INTRODUCTION OF COMPUTER AIDED PROCESS PLANNING

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Production

Production is defined as the step-by-step conversion of one form of material into another through process to create the utility of the product to the user.

Production is the basic activity of all organizations and all other activities revolve around the production activity .the output of the production is the creation of goods or services which satisfy the consumers needs.

The production is the value addition process. At each stage of processing, there will be a value addition.

Production system

The processes, which are used for, create goods or services, which create system is called the production system.

A production system produces goods or services. A steel plant, an automobile industry a transportation company, an insurance agency or hospital network are all production system.

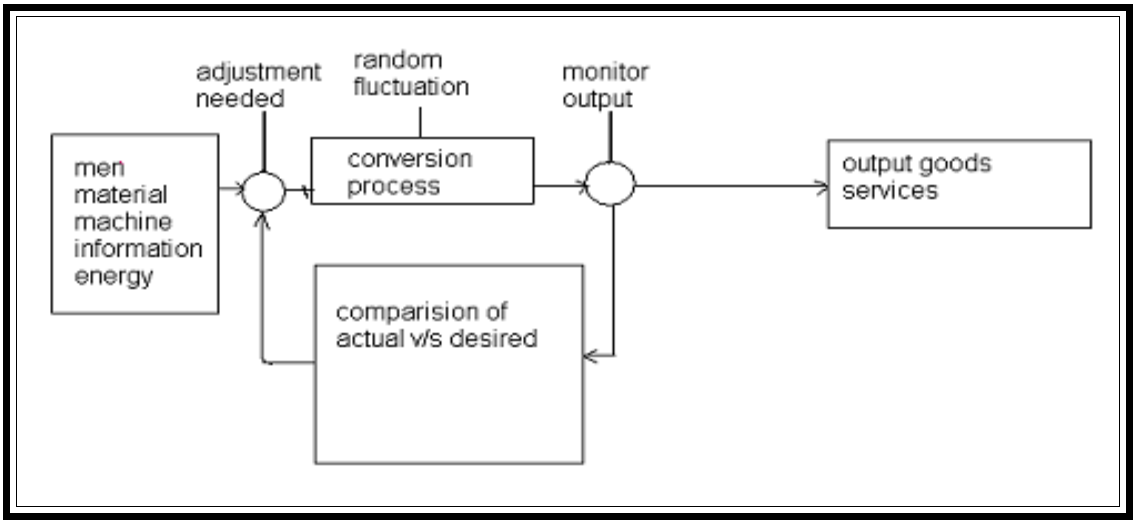

FIG : 1 PRODUCTION SYSTEM

The production system has the following characteristics

The system transform the various input (men, material, machine, information, energy) into useful outputs (goods, services) Production system does not operate in isolation from the other organizational systems such as finance, marketing etc.There exist a feedback about the activities, which is essential to control and improve system performance.

Production management

a set of various activities , which are involved in manufacturing certain products , is named “production management ”. if the same concept is extended to services management , then the set of various management activities are called “operation management ”. in general the concept of manufacturing product/offering services is called production /operation management .

According to the “ Elwood Buffa ” production management is

“Production management deals with decision making related to production processes so that the resulting goods or services are produced according to specifications, in the amounts and by the schedule demanded and out minimum cost. ”

Activities in production / operation management

- Organizing work
- Selecting process
- Arranging layout
- Locating facilities
- Designing jobs
- Measuring performance
- Controlling quality
- Scheduling work
- Managing inventory
- Planning production

A production management includes all of the activities associated with planning, organizing and controlling the process of conversion that produce the final output.

The process of planning includes the selection of policies and programme through which the desired objectives is fulfilled. The planning include product design and development, facilities planning, plant location, layout etc.

For implementation of plan required the numerous activities to be performed. Someone will be authorized to use the available resource for performing the required task and also will be accountable to the management for his/her activities. Defining the authority, responsibility, and span of control of individual employees is known as the organizing the system.

It includes s defining the task to be performed, selection of personnel to perform those tasks, and delegation of authority so that all person can perform there allocated duties.

The conversion process is required to be monitored to ensure that the plans are properly implemented. in case of deviations from the plan , it may be necessary to initiate corrective measure to improve system performance . The control process include inventory control, quality control etc. are some example where managerial activities are required to control the production process.

