Chapter 1

Introduction

1.1 Background of Industry

Plastics or Polymers have been integrated with human's life for many decades. Many products in daily life are obviously made from plastics, such as kitchen-ware, stationary, home appliances, vehicle's parts, consumer products, and etc. Coping with that, Injection Molding, as one of the most versatile methods of mass production plastics reforming process, is vastly developed in various directions.

A mold is an indispensable tool for injection molding process. To make a product from the injection process, plastic melt from the machine is injected into a mold of a certain shape, cooled down to solidified temperature, and then ejected from the mold as a desired product. The mold is a tool that takes the significant role in shaping of a molding part. Normally, a mold for injection is designed specifically for a certain part. If there are ten different kinds of parts to be produced, ten molds are needed.

Beside the variety of molding parts, mold life is another factor that requires injection molders to replace new molds occasionally. Injection molds have a limited lifetime from wear and tear. After being used for a certain number of cycles, depends on the quality of material and design, the mold needs to be replaced or repaired.

For the reasons above, the development of mold fabricating industry is vital for the growth of injection molding industry. In Thailand, manufacturers are accustomed to injection molding process for decades. However, most of the cases relied on imported technology. The injection machines and, especially, the molds are always bought from abroad. Importing those things not only boosts production cost skyrocket, but also obstructs the development of the country's own technology.

Nevertheless, many domestic mold manufacturers are currently developing own technology, and beginning to improve quality and standard in manufacturing, which in turn can help plastic industry grow at a faster pace than before. The existing of some standard parts also help the industry grow faster. However, to make molds for commercial, the price of the mold is an important issue to think about.

The cost calculation of a Plastic Injection mold can be done at different phases of the manufacturing process. A clear distinction must be made between the cost estimation of a mold for a price offer (before manufacturing of the mold) and the post calculation of the cost when more accurate data is available (i.e. during or after the manufacturing process).

The preparation of a price offer is one of the most important and difficult phases of the whole production process. Mold maker needs to prepare a quotation, to submit to the customer, who selects the best bidder to win the contract for manufacturing a mold. If the bid is too high, the customer will runaway. On the contrary, if the bid is too low the mold maker will hardly reap any profit.

The efficiency and accuracy of the cost estimation relies considerably on the validity of cost past records, which in turn are constructed from the reliable costing method. Correct cost calculation is the fundamental stage to provide significant information required for further good cost estimation. There are also other significant criteria which influence customer's consideration, namely, delivery period (lead time) or the reputation of the mold maker. However, cost is the only topic of interest in this study.

1.2 Statement of Problem

Mold cost calculation is very complicated and includes many aspects in consideration. Manufacturing cost of a mold varies greatly depending on feature, size, and mechanism of the mold. To calculate the completely correct cost of a mold, a mold maker needs not only detailed information which demands a lot of time, resources and effort, but also a valid costing concept, which can reflect the cost structure closest to the actual one.

Normally, the benefits of having an accurate calculation have to be weighted with the effort taken to get the detailed information. If the detailed information in every step of mold manufacturing process have to be collected, the cost calculated should be doubtlessly precise but the overhead cost spent in processing of data would outweigh the benefit. Therefore, many cost allocating concepts and methods are popularly employed to indicate the closest cost of a mold without working on unnecessary detailed information.

Manufacturing costs used to be simply classified into three categories; namely, direct labor cost (**DL**), direct material cost (**DM**), and factory overhead cost (**FOH**). Direct labor cost is the cost of labor hours invested in making, assembling, and testing the product. Direct material cost is the cost of materials used to build the product. Overhead is everything required to support the production while the product is being produced. Thus, overhead may include utilities, space rentals, engineering and field supports, cost of money invested in inventory, and machine depreciations.

Like those of other conventional manufacturing processes of which the major cost contributions were direct labor and direct material, traditional approaches used for mold cost calculating use production volume measures such as direct labor hours, machine hours, sales, or material costs as allocation bases to attribute overhead costs to products. These product costing concepts report a reasonably accurate production cost where overhead activity is consumed in relation to production volume.

Unfortunately, manufacturing has changed remarkably, and so does the structure of cost. Overhead cost becomes more important and independent to the cost of labor or material. Allocation of overhead cost by conventional methods might distort the picture of actual manufacturing cost at present. Mold manufacturing process, considered as a job-shop process, might also be influenced by those structural changes inevitably. If so, do the conventional job order costing methods regard the changes? Do those methods still accountable for the entire actual cost?

