# Chapter 1

# Introduction

## 1.1 Introduction

Nowadays, because of concerning with a high quality and more complicated polymeric or plastic products at low cost, injection molding process as one of plastics mass production processes is used widely throughout the plastics industry. Thus, there are many researches and development of injection molding in many different aspects.

In injection mold machines, the mold as a heart of the injection molding process, has a basic function to contain melting plastic from injection system. At this stage, injected melting plastic material is solidified into the required shape of products. In plastic market, there are various typical plastic product are needed. Due to mold designed into a certain pattern, the more the various products, the high the demand for numerous change in shape of mold design. In addition, the limitation of mold life cycle lead to the need for changing some molds and mold components. Molds manufacturing industry as one of important supporting industries, therefore, effects significantly on plastic product manufacturing industry.

Plastic injection molds are unique and complex tools required for high speed and mass production of plastic parts. Although each plastic injection mold is required for the uniqueness of design, all molds can use common components such as assembly bolts, guide pins and sprue bushings. Computer Aided Design ( CAD ) was introduced as a solution to reduce the time to design mold.[4], [11]. By means of CAD system,

special features of common component and standard components could be called from a library database and added to the mold design.

In Thailand, plastic injection moldmaking industry relied significantly on imported technology. Some plastic product manufacturers must buy old injection molds or new complete standard molds from aboard. Presently, however, the local mold manufacturers are playing important role in developing injection moldmaking industry. In addition, the use of standard mold components accelerates the growth of moldmaking industry in Thailand.

## 1.2 Statement of Problems

Presently the use of computer aided design (CAD) become the accepted standard for quality mold design. By means of CAD, mold makers and mold designers can design a mold the methodology it is built, as a series of 3D plates and components, and can added some specific features of molds such as cavity and cores. In addition, the mold engineer can select the former standard components and parts in library databases to reduce lead time of design processes.

Nevertheless, when the company makes decision to manufacture injection mold or changing designs for responding various customer needs, materials selection activity, a vital activity in mold manufacturing, requires systematic decision making because this stage involves with not only design stage but manufacturing process and finishing process as well. The intuitive or in experienced decision effects dramatically on overall production.

In practice, injection mold can not be designed separately because of consisting of various complex components. In manufacturing injection mold, therefore, there are many aspects in design from customer recognition until production. According to figure 1, general design for injection mold is illustrated. Notice that stage of material

