CHAPTER 2
LITERATURE SURVEY AND THEORETICAL CONSIDERATION

2.1 Literature Survey

Ahaheen (1993) examined seven commonly used favourite dispatching rules on a real life job shop environment through simulation. Several practical issues like sequence dependent set-up time, transit time, loading and unloading time, machine breakdown and repair time, etc., has been incorporated in the simulation program. The simulation was performed using the special simulation language SIMAN. The comparative effectiveness of the rules has been measured against four different performance criteria. Two types of due date assignment rule has also been applied to assess the sensitivity of the rules on due date estimation method.

Amatayakul (1996) developed a master production schedule system for a cosmetic factory in order to satisfy the market demands. This thesis reveals a number of problems. Firstly, the proper data had not been utilised for production planning. Secondly, there was no specified procedure for the planning. In addition, this thesis proposed specific policies for each group of products and developed a master production schedule system.

Brown (1994) presented the role of Work Study in TQM. Links the role of work study to TQM and argues that work study methods can play an integral part in TQM. Argues that many TQM programmes fail because they do not have measurement techniques in place which TQM requires on an ongoing basis. Suggests that work study methods provide necessary tools and techniques for TQM.

Gunasekaran, Forker and Kobu (2000) focused on productivity problems in SMEs. Considering the importance of SMEs, the experiences of a small company engaged in continuous improvement and a related conceptual model are discussed here to highlight. The project presents how productivity can be improved with limited resources in a case

study company that produces wiper systems for the automotive industry in the UK. The wiper systems include containers, pumps, jets and hoses. Valeo produces a wide variety of low volume parts for various customers in a job shop environment. The objective of project was to improve productivity in two cells of the company, namely the Honda/Rover cell and the headlamp cleaning cell. Next, the aim was to identify potential areas for cost savings resulting from productivity gains. Finally, implementation issues associated with productivity improvement strategies in a small company are discussed.

Janusz (1997) presented for the model-based redesign of enterprises. It consists of two main steps, the initialisation step and the optimisation step. During the initialisation step, the processes are modelled and analysed. During the optimisation step, the optimal configuration is found for the possible modifications of the processes. Emphasis is placed on the process analysis. The proposed approach is based on activity chains which describe the set of activities needed for the achievement of a given goal, and their execution order necessary to guarantee a low processing time. An algorithm is presented for filtering such activity chains from an enterprise model. It is based on graph theory and corresponds to the solution of an optimisation problem, whereby the sum of weights of all edges belonging to the solution graph should be maximised under some given constraints. Because of the high complexity of the problem, some complexity-reducing measures are presented, measures that arise from the earlier problem analysis.

Jitcharoongphorn (1998) presented project planning and cost control system within a foodservice equipment industry which is a job shop in nature. This thesis firstly contains analysing existing problems and their related causes. Then pre-bid project planning and tracking of project schedule using gantt chart are utilised for improvement. Finally, results of improvement are shown in many measurement forms.

Kloypayan (1996) represented the production planning and follow up system of a garment factory that causes the delay of the target or short of product for each order. The follow up "PERT LOB" technique is applied on this research. The PERT is studied to provide the effective planning. The LOB is studied to applied on follow up and schedule modification system that will be used by production management to systematically help in planning and follow up the planning whenever any problem occurs can be immediately solved.

This research mentions the application of the system that can be applied on other same production systems by using the same concepts.

Lilley (1998) examined one of the reasons for the failure of many business process reengineering (BPR) efforts is that they are conceived and developed at a high level and are not brought in at the front-line team level. To address this problem, the differences between process improvements directed toward the corporate level and the shop floor level need to be determined. The process of shop floor workshops should be understood and their benefits highlighted. In addition, corporate and shop floor efforts have to integrated to achieve maximum synergies.

Limpawattanaphum (1997) focused to minimize makespan, improve machine utilization and code computer program for the use of a model. This research presents the model for scheduling mold machining process which concerns with a job shop manufacturing system to solve the problem of idle time and over load on some machines. SPT dispatching rule is considered and modified to solve the problems in the case study company.

Malmborg (1997) presented expected part delays as a secondary layout criterion in automated manufacturing systems. Delays in the internal movement of parts can directly influence throughput performance in some manufacturing systems. A part delay model for single-vehicle material handling systems is formulated and used to link the problems of facility layout and throughput maximisation in automated manufacturing systems. The model is applied through a two-phase algorithm where a vehicle scheduling procedure bounds the level of expected part delays associated with alternative layout designs. A series of test problems is used to illustrate the performance and examine the robustness of the modelling procedure.

