machines by Machine Interface Unit and sends them to the Factory Vision server which is the main computer that all information is restored (Factory Vision database), by the help of Master Station Factory Vision Server. This server is also responsible for sending some jobs to Machine Interface Unit's by the help of Master Station.

In this environment the Factory Vision takes place in two type of data flows:

- From Production place to visioning environment.
- From Visioning Environment to Production Environment.

Factory Vision Clients can use the information on Factory Vision server in necessary reports. This data helps to the organisation for evaluating past productions and planning the future production according to these evolutions.

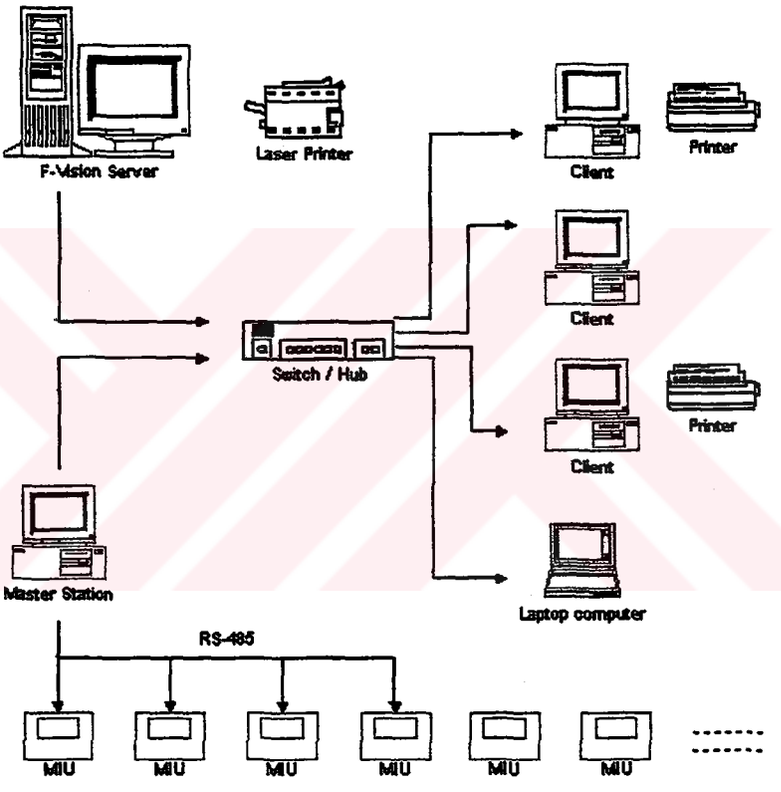


Figure 4.1. Network Schema of the Factory Vision

4.1.3. The Production Management of the Factory Vision

In the Factory Vision production orders follows some different steps. These steps are Defined, Approved, Assigned, Job Started in Progress, Job Started, Job Stop in

Progress, Job Stopped, Job Finished. The Functions that are responsible for these steps are defined and implemented in the Factory Vision.

To follow a production of any product the production order must be defined. In the Factory Vision to define and delete the production order is possible, modification can only be made on defined but not approved production orders. To define the production order we must enter some data for marking production in the Factory Vision.

- Code of the Production Order.
- Definition of the Production Order.
- Code of Product.
- Definition of the Product.
- Amount of Production Order.
- Due Date of Production Order.

To do this operation in the Factory Vision we can use this screen which name is 'Definition of the Production Order'.

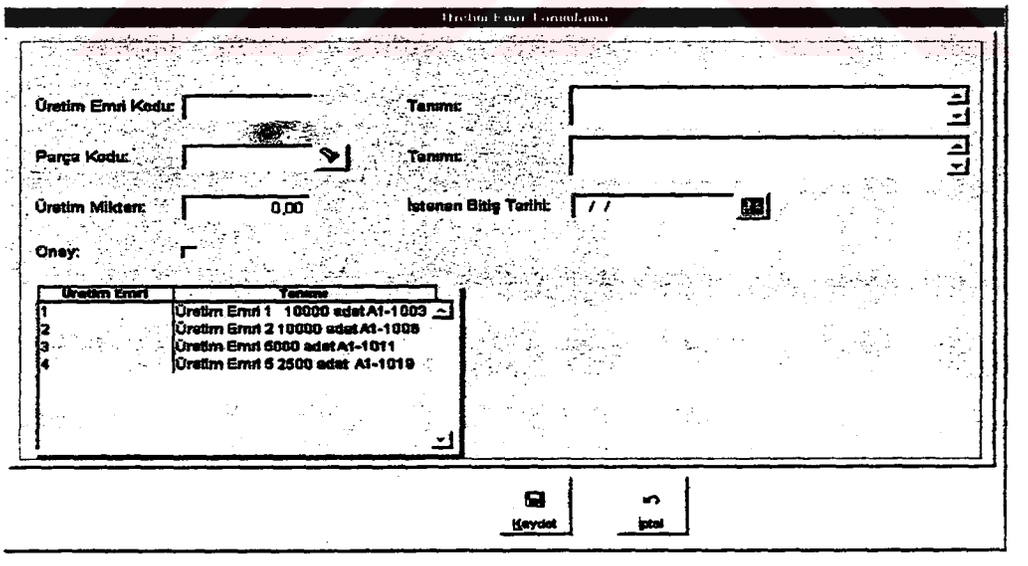


Figure 4.2. Definition of the Production Order Screen

After defining a production order, this order must be assigned to some machines, which is defined on the Factory Vision. To do this assignment has 3 steps:

- Choosing a work center. (It is chosen according to the product that will be produced)
- Choosing machines. (Suitable machines on that work center)
- Choosing tools. (If tool is necessary)

4.1.4. Management of the Production Orders

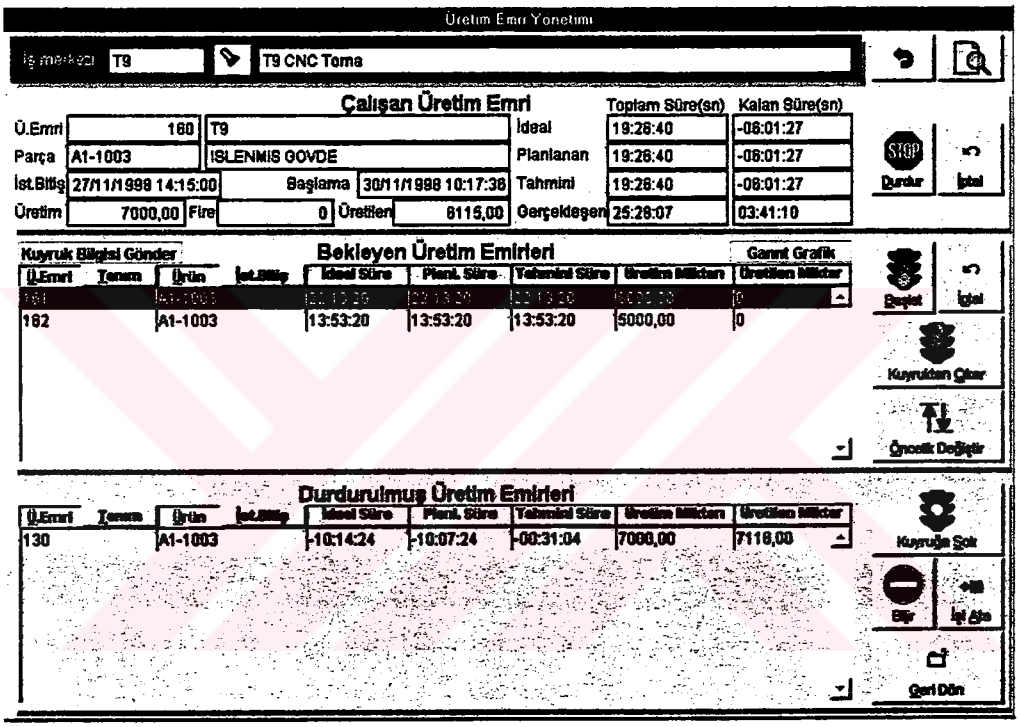


Figure 4.3. Production Management Screen

With this screen :

- Defined, Approved and Assigned production orders can be started.
- Started production order can be stopped.
- Stopped production order can be finished.
- The priority of assigned production orders can be given.

Briefly, in this screen control and management operations can be done about defined work center and production orders on them.

4.2. Production Planning in the SAP System

SAP products empower companies of all sizes and all industry sectors to respond quickly and to dynamic market conditions, helping businesses achieve and maintain a competitive advantage [SAP, 1998]. Its strategic product architecture links all areas of an enterprise. Make sure that SAP products and other products all work together as seamlessly as possible are two efforts:

- The development of open interface to link disparate systems and provide enormous scalability and flexibility.
- Team SAP certification program. SAP, in collaboration with its hundreds of complementary software partners and world-class hardware providers, has created this program to ensure the use of its standard implementation methodologies and realise the solution in an accelerated time frame at least cost to the customer.

4.2.1. SAP R/3 System

SAP R/3 applications cover accounting and controlling, production and material management, quality management and plant maintenance, sales and distribution, human resources management, and project management.

4.2.2. Production Planning

Equipped with the R/3 System's Production Planning and Control application, you can reach your full potential when planning, executing, and controlling your production. The R/3 System's Production Planning and Control application covers the complete production process from the creation of master data to production planning, MRP, and capacity planning, right down to production control and costing.

4.2.3. Production Planning Modules

Using Sales & Operations Planning (SOP), you can create realistic and Consistent planning figures and dates on the basis of expected sales or other key figures of your choice. Then, in Demand Management, these planning figures are split down to product level and the demand program is created. In material requirements planning (MRP), the system calculates the quantities and procurement dates for the necessary materials, right down to the raw materials. You can already plan capacities at this planning phase. Therefore, you can recognise possible capacity bottlenecks with plenty of time to take the necessary preventive measures.

4.2.4. Production Control Modules

It is Depend on your method of production. KANBAN Production Control.
It provides extensive status management functions, controlling per order as well as various operation-related functions. Repetitive manufacturing is especially designed for manufacturers of products that are typically produced repetitively on a particular production line over a longer period. Here, production planning and control as well as controlling are usually carried out based on periods and quantities. R/3's Repetitive Manufacturing module provides a tool based on production rates and lines to cover the requirements of this type of production.

Capacity planning is integrated with production order processing as well as with repetitive manufacturing. Various dispatching strategies and a flexible graphic-planning table support you in planning your resources. If you control production using KANBAN techniques, replenishment or the production of a material is not triggered until a higher production level actually requires the material. In R/3's KANBAN module, various replenishment strategies are available for inhouse production, external procurement, and stock transfer. The signal for replenishing a material can be triggered by bar code or using a graphic KANBAN board.

Quality management, interfaces to PDC systems, distributed control systems, laboratory information systems as well as extensive data analysis functions in the Open Information Warehouse are all also integrated in R/3's Production Control.