The system output is compared with the some pre-defined standard and if the difference is significant, then some adjustment is made in either in input to the system or to the process of conversion so that the system output conforms to the predefined standards.

Objectives of production management

Production is an organized activity and each organized activity has its objective. Which helps to evaluate its performance against the set objectives.

Objectives of production management is stated as to produce goods , services of right quality and quantity at the predetermined time and pre established cost.

Objectives of production management is

- Right quality

- Right quantity
- Predetermined time
- Pre-established cost (manufacturing cost)

Right quality

The quality of the product is established based upon the customers needs. Customer's needs are translated into the product specification by the design or engineering department. the manufacturing department then translate these specification into measurable objectives.

Thus the proper balance must be obtained such that the product quality offered to the customer should be within the pre-established manufacturing cost.

Right quantity

The manufacturing organization should produce the products at the right number.

If the products are produce in quantity excess of demand the capital will block up in the form of inventory and if it is produced in quantity short of demand, these will be shortages product. Thus a decision is to be taken regarding how much to produce.

Manufacturing costs

Manufacturing costs are established before the product is actually manufactured the manufacturing department has to manufacture the product at the pre-established cost in any case, any variation between the actual costs (pre established) and standard should be kept at minimum.

Manufacturing scheduled

Timeliness of delivery (schedule) is one of the most important parameter to judge the effectiveness of production management. There are many reasons like no availability of material at the right time, machine break down, labour are not available etc.which affect the timely completion of the product . so the manufacturing department should organized its activity in such a way that the product will be manufactured .

To achieve the above objective, the manufacturing production department has to make the optimum utilizations of various input like men, material, machine. So have to better utilization of resources, the production department has to achieve the other objectives, which are lower in hierarchy. These objectives are called intermediate objectives are going to optimize the utilization of resources.

The intermediate objectives are

- Machinery and equipment
- Material
- Manpower
- supporting services

Function and scope of the production department

The activities of production department of an organization are grouped into two categories.

- The activities that convert the available capital into physical resource required for production.

- The activities that convert the physical resources into saleable goods and services.

In carrying out the following activities, the production department must fulfill the following activities.

a) Production of the goods at the right time and in sufficient quantity to meet the demand.

b) Production of the goods at the minimum possible cost.

c) Production of goods of acceptable quality.

Function of the production personnel.

Forecasting the demand for the products and using the forecast to determine the requirements of various factors of production.

Arranging the procurement of required factors of production

Arranging for the services such as maintenance, store keeping material handling inspection and quality control etc. That would be required to attain the targeted level of production

Utilizing effectively the factors of production and services facilities available to produce the product.

Scope of production, and management

The objectives of production management are aimed at satisfying the needs of the customer through offering organization products /services.

The scope of the production management can be considered from the point of view of both strategic decisions influencing the production system and operation level

The strategic level decision are mainly concerned with the design of product and production system these decision involve decision, which have long terms implications.

The strategic level decisions are

- New product identification and design
- Process design and planning
- Facilities location and layout planning
- Design of material handling system
- Capacity planning

The capacity planning involve

- Production planning

- Production control
- The other activity include (inventory control, maintenance and replacement cost reduction and cost control and work system design etc.)

Production management framework

The division of production management functions into 5 “p”(product)

The product

The product is the link between production and marketing.

As per the product policy of the organization an agreement is reached between the various function on the following a aspects of the product.

- Performance
- Quality and reliability
- Aesthetics and ergonomics
- Quantity and selling price
- Delivery schedule

The above factors affect the various aspects such as market needs, existing culture, legal constraints and the environmental demand etc.

The plant

The plant is concerned with

- Design and layout of building and office
- Reliability, perfect maintenance of equipment
- The financial constraint

The plant layout deals with the physical arrangement of plants are machineries the selected side.

The process

These are always number of alteration method s of creating a product. But it is required to select the one best method, which attains the objective.

For deciding the process following factors are needed

- Available capacity
- Manpower skills available
- Types of production
- Layout of plant
- Safety
- Maintenance required
- Manufacturing costs

The programme

The programme refers to the time table of production . thus the programme prepare schedules for

Purchasing
Transforming
Maintenance
Cash
Storage and transport

The people

Production depends upon people. The people vary in their attitudes, skill and expections from the work. Thus to make best are of available human resource.

