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# DEVELOPMENT OF PRODUCTION AND INVENTORY DATABASE FOR PLASTIC INJECTION MOLDING MANUFACTURE.

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สำหรับอุตสาหกรรมการฉีดชิ้นส่วนพลาสติก การใช้งานระบบฐานข้อมูลที่ไม่เหมาะสมทำให้เกิดการล่าช้าในกระบวนการผลิตบ่อยครั้ง อันส่งผลให้เกิดการส่งมอบผลิตภัณฑ์แก่ลูกค้ามักล่าช้า ซึ่งการส่งมอบผลิตภัณฑ์ที่ตรงต่อเวลานั้น ถือเป็นหนึ่งในปัจจัยที่สำคัญที่สุดในการดำเนินการทางธุรกิจนี้ ดังนั้นระบบฐานข้อมูลการผลิตและควบคุมพัสดุคงคลังของบริษัทแห่งหนึ่ง จึงถูกทบทวน และ ปรับปรุงใหม่บนพื้นฐานระบบฐานข้อมูลคอมพิวเตอร์ เพื่อพยายามขจัดปัญหาการล่าช้าในกระบวนการผลิตและส่งผลิตภัณฑ์ ซึ่งเป็นจุดประสงค์หลักของวิทยานิพนธ์ฉบับนี้

การพัฒนาระบบฐานข้อมูลแบ่งออกเป็นสี่ส่วนหลัก ๆ โดย ในส่วนแรกเป็นการศึกษาข้อมูลเบื้องต้นของระบบฐานข้อมูลที่ใช้อยู่จริง โดยการเก็บข้อมูลจากการสัมภาษณ์ และ การศึกษาระบบเอกสารที่ใช้งานอยู่จริง และการสังเกตการณ์ของกิจกรรมการผลิตและควบคุมพัสดุคงคลัง ต่อมาจากข้อมูลเบื้องต้นเหล่านี้ สามารถนำมาวิเคราะห์ระบบการทำงานของฐานข้อมูลในปัจจุบันซึ่งเป็นส่วนที่สองของการพัฒนาระบบ การวิเคราะห์ฐานข้อมูลนี้ใช้เครื่องมือ Data Flow Diagram และ Data Dictionary เพื่อแสดงการทำงานของฐานข้อมูลปัจจุบัน ซึ่งจากการวิเคราะห์ระบบฐานข้อมูลทำให้ได้รู้ถึงความต้องการของระบบและผู้ใช้งาน

ส่วนที่สามเป็นการออกแบบและพัฒนาฐานข้อมูลตามความต้องการที่ได้จากการวิเคราะห์ระบบฐานข้อมูล การพัฒนาระบบฐานข้อมูลการผลิตและควบคุมพัสดุคงคลังนี้ ประกอบด้วย ระบบการออกคำสั่งผลิต ระบบเก็บข้อมูล และ รายงานต่าง ๆ การพัฒนาระบบฐานข้อมูลทำโดยโปรแกรมจัดการฐานข้อมูล Microsoft Access 2000 และ Microsoft Visual Basic 6 ซึ่งทำงานบนไมโครคอมพิวเตอร์ ส่วนสุดท้ายเป็นการทดสอบระบบฐานข้อมูลโดยประยุกต์ใช้กับ กลุ่มเครื่องจักรตัวอย่าง ควบคู่กับ ระบบฐานข้อมูลเดิม เพื่อป้องกันความผิดพลาดที่อาจเกิดขึ้น และสุดท้ายทำการประเมินผลการใช้งานระบบฐานข้อมูลที่พัฒนา

จากการประเมินผล พบการลดลงของระยะเวลาพัฒนาผลิตภัณฑ์ถึง 20.61 เปอร์เซ็นต์ อันเกิดจากประสิทธิภาพสูงขึ้นของการสื่อสารข้อมูลการผลิตและควบคุมพัสดุคงคลัง ซึ่งการลดลงของระยะเวลาพัฒนาผลิตภัณฑ์นี้ ทำให้เพิ่มศักยภาพของบริษัทในการส่งมอบผลิตภัณฑ์ที่ตรงต่อเวลา นอกจากนี้ ระบบฐานข้อมูลที่พัฒนายังทำให้ผู้ใช้งานทำงานได้อย่างสะดวกขึ้น อันทำให้ การใช้ประโยชน์จากแรงงานบนกิจกรรมการผลิตและควบคุมพัสดุคงคลังอย่างคุ้มค่ามากขึ้น

ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต
สาขาวิชา การจัดการทางวิศวกรรม
ปีการศึกษา 2543

ลายมือชื่อนิสิต.....
ลายมือชื่ออาจารย์ที่ปรึกษา.....
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

# 4271604021 : MAJOR ENGINEERING MANAGEMENT
KEY WORD : PRODUCTION AND INVENTORY DATABASE
TEERA JUNGTHIRAPANICH : DEVELOPMENT OF PRODUCTION AND INVENTORY DATABASE FOR PLASTIC INJECTION MOLDING MANUFACTURE. THESIS ADVISOR : ASSIST. PROF. RIEN BOONDISKULCHOK, Ph.D., 199 pp. ISBN 974-347-111-1.

For a plastic injection molding industry, the usage of an improper designed information system always causes the lateness in production, which subsequently results in the delay of the products delivery to the customer. The delivery on time is one of the most important factor in this industry. So, a production and inventory database of one company was revised and developed in order to reduce the production development time and the product delivery problems of the company.Thus, this is the main purpose of this thesis.

The development of database consisted of four stages. The first stage was the preliminary investigation which was the fundamental study the current paper based database system. The study was done by many data gathering techniques which included the interviews, the documents analysis, and the work observation. The data collected in the preliminary investigation stage was useful in the system analysis stage which was the second stage. The Data flow Diagram and Data Dictionary were used in the system analysis in order to clearly showed the existing processes in the system. The second stage also outcame the users' and the system's requirements.

The third stage was the design and development of the database system which relied on the system's and users' requirement. The database was developed on Microsoft Access and Microsoft Visual Basic 6 application on the personal computer platform. The final stage was the test, implementation, and evaluation of the developed database system. The implementation was done on the pilot machines group in the parallel consersion style to prevent from suffering damage if the system did not perform.

The evaluation results indicated the shortening of the production development time in a proportion of 20.61 percent due to the more effective communication of the production and inventory information. The reduction of the production development time enhanced the delivery on time ability of the company. In addtion, the developed database also facilitated the users in processing the production and inventory data, thus increased manpower utilization.

The Regional Centre for Manufacturing Systems Engineering Student's signature……..
Field of study Engineering Management Advisor's signature……
Academic year 2000 Co-advisor's signature……...

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# CHAPTER I

## *INTRODUCTION*

## 1.1 Background of the research.

At present, as the world of data communication becomes a fundamental necessity in our lives, the information technology has played increasingly role in the business. Every business is forced to apply the right information technology in order to compete with their competitors. No one can deny that the information system is a critical key for the organization success. In this research, the author aims to adopt the suitable information system in the manufacturing company by developing the efficient database management system for the industrial factory.

Besco International Plastic Co.,Ltd (B.I.P) is the plastic injection molding company. After the establishment in 1996, the company has constantly grown its business until it earns a reputation as a high quality plastic injection molding company. Nowadays, the company has 18 plastic injection machines with over 110 staffs. The main job of the company is hired to produce the plastics injected parts due to the customers' need. General products of the company are electronic parts, automotive parts, office automation equipment, consumer products, and etc. Almost products are plastic engineering parts which need high precision and quality. The primary objective of BIP is to serve the best services with the highest quality of the products to the customers. The crucial factor in the plastic injection industry is the quality of the products and the right on time delivery of those products. Therefore, the production planning and inventory control processes are critical to the business. So far, the company has got a vast numbers of customer orders. The company has encountered the difficulties on managing these gross amount of production orders efficiently because its current poor information system.

When the customers place the purchase orders to the company, there are a lot of information associated with those orders such as the customers' data, plastic parts specification, delivery agreement, trading agreements, and etc. These information are

necessary to flow in various departments in the company in order to carry out the production activities. For instance, when the purchase orders arrive to the company, the Purchase Order documents would then pass to the production departments. Then the production planning section would make three copies of the Purchase Order papers and dispatches them to the accounting department, stock department, and production planning. Each department has to generate a vast amount of data from the documents in order to use in their own department or to control another department. Hence, the data communication in the company is considerably complex.

At present, the company does not pay high attention in improving the information system. The current database system bases on the mixture of the paper based documents and common individual program such as a spread sheet application such a Microsoft excel. However, most information are flowed in the paper based documents which are manually filled. There are over 40 different papers document forms utilized in the factory. These documents are flowed within the department and among different departments. The poor database systems, especially in the production and inventory department, always causes the company in lengthy time to process the activities and hard to check the papers and errors of data. The ambiguity of the information system sometimes causes the misunderstanding among departments. There are a lot of incorrect recorded data in the document forms which are caused from human errors. The error data incur the wrong production planning, stock control, and finished parts delivery. For instance, when the production planning section receives the customer orders, the production planner will generate the production schedule for each machine. The schedule contains the information of the parts, the quantity of each order and the period of time of production. Then the production planner will dispatch the job order lists to the production department. The production department must produce the parts following the production schedule tightly. At the end of each day, the machine operators must report the quantity of finished parts to the production planning and the warehouse department. Then, the finished parts would be inspected by the QA&QC section in order to screen out the defects. This process reduces some amount the finished parts, then the QA&QC section would inform the quality certified parts quantity to the production planning and warehouse department. The warehouse would

then record the information of each finished part and deliver the parts to the customers. The process of information flow is quite complex and wholly manual tasks. It is considerably time consuming task and always causes data errors.

However, because of the poor document design, it forces the operators to fill too much information during the production, whereas some of the information are an unnecessary information. Some information are repetitive duplicated which may cause data in each document hard to update when any data is changed. Moreover, the more manual records in several paper forms arises, the more the problems of recording wrong data due to human error in reading and writing of operators occur.

So, the company need to build a kind of modern computerized database business application integrating with the existing information system that enables various users in the company to access to the data from multiple locations.

## 1.2 Statements of the problems.

At present, the company has encountered the lengthy production development time and the inflexibility to change the information in production and inventory department because of the advent of a Just In Time system (JIT) of a lot of customers. The customers are no longer satisfied with the lengthy production development times. They place orders in smaller volumes more frequently. This makes the task of the information system management more critical. The current information system consumes too long lead time to manage documents before producing the parts. The changes of data in production planning, production, material stock, and finished parts stocks are not updated concurrently as the orders arrive.

These cause the following problems :

1. The lateness of production, which is the result of the lengthy communication time among various departments. The production lateness affects to the lengthy production development time, which frequently causes the wrong delivery. The wrong delivery includes the delay in product delivery and the delivery of the shortage or excessive amount of parts. So far, the company has been charged a large amount of penalties fee due to the wrong

delivery. In addition, it causes the complaint from customers and discredits the company reputation.

2. The low utilization of resource especially on a man power utilization, which always causes high expenditures to the company.

## 1.3 Objective of the study.

The objective of this study is to analyze, design and develop the database system for production and inventory management for the company.

## 1.4 Scope of the study.

This research will cover the database systems development in the production and inventory department. The systems are focused on these specific areas:

1.4.1 The production planning, the production control, the arrangement and control of material stock, the arrangement and control of product warehouse, and the material procurement.

1.4.2 The database will implement on pilot project, which covers for 4 injection machines in the factory. These machines are the same size machines that are Toshiba ENG 100 tons size.

1.4.3 The research will base on the development of five major information system components: people, procedure, hardware, software, and files. Thus the content of the research concerns in :

- Software : The developed database management system which is based on computer program architecture.
- Hardware : The selection of equipment that is needed to implement the system.
- People : The identification of staffs in the factory who are responsible the system.
- Procedure : The tasks people have to take part in the developed system.
- Files : The method of storing data, which may be in the developed computer storage or the sustained existing paper documents.

1.4.4 Software will be evaluated by:

- The change in production development time.
- The change the manpower utilization.

## 1.5 The methodology of the research.

The research is developed in the following steps :

1.5.1 Study related literatures.

1.5.2 Preliminary investigation.

1.5.2.1 Request an authorization for the preliminary investigation.

1.5.2.2 Identify the information that is needed to gather.

1.5.2.3 Request for organization charts for the production and inventory department undergoing study to determine persons to be interviewed.