4.2.4.1. CAPP Standard Values Calculation in the SAP System

The calculation of standard values with CAPP is part of the Production Planning System (PP), as are material masters, bills of material and routing. The PP system is a component of the R/3 System, which, as integrated application software, covers the entire range of business functions in a company. The efficiency of the overall system is achieved by using integrated modules, each of which represents an area of common content. The PP system has interfaces to: Materials Management (MM), Controlling (CO), Personnel Planning and Development (PD).

All modules are real-time applications. This means that all quantities and values are saved directly and the same current data is available to all users of the system.

CAPP belongs to the master data of Production Planning (PP) as do material masters, bills of material, routing and work centers.

4.2.4.2. Introduction to CAPP Standard Values Calculation

Standard values are used in scheduling, capacity planning and costing to determine dates, capacity requirements and costs. They generally have the dimension time. However, in the PP system you can calculate standard values not only with the dimension time with any dimension in the system. Standard values can be determined in several ways:

- The conventional procedure for determining times (for example, time studies, estimating)
- Sampling and statistical procedures for determining times (for example, period time sheets)

- Calculation methods (for example, MTM, WF and planned times)

The following graphic displays the basic data which CAPP uses in calculating standard values. The calculation details can also be generated.

You can trigger the calculation of one or more standard values for an operation when you are within the create or change transaction for routings or when you are creating a production order. During this calculation both the technical data and one or more processes at the work center where the operation is executed are taken into account.

Standard values are calculated using methods that are allocated to the process. The method is used to specify the standard value to be calculated. When calculating methods the system accesses formulas that can in turn access other formulas and/or tables.

4.2.4.3. Relationship of Capacity to Work Center

Capacity is the ability to perform a task. In the R/3 System, capacities define the range of services which people and machines can provide within a certain time period. Several capacities can be assigned to one work center, distinguished by their categories.

Work center capacities, that is, different capacity categories can include: machine capacity, Labor capacity, reserve capacity for rush orders, emission.

4.2.4.4. Routing

A routing and its objects contain all the information required describing a production process. The most important routing objects are operations, sub-operations, and sequences of operations, material components. The calculation of standard values with CAPP (CAPP = computer aided process planning) provides machine support for work scheduling to determine standard values in the routing.

The standard values are calculated using methods or processes that are available at the work center where the operation is carried out.

In the SAP System, routings are used: in Production Orders, in Scheduling, in Capacity Planning, in Costing.

4.2.4.5. Capacity Planning

In capacity planning the standard values and quantities in an operation are used to determine the capacity requirements for executing operations. These requirements are compared to the available capacity defined in the work center.

4.2.4.6. Costing

Costing calculates the costs incurred when a material is produced in-house. Costing provides the basic information for pricing and pricing policy, evaluation, cost control, Profitability analysis. An operation in a routing is linked to cost accounting by the cost centers and the activity types maintained at the work center. If the work center is used for an operation, then you can enter standard values for the activity types stored in the work center. In product costing the valuation of internal activities is carried out based on the rates which were planned for the activity types. The activity types determine how the standard values are valuated.

4.2.4.7. Production Orders

Production orders are work orders, just like maintenance work orders, inspection orders and networks. The operations of a routing used in a production order specify the processing steps to be carried out in the order.

4.2.4.8. Scheduling

In scheduling, the standard values and quantities in an operation in a routing are used to determine the dates for executing the operations. Scheduling calculates the dates on which operations are to be carried out based on a routing. The execution time of an operation is divided into the following operation segments: Setup, processing, teardown.

In addition to the execution time, the following times are taken into account when a routing is scheduled: the queue time, that is, the time a material waits at a work center before the operation is carried out, the move time, that is, the time needed to move the material to the next work center, the wait time, that is, the time a material waits at a work center after the operation has been carried out

The execution time of an operation is calculated in scheduling based on the standard values and the quantities in the operations of the routing as well as the formulas in the work centers. There are two types of scheduling:

- Lead time scheduling: In this case, scheduling is carried out without regard to the available capacity, that is, based on the assumption that the available capacity is unlimited.
- Finite scheduling: In this case, scheduling is carried out based on the assumption that the available capacity is limited.

Capacity planning determines the capacity requirements for carrying out the operations in a routing and compares the requirements to the available capacity defined in the work center.

The capacity requirements for the individual operations are calculated based on the standard values and the quantities in the operations of the routing as well as the formulas in the work centers.

4.2.5. Integrated solution for all industry sectors

PP covers the complete production process from the creation of master data to production planning, MRP, and capacity planning, right down to production control and costing. It can be used in all sectors of industry and provides a whole palette of production methods ranging from make-to-order production/variant processing to repetitive manufacturing/mass production. The PP application provides you with tools, which guarantee a high performance level planning and control of the complete material flow in your production processes. It also provides you with easy-to-use information systems that you can adjust to suit your own particular needs. As a result, planner, work schedulers, and production schedulers are relieved of routine tasks and therefore have more time to concentrate on more Business critical activities.

