Statistical Analysis for Production in Service Industry

Yee Yee Swe, Myint Thu Zar Tun
beautifulsmile24@gmail.com,myintthuzartun@gmail.com
Computer University (Maubin)

Abstract

Capacity planning is the process of determining the production capacity needed by an organization to meet changing demands for its products. A discrepancy between the capacity of an organization and the demands of its customers results in inefficiency, either in under-utilized resources or unfulfilled customers. The goal of capacity planning is to minimize this discrepancy. In this paper, we make up a computerized system that projects the load from a given material requirement planning (*MRP*) *and capacity requirement planning* (*CRP*) *onto the capacity of this system and identifies underloads and overloads. This system will calculate statistical analysis to get optimal solution for future soap production in service industry. According to using CRP, the customer order within the amount of required time is calculated to validate showing accept or reject message. Moreover, the production schedule can be more easily modified to reflect changing customer needs and managers from all functional areas can do a better job in service industry.*

Keywords: capacity planning, material requirement planning, (MRP), capacity requirement planning (CRP), statistical analysis

1. Introduction

Today, the global environment is forcing service industries to integrate the rest of the world within the scope of their competitive strategy. They cannot isolate themselves from external factors such as economic trends, the competitive situation or the status of technology. At the same time, service industries cannot also isolate the decision process of different functional areas. Every industry has to be analyzed as a system in which different areas (e.g., marketing, operating, and finance) as well as the different members (e.g., suppliers, manufacturing, and retailers) are all inter-related. Understanding the relationship among the various areas will enhance the effectives (doing the right things) and efficiency (doing the things right) for reaching the strategies set by top management. Recent research in management strategy has focused attention on the strategic role that operations can play in improving the competitive capabilities of the service industries. [1, 7]

In addition, the management function of manufacturing, operations or production refers to the same discipline within the service industry. It basically consists of understanding the responsibilities associated with the productive unit of an industry and its interface with the other functional areas such as finance and marketing. In the last decade, a large number of service industries have begun to dominate specific markets through the superior capabilities of their production and operations system, i.e., better quantity and service with a low cost, while maintaining a high degree of flexibility to respond to change.

Therefore, Capacity Requirement Planning (CRP) is a well-known methodology for production planning and control in discrete part manufacturing and assembly. The methodology is often unsuccessful in practice because most CRP determines a production schedule under an assumption that work centers have infinite capacity. This may result in a capacity infeasible schedule.

For that reason, when CRP schedules orders, it takes the due date of an order or repetitive schedule and schedules each of its operations from the last operation in the order routing or process backward to the first one. CRP assigns each operation at start data and a due date, using the operation lead time components: queue, setup, run, wait and move-to calculate operation start dates. CRP also provides the ability to add, modify and delete industry planned orders and to convert computer planned orders into industry planned orders. [2,5]

When the problem is lack of capacity, there are many short-term efforts that can be made to overcome it. They include overtime, alternate routings, split lots, and subcontracting, as well as some long-term efforts including a change in make versus buy, hiring, adding shifts, new equipment, increasing efficiency and increasing utilization.

As a result, the ideal situation is to construct the statistic analysis for production system do all of the "grunt work" and the scheduler do all of the "brain work". Accordingly by storing the production schedule on this system, the scheduler needs only to initiate changes to it rather than go through the laborious job of creating the entire plan each time it is needed for material requirement planning. Thus, in this paper, the system can also critique the production schedule through action messages, altering the scheduler to those plans that need to be calculated as opposed to the scheduler having to execute all items. Additionally, the action messages can recommend the correction action, for example, time to order, cancel, etc. Certainly this system's ability to recalculate and

predict the consequences of various plans is superior to the scheduler doing it manually. [4, 6]

The rest of this paper is organized in three major sections: (i) basic of operations management, (ii)planning the system and management and (iii) control of operations. We implement by considering corporate strategic planning and its relationship to the operations function. It is followed by conclusion to the major types of production processes to be found in service industry identifying the distinguishing characteristics and competitive positioning of each process.