1.5.2.4 Conduct interviews to obtain information.

1.5.2.5 Analyze the gathered information.

1.5.3 System analysis.

1.5.3.1 Analyze the current information business process.

1.5.3.2 Determine and analyze the requirements for the developed system.

1.5.4 Database design.

1.5.4.1 Input, output and file pattern design.

1.5.5 Database development.

1.5.5.1 Program development : Design and code the program.

1.5.6 System implementation and evaluation.

1.5.6.1 Testing : System testing.

1.5.5.2 Documentation: System and end user documentation.

1.5.5.3 Training.

1.5.6.2 System changeover in pilot operation.

1.5.6.3 Evaluate the database system implementation.

1.5.7 Conclusion and submission of the dissertation.

## 1.6 Expected outcomes.

The result of the research would outcome:

1.6.1 The software database system that will be implemented.

1.6.2 The documents that describe the current and developed information system.

1.6.3 The documents of system specification and end users usage.

1.6.4 The evaluation of the system implementation.

## 1.7 Expected benefits.

The expected benefit of the research is the improvement of production development time, which is the result of a more efficient data communication of the production and inventory department. This will reduce the delay of finished parts delivered to the customers. In addition, the system is also expected to improve the data accuracy in production planning, production control, material stock, and product warehouse. The developed database system expect the operators to be able to input the data and outcome the data result much more quickly, so that they are able to do other beneficial tasks for the company. Hence, the improvement of the manpower utilization including the computer equipment utilization in the system is anticipated to enhance.

# CHAPTER II

## *THEORETICAL STUDY*

## 2.1 Systems Analysis and Design.

The System Analysis and Design is a traditional approach to develop the information system for an organization. According to Gary B. Shelly, Thomas J. Cashman, Judy J. Adamski(1995), they suggest the approach on constructing the information systems which was consisted of five phases. The approach is called the Systems Development Life Cycle(SDLC) or the Waterfall model. The SDLC consists of the following five phases:

- Preliminary investigation.
- Systems analysis.
- Systems design.
- Systems development.
- Systems implementation and evaluation.

They suggest the company follow each phase in sequence strictly in order to achieve the most effective information system. Each phase may appear in the following figure.

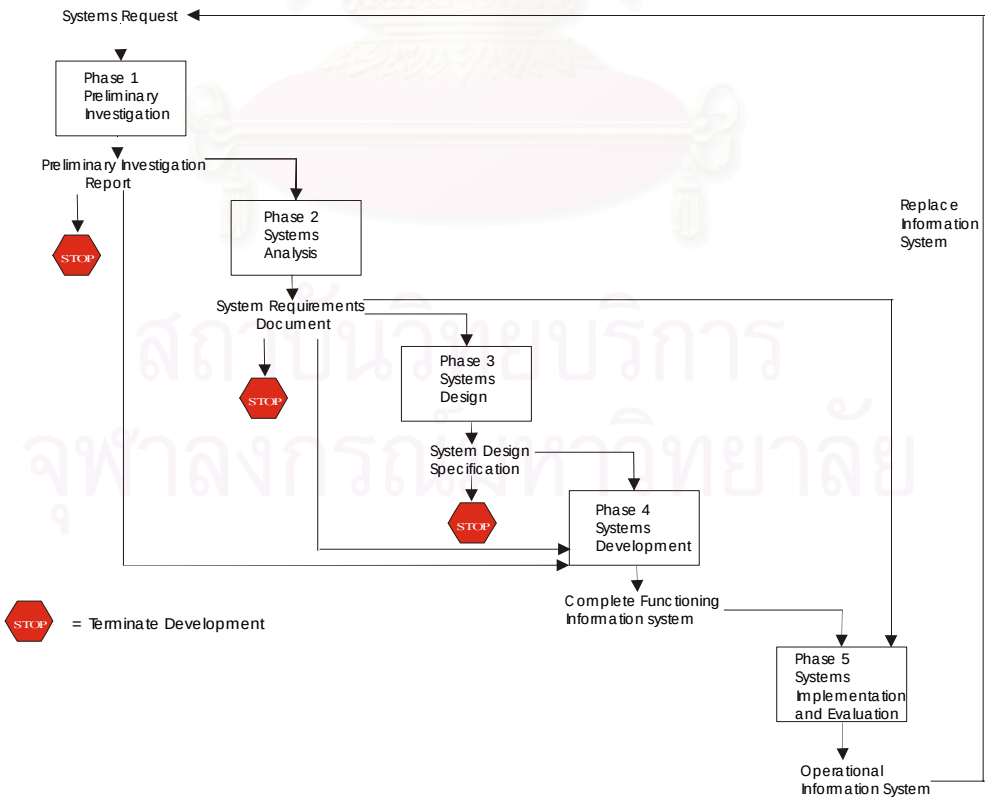


*Figure 2-1 : The five phases of the SDLC and their respective outputs.*

### 2.1.1 The preliminary investigation.

They expressed that the preliminary investigation was the first step in a written request from management or end user triggering the start of the database system development. The work to be done in this step usually is expressed as a problem statement that is a definition of the deficiencies in the information system or of the improvements desired. The work may be substantial which is the creation of an information system to new business requirements, or it could be for the replacement of an existing information system that can not longer handle changing business requirements. In contrast, the work requested can be minor such as requesting for adding a new report in the existing system. The purpose of the preliminary investigation phase is to identify clearly the nature and scope of the problems mentioned in the systems request.

For this research, the author had visited the plastic injection molding company and had acknowledged the difficulties in the production and inventory department of the company which has always incurred several problem in production delay and products delivery of the company as declared in the introduction chapter. So the author had conducted the preliminary investigation phases and found out later that the major cause was from the current poor information system which take too long time to process the production and inventory management activities and always incurred a lot mistakes in data manipulation. So that's why the author intend to develop production and inventory database system for the plastic injection molding company as the topic.

### 2.1.2 The Systems Analysis.

The purpose of the systems analysis phase is to study exactly what happens in the current information system and to determine and fully document in detail what should take place in the system. This includes making recommendations to management on the alternative solutions and their costs in developing the system. All functions performed by the current information system must be defined. At mean time, the determination of what modifications needed by the company in the improved version of the information system is carried on. The out put of this life cycle phase is the system requirements document, which

documents all end user and management requirements, including all alternative plans and the their costs, and the recommendations to management. Thereafter, The result from systems analysis, which are in system requirements document, is then considered by the management. The management will decide on the best alternative. According to the SLDC in figure 2-1, there are four possible alternatives. The company may decide to use a software package, then the company must purchase that software package, and continue to either phase four; systems development in case of package modifications are needed, or phase five; systems implementation and evaluation if that software can be used as it is. Another management's decision alternative may be a in-house software which requires the company to enter to the systems design phase. Finally, management may decide to terminate the development at any phase of the SDLC due to high costs, or failure to meet objectives.

### 2.1.3 The Systems Design.

The purpose of the systems design phase is to determine the way to construct the information system to best satisfy the documented requirements. All required information system outputs, files, inputs, application software programs, and manual procedures must be designed in this phase. The result from the systems design phase is the documented system design specification and is presented to the management and the end users for their review and approval. After all systems design steps have been completed and if the development is not terminated, then the company enter to the next phase, systems development.

### 2.1.4 The Systems Development.

Systems development is the phase which the information system is actually constructed. In this phase, the application programs are written, tested, and documented. In addition, the operational documentation and procedures which are in form of software manual must be completed as well.

### 2.1.5 The Systems implementation and evaluation.

The systems implementation is the installation and the conversion of the developed system over the existing one. Finally, the IS project must be evaluated in order to know how

successful about the system and what needs to be improved. The costs and benefits from the new system have to be identified.

## 2.2 Database Managements.

### 2.2.1 Database Management Definition.

Ralph M. Stair (1996) defines the database definition in which a Database is a collection of data stored in a standardized format and designed to be shared by multiple users. The database management system (DBMS) is software that defines a database, stores the data, supports a query language, produces reports, and creates data entry screens.

### 2.2.2 Components of a Database management system.

Gerald V. Post (1999), described the basic components of a database management system. He listed the 8 basic features which are commonly provided in a DBMS. The components include the database engine, data dictionary, query processor, report writer, forms generator, application generator, communication and integration, and security.

The ***database engine*** is the heart of the DBMS. The database engine is responsible for storing, retrieving, and updating the data. The engine highly affects to the performance or speed of the database system and the ability to handle large problems area or the scalability. While the other components must rely on the database engine to store both application data and internal system data that defines how the application will operate. It is also responsible for setting up business rules regarding the data. For example, If the company does not allow negative price to be used in the database. When the database developer creates that rule, the database engine will warn the users and prevent them from entering the negative value. The database engine is integrated in various sets of commercial software packages such as Microsoft Access, Microsoft Fox Pro, and etc. The ***Data Dictionary*** stores the definitions of all the data tables. It describes the type of data that is stored. It allows the DBMS to keep track of the data and helps developers and users find the data to the location they need. The data dictionary contains the name of the data item, the range of data values that can be used, the type of data such as alphanumeric or numeric, the amount of storage needed for the item, a

notation of who is responsible for updating or accessing the data. The example of data dictionary is shown as in figure 2-2.

| No. | ID | Description | Type | Size |
|---|---|---|---|---|
| 1 | Part_No | The number of the product | Number | 7 |
| 2 | Part_name | The name of the product | Text | 30 |
| 3 | Part_Mat_Name | The name of the product material | Text | 20 |
| 4 | Part_Mat_Code | The code of the product material | Text | 15 |
| 5 | Part_Color | The color of the product | Text | 10 |
| 6 | Part_Weight | The weight of a part | Number | 5 |
| 7 | Runner_Weight | The weight of a runner | Number | 5 |
| 8 | Cycle_Time | The cycle time of machine | Number | 2 |
| 9 | Mold_Code | The code of injection mold | Text | 7 |
| 10 | Mold_Cavity | The number of cavities in the mold | Number | 2 |
| 11 | Qty_Per_Carton | The quantity of parts per carton | Number | 5 |
| 12 | Inspection_Spec | The methodology of the sampling inspection test to accept the products | Text | 50 |
| 13 | Spec_Approve_name | The name who specified the spec. | Text | 25 |

*Figure 2-2 : The Data Dictionary of parts standard specification of BIP document.*

*The* ***Query Processor*** enables developers and users to store and retrieve data. It is responsible to control the data communication of the database. All database operations can be run through the query language. The query language is a fourth-generation language (4GL) which is a high level programming language that its language structure is more English like sentence. The commonly used in standard query language such a SQL (Structured query language) play a great role in data retrieval from the tables. SQL is a powerful query language. The greatest strength of SQL is that it is a standard that most DBMS vendors support. The ***Report Writer*** generates reports that enable the users to see summaries of the data in the database. Most modern DBMS have report writers that enables the users to set up the report on the screen to specify how items will be displayed or calculated. The ***Forms Generator*** or input screen helps the developer create input forms and make it easy for users to enter data. The ***application generator*** is a integration of forms and reports that are designed for a user task. It consists of tools that assist the developer in creating a complete application package. One example of the application generator is the menu and toolbar generators. For BIP developed database, the author wrote the application by Microsoft Visual Basic 6, not in the application generator provided in DBMS of Microsoft Access 2000. This resulted the more flexibility and efficient to input and retrieve data from the database. The ***communication and***

***integration*** of DBMS is designed to store and use the data in several databases running on different machines in different locations. The last component of DBMS is its ***security and other utilities***, the DBMS must be responsible the usage of several users, so it is very important that the DBMS includes the security functions.

## 2.3 Systems Modeling.

David Harris (1999), described the use of graphical modeling methodologies to model the database system. He mentioned that after the problem definition developed in the preliminary stage focusing on the areas within the database system that should be improved or expanded, the database developers or system analyst must fully understand the current information system of the company. By doing so, three proposed graphical system modeling methodologies extremely favored the analysts. There were *Process Models, Data Models, and System Models*.