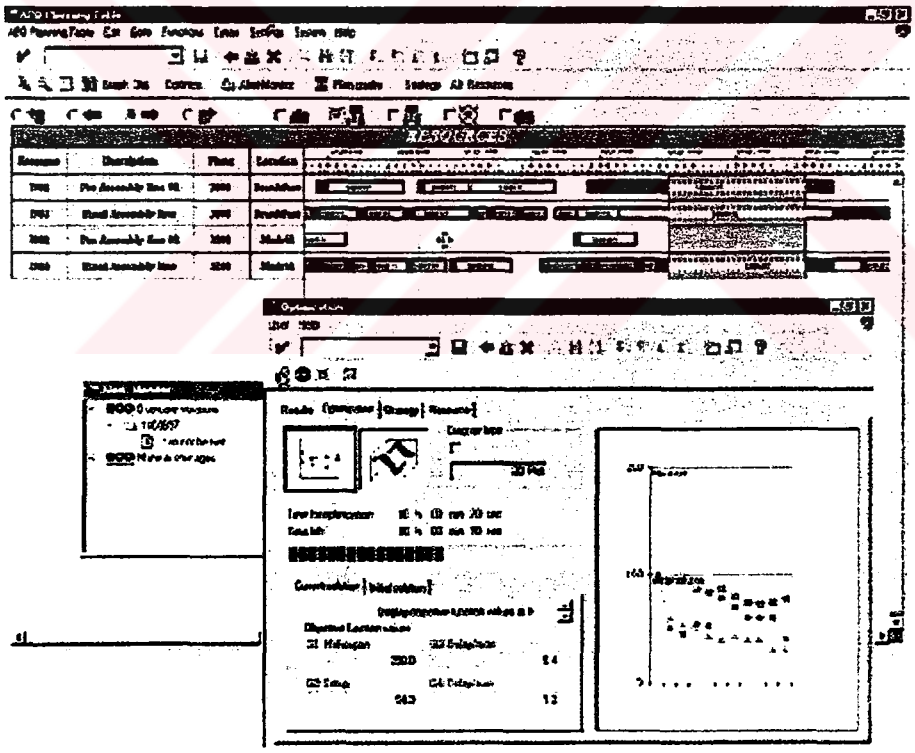


Figure 4.4. Production Management Screen

4.2.6. Capacity Planning in the SAP System

Capacities must be planned in different areas of a company. In the SAP System, the module Capacity Planning is used for this purpose. Depending on the tasks you have, your view of capacities, and how they are planned, you can easily adapt capacity planning to the appropriate view.

A capacity is a resource whose availability is planned over time. In contrast to other resources in the SAP System, such as materials or production resources tools you cannot save capacities. If a capacity has not been used today, then it will no longer be available tomorrow.

Capacity planning is an essential part of the R/3 System, integrated business software, which covers all the business functions of a company. The efficiency of the overall system is achieved by using integrated modules that provide comprehensive support for business functions.

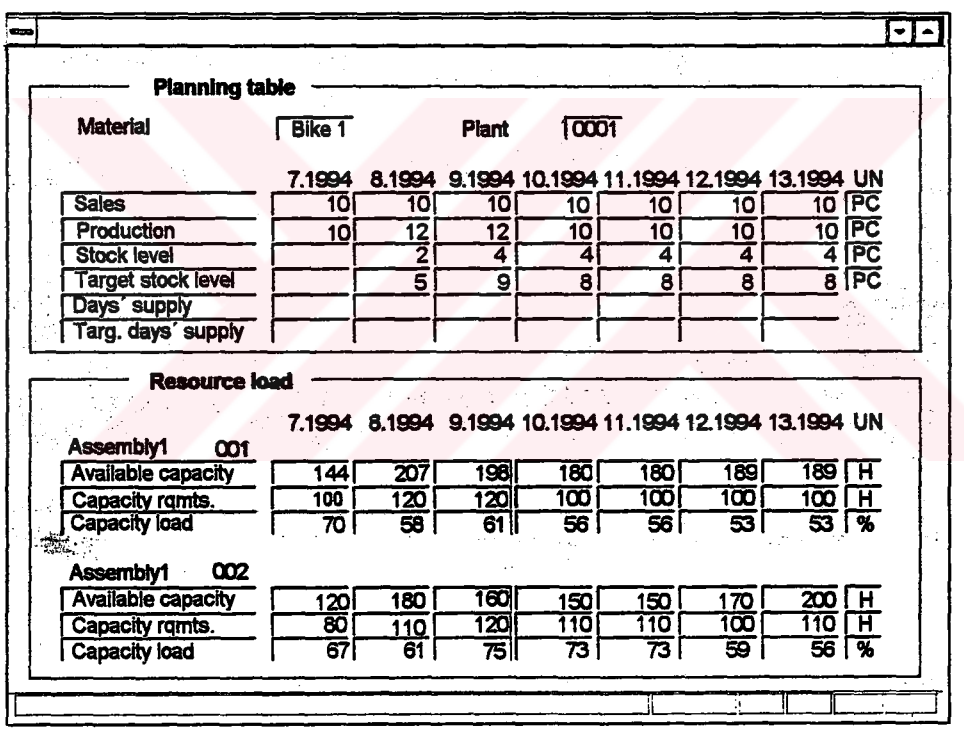
The capacity planning functions are used in the following areas: Sales and distribution, Production planning and control, Plant maintenance, The project system, Personnel planning and development.