The plastic part manufacturer company used as a case in this study also had this kind of problem. In the past, the company was a producer of injection parts which mainly are PVC (Polyvinyl Chloride) pipe fittings and some other peripherals for PVC

pipe work. The molds used in the production were imported mainly from Japan. As the time passed, the company established an internal mold shop for mold maintenance and afterward developed the capability to the point that can manufacture the molds for domestic use.

Furthermore, the company was expanding to be a commercial mold manufacturer to make molds for sales. Capacity of mold manufacturing that exceeded the domestic demands would be used to generate the incomes for the company. In order to accomplish the target above, the company needed a suitable method to aid in calculation of mold cost.

From primary access through the company, there was no significant past record on manufacturing cost information of the former molds available. Traditional approach of the company in allocating overhead costs of mold manufacturing was based on the accumulated value of mold's direct costs, in Baht, at the end of each month. Hence, the mold which had been manufactured for a long time and had consumed a lot of direct costs would hold a large accumulated value inside, and would be charged with overhead cost in relatively high rate, compared with the mold which just start, as a result.

This approach certainly did not reflect the true proportion of resources consumed by each mold manufactured in a month. For instance, in the same period, two molds of different accumulated value might be worked with the same amount of resources, but would be charged with different rates of overhead. This might be unfair. However, in longer period this method might compensate the shortcoming stated above. Every mold, when finished, would be totally charged with a certain amount of overhead. Nobody could tell whether this concept gave the correct indication on the overhead cost, or there should be other better concepts which reflect the overhead cost closely relevant to the actual cost.