The producing manager should be involved in issue like

- Wages /salary administration
- Condition of work and safety
- Motivation
- Training of employees

CAPP

In capp several process planning functions which can be implemented by computer system.

process planning is concerned with determining the sequence of individual manufacturing operation needed to produce to produce a given part or product .the resulting operation sequence is documented on a form typically referred to as a route sheet. The route sheet is a listing of the production operations and associated machine tools for a work part or assembly.

Needs of Capp

Process planning are the function of determining appropriate cutting condition for the machining operations and setting the time standards for the operation.

Planning the process determining the cutting condition, and setting the time standards have traditionally been carried out as task with a very high manual and clerical content. They also typically routine tasks in which similar or even identical decision are repeated over and over. Today these kind of decision are being made with the aid of computer.

Traditional process planning

In traditional process planning, there are variations in the level of detail found in route sheet among different companies.

Process planning is accomplished by releasing the part print to the production shop with the instruction “make to drawing ”. most firm provide list of step describing each operation and identifying each work center .

It is traditionally the task of the manufacturing/industrial engineers in an organization to write these process plans for new part designs to be produced by the shop.

This process planning procedure is very much dependent on the experience and judgment of the planner.

Automated process planning

The problems encountered with manual process planning, attempt have been made in recent years to capture the logic, judgment, and experience required for this important function incorporated them into computer programme.

Based on the characteristics of a given part, the programme automatically generates the manufacturing operation sequence.

The Capp system offers the potential for reducing the routine clerical work of manufacturing engineers. At the same time it provide the opportunity to generate production routing, which are rational, consistent, perhaps even optimal.

Two approaches of Capp

- Retrieval type capp system (variant systems)
- Generative capp system

- **Retrieval type Capp system**

These system use part classification and coding and group technology as a foundation.

In this approaches, the part produced in the plant are grouped into part families, distinguish according to there manufacturing characteristics. For each part family, a standard process plan is established.

The standard process plan is stored in computer files and then retrieved for new work part, which belong to that family. Some form of parts classification and coding system is required to organize the computer files and to permit efficient retrieval of appropriate process plan for new work part.

For new parts, editing of the existing process plan may be required. This is done when the manufacturing requirements of the new parts are different from the standard. The m/c routing may be same for the new product, but the specific operations required at each machine may be different.

The complete process plan must document the operation as well as the sequence of machine through which the part must be routed. Because of the alteration that are made in the retrieved process plan.
This system also called **variant system.**