The main elements of capacity planning are; Available capacities in work centers and capacities. User define the available capacity in the work center using the capacity categories. When planning labor capacity in Personnel Planning and Development you can plan down to the individual person. Depending on the kind of work center defined, the following capacity categories are possible:

- An individual machine on the shop floor
- A group of people operating a production line
- A maintenance work center in plant maintenance
- A group of engineers in the project system

4.2.7. Planning table (SOP)

In sales and operations planning (SOP), you can use the split-planning table for capacity levelling. You can enter the following data for a material or a product group for a specific period in the upper section: planned sales, planned production quantity, warehouse stock, target stock, level. The planning data which you enter in the line for production (the so-called "requirements entry line") generates capacity requirements. In addition to the capacity requirements from SOP, the lower section of the planning table displays the available capacities of work centers where the material or the product group is to be produced and the capacity utilization. The following diagram shows the standard planning table:



Planning table

Material: Bike 1 Plant: 0001

	7.1994	8.1994	9.1994	10.1994	11.1994	12.1994	13.1994	UN
Sales	10	10	10	10	10	10	10	PC
Production	10	12	12	10	10	10	10	PC
Stock level		2	4	4	4	4	4	PC
Target stock level		5	9	8	8	8	8	PC
Days' supply								
Targ. days' supply								

Resource load

	7.1994	8.1994	9.1994	10.1994	11.1994	12.1994	13.1994	UN
Assembly1 001								
Available capacity	144	207	198	180	180	189	189	H
Capacity rqmts.	100	120	120	100	100	100	100	H
Capacity load	70	58	61	56	56	53	53	%
Assembly1 002								
Available capacity	120	180	160	150	150	170	200	H
Capacity rqmts.	80	110	120	110	110	100	110	H
Capacity load	67	61	75	73	73	59	56	%

Table 4.1. Planning Table

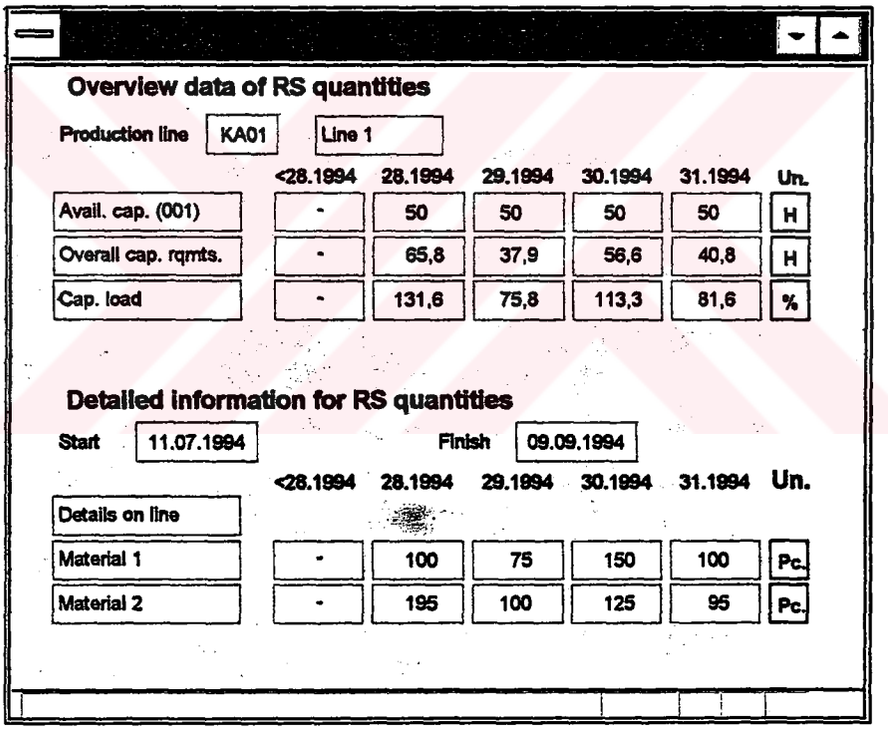
4.2.8. Planning table (REM)

The planning table shown in the following graphic is used in capacity level in repetitive manufacturing. In production line-specific capacity planning in the section

Overview data for master production schedule of the planning table the following data for the planning object is displayed.

- Name of the production line
- Available capacity of the production line
- Overall capacity requirements for the production line
- The percentage capacity load resulting from the capacity requirements or the capacity requirements for the run schedule headers that are produced on this line.

In the section Detailed information on master production schedule you can enter the quantities for a particular analysis period on a period-specific basis.



Overview data of RS quantities

Production line KA01 Line 1

	<28.1994	28.1994	29.1994	30.1994	31.1994	Un.
Avail. cap. (001)	-	50	50	50	50	H
Overall cap. rqmts.	-	65,8	37,9	56,6	40,8	H
Cap. load	-	131,6	75,8	113,3	81,6	%

Detailed information for RS quantities

Start 11.07.1994 Finish 09.09.1994

	<28.1994	28.1994	29.1994	30.1994	31.1994	Un.
Details on line						
Material 1	-	100	75	150	100	Pc.
Material 2	-	195	100	125	95	Pc.

Table 4.2. Planning Table shown capacity level

From the quantities that you enter for the details on the line (for specific materials, per period) the system can calculate the capacity requirements and the load for the production line. So you can adapt the quantities to the available capacity.

4.2.9. Capacity Situation and Capacity Level

You can display two lists in MRP and MPS in which the planning periods are shown on a vertical time axis: Capacity level, Capacity situation

The system displays the capacities in both lists in the same way. However, whereas you can change data in the capacity level list and carry out capacity level from there, you can only display the data in the capacity situation.

You can call up the capacity situation or capacity level list for all the planned orders for a material or for one individual planned order. The following diagram displays the capacity situation for one planned order.

The system displays the following data for a work center in a period-specific form:

1-available capacity of the work center in a period.

2-overall capacity load of the work center generated by all the planned and production orders in a period.