2. Basic of Operations Management

Operations management is the systematic direction and control of the processes that transform inputs into finished goods and services. Operations management is also about the way organizations produce goods and services. Therefore, the essential nature of operations management is concerned with organization the process of getting things done. An operation is a transforming process converting a set of resources (INPUTS) into services and goods (OUTPUT). The input resources may raw materials or even the customer themselves. These resources are transformed into the final goods or services by way of other transforming resources. Operations management involves a lot of different disciplines. To be effective, operations interfaces with many different disciplines within an organization.

Capacity planning is a fundamental discipline for operations management. A good capacity planning system is required to insure that an industry has adequate facilities, capital equipment, direct and indirect laborers, space and money. Whenever these resources do not match the needs of the industry, one or more industry goals will not be achieved; good customer service, low inventory, high productivity, stable labor and/or good utilization of equipment and space. [3]

Therefore, there is one approach to capacity planning. This approach is resource requirements planning (RRP). It determines the quantity and timing of all of the production resources needed to produce the end items in the production. Production resources include raw materials, products parts, personnel and production capacity. Resource requirement planning has a language that has evolved with its growing uses in industry. The two main elements of resource requirement planning system are material requirement planning (MRP) and capacity requirement planning (CRP).

(i) Material Requirement Planning: It is a computer-based system that uses in planning and controlling manufacturing inventories of finished goods. Material requirement planning begins with the principle that many materials held in inventory have dependent demands. The amount of a particular material with dependent demand that is needed in any week depends on the number of products to be produced that requiring material can be calculated. The demand for raw materials and partially end items does not have to be forecast, therefore, because if it is known what finished products must be produced in a week, the amount of each material needed to produce these finished products can be calculated. Thus, material requirement planning is a way to manage inventories by anticipating their use. The basis philosophy of the material requirement planning system is to time the procurement of the specific items comprising a particular product to synchronize with the product schedules. The purpose of MRP is to ensure that materials and components are available in the right quantities and at the right time so that finished products can be completed according to the production schedule.

(ii) Capacity Requirement Planning: The capacity of an industry's production facility is the maximum amount of work that it can deliver in a certain time span. Capacity requirement planning takes the planned order releases from the material requirement, assign orders to work centers and calculate the labor and machine load in each future time period at each work center. Capacity requirement planning model is a power full and flexible decision making process to help people reach the best decision. There are three typical steps to determining capacity requirements. They are:

1. Use forecasting techniques to predict sales of a product line.

2. Calculate equipment and labor requirements to meet product line forecasts.

3. Project labor and equipment availabilities over the planning horizon.

Capacity requirement planning effectively addresses the system capacity monitoring and planning needs, displaying capacity used and available, and load percentage information for all work centers in a single, concise, easy-to-read view. When manager needs to forecast the capacity situations where capacity requirement planning provides the capacity information. It has maximum or minimum situations, making it easier for production. It can divide the production as required shift production and manage resources efficiently. They can view capacity information for day, week or month, as far into the future as necessary. Capacity requirement planning allows the user to easily see what have been schedules for each of the user department for more information on the manufacturing order.

3. Planning the System and Management

Production system is a term used to describe a wide variety of tasks from operations research to computer-integrated manufacturing. Production has the responsibility of determining what consumers want and needed. Once this determination has been made, and the industry's executives decide to meet those wants and needs, it is responsibility of the producing function to product the products. Initially, raw materials and goods in process must be available when needed. The products in this system are soap including four types, such as Soap, Natural Soap, Detergent and Drug Soap. In these soaps, there twelve types of raw materials, such as Titanium, OBA, EDTA, Perfume, Color, Soap Noodle, CalO3, LABS, NaOH, H2O, Talcum Powder and Triclosom. Production must be planned, scheduled and controlled for output that meets quantity standards as well as deadlines.

In this paper, this production system is intended to develop the statistical analysis for production in service industry as shown in Figure 1. In this system, the products can be anticipation of demand, upon receipt of customer's order. According to the order parameters, the manager considered to calculate material requirements and capacity requirement for order. Manager determines to what planning periods the components pasts apply in order to have them available at the proper times for production operations. Production manager considered the actual labor and machine hours that production schedule will require weekly in each work center for this product.

