CHAPTER 1
INTRODUCTION

1.1 Thesis Background

In this thesis, the scheduling problem in automation foundry is focused. Basically, scheduling is a combination of planning and sequencing. Planning is the process of selecting and sequencing activities such that they achieve one or more goals and satisfy a set of domain constraints. Sequencing is the process of selecting among alternative plans and assigning resources and times to the set of activities in the plan. Thus, scheduling is simply a plan setting out when activities are due to happen and usually where they will be performed and by whom.

In manufacturing, schedules are often more formalized. Many manufacturing companies have known the basic schedule as the master production schedule (MPS) that is the link between customers (demand) and the companies (supply). Besides, schedule provides an important interface between operations, marketing, personnel, and finance. Figure 1 demonstrates the link between scheduling and goal of the manufacturing.

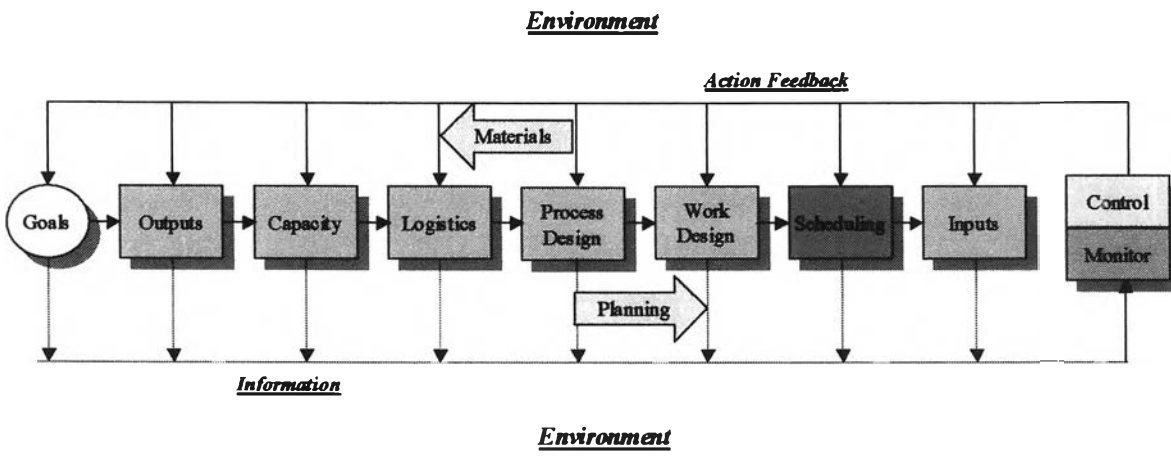

Figure 1 Scheduling: The transformation activities. [Jack R. Meredith, 1980]

According to figure 1, every main station in manufacturing process is linked to each other to achieve the gold of the company, mostly profit / productivity. At the beginning phrase, the companies have to know their own capacity, capability,

resource, process, material lead time, and so on that might impact to the manufacturing ability. After that, scheduling process will plan for all activities, link them to each other, and re adjust when some operations deviate from plan or any disturbances are happened.

Manufacturing scheduling is one of the most difficult problems we are facing today. This is especially when it takes place in an open, dynamic environment. In a manufacturing system, the set of "to do" things is really dynamic. That means the system is asked to do additional tasks that were not anticipated, and sometime interrupt certain tasks. So, the resource allocation has to be changed in order to fit with the new additional tasks. Moreover, the beginning time and processing time of all tasks are also subjected to variation.

Because of this highly combinatorial aspects, dynamic natural and practical interest for manufacturing systems, the scheduling problem has been widely studied by various method such as heuristics, constraint propagation techniques, constraint satisfaction problem formalism, simulated annealing, Taboo search, genetic algorithms, neural networks, etc. Table 1 demonstrates some scheduling techniques and their characteristics.