selection must be related with mold design consideration, manufacturing processes, and mold finishing processes.
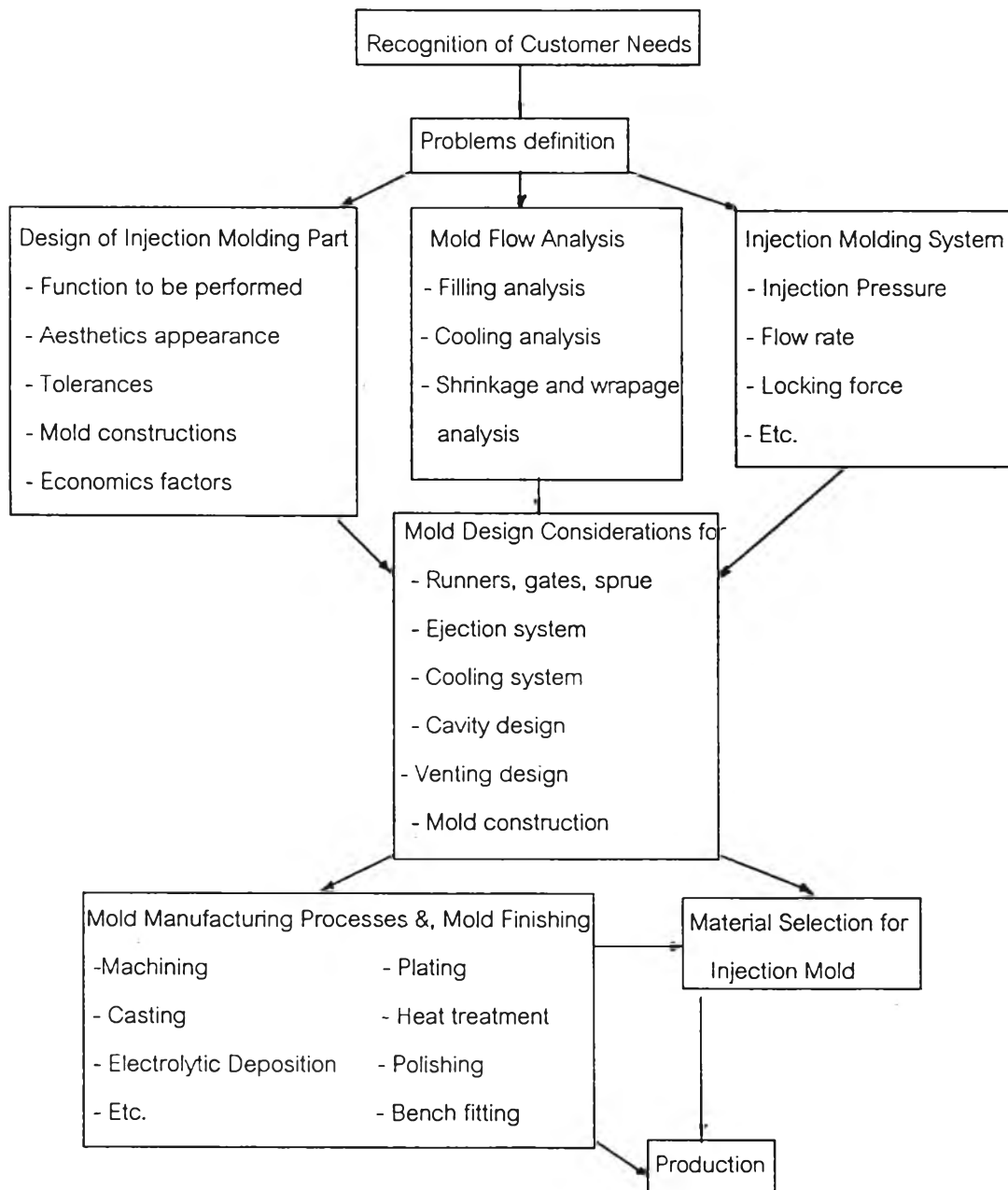
In the stage of materials selection for injection mold making, there are two possible methods in selecting materials. The first possible way is based on related literature such as handbook, textbook, and documents. The second way to achieve the objective above is the heuristic experiences of human experts. In real-time practice, human experts can use their own skills, heuristic experience, and pragmatic intuition to make decision to select materials in moldmaking. During this process, when experts quit, retire or change their job, they also take invaluable knowledge in this field. While the rest may not have enough or deep knowledge so that they can work instead of experts effectively. In addition, there many different types of sort materials for injection molds that can be used in different situation, but selecting the correct one without the aid of expert can be costly. This effects severely on manufacture of injection molds.

In order to assist less experienced mold makers, the development of an knowledge-based system is designed to help with preliminary selection of materials for injection mold, and reducing the dependence on human experts. The knowledge base is a collection of general fact, rules of mold design, materials for injection mold, and practical experience. Furthermore, as the volume of knowledge expands, the Knowledge-based system can function better. In addition, the development of knowledge-based system make that all knowledge from many experts can be stored.

## 1.3 Objectives of the Research

The objective of the research is to create an knowledge-based system to assist mold manufacturers to select materials for making injection molds