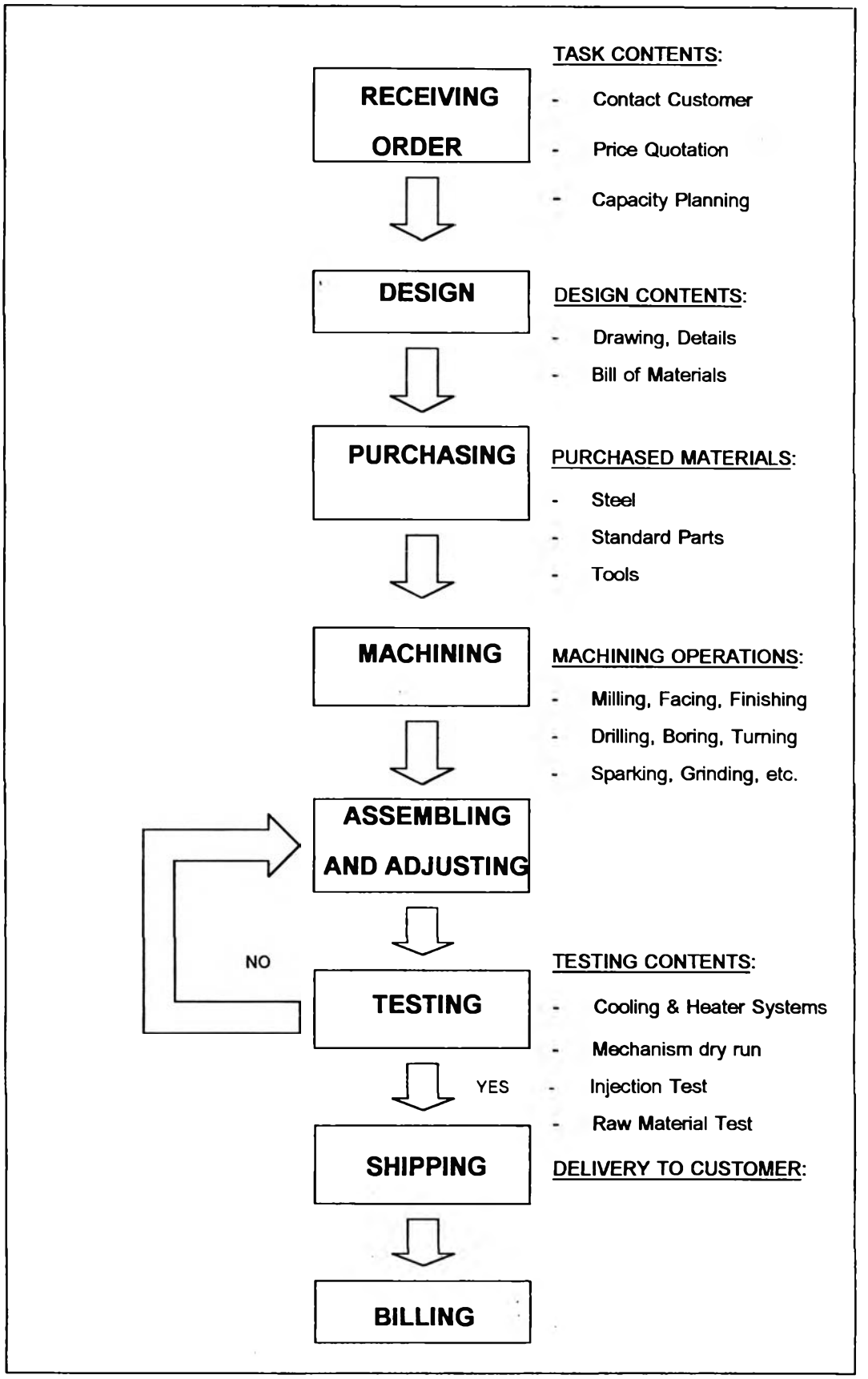

Figure 1-1 Flow Process Chart of Mold Manufacturing in this study

Manufacturing processes of a mold started from the stage of design, down to, raw material purchasing, machining(fabrication), assembling, testing, adjusting and delivery of the mold, until completed when the company received the money from customer, similar to many other manufacturing processes of other products. In each stage, there were a lot of costs induced from many activities, some were visibly seen while some were vague to be detect relatively. Every significant cost which really happens in the process was needed to be recognized by the company for post calculation of the actual cost caused to the company by the mold. Moreover, the same structure of costs could also be applied to facilitate cost estimation of other kinds of mold which had not yet been made.

In this study case, the factory had four production departments, based on type of products, and eight support functions for non-production tasks in the plant. Three major production departments were for manufacturing of plastic products namely (1) pipe-fittings and peripherals, (2) pallet, and (3) PVC door and window. Another production department was (4) mold manufacturing, which was quite different in process and technology from the former three.

Eight support functions were (1) plant service, (2) plant manager office, (3) maintenance, (4) statistical & production data, (5) lab & product-development, (6) mold design, (7) accounting & procurement, and (8) personnel & administration. These functions were existed for giving services to the production departments. Service contribution depended on the contents of task in each department. Management of any activity in the factory was under the supervising of the plant manager and plant management team, which located on the site full-time. As a result, cost of management in factory was charged directly to the factory overhead cost.

Actually, there were also other functions out of the factory such as marketing, sales, engineering, technical service, or even head office administration and top management, but these functions purely worked to serve plastic products, which were main products of the company, and had nothing to do with mold production. That was because both molds produced for domestic use and for sales were ordered, made and charged directly to the account of the factory job by job. No marketing or sales activity was needed. Rather technical factors were involved in the cost content of a mold.

Besides, these functions are located on different site and share no facility with mold manufacturing. Therefore, mold cost would be assumed to be calculated only from the cost occurred at the factory. No cost from head office is involved in this study.

Each production department behaved as a profit center, which made incomes for the company by selling of the products, and would be charged with costs both from inside the department, and from the support functions which provided center services and made no revenue. Mold manufacturing cost of this company, therefore, composed of three major parts namely direct costs, indirect costs from department overhead, and indirect costs allocated from plant support facilities.

For direct costs, each mold produced would be assigned to be a cost center identified by the budget control number. The cost such as direct materials, direct expenses or sub-contracted works, freight & handling expenses, and direct tool & equipment for a mold would be charged directly to the identified budget account. These costs were clearly visible and easy to handle.

For indirect costs from department's own overhead, both fixed costs (FC) such as machines (m/c), and assets depreciation (interest included), employees' wage, supervisors' salary, and variable costs (VC) such as power cost, other materials and supplies, machine repair and maintenance, tools & equipment, travelling cost, etc would be charged directly to the account of mold manufacturing department on monthly basis. Then, these costs would be further allocated to the molds that were manufactured in that month. Every mold in that month would absorb these costs through the allocation of which the suitable criteria are going to be challenged in this study. Traditionally, these costs were monthly assigned to a mold according to the accumulated value to date at month end of that mold, while some were assigned to a certain mold since the early stage before, by the decision of the department manager.

