CHAPTER 2
THEORETICAL CONSIDERATION AND LITERATURE SURVEYS

2.1. Theoretical Consideration

2.1.1. Plant Layout Definition

Plant Layout is the analysis and management of the production resource that allows the operation in the processing line achieve maximize efficiency. The maximization of efficiency is included low cost of production, short lead time, high product quality and employees happy to work. So, plant layout is not only creating new plant, but also include improving an exiting layout such as, reallocate equipment and machine, workstation, management work environment to support operating in processing line.

Rijiravanich, V (1998) said " Plant layout is scheduling and linking machine and workplace, effectively within a constrain of plant layout area. It includes identify material handing areas, warehousing, locating machine and managing workforce of production. The plant layout has a main objective in managing workforce, material, processing equipment and factory to achieve the most efficiency of operation process. To achieve this objective, plant layout focus on a selecting a material flow system that it should be smooth, save and proper to a nature of processing line."

2.1.2. Theory of collecting data that is used in improving plant layout

2.1.2.1. Material flow data

It is a flow of material through each workstation that includes route of flow, volume of material, frequency, method, speed or rate and cost of material handling. All data will be showed in the following chart;

2.1.2.1.1. Process chart

The process chart is mapping and modeling of process by using symbols, operation, transportation, inspection, delay and storage activities. With display all activities in symbol, it seem to easy to understand how the material flow is. As a result, a non value added activity is eliminated to increase performance of productivity.

Symbol	Meaning
○	Operation
⇨	Transportation
□	Inspection
D	Delay
▽	Storage

Symbol	Description	Volume	Frequency	Distance	Time
○ ⇨ □ D ▽					
○ ⇨ □ D ▽					
○ ⇨ □ D ▽					
Total			Total		

FIGURE 2.1: PROCESS CHART

2.1.2.1.2. Flow diagram

It is a figure of material flow in factory, which use symbol of five activities in process chart to show how material flow in real plant layout. The example of flow diagram as seen in page 9.

2.1.2.1.3. From-to chart

It views how often of moving material among each department, machine or workstation. It is very useful in showing the relation between each station to relayout the processing line properly without obstructs of material flow.

TABLE 2.2. : FROM-TO CHART

From \ To	Department 1	Department 2	Department 3	…	Department n
Department 1					
Department 2					
Department 3					
⋮					
Department n					

2.1.2.1.4. Qualitative flow measurement

This concept was introduced by Muther [6] that identified the closeness relationship values among department. The relationship is presented in 6 alphabets, A, E, I, O, U and X.

Value	Closeness
A	Absolutely necessary
E	Especially important
I	Important
O	Ordinary closeness okay
U	Unimportant
X	Undesirable

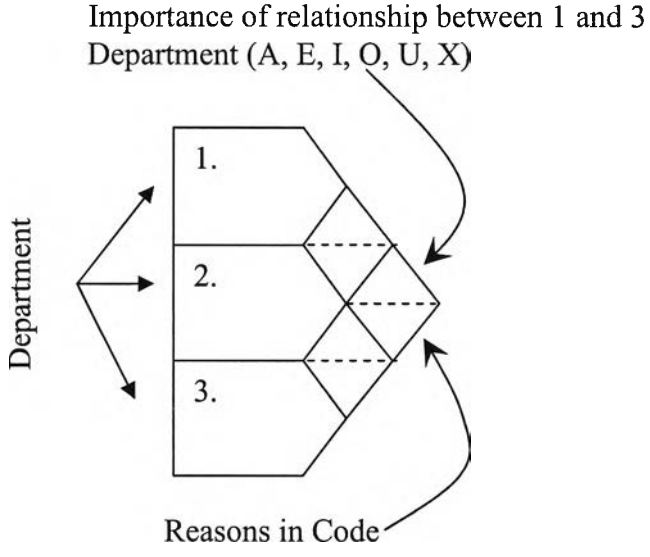

Figure 2.2. : THE RELATIONSHIP CHART

2.1.2.2. Factory Area data

To identify the size and feature of area of the processing line that including the structure of building that effect to space area such as pillar, ladder, wall and inlet and outlet. These data is very useful in identify a proper position of each department in the processing line.

2.2. Example of Plant layout Improvement

According the thesis of Asavapaiboon,.(1991), he aims to study and improve the working methods and the production planning in producing ride-on toys and steel furniture for a factory run as a family business. Five items of the products, which have high sales-turnover, are studied in order to establish a guideline for problem solving in any factory, which produces similar products or has similar production lines. The standard time for production is set for each of the five items in this study to determine a guideline for setting a standard time for production of other products as well. Work-study is also used to reduce idle time. Plant layout is established in order to reduce the time and loss caused by the transportation. A quality control system is established, job sequence and assignment are set to suit the machine so that production time can be reduced. Material requirement planning as well as a management information system in the factory are set to help speed-up the process in the production.