In this system, when the customer makes the order in the industry, the manger starts to plan the resource requirement of the order. Industry must have raw materials to complete and control the capacity planning. In addition to, the manager calculates standard production for order by using material requirement planning. Finally, this system makes the statistical analysis upon the number of workers that is needed for the order by using capacity requirement planning. When all products from the production schedule are included, the total labor and machine hours required weekly in each work center can be compared to analyze the standard production and capacity requirement planning. Such evaluation allows production manager to determine the feasibility of each work center and other overloading and under loading capacities.

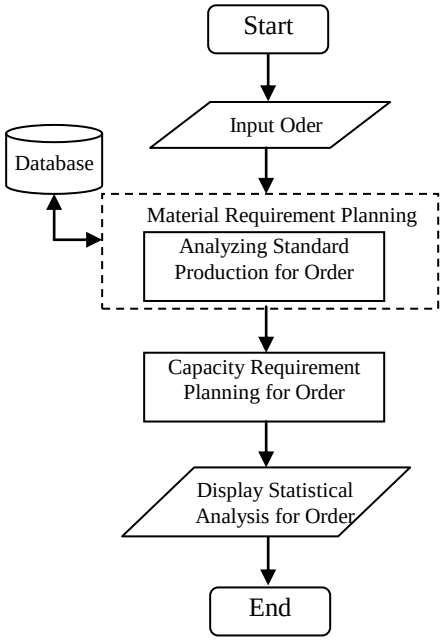

Figure 1: Overview of the System

Therefore, this system consists of two main portions: customer and manager. The customer portion consists of input procedure such as order start date, target date, product type, soap type, and order quality. To compute the statistical analysis, the manager portion consists of many functions for report order information. These functions are received input order from customers that is performed by using capacity requirement planning (CRP) including utilization, efficiency for available capacity, calculation resource requirements in capacity planning and load percent.

All customers must be members to order product in this system. When the user or customer operates the system, firstly he/she faces the interface of production and then the login process by filling user name and password. In this system, password is used for authentication of the user. If all the data filling in the login process is correct, the user can perform inserting input data. Subsequently, the user enters Stock Order form and then he/she chooses input data for ordering procedure. In this procedure, the customer selects order state date on Calendar, and chooses any week of target date in addition to prefer the product type, soap type and order quality. When he finished this procedure, he puts to one side to database. After CRP process, the user or customer perceives the request order information.

Before the manager operates the system, he or she makes certain analyzing standard production for order. Then, he or she enters user name and password for authentication. If the manager is authenticated, he can perform Material Requirement Planning (MRP) and Labor Requirement Planning (LRP) and analyze detail requirement materials for customers' order and

pending order information for customers. If the manager wants to perform Capacity Planning Requirement process, he or she investigates pending order firstly. He or she also verifies detail amount of items based on ordering products. Afterward, he or she carries out MRP and this system executes and displays message of enough materials for customer's order. After MRP, when he or she makes LRP, this system executes labor requirement by using CRP process and displays industry's producing message on customer's order. In addition, the manager puts in raw materials or items for production and quality amount per each item or raw material.

4. Control of Operations

The function of capacity planning is to make certain that there are sufficient personnel, machine and other production facilities available at the right time to meet the industry's planned production. CRP must be determined at different levels of statistical analysis for production in service industry. CRP takes the planned order releases from the material requirement planning, assigns orders to work centers and calculate the labor and load in each future time period at each work centers. Capacity planning is critical in moving materials through several operations stages to final product.

By using CRP, manager determines the capacity available and translates the released and planned order into capacity required. When received orders, manager evaluates the order parameters. According to order parameters, manager calculates the capacities required for each work center and resolves differences between available capacity and required capacity. Capacity available is the capacity of a system or resources to produce a quantity of output in a particular time period. Available (theoretical) can be calculated or measured. To calculate available capacity, one needs to know available time, utilization and efficiency because they are statistical analysis for production of resource requirements and calculation of the capacity planning.