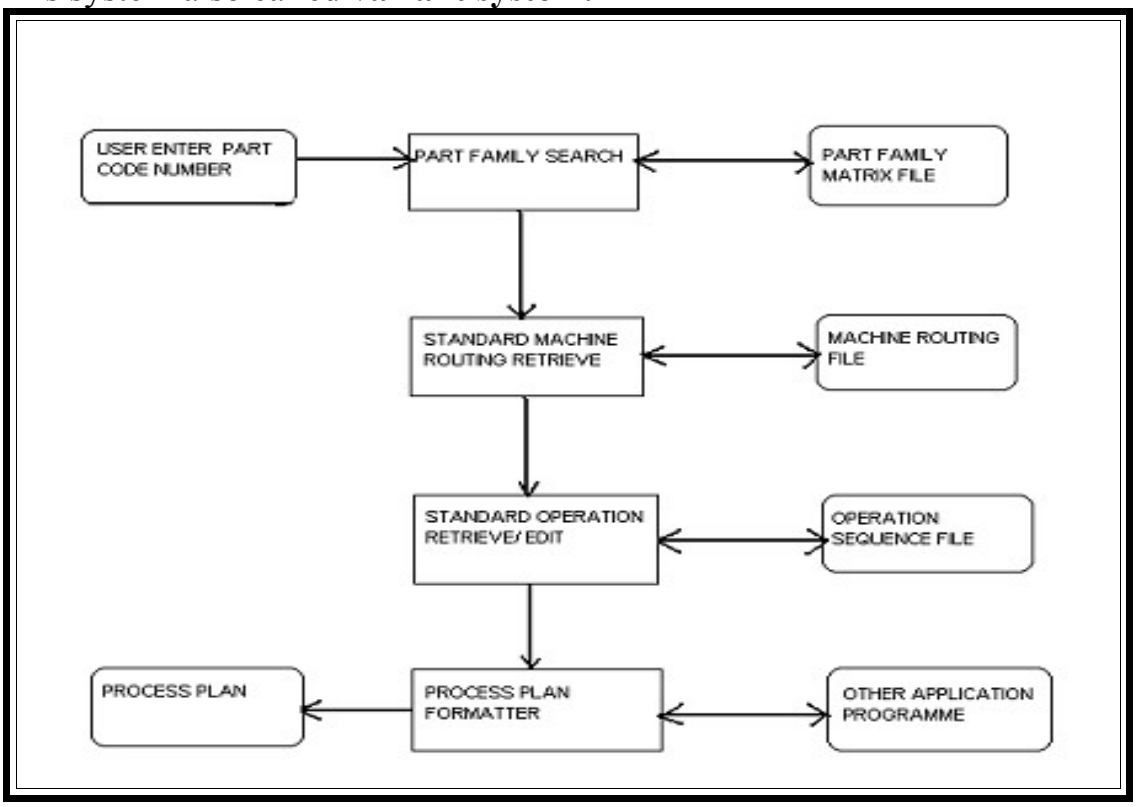

FIG: 2 RETRIEVAL SYSTEMS

Fig shows the process of retrieval process planning .in this system the user would entering the part code number at the computer terminal. the capp programme search the part family matrix files to determine if a match exists.

If the file contains an identical code number, the standard machine routing and operation sequence are retrieved from the respective computer files for display to the user.

The user to permit any necessary editing of the plan to make it compatible with the new part design examines he standard process plan. After editing, the process plan formatter prepares the paper document in the proper form.

If an exact match cannot be found between the code number in the computer files and the code number for the new part, the user may search the machining routing file and the operation sequence files for similar parts that could be used to develop the plan for the new part.

This system would easier to find a match in the machining routing file than in the operation sequence file. Some retrieval systems would use only one such file, which would be a combination of operation sequence file and machine routing file.
The process plan formatter may use other application programme. These could include computing machining condition, working standard, and costs. Standard cost programs can be used to determine total product costs for pricing purpose.

The retrieval system include MIPLAN <MICLASS modules etc.

Generative Process Planning Systems:

Generative process planning involves the use of the computer to create an individual process plan from scratch, automatically and without human assistance. The computer would employ a set of algorithms to progress through the various technical and logical decisions toward a final plan for manufacturing. Input to the system would include a comprehensive description of the workpart. This may involve the use of the some form of part data, but it does not involve the retrieval of exiting standard plans. Instead the generative CAPP system synthesizes the design of the optimum process sequence, based on an analysis of part geometry, material and other factors which would influence manufacturing decisions.

In the ideal generative process-planning package, any part design could be presented to the system for creation of the optimal plan. In practice, current generative type systems are far from universal in their applicability. The tends to fall short of a truly generative capability, and they are developed for a somewhat limited range of manufacturing process.

This system approach by means of a system called GENPLAN developed at Lockheed- Georgia Company.

Benefits Of Capp

1 Process rationalization.

Computer automated preparation of operation routing is more likely to be consistent ,logical ,and optimal then its manual counterpart, The process plan will be consistent because the same computer software is being used by all planners. The process plans tend to be more logical and optimal because the company has presumably incorporated the experience and judgment of its best manufacturing people in to the process planning computer software.

2. Increased productivity of process planners

With computer aided process planning, there reduced clerical work effort, fewer errors are made, and the planners have immediate access to the process-planning database. These benefits translate in to higher productivity of the process planners.

3. Reduced turnaround time.

Working with the CAPP system, the process planner is able to prepare a route sheet for a new part in less time compared to manual preparation. This leads to an overall reduction in manufacturing lead-time.

4 Improved legibility

The computer prepared document is easier to read then manually written route sheets. CAPP systems employ standards text, which facilitates interpretation of the process plan in the factory

5. Incorporation of other application programs

The process planning system can be designed to operated in the conjunction with other software package to automate many of the time –consuming manufacturing support functions.

