RELEVANCY OF SCHEULING AND SEQUENCING

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***Abstract*: We are much familiar with the term scheduling and sequencing in our day to day life. We are more intimate with the outcome of the scheduling that is schedule. A schedule is a tangible plan or document, such as a bus schedule, train schedule, examination schedule. . It can be called as eliminator of gauss work. A schedule usually tells us when things are supposed to happen; it shows us a plan for the timing of certain activities and answers the question, "If all goes well, when will a particular event take place?" When a particular train will arrive and when does it is scheduled for departure? Any plan without a schedule is just a desire or vision. When an ingredient of schedule is added to this, it becomes a reality or a project.**

Scheduling in simple way can be said a relationship between time and event. Although we started recognizing schedules this during mid-nineties, but this existed even during stone-age too. What time one has to go for hunting for which animal? It is a concealed act in our everyday life.

Any schedule is liable to change; depending upon environment and situation, a fresh schedule can be release with valid reason. Although it is not fully static in nature, it is still very useful. There are other activities which are related to any one schedule and those can also be rescheduled to better utilization of time and opportunity. If a train is delayed due to some unpredictable circumstances and is rescheduled, passengers can utilize this time for some other necessary work.

In recent years, it is going to play a vital role in CIVID 19 vaccine distribution across the country. Schedule shall be based on Government policy, Urgency, and readiness of center for storage and distribution of vaccine also training of medical staff for injection and post injection observation. Hence in this case there are four independent variables in this task of distribution. This needs to be examined with appropriate mathematical models that relate to the process of scheduling. The development of useful models, which leads in turn to solution techniques and practical insights, has been the continuing interface between theory and practice. We break the task of vaccination of entire country into small towns in rural and urban area. We call this task as job and the centers of vaccination as resources. In this case the jobs are too many and resources are quite limited which composes a complex algorithmic equation having large number of independent variables. For confirmation of various jobs as per schedule, possibly for the first time Government has to perform to two times dry run of entire event.

***Keywords*: Integrated approach to Scheduling and Sequencing confirms customer satisfaction and accelerates multi-tasking with very little or Negligible chances of error, thus cost saving.**

Methodology:

Scheduling problems in industry have a similar structure: they contain a set of tasks to be carried out and a set of resources available to perform those tasks. Given tasks and resources, together with some information about uncertainties, the general problem is to determine the timing of the tasks while recognizing the capability of the resources. This problem usually arises within a decision-making hierarchy in which scheduling follows some earlier, more basic decisions.

In industry, decisions are usually said to be part of the planning function. Among other things, the planning function might describe the design of a company's products, the technology available for making and testing the required parts, and the volumes to be produced. In short, the planning function determines the resources available for production and the tasks to be scheduled on various resources to draw the maximum utilization of resources.

In the scheduling process, we need to know the type and the amount of each resource so that we can determine when the tasks can feasibly be accomplished. When we specify the resources, we effectively define the boundary of the scheduling problem. In addition, we describe each task in terms of such information as its resource requirement, its duration, the earliest time at which it may start, and the time at which it is due to complete.

We should also describe any technological constraints (precedence restrictions) that exist among the tasks. Information about resources and tasks defines a scheduling problem. However, finding a solution is often a fairly complex matter, and formal problem-solving approaches are helpful.