The ***process model*** is a formal way of representing how a business system operates. It illustrates the processes or activities that are performed and how data moves among those processes or activities. A process model can be used to document the current system or the new system being developed, whether computerized or not. There many different process modeling techniques in use today. In this research, the author selects one of the most commonly used techniques: ***Data Flow Diagram*** (DFD) which depicts the flow of data into, out of , and between processes. The DFD shows many of the important relationships between the data or information, procedures, and people components of the system. Whereas, the ***Data Models*** show the files structure and their relationships. The efficient data model suggested by Harris, used in the research, is ***Entity Relationship Diagram (ERD)***. The system models explicit the selection and design of the hardware and software components of the database system, in accordance with the process and data models.

### 2.3.1 The Data Flow Diagram (DFD).

The DFD presents a picture of what the people and procedures do to transform data to information. The data in the system flow in a way that of common IPO framework or Input-Process-Output. The DFD methodology provides a formal method to record the analyst's understanding of the numerous inputs, processes, and outputs of the system under system analysis study.

#### 2.3.1.1 Standard symbols for DFD.

The standard four distinct symbols set of DFD proposed by Gane-Sarson are illustrated in figure 2-3 below.

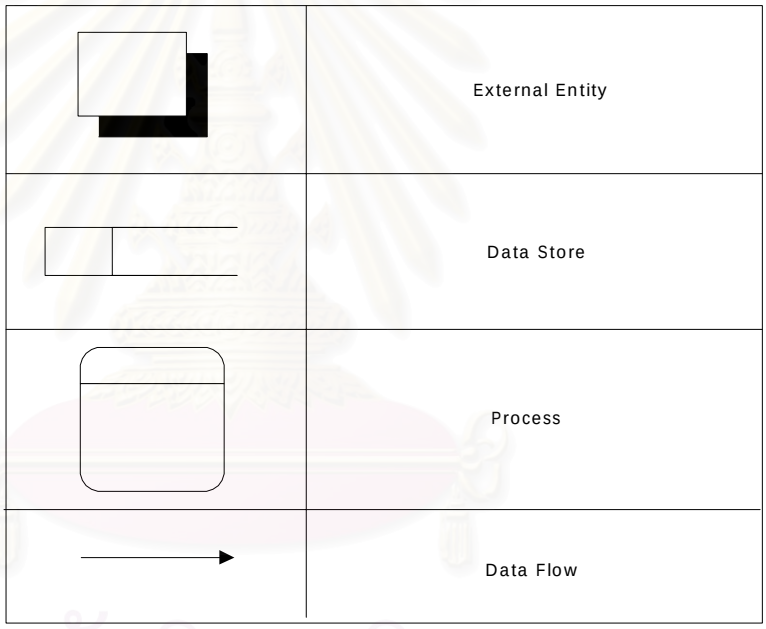


*Figure 2-3 : The Gaine-Sarson symbols of DFD.*

**The external entity.**

The external entity is a data source which originates information or a data receiver which takes in the information. The external entities are outside to the interested system. It may be from outside the company such as customers who order a product, suppliers who supply raw material, subcontractors who the company hires to produce a product, and etc. It may be from inside the company such as the production manager who evaluates the daily

production report, or it may be another information system such a accounting database system if it serves as source or receiver of information.

**The process.**

The process is a procedure that operates on data. There are common processes which are operations associated with data manipulations such collecting, sorting, selecting, summarizing, analyzing, and reporting the data.

**The data store.**

The data store is a place where keeps data for later reference in data modeling. The names associated with data stores are abstract which they do not describe the detailed characteristics of the store, such as how the stored data is organized or accessed. Hence, This data store will be itemized deeply in detail in the data modeling such a Entity Relationship Diagram (ERD).

**The data flow.**

The data flow means by which data and information are transported from one place to another. It is a movement of data from external entity to a process, or from a process to a data store. There are always descriptive annotations that appear above or aside the flow as shown dataflow diagram in appendix A . These annotations attempt to identify the data or information that is transported.

### 2.3.1.2 Standard rules for DFD construction.

The following rules for DFD construction is commonly agreed that it would help reduce the possibility of adding unnecessary elements or omitting necessary ones. The DFD of BIP process model is constructed under these disciplines:

- Data flows should not connect an external entity directly with a data store or to another external entity. There must be an intervening process.
- Data flow should not connect a data store directly to another data store. There must be an intervening process as well.
- Data stores should have at least one entry data flow and one exit data flow and can connect only to the process.

- Each process must have at least one entry data flow and at least one exit data flow.

## 2.4 Transaction Processing System.

The designed database for BIP bases on a Transaction processing system (TPS). The transaction processing is one of the first business processes to be computerized. Without database for transaction processing, the business processes would consume huge amounts of organization's resources due to an enormous recording and processing business transactions. The transaction processing systems perform routine operations such as ordering, billing, purchasing, invoicing, and often performing the same operations daily or weekly. These systems require a large amount of input data and produce a large amount of output without requiring sophisticated or complex processing.

Currently, BIP has used a manual TPS, which the detailed data is necessary to update records in a paper douments about the fundamental business operations of the company such as a customer order, purchase orders, invoices, and etc. The company notices the importance of this Transaction Processing, It is expected that the automated TPS will help to accomplish a number of objectives as shown followings :

- *Produce timely documents and reports.*

Manual transaction processing systems may take hours to produce routine documents. Fortunately, the use of computerized transaction processing systems significantly reduces this response time. The ability to conduct business transactions in a timely way can be very important for the profitable operations of the company. For instances, in the injection order release from the production planning, the sooner the order is released, the less in machine idle time for machine set up and result in the quicker production finish date.

Timing is also crucial for related applications such as order processing, invoicing, inventory control, and etc., because of electronic recording and transmission of the information, transactions can be processed in seconds rather than hour.

- *Process and store data generated by transactions.*

The primary objective of the TPS is to capture, process, and store transactions and to produce a variety of documents related to routine business activities. For examples, the processing orders, purchasing material, controlling inventory, invoicing customer and etc. are a result of customer orders. These activities result in transactions that are processed by the TPS.

- *Maintain a high degree of accuracy.*

One objective of TPS is to minimize error data input and processing. Even before the introduction of computer technology, employees visually inspected all documents and reports introduced into or produced by TPS. Because humans are fallible, the transactions were often inaccurate, resulting in wasted time and effort and requiring resources to corrected them.

- *Ensure data and information integrity and accuracy.*

Another objective of a TPS is to ensure that all data and information stored in computerized databases are accurate, current, and appropriate. As the volume of data being processed and stored increases, it becomes more difficult for individuals and machines to review all input data. The company must ensure both data integrity and accuracy. The processes of verification and editing are used to check whether data is accurate and up to date before it is stored, are very important.

- *Increase labor efficiency.*

Before computers existed, manual business processes often required several clerks and equipment to process the necessary business transactions. Today, transaction processing systems can substantially reduce clerical and other labor requirements. TPS will therefore be cost desirable by labor savings.

- *Help build and maintain customer loyalty.*

A firm's transaction processing systems are often the means for customers to communicate. It is important that the customer interaction with these systems keeps customer satisfied and returning.

### 2.4.1 Transaction processing activities.

TPS performs a common set of basic data processing activities. TPS captures and processes data that describes fundamental business transactions. This data is used to update databases and to produce a variety of reports for use by people both within and outside the company. A simplified overview of a TPS is shown in figure 2-4.

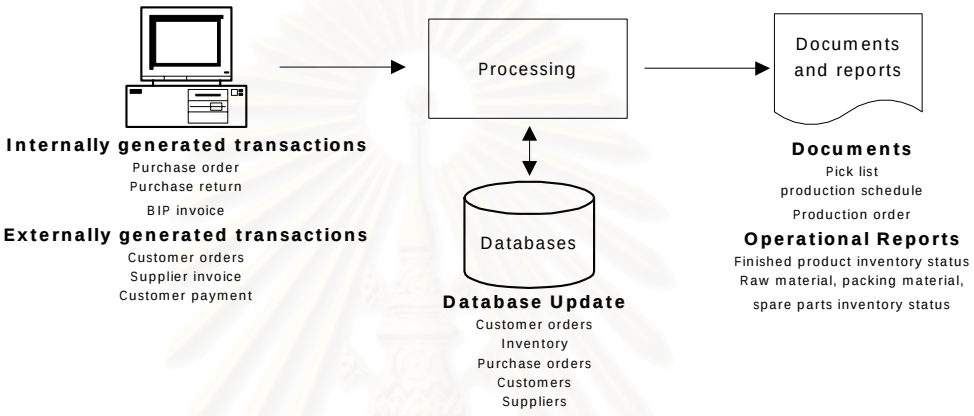


*Figure 2-4 : The simplified overview of a Transaction Processing System.*

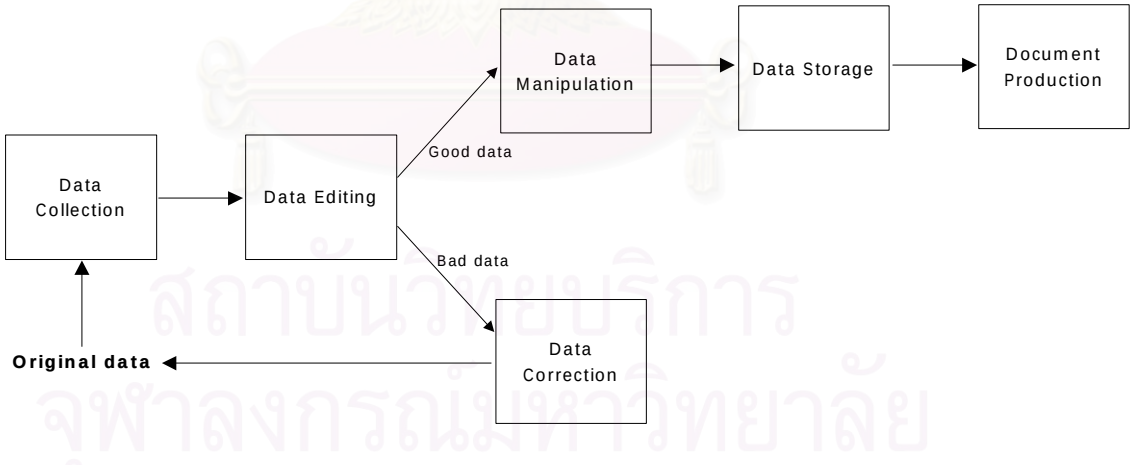


*Figure 2-5 : The common of TPS Data Processing Activities.*

The transaction processing cycle consists of data collection, data editing, data correction, data manipulation, data storage, and document production. The cycle is shown in figure 2-5 above.

***The data collection*** is a process of capturing and gathering all data necessary to complete transaction. Data should be captured at its source, and it should be recorded accurately, in a timely manner, with minimal manual effort, and in a form that can be directly entered to the computer rather than keying the data from some type of ducument. ***Data editing*** is to detect any problems with the data. For example, the quantity and cost data must be numeric and names must be alphabetic; otherwise , the data is not valid. If the data is not valid, it is not enough to reject invalid data. The system should provide error messages that alert those responsible for the data edit function. Therefore, the ***data correction*** is needed to reenter miskeyed data that was found during data editing. Another major activity of TPS is ***data manipulation*** which is the process of performing calculation and other data transformations related to business transactions. Data manipulation may include classifying data, sorting data in the database, performing calculations, summarizing results, and etc. Whereas ***data storage*** involves in updating one or more database with new transactions. When the update process complete, this data can be further processes and manipulated by other systems so that it is available for management decision making. Finally, the ***document production*** in which TPS produce important business documents. It involves in generating the records and reports. A report showing current inventory status is one example of document production.

## 2.5 Designing a database.

Merle P. Martin(1995) mentioned two widely used design approaches which are *top-down* and *bottom up* approach. He commented that the *top-down approach* is always used in developing data models for transaction processing systems (TPS). This is because of the fairly standard of TPS characteristic, which system analysts know rather obviously in the developing system. Analysts have to develop a prior data model of how they think the system should operate. They do so based on experience and intuition. Then, they refine this model during the requirements analysis stage by discussing it with knowledge end users.

In contrast, the system analysts often use the *bottom-up approach* in the system they do not familiar with, or with the system in higher level that may be hard to use the intuition, for examples in designing Management Information Systems, Decision Support System, or

Expert Systems. Hence, the bottom-up design approach is the preferred approach for inexperienced systems analysts.

For designing database for Besco International Plastic Co.,Ltd, the author found out that the *bottom-up approach* was more appropriate because there was no structured system plan or data model in the company, so that the author could not use it to understand the current system clearly. Moreover, the author had not much experience and intuition.