Machinability Data System

In the machine shop, process planning should include selection of the cutting condition that are to be used in the various machining operations. The cutting conditions consist of the speed, feed, and depth of cut. Depth of cut is usually predetermined by the workpiece geometry and operation sequence. Therefore, the problem reduces to one of determining the proper speed and feed combination. Machinability data systems are basically intended to solve this problem.

Definition Of The Problem

The objective of a mach inability Data system is to select cutting speed and feed rate given that the following characteristics of the operation have been defined

1 Type of machining operation
2 Machine Tool
3 Cutting Tool
4 Work part
5 Operating Parameters Other Than Feed and Speed

The magnitude of the problem can best be appreciated by contemplating the multitude of different parameters that are included within this five-operation characteristic.

The methods of solving the speed/feed selection problem are

1. Experience and judgment of process planner, foreman, or machine operator
2. Handbook recommendations
3. Computerized machinability data systems

1 Experience and judgment of process planner, foreman, or machine operator

Relying on the experience and judgment of any individual is the least systematic approach and carries the greatest risk. The risk lies in the potential loss of the individual who has acquired the experience and judgment over many year in the shop. Personal judgment is also undesirable because it usually has no scientific foundation. Cutting condition derived from personal experience are not base on economic criteria.

2 Handbook recommendations

Handbook recommendations are compiled from the experiences of the more than one person. Handbook of machinability data is generally developed from a systematic analysis of large quantities of machining data. The cutting recommendations are often based on laboratory experience whose objective is to determine speeds and feeds. The best known of these handbooks is the machining data Handbook.

Although the handbook approach represents a define improvement over personal judgment, it often suffers from several drawback when applied to a particular company's machining environment.

First, Handbook recommendations tend to be conservative, meaning that the suggested feeds and speeds are based on worst case conditions.

Second, Handbook must be considered as general guides and may not coincide with the particular product line and machine tools of the given shop.

Third, the use of the handbooks is not compatible with the automation of the process planning function using a computerized database.

3 Computerized Machinability Data System

To overcome these difficulties, efforts have been directed to the development of computerized machinability data systems. These efforts date back to the early 1960s and are continuing today. Some of the systems have been developed by individual firms to meet their own specific requirements. The of these systems has grown with the increase in the use of NC machines and the economic need to operate these machines as efficiently as possible. The important of computerizes machinability data systems will continue to grow with the development of integrated manufacturing databases.

Pressman and Williams have classified computerized machinability data systems into general types

1 Data base systems
2 Mathematical modal systems

Data Base Systems

These systems require the collection and storage of large quantities of data from laboratory experiments and shop experience. The data base is maintained on a computerized storage file that can be accessed either by a remote terminal or in a batch mode for a more permanent printout of cutting recommendations.

To collect the mach inability data from the data base system, cutting experiment are performed over a range of feasible condition. These experiment are commonly conducted in the laboratory. However many data base mach inability mach inability system allows for shop data to be entered into the files also. For each set of condition, computational are made to determine the cost of operation. Not only is total cost per piece are calculated, but the cost components that make up the total cost are also calculated.

The computations are based on the traditional concept in machining economics that the total cost per piece is composed of element are given in the following equation.

$$C_{PC} = C_o T_m + C_O T_h + \frac{T_m}{T}(C_t + T_{TC})$$

C_{PC} =Cost per w/p

C_o =Cost to operate the machine tool

T_m =Machining time
T_h =Machine handling time
T =Tool life
C_t =Cost of tooling
T_{TC} =Tool change time

Mathematical Modal Systems

These systems go one step beyond the data base systems. Instead of simply retrieving cost information on operations that have already been perform, the Mathematical modal systems attempt to predict the optimum cutting conditions for an operation. The prediction is generally limited to optimum cutting speed, given a certain feed rate .The definition of optimal is based on either the objective of minimizing cost or maximizing production rate.

A common mathematical modal to predict optimum cutting speed relies on the familiar Taylor equation for tool life,

$$VT^n = C$$

V=surface speed
T=tool life
By combining equation 1 and 2 and accounting for the fact that machining time is inversely proportional to cutting speed the equation for minimum cost cutting speed can be derived .

$$V_{\min} = C/(\frac{1-n}{n}\frac{C_0 T_{tc} + C_T}{C_0})$$

In similar way , the cutting speed that yields maximum production rate can also be derived.

$$V_{\max} = \frac{C}{\left[\frac{1-n}{n} T_{tc}\right]^n}$$

The weakness of the mathematical model system is an empirical equation derived from experimental data that contain random error . this random error tends to distort the accuracy of the minimum cost and maximum production equation .