Newman and Maffei (1999) examined the relative effects of alternative approaches to dealing with the intractable problem of managing a job shop. The effect of routing flexibility, simple order release mechanisms based on aggregate shop load, and local job prioritizing rules are examined together. While the impact of each experimental parameter is found to be significant, the impact of flexibility greatly overshadows those of the other parameters. These results support further examination and more normative understanding

of how flexibility and better production planning and control may best be used in various competitive situations.

Nyunt (1990) presented the development and proposed implementation of a production planning methodology for jewelry manufacturing. The objective of this research is to find an efficient method for production planning. The first part is concerned with the application of Graphical Evaluation and Review Technique (GERT) to model the major steps of production process. The model works out processing time and probability of success for each job by using each step processing times, rework, and reject rate. Second part discusses the application of Goal Programming to construct an integer programming mode. This model purposes to find the optimal sequencing solution for production planning by fulfilling company objectives. The last part explains the development of heuristic production sequencing algorithms by using two conflicting objectives. Computational results and long terms analysis are covered in this research by simulation.

Salegna (1996) examined work release and due-data assignment rules within the context of a planning system that is integrated with shop floor operations using a simulation approach. Data were collected by the batch means approach. The results indicate that the capability of the planning system to adjust the work load on the shop floor, and to incorporate shop information in assigning due dates, is important for improving shop performance.

Tam (1995) addressed production planning, scheduling problem and sensitivity analysis of capacity and product demand. The planning problem is formulated in a Multi-product, Multi-period and capacitated environment. Demand is considered deterministic. The objective of the production planning is to select production quantities of products which maximize the profit of the factory. The production planning and scheduling problem is divided into two steps. In the first step, a linear programming model is advised for profit maximization which can provide additional managerial information. In the second part, the problem of scheduling to minimize total setup time is solved. Two alternatives to determine the production sequence for a sequence dependent setup problem are the Branch and Bound approach and a heuristic solution.

Thongchiew (1995) developed a new documentation system for production control system of air-conditioner factory. This thesis aim to brought up the documentation system concept for solving the problems. Starting with working and activity improvement, followed by documentation system improvement by decrease the complex procedure, increase the necessary procedure and define and design the document flow and document for using in record data, transmit data and confirm the activity in production control by having the document control for setting the standard.

Tsurutan (1990) describes the development of a shop floor control system (SFCSs) over the past decade and also discusses activities aimed at improving productivity through the use of an SFCS. An SFCS has the following functions: database operation, data collection, information services, and manufacturing equipment control and monitoring. Two examples of leading edge and typical SFCSs in the Japanese electronics industry are provided. The implementation and use of SFCSs are discussed.

Yeh (2000) presented a customer-focused approach to effective planning of make-to-order production, in which production activities are driven by customer orders and all products are made to customers' specifications. The approach plans, schedules, and co-ordinates production activities, based on the needs of individual customer orders. In particular, an integrated bill of material and routing data structure is used to effectively organise production data in response to product specifications of customer orders. It facilitates the creation of production jobs with varying routings and material requirements. A job-oriented finite capacity scheduling system is used to effectively accommodate specific needs of individual customer orders. It allows for realistic setting of delivery dates and negotiation of order changes. Key features of the approach presented show its effectiveness in planning multi-item customer orders and multi-level products.

2.2 Theoretical Consideration

2.2.1 Tools of the Methods Analysis

Process chart is one of the most important tools of the methods engineer. A process chart is a graphic presentation of any manufacturing. There are eight different process charts usually use, each of which has specific applications. These are:

1). The operation process chart.
2). The flow process chart.
3). The flow diagram.
4). The worker and machine process chart.
5). The gang process chart.
6). The operator process chart.
7). The travel chart.
8). The PERT chart.

The operation, flow, and PERT charts and the flow diagram are used principally to present problems. Usually a problem cannot be adequately solved unless it is properly presented. Consequently, these charts are discussed their utilisation and benefits provided.

1) Operation Process Chart

The operation process chart represents the chronological sequence from first input of raw material to output of finished goods. It includes all operations, inspections, time allowances, and materials used in a manufacturing

In making the operation process chart, two symbols are used: a small circle, denotes an operation, and small square, denotes an inspection. Operation is used when the part is transformed or performed productive work on it whereas, inspection is used when the part is examined to determine conformance of standard.

Vertical line is used to indicate the general flow of the process as work is being accomplished, while horizontal line feeding into the vertical flow line is used to indicate material performed during the process.

After finish making operation process chart, questioning should be adopted in order to identify necessity each operation and its improvement. By gathering answer of question, that may lead to improvement. Better way of doing the work may be introduced.