We make use of utilization and efficiency for available capacity. Utilization is the percent of available time spent working in Equation 1. In this equation, scheduled available hours means industry's defining hours and standard hours changed is the regular working hours in industry. Also, in Equation 2, actual hours changed is the actual working hours in industry.

$$Utilization = \frac{ActualHoursCharged}{ScheduledAvailableHours} \quad (1)$$

Efficiency is how a well a machine or worker performs compared to a standard level in Equation 2.

$$Efficiency = \frac{StandardHoursCharged}{ActualHoursCharged} \quad (2)$$

In general, production capacity is the maximum production rate of an industry (or maximum conversion rate of a production system) in any given period. For calculating the resource requirements, capacity planning must use Equation 3.

$$Capacity = no.\ of\ workers * no.\ of\ shifts * utilization * efficiency \quad (3)$$

In solving Equation 3, manager may calculate the needs of workers and considered the other factors of Equation 1 and Equation 2. First, manager uses the capacity per day product of the industry. Industry working times are mostly limited and when solving Equation 3 manager needs to consider the number of shifts (working time), efficiency and utilization as shown as the following Example. In this Example, we assume that number of workers is 10 workers, number of shift is 60 hours, actual hour charged has 10 hours, schedule available hours are 12 hours, and standard hour charged supposes 9 hours. In order that, we compute the industry capacity planning by using Equation 3, Equation 1 for utilization, Equation 2 for efficiency.

No. of Workers = 10
No. of Shifts =60 hours
Utilization = 10/12=83%
Efficiency = 9/10 = 90%
Capacity = 10 * 60 * 0.83 * 0.9 = 450 hours

In this system, CRP produces load profile. Load refers to the standard hours of work assigned to a facility. CRP uses the information to produce a load profile for each machine or work center. Load percent is the ratio of load to capacity as shown in Equation 4. It is important to divide the work loads for each work center or department.

$$LoadPercent = \frac{Load}{Capacity} * 100\% \quad (4)$$

CRP calculates load from planned and/or released work orders, as well as, exploded repetitive schedules. Work center's machine requirements are expressed in hours and can be reported within user-specified time periods based on days, weeks, or months. CRP also recalculates time-phased capacity plans and produces capacity planning reports.

The following example illustrates the calculating the Load Percent by using Equation 4. Systems with a Load Percent over 100 will not complete assignments on time without adjustments to the system. In this example, first, we calculate the load profile. We

assume that for the month 50 soaps are needed for week one, 40 for week two, 30 for week three, and 60 for week four. When calculating load percent over 100 percent will not complete assignments on time and therefore, this system reports the 'Reject' message without adjustments. Also, if the system calculates the load percent within 100 percent, this system gives 'Accept' message for the manager.

- Load
  Week 1 = 50 * 10 = 500
  Week 2 = 40 * 10 = 400
  Week 3 = 30 * 10 = 300
  Week 4 = 60 * 10 = 600

- Load Percent
  Week 1 = 500/450 = 110% (Reject)
  Week 2 = 400/450 = 88% (Accept)
  Week 3 = 300/450 = 66% (Accept)
  Week 4 = 600/450 = 133% (Reject)

In this system, the soup manufacturing uses the database for calculating the parameters from the customer order. Therefore, this system also creates the database that will be used to prepare the manufacturing plan during Capacity Requirement Planning process. The customer's orders are accepted and combined with CRP and MRP by the system. The customer's order can be captured in the database and used with this system that will apply these data to a specific decision making for order. The user can review accept or reject message to manufacture order products in industry. The result of material requirement for order (detergent 200g of 50 pics) is shown in Table 1.

Table 1: Result of Material Requirement for Order

Material	Amount
$CalO_3$	3705g
LABS	600g
EDTA	40g
Perfume	40g
NaOH	75g
H_2O	540g

5. Implementation of System

In this system, the entertainment in installments production uses the calculation of the parameters for the customer order. The task of production manager is to make the best use of available resources to accomplish production objectives. Managers ordinarily are constrained by their resource: personnel, machine and material. When the customer is being calculating the order parameters, there needs to consider standard production in service industry. Standard production uses the current workers, kind of soap, soap types for the day per production. Material requirement calculates based on kind of soap, soap types and its accessory types. Raw material is important the operation level of statistical analysis for production on a short-term basis.