## Figure1: General Injection Mold Design Consideration & Material Selection

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                    ┌─────────────────────────────┐
                    │ Recognition of Customer Needs│
                    └─────────────────────────────┘
                                  │
                        ┌──────────────────┐
                        │ Problems definition│
                        └──────────────────┘
```

**Design of Injection Molding Part**

- Function to be performed
- Aesthetics appearance
- Tolerances
- Mold constructions
- Economics factors

**Mold Flow Analysis**

- Filling analysis
- Cooling analysis
- Shrinkage and wrapage analysis

**Injection Molding System**

- Injection Pressure
- Flow rate
- Locking force
- Etc.

**Mold Design Considerations for**

- Runners, gates, sprue
- Ejection system
- Cooling system
- Cavity design
- Venting design
- Mold construction

**Mold Manufacturing Processes &, Mold Finishing**

-Machining          - Plating
- Casting           - Heat treatment
- Electrolytic Deposition   - Polishing
- Etc.              - Bench fitting

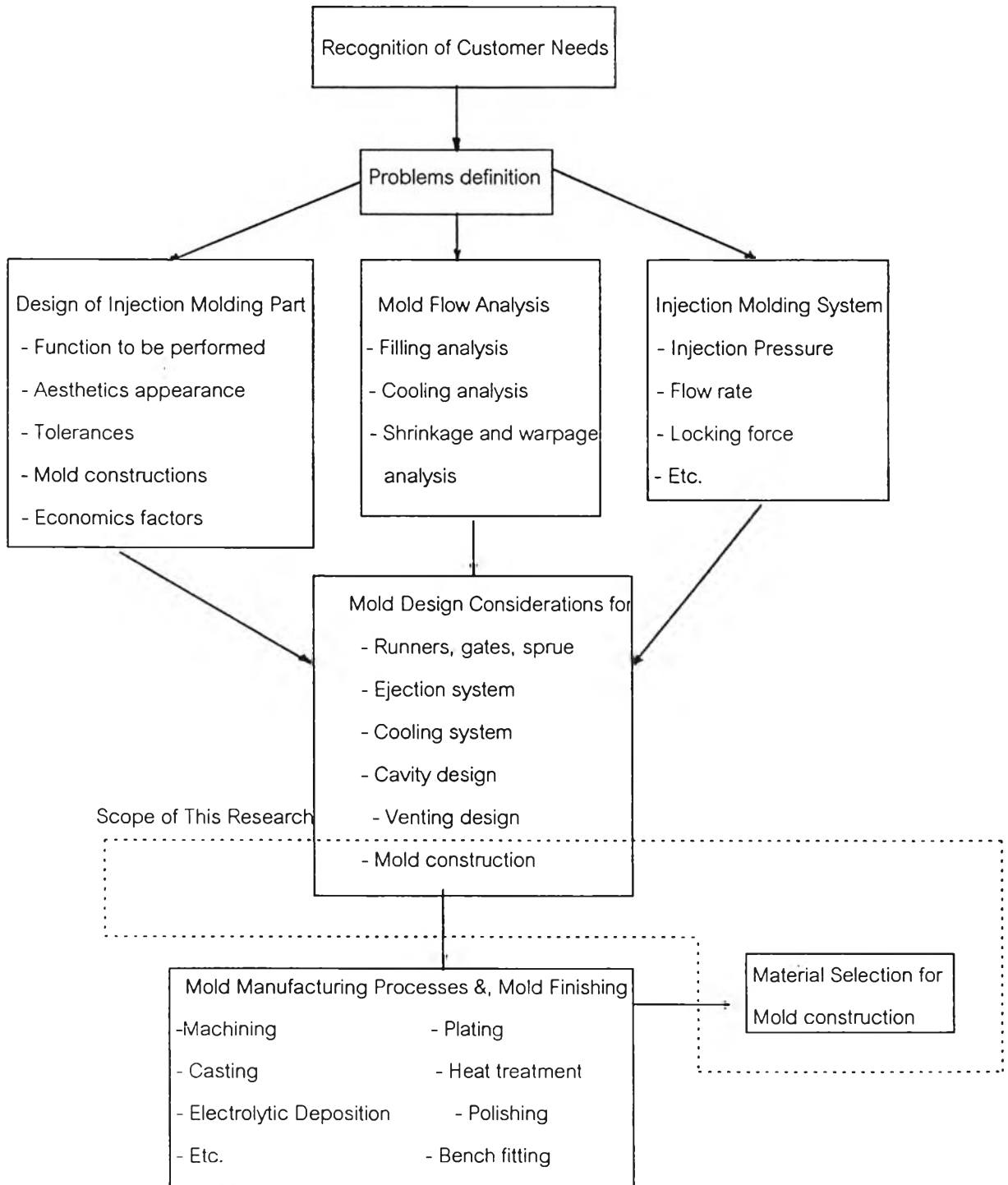**Material Selection for Injection Mold**

**Production**

## 1.4 Scope of the Research

◆ This research focuses on the main injection molds for plastic materials, which are mold bases. The other components being mostly are standard components and other types of molds are not related in this research. The scope of this research is limited within dotted-line frame in figure 2.

◆ Knowledge related materials properties and material selection will be obtained by studying from related literature such as handbook, manual, and textbook. Some will be obtained by human experts.

Figure 2: General Injection Mold Design Consideration & Material Selection

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                    ┌─────────────────────────────┐
                    │ Recognition of Customer Needs │
                    └─────────────────────────────┘
                                  │
                                  ▼
                         ┌────────────────────┐
                         │ Problems definition │
                         └────────────────────┘
```

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|---|---|
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| - Etc. | - Bench fitting |

**Material Selection for Mold construction**

## 1.5 Research Procedures

The procedure of this research will be followed the planned steps shown as belows:

1.  Study related literature about injection molding, materials and manufacturing processes selection, and expert or knowledge-based systems.

2.  Collect data and information from related documents and expertise.

3.  Analyze information and design the system and methodology of material selection.

4.  Construct the knowledge-based software programming.

5.  Apply the system with actual data and parameters obtained from injection mold maker.

6.  Discuss the application of the software from research work with existing manufacturer method.

7.  Conclude the research work and suggest for further research.

8.  Write up thesis and submit thesis form.

9.  Final examination.