Some simple way to represent schedule and sequence

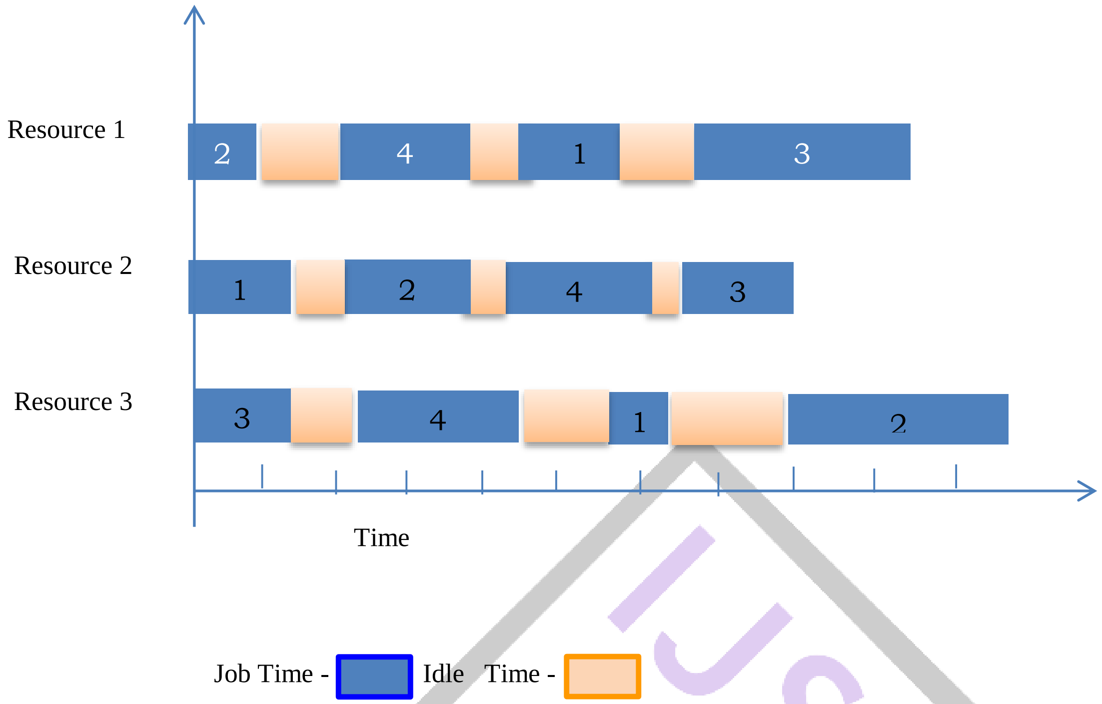

Figure. – 1.1 Gantt chart

Gantt chart: Gantt chart is one of the simplest ways to represent scheduling and sequencing. It is a simple bar graph that is ideal for long term projects.

- The chart shows estimated and actual times for each activity, with time on the horizontal axis and the activities listed vertically. Assists with planning ahead and the allocation of resources.
- It outlines the activities that need to be performed, the order in which they should be performed and how long each activity is expected to take.

It also indicate the idle time which is a function of length of the operation and technological limitations

Critical Path Analysis (CPA):

- Shows what tasks need to be done, how long they take and what order is necessary to complete those tasks.
- Its timing is more precise than a Gantt chart and distinguishes between critical and non-critical tasks.
- It is based on a 'network diagram' and the 'critical path' is the longest route that can be taken through the network diagram.
- It is useful to identify which tasks are the most important.

Many of the early developments in the field of scheduling were motivated by problems arising in manufacturing. Therefore, it was natural to employ the vocabulary of manufacturing when describing scheduling problems. Now, although scheduling work is of considerable significance in many non-manufacturing areas, the terminology of manufacturing is still frequently used. Thus, resources are usually called machines and tasks are called jobs. Sometimes, jobs may consist of several elementary tasks called operations.

The theoretical perspective is also largely a quantitative approach, one that attempts to capture problem structure in mathematical form. In particular, this quantitative approach begins with a description of resources and tasks and with the translation of decision-making goals into an explicit objective function.

Objective function should consist of severity of importance (requirement) and all cost involved.

Nevertheless, three types of decision-making goals seem to be prevalent in scheduling: **turnaround, timeliness, and throughput**.

a. Turnaround measures the time required to complete a task.
b. Timeliness measures the conformance of a particular task's completion to a given deadline.
c. Throughput measures the time between start on the job and finish of the job including stoppage time.