No.	Type	Product	Characteristics	Typical Scheduling Tools
1	Pure process	Chemicals, steel, wire, and cables, liquids (beer, soda), canned goods	Full automation, low labor content in product costs, high-volume output, facilities dedicated to one product.	Liner programming
2	High-volume manufacturing	Automobiles equipment, partial automated handling, moving assembly lines, most equipment in line, factories dedicated to various models of product.	Automated equipment, partial automated handling, moving assembly lines, most equipment in line, factories dedicated to various models of product.	Just-in-time scheduling (Kanban), Line balancing algorithms
3	Job shops (low-volume)	Capital goods, hand tools, hardware, instruments.	Machining centers organized by manufacturing function (not in line), high labor content in product costs, general-purpose machinery with significant changeover time, little automation of material handling, large variety of product.	MRP based scheduling software, Simulation Assignment method
4	Projects (very low volume)	Officers, roads, theme parks, homes	Production at the point of use rather than in a factory.	PERT / CPM

Table 1 Type of manufacturing processes and scheduling tools. [Chase and Aquilano, 1995]

Scheduling is an important aspect of operations control in manufacturing. It can enhance the competitive advantages of the manufacturing by improve on-time

delivery, reduce inventory, cut lead times, and maximize the utilization of bottleneck resources. Besides, it is a key factor for manufacturing productivity.

1.2 Statement of Problem

Regarding figure 2 and table 2, it clearly addresses that, with the existing production scheduling, company cannot achieve the on time delivery criteria and also have high % of missing shipment parts. The tardiness number cannot be quantified in this case because some jobs did not be completed until the end of that month. These problems also forecast the long term relationship problem as well as the business security of the company.

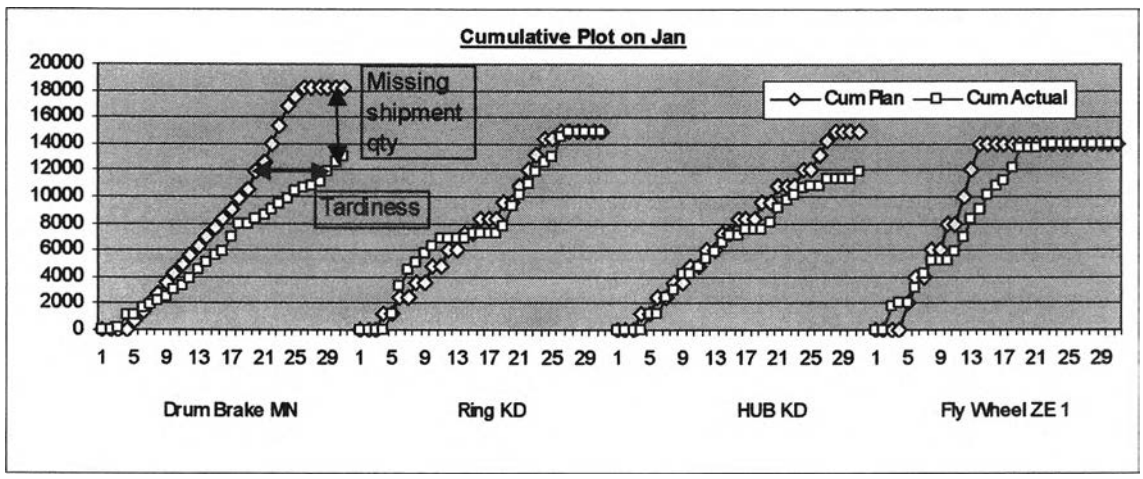

Figure 2 The Cumulative Plot of Shipment Plan and Actual Shipment by Product on Jan' 04.

		Jan' 04		
No	Product	Qty (Total)	Qty (Miss)	% (Miss)
1	Fly Wheel ZE0	3000	-	-
2	Drum Brake MN	18200	5250	28.8%
3	Fly Wheel FCC.	2000	-	-
4	Hub P -Car 02.	1600	-	-
5	Hub KD .	1400	192	13.7%
6	Inertia Ring KD	15000	-	-
7	Hub NOK .	14900	2934	19.7%
8	Ring NOK	7000	1106	15.8%
9	Fly Wheel ZE1	14000	-	-
	Total	77100	9482	12.30%

Table 2 The % Missing Shipment by Product on Jan' 04.

The % missing shipment varies from 13 % to 28%. This is totally unacceptable for the company because it does not impact only to the customer satisfaction, but also the company profit. The missing parts from that month might or might not be included into the next month MPS.

Even though the current situation between company and SBM is doing fine, these problems might becomes a serious issue in the future if the company does not have any correct action for further improvement.