The manager first opens the stock order information and sees the order arriving. In production, material requirement is important because it includes raw material, that are need to process the order. Industry must have the raw materials to complete and control the capacity planning. System shows the raw materials with describing based on kind of soap and soap types in Figure 2.

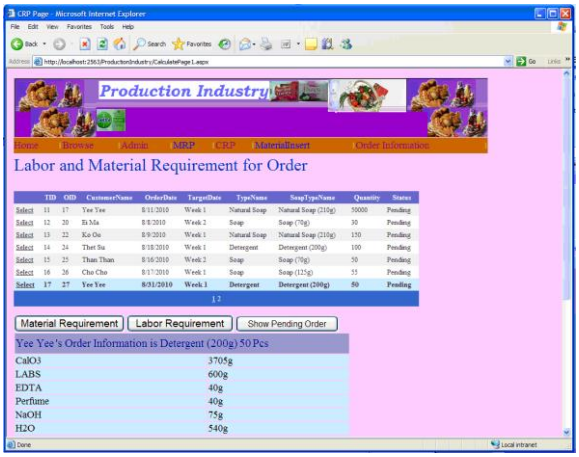

Figure 2: Requirement of Raw Materials based on kind of Soaps and Soap Types

Subsequently, when manager calculates material requirement planning for the order, manager gets on the material requirement button. After the processing the material requirement planning, the system illustrates "enough" or "not enough" message for the material requirement planning of the order in Figure 3. For calculation of capacity requirement planning, the system uses the number of days, capacity per day product, order quantity, and choose the number of shifts, utilization and efficiency. Manager chooses the labour calculate button and then the system produces "Accept" or "Reject" message to analyze the order as shown in Figure 4.

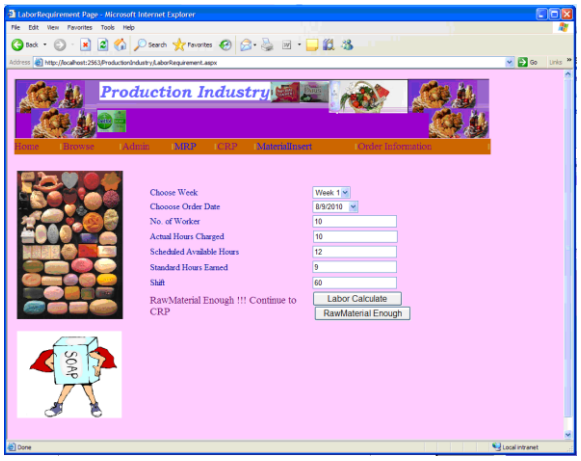

Figure 3: Show Enough Message on Raw Materials for Order

Figure 4: Analyzing CRP for Order

6. Conclusion

The production system is designed to produce the goods products and services from the customers' order. This system supports the statistical analysis for the operation, and the planning of the production resources. Additionally, computers are important notes in business organization, when computing and analyzing of the production systems are strategic statistical in service industries. In certain case, corporations have been put out of business by competition with better computing resources, It is necessary to build in a short time without excessive cost. This system also carries to reduce time consuming quickly for many records instead of documents or papers.

Reference

[1] C. Voss, N. Tsikriktsis and M. Fronhlich, "Case Research in Operations Management",

[2]"CDC Unified Process Practices Guide", Capacity Planning Practices Guide.

[3] E. Wustenhoff, M. J. Moore and D. H. Avery, "Opeations Management Capabilities Model", Sun BluePrints™ OnLine, February, 2005.

[4] J. A. Collins, "Progress in Operations Management", *Invited for Production and Operations Management*, 3 December, 2001.

[5] J. M. Swaminathan, "Introduction to Operations Management", Spring 2000.

[6] T. Wuttipornpun and P. Yenradee, "A New Appraoch for a Finite Capacity Material Requirement Planning System", Thammasat Int. J. Sc. Tech., Vol. 12, No. 2, April-June 2007.

[7] W. E. Goddard, "Practical Principles of Capacity Planning", The Oliver Wight Companies.