The first two goals need further elaboration, because although we can speak of turnaround or timeliness for a given task, scheduling problems require a performance measure for the entire set of tasks in a schedule.

We categorize the major scheduling models by specifying the resource configuration and the nature of the tasks. For instance, a model may contain one machine or several machines. If it contains one machine, jobs are likely to be single stage, whereas multiple-machine models usually involve jobs with multiple stages. In either case, machines may be available in unit amounts or in parallel. In addition, if the set of jobs available for scheduling does not change over time, the system is called static, in contrast to cases in which new jobs appear over time, where the system is called dynamic. Traditionally, static models have proved more controllable than dynamic models and have been studied more extensively. Although dynamic models would appear to be more important for practical application, static models often capture the essence of dynamic systems, and the analysis of static problems frequently uncovers valuable insights and sound heuristic principles that are useful in dynamic situations.

Finally, when conditions are assumed to be known with certainty, the model is called deterministic. On the other hand, when we recognize uncertainty with explicit probability distributions, the model is called stochastic.

Two kinds of feasibility constraints are commonly found in scheduling problems. First, there are limits on the capacity of machines, and second, there are technological restrictions on the order in which some jobs can be performed. A solution to a scheduling problem is any feasible resolution of these two types of constraints, so that "solving" a scheduling problem amounts to answering two kinds of questions:

a. Which resources should be allocated to perform each task?
b. When should each task be performed?

The pure sequencing problem is a specialized scheduling problem in which an ordering of the jobs completely determines a schedule. Moreover, the simplest pure sequencing problem is one in which there is a single resource, or machine, and all processing times are deterministic. As simple as it is, however, the one-machine case is still very important. The single-machine problem illustrates a variety of scheduling topics in a tractable model. It provides a context in which to investigate many different performance measures and several solution techniques. It is therefore a building block in the development of a comprehensive understanding of scheduling concepts. In order to completely understand the behavior of a complex system, it is vital to understand its parts, and quite often the single-machine problem appears as a part of a larger scheduling problem.

In other words, a scheduling problem gives rise to allocation decisions and sequencing decisions. From the start, the scheduling literature has relied on mathematical models for these two kinds of decision problems. In more recent developments, referred to as **safe scheduling,** the models recognize service levels as well. Safe scheduling may also involve the decision to accept a job or reject it in the first place, so that when we make commitments to customers, we can be confident that their jobs will finish within the time allowed. An alternative approach to safe scheduling minimizes the expected economic cost of a schedule, including the cost of tardiness and the cost of safety time. Instead of specifying a service level in advance, this approach determines economic service levels as part of the solution.

Scheduling tasks are largely a function of volume of system output. High volume system requires approaches substantially different from those for intermediate and low volume (job shop) systems.

Scheduling in High-Volume system: Scheduling encompasses allocation workloads to specific work centers and determining the sequence in which operations are to be performed. High-volume systems are characterized by standardized equipment and activities that provide identical or highly similar operations on products as they pass through the system. The goal is to obtain a smooth rate of flow of goods or customers through the system in order to get a high utilization of labor and equipment. High-volume system where jobs follow the same sequence, are often referred to as flow systems: scheduling in these systems is referred to as flow-shop scheduling. The major aspect in the design of flow systems is line balancing which concerns allocating the required tasks to work stations so that they satisfy technical constraints and are balanced with respect to equal work times among stations. Highly balanced system results in the maximum utilization of equipment and personnel as the highest possible rate of output or productivity.