Merle P. Martin proposed nine logical steps required to design a business database as followings :

2.5.1 Examine each report and form of the company. The physical Data Flow Diagram(DFD) is an excellent tool to determine which reports and forms to examine.

2.5.2 Create or update report and form fields in a preliminary data element dictionary.

2.5.3 Examine current files. These are data stores in the physical DFD.

2.5.4 Create of update file fields in the Data Element Dictionary (DED). In a structured design environment, the DED is that part of the data dictionary comprised on of data element specifications.

2.5.5 Look for questionable data fields. These are fields that are never output and not on daily input forms (transactions). Thus it is difficult to keep it current. So, these field should be dropped and updated in the DED.

2.5.6 Look for the storage redundancy.

2.5.7 Determine file or entity relationships. For each file, decide if and how that file relates to other files. Use Entity Relationship Diagram (ERD) for this purpose.

2.5.8 Develop the schema of the physical view of the data model. The schema includes all integrated file formats, including linkages between files.

2.5.9 Develop end users subschema. The subschema is a logical view of data tailored to specific end user needs. It is constructed for each end user group to meet the end users needs. The subschema is also used to control and access to the database.

## 2.6 Database structures.

Due to Gary W. Hansen and James V. Hansen ( 1996), Databases can be designed to one of three structures which are :

(a) Hierarchical architecture.

The hierarchical architecture is a database system that stores group of files in hierarchical form. For example, the below figure 2-6 shown the hierarchical structure for materials control system, it shows how three material control system files can be linked. Each vendor has a single vendor record. Each vendor has multiple inventory records which are one for each inventory item supplied by that vendor. For each inventory record, there are multiple occurrences of purchase order records. A particular inventory item may be ordered many times for many different customers and for stock replenishment.

In the hierarchical system, each higher level is called as a parent and multiple occurrences of records originating from the parent at the next level are called children. The contents of each record contains a field that links the record to its children and parents. For example, in the figure 2-7 shows this hierarchical linkage relationship, the record for vendor AAA may include a linkage field sharing the address of the first inventory record (123) for that vendor. The contents of this first inventory record will contain a linkage field containing the address of the second inventory record for vendor AAA.

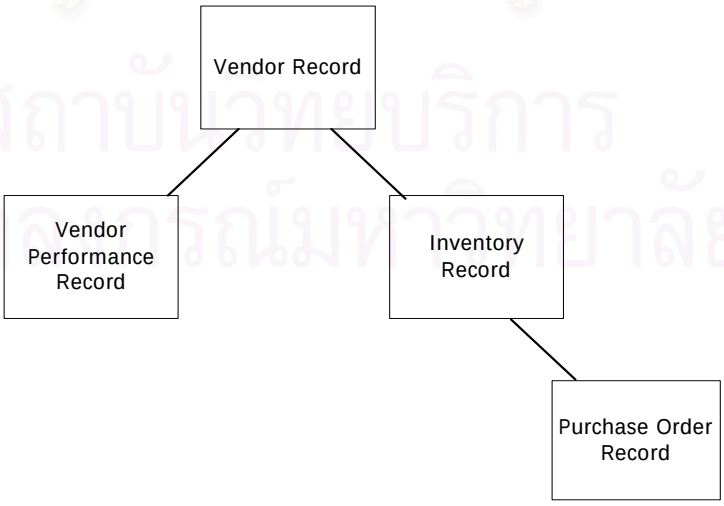


*Figure 2-6 : The Hierarchical structure for materials control system.*

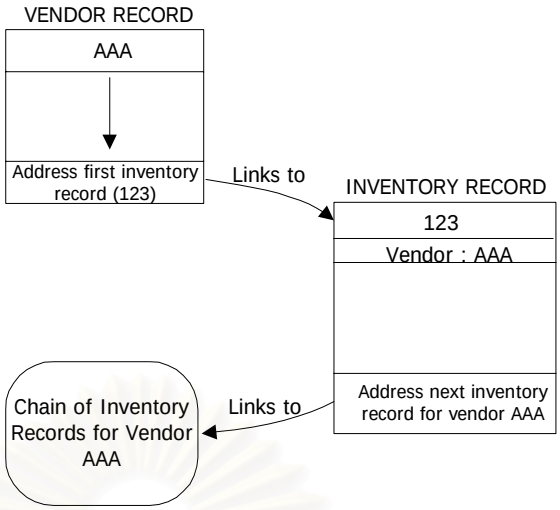


*Figure 2-7 : The hierarchical linkage for vendor to inventory record.*

(b) Network architecture.

The network structure is similar to the hierarchical structure except that a child can have more than one parent. For instance, if the figure 2-6 is modified to allow a single inventory item to be ordered from more than one vendor. By now, each vendor is linked to several inventory records. However, each inventory record can be linked to more than one vendor. Hence, this approach is more complex than the hierarchical structure.

(c) Relational architecture.

The relational architecture consents record search efficiencies and speeds associated with the hierarchical and network architecture. This structure emphasizes ease of database creation, update and retrieval. Hence the ease of use of this database structure allow the non technical users are capable to use it. The relational database is more applicable to an environment where there is a relatively low level of database transactions in which the access speed is not as important.

The figure 2-8 shows an example of a simple relational structure for vendor code and shipping code as they relate to each inventory record. Here two separate tables are used rather than integrating the data into a single, flat record. Linkage fields are not required.

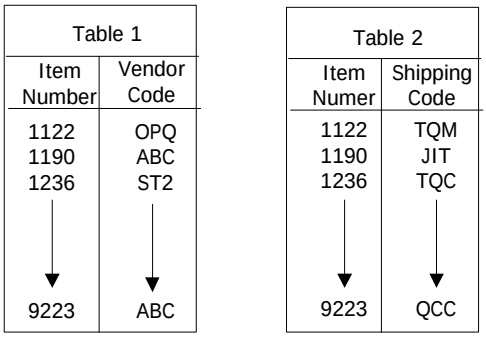


*Figure 2-8 : Relational architecture ( separate files are required)*

## 2.7 Production Activity Control.

The function of production activity control (PAC) is to have activities performed as planned, to report on operation results, and to receive plans as required to achieve desired results. PAC is concerned with converting plans into action, reporting the results achieved, and revising plans and actions as required to achieve desired; results. Thus, PAC converts plans into action by providing the required direction. This requires the appropriate master planning of orders, work force personnel, material, and capacity requirements. Production activity control procedures include order release, dispatching, and production reporting.

The PAC system in a job shop or batch production must be capable of the following:

2.7.1 Releasing orders to the production department on schedule (per the order release plan), having verified materials, information, tooling, personnel, and equipment availability.

2.7.2 Informing the production department of the scheduled start and completion dates of steps (individual operations) in the production process as well as the scheduled completion date of the order.

2.7.3 Informing the production department of the relative priorities of the orders released.

2.7.4 Recording actual performance of steps in the production process and comparing actual performance to the schedule.

2.7.5 Revising order priorities on the basis of performance and changing

conditions.

2.7.6 Monitoring and controlling input and output, lead times, work center queues, and work in process.

2.7.7 Reporting work center efficiency, personnel attendance, operators times, and order quantity counts for planning, payroll, department efficiency, and labour distribution reports.

*Order Release.*

Order release initiates the execution phase of production. It authorizes production to begin the production or the purchasing process. Order release starts when the company receives the purchase order from the customers. The company must firstly plan for the resources allocation, check for the availability of material and production equipment. Order release triggers the release of the following :

- Requisition for material and components required by the order. If some of these items are not required immediately and have not been allocated previously, they are allocated at this stage.
- Production order documentation to the plant. This documentation may include a set of both engineering drawings and manufacturing specifications and a manufacturing routing sheet.
- Requisitions for tooling required in the first week or so of production. Tooling can be a production schedule.

*Dispatching.*

Dispatching informs the priorities of the released orders, that is the sequence in which orders should be run. This information can be transmitted via a paper documents which may be had written, typed, or computer printout or via the video output on a cathode ray tube (CRT). Telephone and face-to-face conversations also can be used but do not document the decisions. A dispatch list should be prepared for each time period with the frequency of updating depending on the typical order processing time. If orders take a day or less to process, dispatch list usually are prepared daily. If orders take a few days, lists may be prepared weekly.

| Plant 01 Date 11/11/2000 | M/c No. 3 | Order Number | Quantity | Cycle time | Total Standard Hour | CR priority | Capacity Pcs/day | Due date |
|---|---|---|---|---|---|---|---|---|
| Part Code | | | | | | | | |
| M-781751 | | BIS 012 | 2500 | 11 | 20 | 1.74 | 6500 | 11/14/2000 |
| M-781749 | | BIS 013 | 2600 | 20 | 20 | 1.1 | 3600 | 11/15/2000 |
| M-781939 | | BIS 014 | 4800 | 8 | 20 | 2.1 | 9000 | 11/15/2000 |

*Figure 2-9 : Dispatch list.*

The figure 2-9 is an example of simple dispatch list information. It identifies the date, the plant, and the work center; it includes the work center capacity requirement; and it lists the order, their quantity, their capacity requirements, and their priority. Orders usually are listed in descending priority for a specific period. The planner determines the final dispatch list ranking of orders on the basis of multiple criteria including a formal priority index such as the critical ratio or the due date.

*Production reporting*

Reports describe the actual production status are necessary for the production control. The information in the report will enable management to take meaningful corrective action concerning production schedules. The example of typical reports, that is generally used, are the status of work in process, inventory availability, and work center queues. A lot of reports are done in real-time reporting system which enable the planners is able to obtain current status information virtually instantaneously. The other reporting system is periodic report is always used to evaluate production performance such as enabling the planner to compare the actual output with the output planned. The following information should be available in the reports on either a real time or periodic basis.

- Released order status. This report gives the status of every order that has been released physically to the factory and includes part number, description, quantity, order release date, order due date, operations completed, order location, quantity scrapped, and quantity good.

- Unreleased order status. This report lists all orders whose release is past due. It also notes the cause of the delayed release.
- Dispatch list or the priority scheduling report. This report lists in priority sequence all orders in the department.
- Exception reports. The exception report are some additional reports that may be important to the company such as the scrap report, a rework report, and etc.
- Performance summary report. The performance summary report should state the number and percentage of orders completed on schedule during a specific period such as day, week, or month, including the lateness of late orders.

## 2.8 Fundamental principle of Inventory management system.

According to Richard B. Chase(1998), **Inventory** is the stock of any items or resources used in an organization. Generally, manufacturing inventory refers to items that contribute to or become part of a company's product output. Manufacturing inventory is typically classified into raw materials, finished products, component parts, and work in process. For BIP, the company holds inventory for the raw materials ( plastic resins), finished products ( plastic parts), and some machine spare parts of the injection machine. These inventories play a great role in the business operation of the company.

Richard B. Chase mentioned about an **inventory system**. He expressed that the inventory system is the set of policies and controls that monitors levels of inventory and determines what levels should be maintained, when stock should be replenished, and how large orders should be. The system provides the organizational structure and operating policies for maintaining and controlling items to be stocked. The system is also responsible for ordering and receipt of items such as the time when the order has to be placed, the quantity to be ordered, and which supplier should be bought from. It is also responsible for the tracking system of what has been ordered in the stock.

Theoretically, There are two general types of inventory systems : fixed-order quantity models and fixed-time period models. The fixed-order quantity models are triggered by an event which means the model is initiated an order when the event of reaching a specified reorder level occurs. The event may take place at any time, depending on the demand for the items considered. Whereas, the fixed-time period models are triggered by time which means the model is limited to place orders at the end of a predetermined time period.

The use the fixed-order quantity model ( which places an order when the remaining inventory drops to a predetermined order point), the inventory remaining must be continually monitored. So, the fixed-order quantity model requires the every time a withdrawal from inventory or an addition to inventory is made, records must be updated to ensure that the reorder point has or has not been reached.

The selection of the inventory system highly relates to the inventory costs basis. The implemented inventory system should bring the minimization of the inventory costs. The inventory costs include Holding costs. The cost includes the costs for storage facilities, handling, illegal lost (stealth), obsolescene, depreciation, and taxes. Obviously, high holding costs tend to favor low inventory levels and frequent replenishment. Ordering costs. These costs refer to the managerial and clerical costs to prepare the purchase or production order. The Ordering costs include all the details, such as counting itmes and calculating order quantities. The costs associated with maintaining the system needed to track orders are also included in ordering costs. The Shortage costs. When the stock of an item is depleted, an order for that item must either wait until the stock is replenished or be canceled. This would cost the company if the existing items is not sufficient for the production activities for the company.