3-capacity requirements generated by a material, for which planning is carried out in a period.

If you called up the capacity situation or the capacity leveling list for a planned order, then the system displays the capacity requirements generated by the planned order in a period.

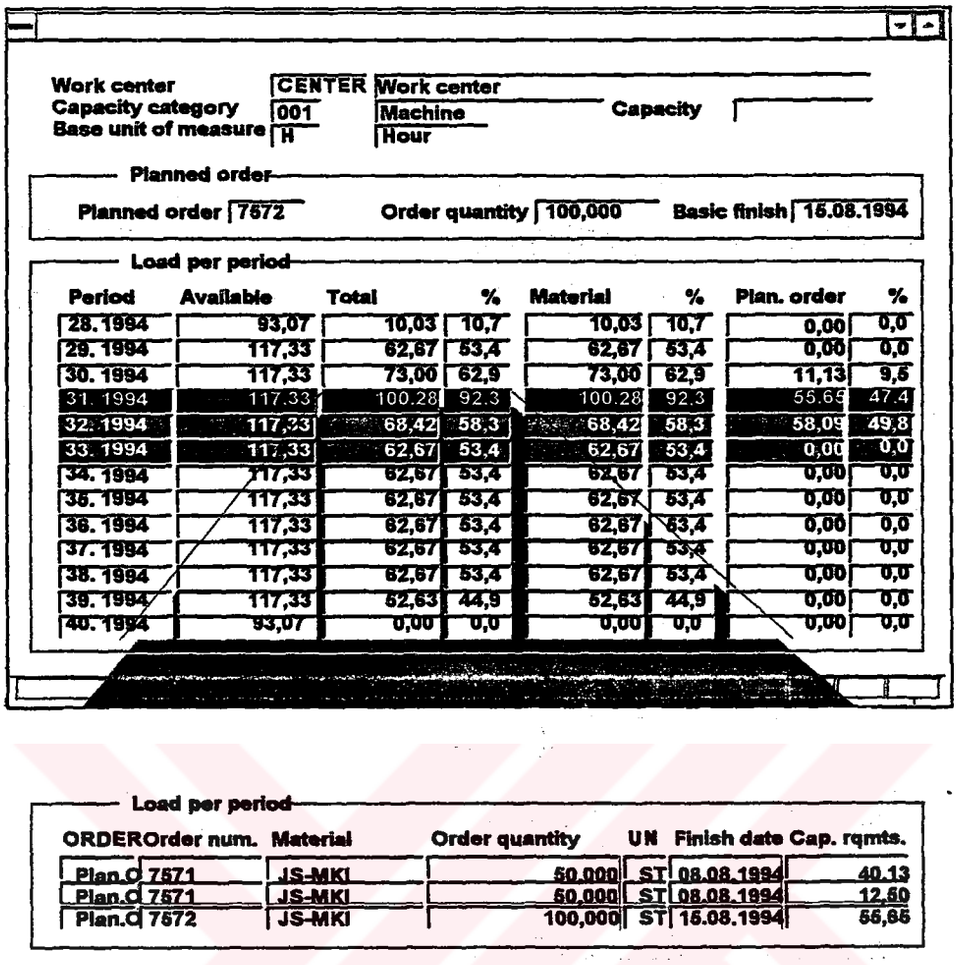


Figure 4.5. List for a Planned Order

If the material is processed at several work centers, you can display data for the different work centers one after the other. By changing the order quantity and the order finish date, you can eliminate capacity underloads and overloads at the work center in question.

4.3. Production Planning in Mixed Model Schedular (MMS)

Current MRP based production management systems are capacity insensitive as they depend on the premise of known fixed lead time. On the other hand, finite capacity scheduling is not appropriate for mid and long term production planning. The finite capacity approach that MMS suggest will utilise information at the level of

detail it has been produced, schedule production on the basis of resources and resource groups and derive material requirements and capacity plans[IMS, 1998].

Software department of IMS has some activity one of them is Mixed Model Schedular (MMS). MMS can solve Finite Capacity Planning-Scheduling problem and MMS is strong and effective software that improve and automate Finite Capacity Planning-Scheduling, give some operation to the machines by using scheduling algorithms and MMS is suitable for different types of factory's necessity of the capasity planning.

MMS is developed as a system where it would be possible to plug in any type of scheduling algorithm, as required. It is also aimed to make it possible to perform what-if analysis and easily evaluate the resulting solution, independent of the algorithm used, through a common user-friendly interface. The technology, which enables MMS to be a powerful, and yet a flexible scheduling system is called the Object Oriented Design and Programming.

4.3.1. Finite Capacity Planning in MMS

As it was mentioned in the previous section, most of the time heuristic techniques are employed in solving finite capacity scheduling problems as such problems are too complex to be solved in reasonable duration. However, research results indicate that no single scheduling approach produces successful results in all probable problems in real manufacturing settings. Hence, instead of constraining its presence to a particular scheduling paradigm, MMS is developed as a system where it would be possible to model the problem in a flexible manner, plug in any type of scheduling algorithm, as required, and perform analysis on the suggested schedule. Furthermore, it was also aimed to easily integrate modules of MMS to the data repository where enterprise data reside.

The MMS uses a robust object oriented scheduling engine that is called the MMS Scheduling Class Library (MMSLib), which provides a large collection of objects to

perform various scheduling and user interface functions. Object oriented structure enables software developers to inherit certain objects provided in the library, and modify the way they perform their functions.