Intermediate-volume system outputs fall between the standardized type of output of the high-volume systems and made-to-order[MTO] output of job shops. Like the high-volume systems intermediate-volume systems typically produce standard outputs. If manufacturing is involved the products may be for stock [MTS] rather than for special order. However volume of output in such cases is not large enough to justify continuous production. Instead, it is more economical to process these items intermittently. Thus intermediate-volume work center periodically shift from one job to another. In contrast to a job shop, the (batch) size is relatively large.

$$Qo = \sqrt{\frac{2DS}{H}}\sqrt{\frac{p}{p-u}}$$

Where-

Qo – Optimal operation quantity;
H – Holing (carrying) cost per unit per year
D – Demand in units per year
S – Ordering cost per order
P – Production or delivery rate.
U – Usage or consumption rate

Low-Volume System: The characteristics of low-volume systems (job shop) are considerably different from those of high- and intermediate-volume systems. Products are made to order[MTO] and order usually differs considerably in terms of processing requirements, materials need, processing time and processing sequence and setups. Because of these circumstances job-shop scheduling is usually fairly complex.

The need to account for safety time also has important implications for sequencing decisions. As an example of the economic approach to safe scheduling, consider a hub airport that serves several cities (Trietsch, 1993). Instead of providing direct flights for all pairs of cities, incoming flights from each city are directed to the hub, and passengers then take outgoing flights to their destinations. Flights are interrelated because they feed each other with passengers. Ideally, all incoming flights should arrive at about the same time and all outgoing flights should leave at about the same time. In practice, however, sufficient time gaps must be maintained between aircraft when landing or taking off, so both sequencing decisions and timing decisions are necessary. In sequencing, we must account for the fact that different incoming flights have different variances: in general, higher variance implies the need for more safety time, so flights with high variance should be scheduled to arrive earlier.

A useful perspective on the relation of scheduling problems and their solution techniques comes from developments in a branch of computer science known as complexity theory. The notion of complexity refers to the computing effort required by a solution algorithm. Computing effort is described by order-of-magnitude notation. For example, suppose we use a particular algorithm to solve a problem of size n. (Technically, n denotes the amount of information needed to specify the problem.) The number of computations required by the algorithm is typically bounded from above by a function of n. If the order of magnitude of this function is polynomial as n gets large, then we say the algorithm is polynomial. For instance, if the function has order of magnitude n^2, denoted $O(n^2)$, then the algorithm is polynomial. On the other hand, if the function is $O(2^n)$, then the algorithm is non-polynomial (in this case, exponential). Other things being equal, we prefer to use a polynomial algorithm because as n grows large, polynomial algorithms are ultimately faster.

A class of problems called NP-complete problems includes many well-known and difficult combinatorial problems. These problems are equivalent in the sense that if one of them can be solved by a polynomial algorithm, then so can the others. However, many years of research by mathematicians and computer scientists has not yielded a polynomial algorithm for any problem in this class, and the conjecture is that no such algorithm exists. Optimization problems as difficult as these, or even more difficult, are called NP-hard problems. From user's prospective such advancement in information technology has added accuracy with much more ease of application with speed of decision making. Consequently there is a great minimization or risk of malfunctioning of entire operation and utilization of mostly all the non-productive time.

Conclusions

All scheduling decisions deal with the collection of scarce resources to jobs, activities, tasks, or customers. Within the available resources, scheduling seeks to satisfy the Conflicting objectives of low inventories, high efficiency and good customer services. Scheduling, however, differ between mass production, batch production & job shop Production. The production line is utilized to the extent needed for the single product, however for multiple products; a line capacity scheduling is needed for different products. In batch production too little impact will result in low inventories low

Utilization of labor and machines, and fast customer service. Too much impact will result in high utilization and long customer's delivery times. For scheduling individual jobs, either sequencing on dispatching rules may be used. If sequencing is used a Gantt chart is developed which shows exactly when each operation is planned for each job. When dispatching rules are used, jobs are selected for the next operation on the basis of prescribed priority rule. Scheduling system in general should answer the following questions (1) What delivery date do I promise? (2) How much capacity do I need? (3) When should I start each particular activity, or task? (4) How do I make sure that the

Job is completed on time? To take care of this dynamism of operations, accuracy and ease of operation, it is has been computerized.

Resources:

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