Currently, BIP uses the most appropriate inventory system which aims to produce the minimum of these inventory costs. The inventory system of BIP bases on the grouping of the inventory; plastic resin, dues to their frequency of usage. This is similar to the concept of the ABC inventory classification.

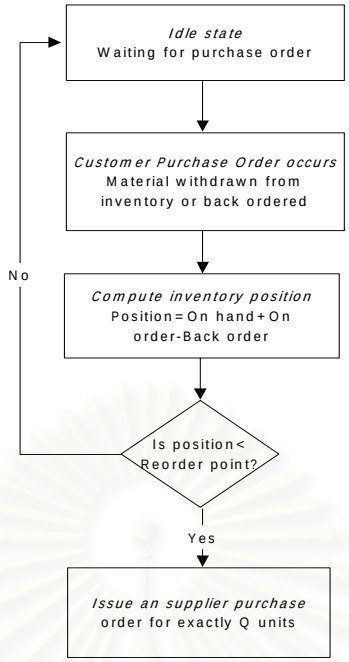


*Figure 2-10 : The fixed order quantity reordering inventory system.*

### 2.8.1 ABC inventory classification.

ABC inventory classification is the priority set up of the importance of the inventory in the manner that try to use the available resources to control inventory in the best way, in other words, focus on the most important items in stock. For any inventory system, it must specify when an order is to be placed for an item and how many units to order. Most inventory control situations involve so many items that it is not practical to model and give thorough treatment to each item. To cope with this problem, the ABC inventory classification approach divides inventory items into three groupings: High value(A), Moderate value(B), and Low value(C). The value is a measure of importance measured by the money(Baht) spent on those itmes usage in production.

By grouping the items into three groups, the Group A consitute approximately the top 15 percent of the items, B items the next 35 percent, and C items the last 50 percent. The segmentation may not always occur so neatly. The objective, though, is to try to separate the important inventory from the unimportant inventory. The purpose of classfying itmes into groups is to establish the appropriate degree of control over each item. It may base on periodic basis suchas Class A items may be more clearly controlled with weekly ordering, B items may be ordered biweekly, and C items may be ordered monthly.

BIP inventory management utilized the concept of ABC classification on its inventory management. The company also classified the material into three groups. The company also established different inventory strategy on the different group. But the classification was done by the management feeling not on the past information or theoretical basis.

| Material number | Annual usage value (Baht) | Percentage of Total value |
|---|---|---|
| 14 | 95,000 | 40.8% |
| 65 | 75,000 | 32.1% |
| 27 | 25,000 | 10.7% |
| 02 | 15,000 | 6.4% |
| 10 | 13,000 | 5.6% |
| 17 | 7,500 | 3.2% |
| 59 | 1,500 | 0.6% |
| 66 | 800 | 0.3% |
| 77 | 425 | 0.2% |
| 41 | 225 | 0.1% |
| | 233,450 | 100% |

*Figure 2-11 : The example of annual usage of inventory by value(used for ABC classification)*

For BIP, the company has never kept the information of the annual usage of inventory by value, so that the company is not able to classify the inventory into group theoretically. But the company ranked the importance of material in stock into three group ( Not based on the past information), the first group;high usage ( most often use) , moderate usage ( always used), Low usage ( sometime used). The ranking were estimated from the management feeling. The management feel that some items are often used, and that's not worth if the company always place supplier purchase order on those itmes, thus it potentially causes high shortage costs. The company do not tolerate the material purchase lead time of the itmes of class A and B. The different inventory systems implemented on each group resulted in the reorder or purchase policy of the company. The detail is declared in the BIP purchase procedure in chapter3 (page 46).

## 2.9 Literature Surveys.

### 1. Gary W. Hansen (1996).

Gary W. Hansen mentioned about a traditional system development life cycle or SDLC. His approach had six stages and was merely identical to Adamski's approach as mentioned earlier, but he added a feasibility study phase after the preliminary investigation. The feasibility study covered 3 areas which were a technological feasibility, an operational feasibility, and an economic feasibility. The technological feasibility study was to determine whether hardware and software were available to service the company's information needs. It included analysis of whether the capabilities and resources were already present in the company or whether they would have to be purchased, and whether training was needed. It turned out that all required hardware was already present Besco International Plastic Co.,ltd, although the DBMS would have to be acquired. Whereas, the operational feasibility study included analysis of skill and labour requirements needed to implement the database system. Finally, the economic feasibility study was a cost to benefit study of proposed database system. It determined how worth of implementing the database system.

The results of each feasibility study were finally examined, and if they were favorable for the company then the management would give an approval to move ahead with the next stage, *system analysis*.

### 2. Date (1995).

Date explained the need of the computerization of company recording system. The system was used to manipulate the information and provide that information available on demand. He classified four major components in database system in which were data, hardware, software, and end user(s).

Date mentioned that the database systems could be based on many different approaches such as hierarchical, relational, object-oriented systems, but the trend was moving to the object-oriented database system because of both an economic and a theoretical perspective, whereas the relational approach was still the most important system. In a relational system, the data was stored in form of tables. The normalization and entity-

relationship diagram were very important concept and tool for building an effective relational database.

### 3. Apinan Klawwutinun, (1990).

Apinan did the research on applying Material Requirements Planning techniques in steel furniture manufacturing by introducing computer program in recording information of vendor, inventory transaction order, purchasing order, and single level bill of materials. The result of the research showed the calculation of the requirement quantity more accurate. His program was able to calculate gross requirement, net requirement, and planned order release by studying information from bill of materials, stock status, purchasing lead time, ordering and holding cost. This thesis was applied with the technique of calculation lot size to purchase in order to calculate demand of various material as well.

### 4. Chatchawan Chinvipai (1997)

Chatachawan did the research on the improvement of production management and information system in the sleepware industry by improving a computer program in recording information of operation. The result of improvement showed a comparison between traditional and developed method in term of usage time to edit and prepare document.

### 5. Siradate Chartniyom (1987)

Siradate showed a development of an information system for production control in the manufacturing of control switch board and cable tray by improving a document managing system. This thesis suggested a solution to design and apply an information system for controlling a production process. It showed the pattern of workflow and document managing system.

### 6. Sirichai Ngowkarnchananak (1996)

Sirichai presented the management information system for controlling the produciton in toy industry by improving an organization structure, workflow, working procedure and frequency of delivering documents. These improvements were based on an information

system to solve the communicating data, relationship, and decision making of management level.

### 7. Siriwat Jitrhansa (1999)

Siriwat did his thesis research on the development of the bar code system to control the inventory of the automotive parts manufacturer. The thesis explained about the inefficient manual process on paper documents, which always affected the accuracy and speed of the data that influenced managers' decisions. The author mentioned the necessity of the computerized inventory system for company to meet higher precision and more rapid data. The technique of EOQ (Economic order quantity) and Bar Code system were integrated together to classify and identify various materials and products in the warehouse and handle the numerous stores' documents. The thesis concentrated on the development of applications of the software which covered materials management from receiving, picking, serving, recording, checking, shipping, summarizing and issuing documents.

### 8. Heizer, and Render (1997).

Heizer and Render emphasized on material management, which supported JIT methodology. Moreover, the author also presented to the reader the advantages of computer in inventory controlling in order to meet customer satisfaction. With the help of the computer, the high accuracy and high-speed of the data could be obtained, that was maximizing the efficiency of warehouse management.

### 9. Alan Dennis and Barbara Haley Wixom (2000).

Alan Dennis and Barbara Haley Wixom applied the System Analysis and Design approach on the CD Selections store on the internet sales system. In the analysis phase of Systems Analysis and Design, they began with creating the context DFD diagram which listed all major external entities. Then they created the DFD fragmentation into the higher levels; level 2,3, and 4. One example of the designed process in the first level DFD was the "Take CD order" which was fragmented into 6 processes in level 2; find CDs, Display CD information, Maintain CDs selected for Purchase, Process Checkout, Place order, and Reject order. After the DFD was completed, they validated the designed DFD by the meeting of the

project teams and the users who took part in developing the internet sales database system of the CD selection stores. With his DFD design of the CD Selection store on internet sales system, it was quite a good guideline to develop the DFD diagram for BIP system in the research.

They commented that the drawing of DFD was rather busy and complex. Drawers should be careful of the input and output between the processes.

**10. Gerald V. Post (1999).**

Gerald V. Post took an example of building business applications in a database environment which began with the forms and reports creation. He used the Pet store (Sally's Pet Store) as an example. He showed that how to design and modify forms and reports to make them useful and user-friendly. He also introduced the use of the Visual Basic for applications programming language to manipulate data. He presented how to use forms and programming to improve the usability of the applications. He discussed how to complete the application so that it was polished and how to add the menus, toolbars, and custom help features that users require from a modern application such the Visual Basic programming.

**11. Chalermlarp Rungkamol (1999).**

Chalermlarp did the thesis research on developing a Decision Support System for Maintenance Planning for a Printing Machinery. His research aimed to develop the computer program that was able to assist the manager in the printing company in making and selecting the suitable maintenance plan for the offset-type printing machinery. His program used the data of the past maintenance failured records and the production schedule to simulate the situations for running the software. After he had finished his program, he implemented to the printing machinery to evaluate the software capabilities and to find the limits and errors of the software for improvements. The capabilities of his software were categorized into three main functions. There were to recommend the suitable maintenance tasks for the maintenance planning, to plan and schedule the maintenance tasks, and to summarize and calculate the maintenance costs and indexes for measuring the maintenance performance.

12. Sitthikorn Manomaiwiboon (1999).

Sitthikorn did the thesis research on developing of an information system for production activity control for the automotive parts manufacturer. His aim of the research was to eliminate the high production costs and excessive inventory due to shortage of automotive parts, poor scheduling of operations and poor utilization of resources. In his research, he used the IDEF0 modelling technique to study and analyze the existing information system of production activities. His information system was developed in the computer database approach using the Microsoft FoxPro running on a microcomputer as the tool for the database management and the application development. The result of his research showed the enhancement of the manpower utilization and the reduction of the work-in-processes and increasing the production outputs.

13. Fred R. McFadden, Jeffrey A.Hoffer, and Mary B.Prescott (1999).

Fred R. McFadden, Jeffrey A.Hoffer, and Mary B.Prescott showed the use of Microsoft Visual Basic for applications (VBA) in client application accompanied with the Microsoft Access 97 as a database system. They took an example of Pine Valley Furniture business to demonstrate how to develop the database on this approach. They commented that the Access 97 had a limit on its capability to create a prototype of an application. So, the using of Visual Basic for application would outcome more efficient database system. VBA could be used to accomplish more complex functionality, handle errors, achieve faster execution, easier maintenance, and more programatic control.

# CHAPTER III

## *EXISTING SYSTEM*

## 3.1 Introduction.

In this chapter, the description of Besco International Co.,Ltd will be reviewed which includes the company history, its products, and the management structure. The important part of this chapter is the analysis of the existing systems ( System Analysis) that explains the existing production and inventory management processes in the company in the form of the process model; dataflow diagram (appendix A), so that enables the readers clearly understand how the existing system performs.

### 3.1.1 Background of the company.

Besco International Plastic Co.,Ltd was established in 1996 by a family Jungthirapanich. The company is located at Nongkhae district in Saraburi province. The company is hired to produce the plastic injection parts according the customers' needs. Major customers are well known international manufacturing company such as Hewlett Packard, Cannon, Tomy, Oki, and etc. The company has launched its business for more than 4 years and has grown its business from a small factory with 3 plastic injection machines in the first year until there are 18 plastic injection machines in the factory with over 110 staffs at present. The company performs as a subcontractors for other companies which are mostly Japanese manufacturers in Thailand. These oversea companies subsequently assemble BIP plastic parts in their products and distribute them to worldwide countries, thus, it is an indirect export business. Currently, the company is supported by the Board Of Investment of Thailand as an indirect exporter and the company earns a lot privileges from tax payment to the government. The future prospect of the company is still bright because the current economic recession resulting in the considerable devalue of Thai Baht. This causes export business fully benefit in this age.