The operation process chart helps to visualise the present method with all its details, so that new and better procedures may be devised. Effect of change on a given operation will have on the preceding and subsequent operations is shown. Proposed method can be promoted. It also indicates the general flow of all components entering into a product, and since each step is shown in its proper chronological sequence, the chart is in itself an ideal plant layout. Consequently, it is extremely helpful in making new layouts and in improving existing.

2) Flow Process Chart

Flow process chart is not adapted to complicated assemblies as a whole. But it is used primarily on one component of an assembly or a system at a time in order to provide maximum savings in manufacturing. Hidden costs, such as distances travelled, delays, and temporary storage is recorded by the flow process chart. Once these non-value added periods are highlighted, improvement steps can be taken. Furthermore, the moves and delays in storage are illustrated in the flow process chart. Along with the operation and inspection symbols used in operation process charts, flow process charts use several other symbols. A small arrow signifies transportation. It is used to define moving of an object from one place to another. A large capital D indicates a delay. A delay occurs when a part is not permitted to be immediately processed at the next workstation. An equilateral triangle standing on its vertex signifies as storage. It is used when a part is held and protected against unauthorised removal.

There are two types of flow charts in general use: product or material and operative or person. While the product chart provides all details of the events that take place involving

a product or a material, the operative flowchart details how a person performs an operation sequence.

Like the operation process chart, the flow process chart is not used as an end in itself. It facilitates elimination and reduction of hidden costs of a component. Since the flow chart clearly shows all transportation, delays, and storage, it provides the information that can lead to both the reduction of the quantity and the duration of these elements.

Once the flow process chart has been constructed, the questioning approach based on the considerations primary to operation analysis should be used. With the flow process chart, special consideration is given to materiel handling, plant layout, delay time, and storage time.

In making flow process chart, it familiarise all the relevant details related to the direct and indirect costs of a manufacturing process so that these costs can be analysed for improvement. At lease, all the facts relating to a method are known, it is difficult to improve that method. Casual inspection of an operation does not provide the information needed to do a thorough job of methods improvements. Since distances are recorded on the flow process chart, the chart is valuable in showing how the layout of a plant can be improved. Clever use of the flow process chart results in improvements.

3) Flow Diagram

Flow diagram is a pictorial representation of the layout of floors and buildings showing the location of all activities on the flow process chart. The existing drawing is helpful in developing a new method. For example, before a transportation can be shortened, it is necessary to see or visualise where room can be provided to add a facility so that the transportation distance can be diminished. Likewise, it is helpful to visualise potential temporary and permanent storage areas, inspection stations, and work points.

In making a flow diagram, each activity should be identified by symbols and numbers corresponding to those appearing on the flow process chart. Placing small arrows periodically along the flow lines is used to indicate the direction of flow

The flow diagram is a helpful supplement to the flow process chart because it indicates backtracking and areas of possible traffic congestion, and facilitates making an ideal plant layout.

4) Work and Machine Process Chart

Work and machine process chart is used to study, analyse, and improve only one workstation at a time. It represents the exact relationship in time between the working cycle of the person and the operating cycle of the machine. Areas in which both idle machine time and worker time occur is shown clearly in the worker and machine chart. These areas are the good place for starting effective improvements.

Making worker and machine process chart should be performed when working cycle of the operator is shorter than the operating cycle of the machine. The logical place for considering improvement possibilities is during the idle portion of the operator's cycle.

5) Gang Process Chart

Gang process chart is an adaptation of the worker and machine chart. Economical number of machines one worker operate is determined. It shows the exact relationship between the idle and operating cycle of the machine and idle and operating time per cycle of the workers who service it. The possibilities for improvement by reducing both idle operator time and idle machine time is shown clearly in this chart.

6) Operator Process Chart

Operator process chart is a tool of motion study. It is sometimes called a left and right hand process chart. It represents all movements and delays made by the left and right hands. It aims to show a given operation in sufficient detail so that the operation can be improved.

7) Travel Chart

Travel chart is helpful in connection with both plant layout and material handling work. It helps to diagnose problems related to the arrangement of department and service sector of plant. Travel chart presents in matrix form the magnitude of material handling that takes place within manufacturing.

8) PERT Chart

PERT charting is a prognostic planning and control method that graphically portrays the optimum way to get some predetermined objective in terms of time. Normally PERT charting is used to improve scheduling from the standpoint of cost reduction and customer satisfaction.

On the PERT chart, events which isrepresented by nodes are positions in time showing the start and/or combination of a particular operation or group of operations. Each operation or group of operations in a department is referred to as an activity and is identified as an arc on the PERT chart. Each arc has attached to it a number representing the time needed to complete the activity. Activities that utilise no time or cost are referred to as dummy activities and are plotted as dotted lines.