Problems With Traditional Production Planning And Control

There are many problems that occurs during the cycle of the activities in the traditional approach to production planning and control. Many of these problems results directly from the inability of the traditional approach to deal with the complex and ever-changing nature of manufacturing. The types of comely encountered in the planning and control of production are the following.

1. **1 Plant Capacity Problems**

Production falls behind schedule due to a lack of labor and equipment. This results in excessive overtime, delays in meeting delivery schedules, customer complaints, backordering and other similar problems

.

2. **Sub Optimal Production Scheduling**

The wrong jobs are scheduled because of lack of clear order order priorities, inefficient scheduling rules, and the ever changing status of jobs in the shop. As a consequence, production runs are interrupted by the jobs whose priorities have suddenly increase, machine set up are increase, and jobs that are on schedule fall behind

3. **Long Manufacturing Lead Times**

In an attempt to compensate for problems 1 and 2,production planners allow extra time to produce an order priorities become confused, and the result is the excessively long manufacture lead times.

4. **Inefficient Inventory Control**

At the same time that total inventories are too high for raw materials, work-in process, and finished products, there are stakeouts that occur on individual items needed for production. High total inventories mean high

carrying cost, while raw material stakeouts mean delays in meeting production schedules.

5. **Low Work Center Utilization**

This problem result in part from poor scheduling, and from other factor over which plant management has limited control (e.g. equipment break-downs, strikes, reduced demand for product)

6. **Process Planning Not Followed**

This is the situation in which the regular planned routing is superseded by an ad hoc process sequence. It occurs, for instance, because of bottlenecks at work centers in the planned sequence. The consequences are longer setups, improper tooling and less efficient processes.

7. **Errors In Engineering And Manufacturing Records**

Bills of materials are not current, route sheet are not up to date with respect to the latest engineering changes, inventory records are inaccurate, and production piece counts are incorrect.

8. **Quality Problems**

Quality defects are encountered in manufactured components and assembled products, resulting in rework or scrapped parts, thus causing delays in the shipping schedule.

Computer - Integrated Production Management System

There have been several factors working over the last several decades to cause the evolution of a more modern and effective approach to the problems of production planning and control cited above. The most obvious of these factors was the development of the computer; a powerful tool to help accomplish the vast data processing and routine decision-making

chores in production planning that had previously been done by human beings

In addition to the computer, there were other factors, which were perhaps less, dramatic but equally important. One of these was the increase in the level of professionalism brought to the field of production planning and control. Production planning has been gradually transformed from what was largely a clerical function in to a recognized profession requiring specialized knowledge and academic training. Systems, methodologies,and even a terminology have development to deal with the problems of this professional field.

Important among the methodologies of production planning and control, and another significant factor in the development of the field, is operations research. The computer because the important tool in production planning, but many of the decision-making procedures and software program was based on the analytical models provided by operations research. Linear programming, inventory models, queuing theory, and a host of other techniques have been effectively applied to problems in production planning and control.

Another factor that has acted as a driving force in the development of better production planning is increased competition from abroad. Many American firms have lost their competitive edge in international and even domestic markets.Increaseing U.S. productivity is seen as one important way to improve our competitive position. Better management of the production function is certainly a key element in productivity improvement.

Finally, a fifth factor is the increase in the complexity of both the products manufactured and the markets that buy these products. The number of different products has proliferated, tolerances and specifications are more stringent, and customers are more particular in their requirements and expectation. These changes have placed greater demands on the manufacturing firms to manage their operation more efficiently and responsively.

As a consequence of these factors, companies are gradually abandoning the traditional approach in favor of what we are calling computer-integrated production management system.