### 3.1.2 Products of the company.

The company products are plastic engineering parts. The products are electronics parts, automotive parts, office automation plastic components, consumer products, toys, and etc. The example products are shown as following figure:


*Figure 3-1 : The examples of BIP products and the factory.*

### 3.1.3 The management of Besco International Plastic Co.,Ltd.

#### 3.1.3.1 The organization structure of BIP.

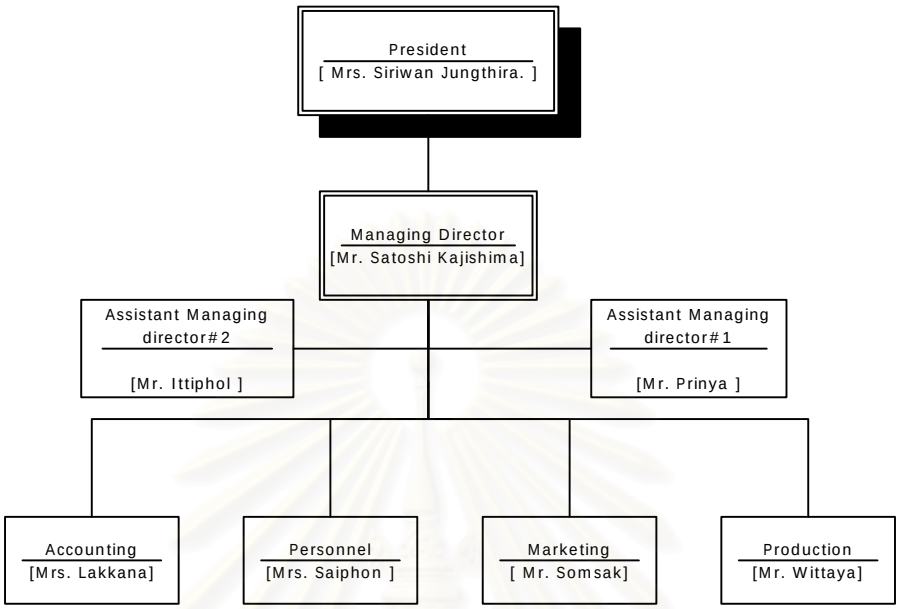


*Figure 3-2 : The organization chart of BIP*

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#### 3.1.3.2 The responsibilities of the management :

- Managing Director.

The managing director is responsible for strategic level management. He is responsible to plan and set up the company's policy, the business objective, set the business direction. He is fully authorized in overall departments including the investment decision, accounting, and etc.

- Assistant managing director # 1

The first assistant manager is responsible for the control of the company's financial status, personnel and accounting department, and marketing department.

- Assistant managing director # 2

The second managing director is responsible for the control of the factory management including the production, production planning, procurement and warehouse. The second assistant manager is a stand by for the director when he is absent.

- Personnel and accounting division.

The company combines these two departments together. The department is responsible for proceeding the staff recruitment, the social security for staffs, the arrangement salary regulation, and financial accounting.

- Marketing division.

The marketing department is in charge with contacting customers and seeking new markets for the company.

- The production division.

The production division is the most important part of the company. The division consists of the production planning, the production control, and warehouse department.

### 3.1.3.3 The management of the production division.

The management of production division is shown in the production organization chart of the figure 3-3.

- Production planning.

The production planning is the documentation center for the factory. It coordinates the works of overall departments as to achieve the target in the production plan.The department takes part in short-range planning of the company. The department controls the input/output planning, Production Activity Control(PAC), and Purchase Planning and Control. The main task is to prepare a production schedule or a time-phased plan of the customer parts and the quantity of each that the company intends to produce. The schedule of BIP cover the production plan from present to 1 week in advance. The other major tasks are the control of Input/Output from the production process, order sequencing, reporting performance. The function of order sequencing is to determine that the sequence in which tasks are to be performed is consistent with their relative priority. Whereas, the reports of actual department output reveal actual capacity and anticipated late completion of specific jobs, provide the feedback that enable to make a corrective action such as adjusting production schedule and outsourcing the over capacity jobs to subcontractor. Planning and controlling the priorities of purchased items such as material and production instrument are also the tasks for the department.

- **Production control.**

The major task of the production control department is to proceed the production activities as ordered by the production plan section. The department is responsible for the injection process, Quality Control and Quality Assurance, and maintenance tasks. The staffs in the injection process are; shift supervisor who is a production chief in the shift , the leader who is the foreman of machine operators, the technician who is responsible for the machine set up and maintenance tasks, and the machines operator who is directly control the machine. The Quality management staffs control the quality of parts from the production process. The staffs consist of the quality manager, Quality Management Representatives (QMR), finished parts inspectors, and packaging staffs. The maintenance section takes care the machine conditions by running the preventive maintenance program and repair the break down machines.

- **Warehouse management.**

The warehouse management controls all inventory for the company. It controls the procurement and the stock of material and production instruments and the stock of the finished products from the injection process before deliver to the customers. The BIP inventory management concerns the decisions of what to order, how much to order, when it is needed, when to order to purchase or production, and how and where to store it.

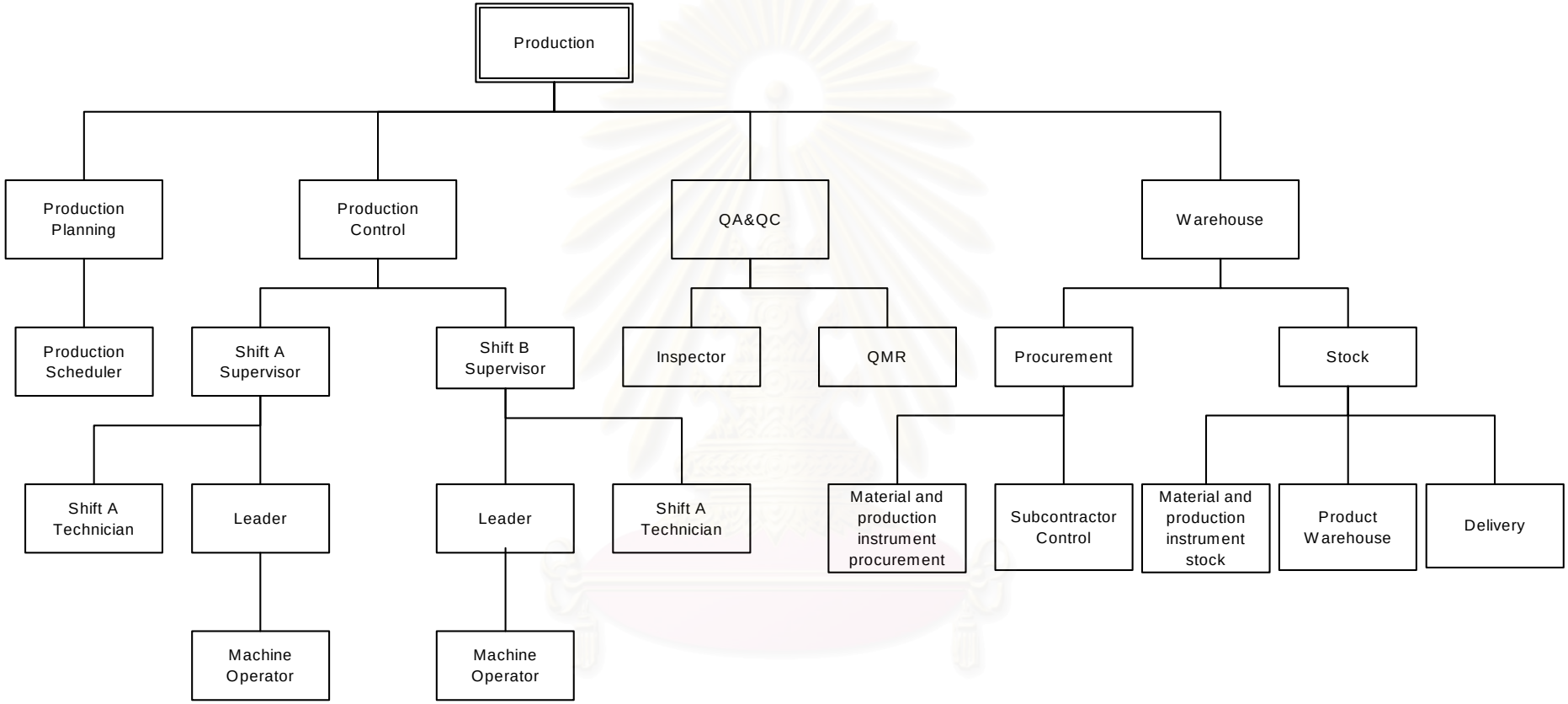



*Figure 3-3 : The organization chart of production department.*

### 3.1.4 The characteristic of plastic injection industry.

There are a lot of success factors in this industry. Nowadays, any plastic injection manufacturers who want to win in the business may have to achieve a lot criteria. The order-winners and order-qualifiers from Terry Hill(1994) manufacturing strategy formulation are an appropriate tool to understand the characteristic of this industry. According to Terry Hill, the order-winner are those criteria that enable to win or dominate in the market beyond the competitors. Whereas, the order-qualifiers are those criteria that a company must at least meet, in order to survive in the business. To provide order-qualifiers, company need only to be as good as competitors, while to provide order-winners, they need to be better than competitors. The order-winners and qualifiers are both important for the company to maintain the existing market share and grow.

**The order-winners of the plastic injection industry.**

- The product design and injection mold manufacturing capability.

The product design and injection mold manufacturing capability are tremendously important for this business. In general, the plastic injection company only serves the plastic injection machines for injecting customer's plastic parts. This requires the customers to arrange the injection molds for their own and then supply the molds to the injection company. Therefore, the injection company is not responsible to design and produce injection mold. Most customers will order the company who is able to design and produce the mold due to the customer prototype or products drawing model. So, it is a big advantage for the plastic injection company who is able to design and produce the customer plastic parts and mold.

- ISO9000 series standard certification.

The quality standard is also important to the industry. A lot of large size with high reputation company always subcontract their plastic parts to only the subcontractors (plastic injection company), who are approveded in ISO9000 series. Nowadays, only few player in the industry has been certified the standard, and that's a big opportunity for the standard certified company.

- Japanese management.

The big companies in Electronic, Automotive, Automation equipment, and computer parts manufacturer in Thailand are majority Japanese companies. These industries consume a vast amount of the plastic parts to assembled their products, so that they are the major markets for the plastic injection industry. It is well known that the Japanese company behaves in a nationalism business style. They always give a high priority to the Japanese business dealer. Therefore, a lot of plastic injection players hire Japanese management staffs in order to contract with the customers. That's the B.I.P current strategy as well.

- Delivery speed.

A company may win beyond other competitors through its ability to deliver more quickly than the competitors. Products that compete in this way need a manufacturing process that can respond to this requirement. The production development time directly concern to the delivery speed. If customers know that the company offers shorter production development time than the other companies, the customers potentially placed their orders to those companies with shorter the development time.

**The order-qualifiers of the plastic injection industry.**

- Products quality.

The aspect of quality that concerns in the plastic injection industry provision is the conformance which is to make a plastic product strictly right to the specification. The quality is not a winner orders criteria, but it is an order qualifier instead, because it is driven the customer product quality that require considerable high quality standard as a facet of their competitive thrust in order to stay in the market. So, the plastic injection company must produce high quality plastic parts as a primary basis in order to survive in the industry.

- Delivery reliability.

The delivery reliability means that the On-time delivery is very important. On-time delivery (OTD) means the supplying of the products ordered on the agreed due date. Therefore, it is a major concern of both the manufacturing and distribution functions. This

criterion is very sensitive qualifier because if a company often miss due date, customers will increasingly stop considering them as potential suppliers.

- Low cost.

Plastic parts prices are almost settled by the customers. Nowadays, several numbers of new plastic injection players enter into the rivalry battlefield which cause the price of the plastic parts sharply fall down. So, in order to survive in the business, the plastic injection companies must control and reduce their production costs. The more reduction in production cost will though benefit more to the company. The cost reduction may be done by increasing the utilization of work power, machines, and etc.