The MMSLib provide two basic sets of functionality: Finite capacity scheduling and scheduling user interface.

4.3.2. Modelling

MMS provides a set of objects specifically designed for modelling manufacturing settings. These objects and the interactions among them are flexible enough to represent real life scheduling and capacity planning problems. Modelling objects can be divided into two categories. First category includes objects representing the static information and the second includes objects representing dynamic information.

4.3.3. Finite Capacity Scheduling

There are some heuristic solution procedures in this scheduling, the MMSLib provides enough functionality to easily develop any type of algorithm and easily plug into the standard library. The scheduling functions of MMSLib are based on a class named Scheduling Algorithm. This class acts as a repository of basic functions, like calculation of standard statistics, managing various types of lists or queues of scheduling objects, and performing time based arithmetic in the presence of resource availability patterns. Hence, any algorithm, which inherits from Scheduling Algorithm needs only to deal with the workings of the algorithm itself and not the details of various, irrelevant, and tedious calculations. Furthermore, since within MMSLib user interface and the scheduling functionality are seamlessly integrated, the user can immediately obtain the Gantt Chart and other supporting visual representations of the solution generated by the algorithm, and perform what-if analysis.

4.3.4. Scheduling Analysis

The MMSLib introduces a powerful user interface that is integrated with the scheduling functionality. Scheduling analysis tools are designed to assist the schedular to easily and quickly run available scheduling algorithms, obtain various visual representations of the solution, and to perform drag-and-drop based what-if analysis. Within MMSLib user interface and the scheduling functionality are integrated and the user can immediately obtain the Gantt Chart and other supporting visual representations of the solution generated by the algorithm, and perform what-if analysis.

User can also generate statistical charts and reports to evaluate the performance of the algorithm in different settings, or to compare performances of available scheduling algorithms over a specific problem.

4.3.5. Finite Capacity Planning

MMS will have a Finite Capacity Planning module fully integrated with finite capacity scheduling with coming releases. Finite capacity planning will operate on less detail information than required by the finite capacity scheduling. It will be utilised for middle and long term material and capacity requirement determination.

4.3.6. Reading the Gantt Chart

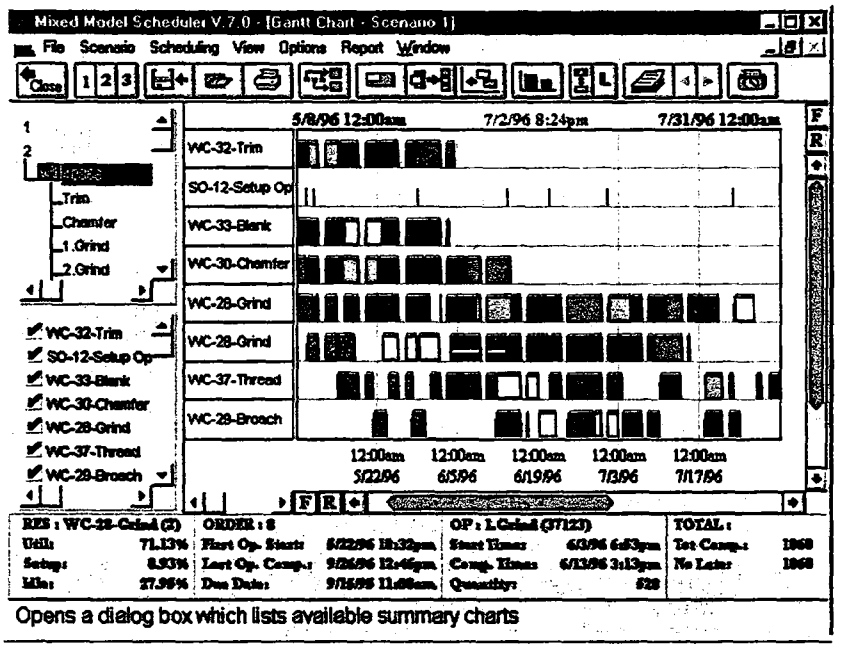


Figure 4.6. Gantt Chart

Gantt Chart is a basic and powerful tool to present the schedule information. It both displays the sequencing and schedule information of operations. User interface of MMS is designed to fully utilise this capability. The horizontal axis of the Gantt Chart represents the time and every box on it represents an operation. The length of a box in the x-axis is drawn proportional to its operation time. The setup time before an operation is also displayed as a shorter black box in front of the operation. Two basic types of Gantt Charts are available in MMS, namely Resource based and Order or Job Based.

4.3.6.1. User Friendly Gantt Chart Interface

- Easy zooming on the Gantt chart to varying depths
- Control panel sub-windows containing order, job, resource, operation predecessor, operation successor and combined operation information
- Online statistics about order, resource, job, operation and global data displayed below the Gantt chart

- Displaying of schedule information on resource, order or job based gantt charts
- Possibility of printing operation codes on the Gantt chart

4.3.6.2. Resource Based Gantt Chart

Resource based Gantt Chart groups operations according to the resources they are processed on. Every line on the resource based Gantt Chart represents a resource on the shop floor. On each line operations to be processed on that resource is displayed in the form of colour box. The operation boxes are drawn proportional to their operation times and their left and right edges represent start and finish times on the time axis, respectively. When an operation is late, a strip is drawn on top of its box starting from its due date. With this strip the user can identify late operations easily.