For indirect costs allocated from plant support facilities, most were treated as fixed costs by establishing budgets such as assets depreciation, employee salary, management cost, power cost, other materials & supplies, travelling cost, employee welfare, communication cost, etc. These were similar to the indirect fixed costs from overhead inside department, but needed more steps to work on and needed different

criteria in allocation. These costs would firstly charged to the account of relating function. Then, the cost of support functions would be monthly allocated to the production departments based on the suitable basis, that was conventionally the weighted average percentage of service of each function to production departments. After some parts of these costs were assigned to mold manufacturing department, the department would further assigned these costs to each mold in that month by the accumulated value to date of the mold, accordingly.

In conclusion, the problem of traditional mold costing system of the company was that, any cost happens in the processes or support functions was recorded and classified in the form of accounting cost centers according to the functions, or the molds, or the products which that cost happens for. If the cost simply belonged to any certain mold, it could be charged easily as a direct cost. However, if the cost was ambiguous to fall into a mold cost center, the department manager would consider based on own discretion to put the cost into a mold cost center. Otherwise, the function or department would absorb the ambiguous cost as an overhead and assign to all molds later, according to the value to date of each mold. These might not be the proper way to calculate mold cost. In fact, there might be other reasonable criteria, for example - the activity, to be used as the allocating base for the overhead cost of mold manufacturing.

1.3 Objective of Research

The objectives of research were (1) to study the structure of mold manufacturing cost using "Activities-Based Costing" analysis method (ABC), comparing with conventional job order costing concepts, and (2) to find out the most effective method of calculating the actual cost of mold.

1.4 Scope of Study

This research was aimed to be conducted within the scope below:

1. Studied the methodology of "ABC" and conventional job order costing concepts to be used in calculation and comparison of cost of mold manufacturing.
2. Studied the activities and cost structure of mold manufacturing process (only the mold for fittings) in the case company, from the stage of design until delivery to customer.
3. By using the principle of "ABC", activities in the processes should be determined and classified to reflect the structure of costs
4. "ABC" concept and other conventional concepts would be applied for post calculation of mold cost. The number of mold, of which information would be brought to calculation in the case, depended on the time constraint and the company's production schedule planned. The result would be compared and concluded for the benefit achieved from each concept and the success of "ABC" application.

1.5 Research Procedure

The procedure of this research was planned to be:

1. Surveyed related literatures about conventional job order costing methods used in calculation of mold cost.
2. Studied the methodology of "ABC" and the applications which could be adopt for the case.
3. Studied and collected information of mold manufacturing processes, the parameter of cost characteristics and relating activities. Examined the existing cost systems.
4. Defined and classified costs of each stages into activities as the cost pools.
5. Prepared structures of cost calculation by "ABC" and conventional concepts which covered all ranges of costs in mold manufacturing.

6. Selected fitting molds which were scheduled to be manufactured in the period of study to be sample molds, collected costs information of the sample molds, and used each costing concept to calculate the actual cost of the molds.

7. Compared the result and analyzed the accuracy, cost accountability and reliability between each concept, especially in term of the overhead cost reflected. However, the evaluation of each concept also depended on the cost policy and values perceived by the company who implemented it.

8. Summarized the study.

9. Prepared thesis report.

10. Final examination.

1.6 Expected Advantages of Study

The benefits which this research expected to achieve were:

1. The advantages and disadvantages of applying "ABC" concept to calculate cost of mold manufacturing, which is a job-shop manufacturing process, would be studied and clarified.

2. A comparison of mold manufacturing costing concepts, between "ABC" and other conventional job order costing concepts, would be conducted, on the basis of information from fitting molds.

3. The study would reflect the correct idea about cost structure of fittings mold manufacturing, at least in the working environment of case company. The study should, otherwise, provide various systematic ideas to be the frame for selection of mold cost calculation approach which is suitable for constraints in other cases.

4. The calculation concept can be adopt to be used widely in calculating the costs of other kinds of manufacturing processes, especially for the job-order fabrication works.

5. The study could be fundamental literature for further study and development of overhead cost allocation-bases concept.

6. The actual costs and characteristic of cost structure of mold calculated from this study can be recorded to create a significant data base for better cost estimation system in the future.