### 3.1.4 Besco International Plastic Business Situation.

At Besco Internaional Plastic, the company is aware of these all above important criterion. Now, the company has got a plastic subsidiary injection mold manufacturer in which enhances the serviceability of the company. The company fully supports customers ranging from mold production to the plastic parts injection. The company is now running through ISO9001 quality standard program, which expects the company to be certified in the year2001. Moreover, the Japanese staffs have been recruited and worked well with customers. The company is proud in the high reputation as a high quality plastic part supplier which most customers always trust in. That's why the company have got a large customers orders in the past 2 years.

Once, the orders have been steeply arisen, the company is not able to sustain an excellency in service especially on the products delivery. Nowadays, the company has encountered a violent difficulties in a slower delivery speed and a lower in delivery reliability. There are two major causes, firstly come from the long production development time, and secondly come from the insufficiency work power. The longer production development time results in the more numbers in delay of the products delivery. The customers always complain on this subject more often than before. This reduces the customers loyalty and may potentially cause the decline in customer orders if the problems are not solved promptly. So, in this emergency situation, the company should promptly consider how to eliminate this

threats and that's what the beginning of this project. Once, the problem structures of the study in the delay in products delivery is illustrated in the following figure 3-4.

*The problems structure of BIP.*

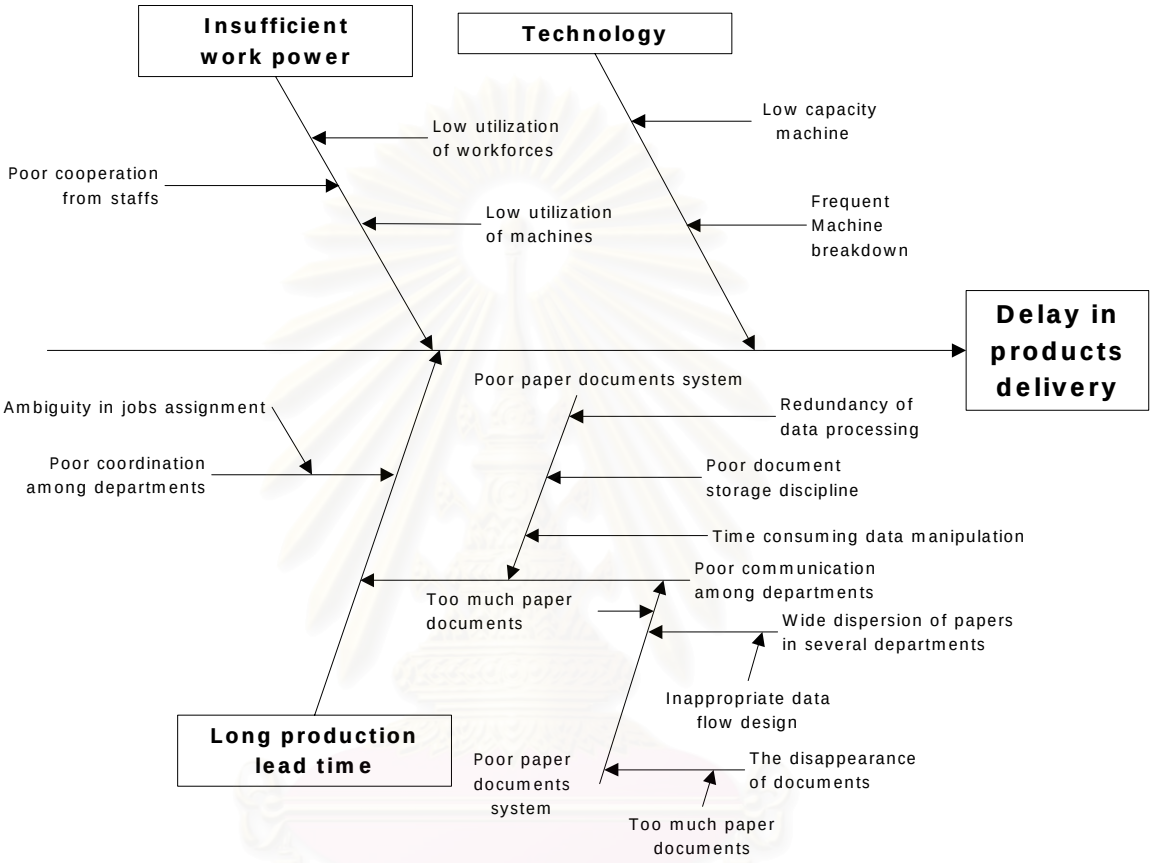



*Figure 3-4 : The problems structure of BIP.*

## 3.2 Analyzing the current Business Processes : System Analysis.

### 3.2.1 Data Gathering.

System analysis is the process of gathering information about the current system which will result in to truly understand how the current system works. Then we analyze the current system in its strengths and problems in order to produce a concept for the new system.

For BIP, the data is gathered in many ways to ensure the correctness of the current process. The author used a variety of information gathering techniques and make sure that the current business processes and the needs for the new system are well understood before moving to the design phase. The data gathering techniques that were used in BIP were:

#### 3.2.1.1 Interviews.

The interviews were conducted in order to know roughly how the current production and inventory information system roughly work. The author spent a large amount of time interviewing the company's staffs from various departments, covering from the top management of the factory who is the key stake holders of the company; managing director, to the common machine operators. The author interviewed one of vice factory managers who took account of the warehouse management to get a better understand how the inventory or warehouse process worked. At mean time, the managing director, the factory manager, and other injection department staffs were conducted in the interview in the production activities issue. In the interviews, the author found out that people at different levels of the company have different perspectives on the current system. This was quite useful to the author to know the problems of different staffs and address the compromising solutions or improvements opportunities of new system in the design phase.

#### 3.2.1.2 Document analysis.

The author studied the current system from the documents used in the factory. All forms and reports were examined in details, which would come out the right business process model. There are some problems occurred in the document analysis, a lot of

documents were only the formal forms that the company had designed for use, but in actual work, those forms had almost never been used. A lot of data communication in BIP were informal such as the order by speech, which did not document the information.

3.2.1.3 Observation in actual work.

The study of documents and interview were not enough for analyzing the system. So, the observation was conducted as to see the reality of work situation rather than just listen to the staffs described it in interviews. The observation identified the validity of information when compared with the information gathered from the interviewed. The result of BIP work observation rather conflicted with the information from the interviews. This was caused there was no standard job description for the staffs and it resulted in no standard work pattern which occurred work looseness of the staffs.

## 3.2.2 Processes Model.

From the data gathering in BIP, the author can summary the current business process in a data flow diagram as shown in appendix A. In this topic 3.2.2, in order to clearly understand the business process, readers may have to read the Data Flow Diagram in appendix A together with the process descriptions below. The actual business processes in BIP consists of :

### 3.2.2.1 Purchasing process.

The purchasing process of BIP is a part of inventory system. It takes account for 2 major tasks which are the material and production instruments procurement and the subcontractor control that manages the purchasing parts from the company's vendors or subcontractors.

3.2.2.1.1 Material and production instrument procurement.

The process of purchase or procurement of the material and production instrument related to the role of the inventory system of BIP. As described in chapter 2, the inventory system is the set of policies and controls that monitors levels of inventory and determines what levels should be maintained, when stock should be replenished, and how large orders

should be. The system is also responsible for ordering and receipt of items such as the time when the order has to be placed, the quantity to be ordered, and which supplier should be bought from.

The company classified the raw material inventory into three groups :

**Group 1** : High usage value material.

The materials in the first group were the material that were often used. It's not worth if the company always placed supplier purchase order on these materials, thus it potentially caused high shortage costs. The company did not tolerate the material purchase lead time of the first group. This meant, the materials were everytime available whenever the production required to use these materials from stock. The replenishment of the material was done only when the inventory level reached a specified inventory level, which was 50 Kgs left in stock. The quantity ordered each time was 250 Kgs. The monitor of inventory remaining level was done every time a withdrawal from inventory or an addition to inventory was made. Whenever, the left material reached 50 Kgs, then the stock staff would place the supplier purchase order for a certain quantity at 250 kgs. The examples of these materials group are Polypropylene, Polystrylene, ABS, and etc.

**Group 2** : Moderate usage value material.

The materials in the second group were the material that were quite often used. In this group, the reorder inventory level was 25 kgs, and the order size was 150 kgs. The monitor of inventory remaining was also done every time a withdrawal from inventory or an addition to inventory was made. Whenever, the left material reached 25 Kgs, then the stock staff would place the supplier purchase order for a certain quantity at 150 kgs. The examples of these materials group were POM, PMMA, PVC and etc.

**Group 3** : Rarely usage value materials.

The materials in the third group were the material that were rarely used. It's not worth if the company hold the stock of these material. It considerably increased the holding costs of inventory, because the materials were rarely used. The company did not hold any material in stock. The order size of material in this group was just enough with the demand in the customer purchase order. Thus, if the demand of parts made form these material types arrived, then the production must wait for the material purchase lead time. The production schedule of these types of material must tolerate for the purchase lead time. This is similar to

the Material Requirement Planning (MRP) sysem. (In actual, the company did not implement the MRP system). The example of this material group was Tyresin.

When the stock staffs have to replenish the material stock, they will firstly prepare a "Purchase proposal" which contains the detail of the items intended to be purchased. The documents are made in 2 papers, the original paper is submitted to the procurement division for the consideration of purchase decision and the other copy is kept at the stock as a documentary evidence.

After the procurement division has received the purchase proposal, then the "Purchase order" is released in later process. However, the release of purchase order must be proceeded under the supplier selection process. The procurement staff has to search the supplier and items information from the catalogue or price lists of various suppliers kept from the past purchase. The staff has to compare at least 2 suppliers to ensure that the company can buy the most reasonable price. The staff may facsimile to the suppliers to inquire the price of the suppliers. So, the staff is able to the select the supplier to purchase and its price. Then, the staff has to prepare the "Purchase request/Price comparison" which specifies the detail of price comparison and the reason of the supplier selection. After the Purchase request/Price comparison is approved by the procurement chief, then the staff will prepare the purchase order and submit it; to the assistant managing director if the price of purchased item is not too high or submit to the managing director if the price of is quite high, for approval. The approved purchase order is then sent to the supplier.

After the purchase has been already agreed, the supplier delivers the material to the procurement division on the due date. The division has to check whether the delivered items are exactly the right items that the company has purchased. It is checked by comparing the invoice, purchase order, and the items. Then the items will be kept in the material and instrument stock, but before keeping them, the stock will check the quality of the purchased items whether they conform to the specification. If they are poor quality, the stock will order the procurement division to return the items to the supplier.

3.2.2.1.2 Subcontractor control.

The subcontractor control copes with the excessive orders that the company is not able to produce in house. Therefore, the company has to outsource these orders to the subcontractors. Anyway, the company does not prefer to outsouce because the company can not control the quality of the subcontracted parts.

### 3.2.2.2 Warehouse management process.

The warehouse management of BIP consists of 2 major parts which are the material and production instrument stock and the finished product warehouse.

#### 3.2.2.2.1 The material and production instrument stock.

The material and production instrument stock takes account of these major tasks:

- Control the entry-exit of the items in the stock.

When the production staffs request for the material or production instrument for usage, they will request the machine operator leader for fetching the required items from the stock. The items may be a plastic resin used in the machine set up and injecting processes, packing equipment used in packaging process, or machine spare parts used in a machine repair. The leader must arrange these items to the staffs by submitting the “Item requisition form” to the stock. The item requisition form specifies the detail of required items and its length period of use. After the stock receives the requisition form, the stock has to pay out the items to the injection staffs.

Similarly, when the injection staff has already finished the use of the items, then they have to return the left amount of items to the stock. The “Item return form” is then filled before handling to the stock. Therefore, the stock is responsible to control and monitor the usage of these material and instruments by recording and reading the data in “material and production instrument control form”.

- Check the availability of the material or production instruments stock status.

The status is checked to know whether the items in stock are available to support the production activities. By doing so, the stock staff has to check the level of stock everytime items are received or withdrawn. In addition, the stock has to check the validity of stock figures by checking the actual amount of items positioning on shelves comparing with the

figures shown in the “Material and production instrument stock” document which shows the status of stock available at a time. The stock status validity is checked once a week.

The stock has to give the stock status to the injection control division if the later wish to evaluate the available stock whether it is sufficient for the future production. If it is not enough, the stock will release the purchase proposal to the material and production instrument procurement division for the purchase process.