The first analysis indicates that the potential problems for this delay are

- High fluctuation in demand:

SBM keeps changing the MPS due to demand uncertainty, so that, it is very difficult for the company to make a long-term plan.

This problem cannot be solved easily. The right way to go is to establish the supply chain management through the chain. This requires high collaboration and many supported systems. So, this cannot be a short-term solution for now. But, it will be a long-term solution.

- Ineffective scheduling and shop floor control system:

The efficiency of the scheduling system is totally depended on man's skill. That means it has no systematic and has very high uncertainty in the production line. This

can be directly impacted to the production scheduling and also the shipment. Moreover, without shop floor control system makes the company lack of

- Problem detection capability
- Lot status tracking capability

Developing and implementing some scheduling model seems to be a short-term solution. It will help the company to deal with high complexity of product ranges and shipments.

The shop floor control is also necessary for the short-term solution. At least, it will help the company to track the status of each job as well as watch out the problem that might be occurred. So, the company can readjust the plan in case of some jobs will be deviate from the original plan. Besides, it also helps the company to manage all the inventories.

The consecutive problems from current scheduling model are

- Cannot achieve MPS (Master Plan Scheduling).
- Loss business opportunity: In some case the missing quantities do not include in the new MPS, but they are cancelled.
- Difficult for resource planning and resource management.
- Tend to have relationship problem with SBM in the long term.
- There is an opportunity for the new entry.

The key parameters indicated in this problem are

- Mean Tardiness.
- % missing shipment parts.

1.3 Objective

The major purpose of this study is to establish the scheduling model for foundry in order to maximize the on time delivery and minimize % missing parts. In this case, "*total tardiness*" and "*% missing shipment parts*" are key measurement. Moreover, maximize the resource utilization and output is also considered.

1.4 Scope and Assumption of the Research

The scopes and assumptions of this thesis are concluded as follows:

1. This thesis will propose a model for scheduling the automation parts in the foundry. The concerned operations are starting from melting operation to quality inspection operation. However, since melting operation is only one bottleneck in this process, the scheduling model will concentrate on this operation only. For the other operations, backward scheduling is applied.

2. The necessary data used for scheduling are come from actual historical data.

3. This model is developed under the condition that
   - No demand change within a week.
   - Raw material is always available.
   - No machine / line breakdown. Be noted that the maintenance scheduling is already taken into account.

4. The considered criteria for scheduling method in the production are
   - The production lead-time: An amount of time starting from receiving MPS plan until completing the shipment.
   - Work In Process (WIP) / Inventory: Finish goods inventory has to be considered as well as in-line inventory. For in-line inventory, not only quantity but also lead-time from that operation to finishing is considered.
   - Machine / Manpower utilization:

This thesis still needs manufacturing manager to adjust / modify schedule according to suddenly demand changes or priority changes from customer.

1.5 Methodology

In automation foundry, they are consisted of many operations, in series, and many product configurations. Each configuration has its own process mapping that means it might not need to be processed at all operations. The scheduling model is developed under this condition.

1. Study the existing scheduling system and process in this foundry.
2. Academic study about scheduling system for shop floor control.
3. Study the current scheduling system foundry in more deep details.
4. Collect the necessary data.
5. Simulate and fine tune the scheduling model.
6. Consolidate and summarize all data.

1.6 Research Procedure

1. Study related literatures.
2. Study current process in the selected foundry.
3. Generate the plan and timeline for data collection.
4. Analyze the data from historical database.
5. Develop scheduling model for production.
6. Data collection and data analysis.
7. Evaluate the efficiency of the developed method.
8. Write and submit thesis and prepare the presentation for final debate.

1.7 Expected Results

The result of this thesis, scheduling model for automation foundry, will consist of

- Scheduling procedure.
- Scheduling model and algorithm.
- Future improvement plan for scheduling model.

1.8 Expected Benefits

The scheduling model from this thesis tends to improve the scheduling system in the automation foundry. The expected benefits considered under assumption addressed in four items are as below:

- Improve on time delivery with minimum inventory.
- Reduce the missing shipment quantity.
- Maximize the resource utilization.
- Give the clear instruction for production in term of shop floor control.