- Possibility of showing or hiding off-shifts on the Gantt chart
- Choosing the list of resources to view on the Gantt chart
- Showing resources of the selected order / job only
- Viewing only selected order / resource, later orders or activated operations in color
- Color coding of operations based on order, part or job on the Gantt chart

4.3.6.3. Order - Job Based Gantt Chart

Order-Job based Gantt Chart groups operations according to the Order-Job they belong to. Every line on the Order-Job based Gantt Chart represents an Order-Job. On each line operations of that Order-Job is displayed as a coloured box. In this view, operations in blue are early or on time, whereas operations in red are late. The operation boxes are drawn proportional to their times and left and right edges represent start and finish times on the time axis, respectively. With an option (Show off-sifts) also the duration from the release time to due date is displayed as a grey zone on the Gantt Chart.

4.3.6.4. Zooming

The Gantt Chart displays all the schedule session information in a compact way. However, as the number of resources scheduled and the length of the scheduling period increases, it becomes difficult to concentrate and retrieve useful information. Zooming to a certain period and /or to certain resources makes information displayed easily comprehensible. Zooming into the Gantt Chart is easy and flexible in MMS.

4.3.6.5. Summary Charts

Summary charts are visual forms of calculated statistics about scheduling objects. As visual representations make comprehension of information easier, certain statistics are displayed in the form of summary charts. Summary charts include Resource Utilisation Histogram, Average Waiting Time Histogram etc.

4.3.7. Reports

Reports are textual forms of output of a scheduling session. Reports are also based on scheduling object statistics and they are usually organised in a certain manner. Usually, reports are used for dispatch lists etc.

Reporting and Online Access to Scheduling Statistics:

- Enabling / Disabling statistics calculation
- Statistics and parameter selection to view or create report
- Rapid report print preview
- Elegant report formatting

Reports types include:

- List of Jobs Grouped by Orders
- List of Operations Grouped by Orders
- List of Operations Grouped by Jobs
- List of Operations Grouped by All Resources

- List of Operations Grouped by Renewable Resources
- List of Operations Grouped by Non-renewable Resources
- List of Orders
- List of Jobs
- List of Operations
- List of All Resources
- List of Renewable Resources
- List of Non-renewable Resources

4.3.8. What If Analysis

A schedule developed by MMS using a certain scheduling algorithm is usually not the optimum solution for the problem at hand due to the difficulties of solving such a problem. However, MMS suggests a feasible schedule using the algorithm specified based on the input parameters. User may perform what if analysis by creating scenarios of other possible production schedules. Using the analysis tool provided by MMS, user decides on the final schedule. The following methods enable different scheduling scenarios.

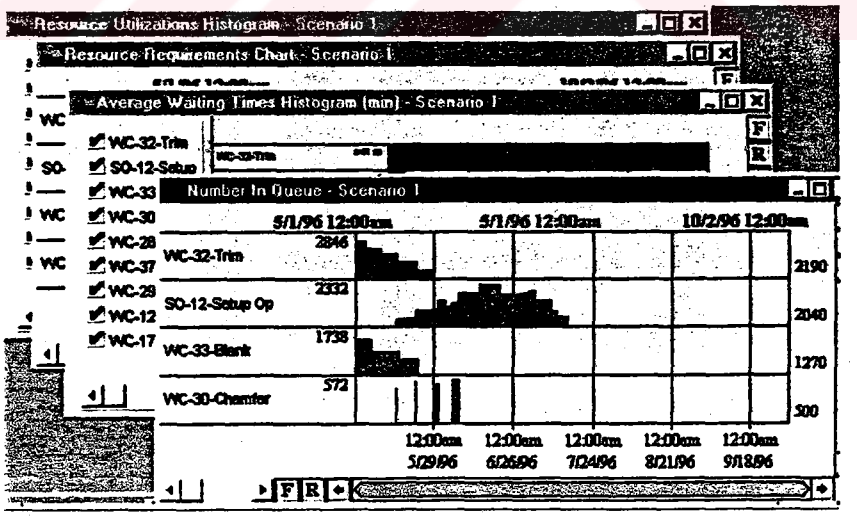


Figure 4.7. Scenario of Some Requirement

4.3.9. Database Connectivity in MMS

MMS can interface with most major PC and SQL database servers using the Borland Database Engine (BDE). BDE (using Borland SQL Links) provides direct connection to Paradox and Dbase files, an ODBC socket, and high performance native drivers for the following SQL servers: Oracle, MS SQL Server, Sybase, Informix, InterBase, DB2.

The MMS Standard uses Paradox as the default database. One important feature of MMS database connectivity is that, not all the files or tables need to reside on the same type of repository. For example, it is possible to configure MMS so that while the order information is maintained in Oracle, the scheduling information may be maintained in Paradox tables.

CONCLUSIONS

The production planning and capacity planning system is proposed for the production management. According the method proposed the production and capacity plans for the definite orders are arranged by means of algorithm. The expected and definite orders are planned with product basis and in accordance with machine capacities. This system also includes the middle and long term material requirement releases and purchasing commands pertinent to this requirement.

The method proposed ensures the accurate and effective evaluation of MRP based production planning system and a firm integration with other system modules.

This study describes the Client-Server architecture and the requirements for Internet worked distributed systems in which servers will manage and share information with many other clients and servers. Basic Client-Server Model is analysed to designate the places of connection in the network area. The Client Server model's idea is to structure the operating system as a group of cooperating process, called servers, that offer services to the users, called Clients.

And also contain three different production planning program in detail. And it also answer some question which are about production management, What kind of production management system prefers, their production planning approaches, etc. Three different systems are about production planning but all of them have different approaches in this sector.

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