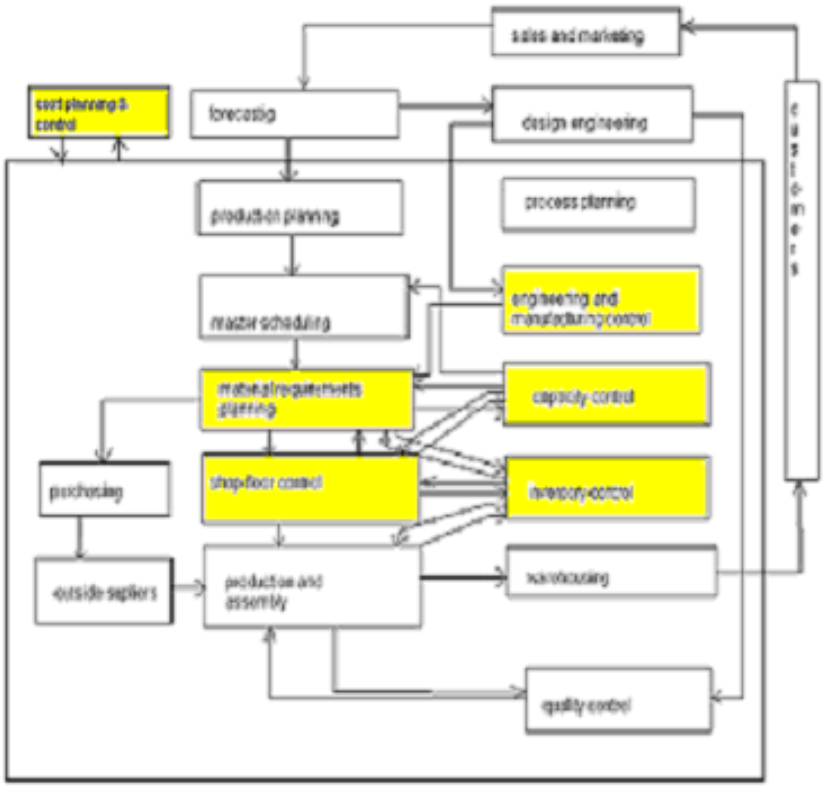

Fig 5 COMPUTER - INTEGERATED PRODUCTION MANAGEMENT SYSTEM

Fig shows a block diagram illustrating the functions and their relationships in a computer-integrated production management system. Many of these functions are nearly identical to their counterparts in traditional production planning and control. For example, forecasting, production planning, the development of the master schedule, purchasing, and other functions appears the same in fig 4 and 5. To be sure, modern computerized systems have been developed to perform these functions, but the functions themselves remain relatively unchanged. More significant changes have occurred in the organization and execution of production planning and control through the implementation of such schemes as MRP, capacity planning and shop floor control.

Engineering And Manufacturing Data Base

This database comprises all the information needed to fabricate the components and assemble the products. It includes the bill of material, part design data, process route sheets, and so on. Ideally, these data should be contained in some master file to avoid duplication of records and to facilitate update of the files when design-engineering changes are made or route sheets are updated. As shown in fig, the design engineering and process planning functions provide the inputs for the engineering and manufacturing database.

Material Requirements Planning (MRP)

MRP involves determining when to order raw materials and components for assembled products. It can also be used to reschedule orders in response to changing production priorities and demand conditions. The term priority planning is now widely used in describing computer base systems for time – phased planning of raw materials, work-in- process, and finished goods.

Capacity Planning

MRP is concerned with the planning of the materials and components. Capacity planning, on the other hand, is concerned with determining the labor and equipment resources needed to meet the production schedule. The term "plant capacity" is used to define the maximum rate of output that the plant can produce under a given set of assumed operating conditions. The assumed operating conditions refer to the number of shifts, number of day of plant operation per week, employment levels, and whether or not over time include in the definition of the plant capacity. Capacity planning is concerned with determining what labor and equipment capacity is required to meet the current master production schedule as well as the long term future production needs of the firm. Capacity planning is typically performed in terms of labor and/or machine hours available.

Inventory Management

In the manufacturing environment, inventory management is closely tied to material requirements planning. The objectives are simple- to keep the investment in inventory low while maintaining good customer services. The

use of computer systems has provided opportunities to accomplish these objectives more effectives more effectively.

Shop Floor Control

The term “shop floor control” refers to a system for monitoring the status of production activities in the plant and reporting the status to management so that effective control can be exercised.

Reference book

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