The result shows that work study can reduce the production time as well as the defect of production. The production planning makes it possible to produce the product to meet the delivery schedule of customers and to determine whether an order should be accepted. A concrete and updating primary information is needed to establish a production planning effectively. It is crucial that all the information needed to establish a production planning must correspond to the real situation of the plant or possible conditions. Besides, the cooperation of the workers is needed to create a new idea or new approach to solve any in the production effectively.

Apart from the above example, Jananunporn, (2000) was a research in improving productivity in a hard disk drive factory. At first, he started to investigate a problem and its causes and improved the exiting process. He presented the result in the form of machine downtime (hours/month) and production rate (pieces/month). Also in the research of Jirachutiroj, S. (1995), this research is to study the production system and to improve the layout of a bicycle manufacturing plant, which is used as a case study, by using a computer package program. It was found that some major problems of this plant the inadequate layout and production database. Therefore this research sought to establish a good database system so that systematic layout improvement would be possible and it would be a guide for further production data collection. Using a computer package program: namely Quant System Version 2.0, and the obtained data, an improved layout was produced.

There are some cases of applying knowledge of industrial engineering that Barnes, (1980) provided in his book. He intended to present the principle of successful application of motion and time study that include improving equipment utilization, management of material and energy, reducing human error. His concept is one way to improving productivity that useful for developing the real processing line. Moreover, Muther, (1973), He provided the Systematic Layout Planning (SLP) that he aimed to apply this technique in practical. There are many techniques that he suggested to use. Starting from P, Q, R, S, T key, flow of material, flow relationship, activity relationship diagram, space determinations, space relationship diagram, selecting layout and implementation of new layout. Also, Srisupinanon (1978), he discussed how to design plan layout. He suggested form the objective and scope, selecting plan location, principal of plan layout and technique that are used in plant layout. Besides, Tompkins (1996), presented facilities planning from analytical model. He describes it from a requirement for people, equipment, space, and material in the facility. Later, he provided alternative techniques in material handling. Moreover, he suggested new system as computer-aided layout quantitative facilities planning models, and selection, preparation, presentation, maintenance of plans and the area of computer technology and materials handling.

Applications of the above theory may be found in the research of Lohasomboon, E. (1989). This research intends to study problems and apply the knowledge of industrial engineering and management to improve productivity in a small-scale aluminum ware factory in Thailand. It was found that the problems of this factory were in the production and management department. That the cause of problems may come from poor operation management, plant layout, production process, working environment, storage space of production equipment, and production planning and control. All of these factors lead to low productivity that make it hard for the company to grow the future . The plant was improved by redesigning the organization to balance and distribute work load to management team equally. Moreover, a new plant layout of aluminum sheet factory that is based on systematic layout planning (SLP) and aluminum ware factory was suggested based on group technology (GT). To improve the new plant layout, a new material handling system by belt conveyor was applied. The environment of workplace also was developed, and a local exhaust ventilation system was implemented to eliminate unsafe condition. The data base system was improved by using classification and coding system of product and production equipment for analyze capability.

Moreover, Phungpai. (1992) studied problems in a typical small air conditioner factory in Thailand and applied theories of industrial engineering for improving the productivity. This finding was proposed for future productivity improvement in similar factories. The result of this study reveals most problems that effect production and management, factory planning and layout, production processes, storage areas and balancing production line. All these problems bring about low production efficiency. This research has suggested methods to improve productivity by way of organizational restructuring, setting up a new plant layout, redesigning of production areas, storage and dispatching systems, and balancing production line assembly.

Furthermore, Treesuwan (1995), he aims to study and suggest a systematic approach to improve productivity. The thesis has been carried out in a production process in a sample factory, which produces automatic clutch and intended to establish a guideline for problem solving in any production process, which has similar production operations. The standard production time in this study is set for a guideline to set a standard production time for production of other products as well. Work-study

is also used to reduce idle time. Plant layout and material handling is established in order to reduce the time and loss caused by the transportation. Finally, Wisuttipaet(1986) aims to study and observe the main problems and to propose suggestions or solutions in order to improve the production planning of a small can factory in Thailand. The emphasis was on the machine used in the production, processing method, production process, plant layout, can quality, and production schedule.