The minimum time needed to complete the entire project correspond to the longest path from the initial node to the final node. The longest path is the critical path since this path establishes the minimum project time. There is always at least one such path through any project. However, more than one path can reflect the minimum time needed. This is the meaning behind the concept of critical paths.

Activities not on the critical path have time flexibility referred to as "float." Thus, the float is the amount of time that a noncritical activity can be lengthened without delaying the project's completion date.

Summary

All mentioned charts are valuable tools for presenting and solving problems. Just as several types of tools are available for a particular job, so several designs of charts can help solve an engineering problem. However, in determining a specific solution, one chart usually has advantages over another. Analysts should understand the specific functions of each process chart and choose the correct one to solve a specific problem. In summary, their functions are as follows:

1. *Operation Process Chart.* Used to analyse relations between operations. Good for studying operations and inspections on assemblies involving several components. Helpful for plant layout work.
2. *Flow Process Chart.* Used to analyse hidden or indirect costs, such as delay time, storage costs, and material handling costs. Best chart for complete analysis of the manufacture of one component part.
3. *Flow Diagram.* Used as a supplement to the flow process chart, especially where considerable floor space is involved in the process. Indicates backtracking and traffic congestion. Necessary tool in making revised plant layouts.
4. *Worker and Machine Chart.* Use to analyse idle operator time and idle machine time. Ideal for determining the amount of machine coupling to be practiced. Used as a training tool to show the relationships of work elements in a multimachine work center.
5. *Gang Process Chart.* Use to analyse idle facility time and idle time of operators servicing a facility or process. Ideal for determining the labor requirements of a production facility. Used as a training tool to show the work elements of several operators working with a production facility.
6. *Operator Process Chart.* Use to analyse a workstation for proper layout, proper operator motion patterns, and best sequence of elements. Best chart to use for improving repetitive manual motions.
7. *Travel Chart.* Use to analyse problems related to the arrangement of departments areas as well as to the location of equipment within a given sector of the plant.

8. *PERT Chart*. Use as a project scheduling tool. Especially desirable for use in major projects involving six months or more.

2.2.2 Gantt Chart

A traditional device used for sequencing work on machines and monitoring progress is the Gantt chart. There are two basic forms of the chart: the job or activity progress chart and the machine chart. The progress chart graphically displays the current status of each job relative to its due date and its scheduled completion date.

2.2.3 Manufacturing Flow Evaluation

Manufacturing flow evaluation refers to the speed which one lot of product pass through manufacturing process. Low speed means that there is a problem which leads to delay from schedule and causes loss.

In general, the flow is evaluated from manufacturing flow efficiency including the following:

- Manufacturing flow efficiency per lot

  Processing time for lot / manufacturing flow time for lot

- Manufacturing flow efficiency per unit

  Processing time for unit / manufacturing flow time for unit

2.2.4 Information Flow Analysis

There are three techniques for aiding in the performance of analysis when the problem concerns an information system. The three techniques are:

1). Functional forms analysis chart.
2). Process chart-combined analysis.
3). Forms and formats design procedures.

1) Functional Forms Analysis Chart Defined

A functional forms analysis chart is a tabular presentation of the activities of an organisation and the forms the organisation uses for communication in performing each function of each activity in order to indicate areas with too many different or overlapping forms, or too few. It is used to analyse and improve an existing situation.

2) Process Chart-Combined Analysis Defined

A process chart-combined analysis is a graphic means of portraying the step-by-step procedure used with an information system when the work done involves more than one workstation. The chart may also show the interrelationships between any two or more items, such as several data collections, information and material, information and workers, and so forth. Such charts are particularly useful for analysing the effectiveness of most control or information-reporting procedures or for designing a control or information flow procedure.

3) Forms and Formats Design Procedures Defined

Forms and formats design procedures are sequences of actions and general principles for systematically designing effective forms and formats, as well as for improving existing ones.

Use of the Techniques

These techniques are used in examining the flow of information, as a prelude to improvement, in such situations as the following:

1. The total communication system of an organisation.
2. A job wherein the human physical activity and the flow of information are interrelated.
3. The processing and the use of information for decision making.

Summary

1. *Functional forms analysis chart* is used to study the total communication system of an organisation to:

    - Assess the scope of the form-communication problem.
    - Determine activity-function areas with excess forms or without forms.

2. *Process chart-combined analysis* is used for information leading to change in information procedures when the aspect under study concerns:

    - The flow of control information in relation to output flow.
    - The flow of information, where its relationship to human work is important.
    - The processing and use of information for decision making and so forth.

This technique is also used for the design of a paperwork procedure, as an aid to the study of an organisation. In addition, it can be applied to assist in designing an effective organisation structure.

3. *Forms and formats design* is used for design or revise forms or formats to make them more "user friendly."