- **Check before take in the purchased items into stock.**

The stock staff has to inspect the purchased material and instruments whether the items conform to the specification or in good quality, otherwise the staff has to reject the items.

#### 3.2.2.2.2 The finished products stock.

There are two major tasks of the products stock control process.

- **Keep the finished products or the defects from the production process into the stock.**

The products will be kept in the warehouse area before handling to the customers. The reason that the company has to keep them in stock, although the company is made-to-order company, because some companies use Just In Time (JIT) system for their supply chain management. Some customers may order a huge lot size and order the company to deliver a small amount size at a time, for example, five times in a month. Therefore, it is quite often that BIP produces the whole lot sizes at a time and keep the finished products sitting in stock waiting for delivery. Moreover, some products may be finished earlier than the customer’s due date which result these products have to be kept in the stock as well.

The products stock takes account for this issue. At the end of everyday, the finished products enter into stock with the “Packing List” attached beside the carton. The packing list identifies the information about the products of the parts in the carton. The production control division also submits the “Daily finished products” information to the stock. The document informs the total finished parts produced in a day that would be entered into stock. Before the

products enter into stock, the “Products allocation” has to be recorded. The document identifies the entered products into stock including the location of the products are kept.

Not only for the products, the defective parts are also kept in the product stock too. The defects may come from the rejected products form the customers or the rejected parts from Inspection process in the Quality Control section of BIP, or the scrap during the injection process. Similarly to the product stock entry process, before keeping the defects or scrap in the stock, the “ Rejected products allocation” or the “ Scrap allocation” must be recorded for the identification of these things in stock.

After the products, defects or scrap have been kept in stock, the stock staff is responsible to record the stock status in the “ Products stock” or “ Rejected products stock” or “Scrap stock” as identified in the stock entry process. The documents are used to monitor the products, defects, or scraps stock status in which shows the available amount of the items sitting in stock. These documents are recorded whenever there are an entry or exit of products or defect or scrap from stock.

- **Products delivery.**

The other major task of the products stock is to deliver the products to customers as ordered by the production planning division. The production planning will issue the “Delivery order” to the delivery section for the products delivery. The delivery order contains the information of the product name, quantity, customer, and destination of product to be delivered. Meanwhile, the products invoice is enclosed with the delivery order. The invoice identifies the products which will be sent with the products.

When the customers have received the products, they will check the products quality by quality sampling inspection. If the inspection is approved, then the customer accept BIP products, then the invoice is signed and the copy of invoice is taken back to the company as a documentary evidence. But, if the inspection fail, the BIP driver has to bring the products back to the company with the invoice that is not signed by customers yet. These rejected products are then kept in the BIP stock as described in the earlier process in defect stock entry.

### 3.2.2.3 Production planning process.

There are three major tasks of the production planning process.

- Customer support.

The beginning of business cycle of BIP starts from the customer order to produce the plastic parts. The customers firstly send their parts prototype and parts standard specification to the company for the price appraisal. The price negotiation begins, until meet the agreed price that satisfies both sides. These processes are arranged by the managing director with representatives from the production planning division and marketing department.

Then, the quotation is prepared and submitted to the customer waiting for issuing the customer purchase order. Hence, the production tasks of BIP start when the "Customer purchase order" arrive at the company. When the managing director, whose major function is to directly support the customer, receives the customer purchase order, then he will distribute copies of purchase order to the production planning division who releases the production schedule, the assistant managing director who coordinates the production control, production planning, and warehouse division. The production planner uses the purchase order as a data for scheduling the jobs, whereas the assistant managing director uses it for following the progress of the jobs during production process and releasing delivery order when the due date comes.

- Production scheduling.

The production scheduling is a fundamental task of production planner. Scheduling is the designing of starting and completion times to orders. BIP schedule is the allocation of orders on each machine in day by day operation. Production planner will schedule the orders for one week in advance. After the planner receives the purchase order, he firstly identifies the existing production capacity of the company by looking the production schedule. If the company can handle the order, then the planner will arrange it in the production schedule.

To depict the task of scheduling, let's use the examples, as described in the introduction, the company has 18 machines on plant. The machines are different in size and are capable to inject different size of plastic parts. The 100 ton size of injection machine is capable to inject parts up to weight 120 grams. If the company receives the purchase orders of 120 grams weight, it is found out that the a schedule of the 100 tons machines is not vacant, then the planner has to outsource this over capacity jobs to the subcontractors or vendors of BIP. So, the order will be place in the "Subcontractor production plan" instead. Anyway, at meantime, if the purchase order of 750 grams plastic parts arrive the company, and the schedule for the 350 tons size machine; which is capable to inject that size of part, is vacant. Then the planner will place the order to the in-house schedule or "Daily production schedule" of BIP. The production schedule document of BIP is shown in figure 3-5.

The schedule task of BIP is quite complex and critical to the company. This is resulted from the group of different sizes 18 machines to schedule. Now, there are no standard priority rules for the scheduler but only the personal judgement.

The production schedule is reviewed and adjusted everyday at the end of shift A or day shift. The planner will use the "Production daily reports" which shows the actual production output of every machine. The planned outputs in the schedule are then compared with the actual figure, the shortage number of parts at each machine appears. In additions, during the injection process, there may any difficulties such as machine down time or break down, so that it need time to fix the problem. The machine may be idle for a while, so this condition is informed to the production scheduler for the schedule adjustment as well. Thus, the adjustment of production schedule is necessary for everyday plan.



- **Factory administration.**

The assistant managing director takes account for the factory administration function as a person who coordinates all divisions in production department. The major tasks of factory administration are to take the production schedule and follow the orders in the injection process and order the products delivery when the due date comes.

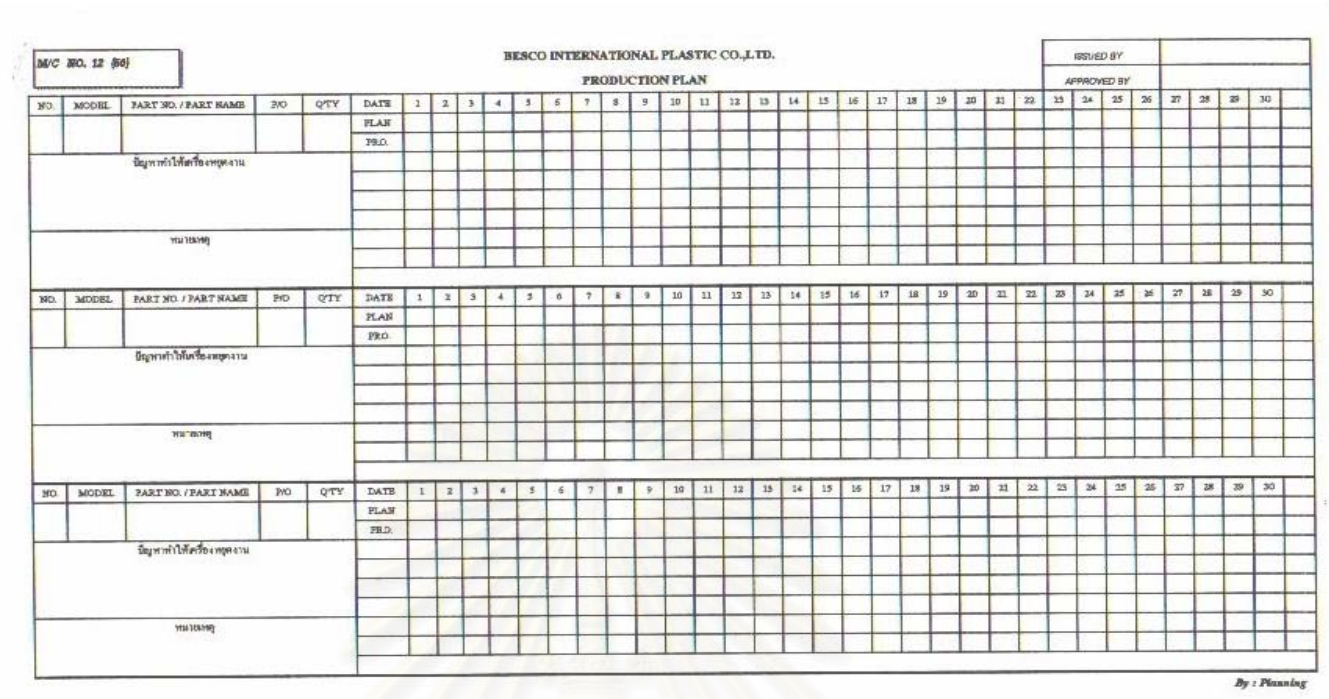



*Figure 3-5 : The production plan document in BIP.*

### 3.2.2.4 Production control process.

The production control division consists of three major sections.

- Injection section.

The injection process begins when the “Injection order” is released by the shift supervisor at the beginning of each shift. When the production planning handles the production schedule to the shift supervisor, then the supervisor would assign each machine tasks in a day by the “Injection order”. The order contains the jobs have to be accomplished in each machine with specifically assigned machine operator. The order also contains a machine set up condition information which is a set up reference instruction for a machine set up technician.

The injection order is issued in three copies, one copy of the order is submitted to the technician. When the technician receives the order, he realizes that he has to set up the machine immediately. The injection mold and plastic resin are taken out from the stock to the machine. The machine set up process relies on the past data form the machine “ Try out record”of the same parts used to be injected with the same model of machline or proximity to.

However, if the past try out data is not available, the technician has to use the trial and error approach by his own knowledge based. Thus, for the later approach, the machine set up condition has to be recorded in the “try out record”, so that the condition may be used in the future set up. The machine set up continues until the machine condition give the parts that the quality and property conform with the part standard specification and the cycle time meet the requirement.

The injection starts when the set up is finished by the machine operators. The operators have to operate the machine following the injection order as a guide. The injection process accomplish when the finished plastic parts are produced completely as ordered in the injection order. However, the volume of finished parts do not include the defective parts from process.

When the injection finish, the machine operator will call the technician to take off the mold from the machine, and sets up the new mold as ordered in the injection order instead. The taken off mold is returned to the stock, while the new mold is brought out from stock. During the injection process, the machine operators have to observe for any unusual condition such as the deviation of cycle time, the machine abnormality and have to report these events suddenly to the machine operator leader when it has happened.

At the end of the shift, the “Production report” is arranged by each machine operator to review the production outcome to the leader. The leader has to collect the production report from every machine to complete the “Production daily report” to the shift supervisor consecutively.



- QA&QC section.

The quality management of BIP begins with the parts inspection from the injection process. The parts are sampled to check basing on the “ Sampling inspection plan” sheet prepared by the production planning division. The sampling inspection plan sheet specifies the inspection methodology have to be used. The inspectors have to report the inspection result in the “Inspection report” which provides an information for the Quality Assurance chief

to decide whether to accept or deny the parts lot. If the parts are accepted by QA, then they will be packed in the cartons by the packing staffs. Before the staffs handle the packed cartons to keep in the warehouse, the “Packing list” is issued and attached beside every carton. The packing list identifies the parts information in the cartons.

On the contrary, if the parts are not approved in quality. QA chief will request the injection section to rework these parts in order to correct the trouble that cause the quality decline. The “Corrective Action Request(CAR)”, identifying the solution to get rid of the problem, is submitted to the injection operators to rework these incomplete parts. When the parts have been already rectified, then they will be sent for inspection again. The “Corrective report for reworked parts” is a supplementary document for the inspector and quality chief to check for the improvement. Finally, these parts will be packed and sent into the warehouse though.

- **Maintenance section.**

The factory technician is not responsible only for the machine set up task, but includes the maintenance tasks. The maintenance process in BIP divided into two types :

- Periodic machine treatment and inspection. ( Preventive maintenance program).

The technician will follow the “ Daily and Monthly maintenance check” which contains the guide line of check methodology. The machine treatment and inspection are routine tasks that are assigned for a practice technician.

- Emergency machine repair ( Break down maintenance)

When the machine break down occurs during production or any parts of machine do not work properly, the machine operators have to inform the maintenance technician to fix the machine suddenly. Before doing so, the “Machine break down report” is prepared first for requesting to stop the injection process from the production planning division. The report contains the break down symptom and its cause. When the repair is approved, then the chief technician will issue the “Repair order” to the technician to repair the machine within the period of time notified in the repair order.

When the machine repair finish, the technician has to record the “ Machine repair record” which may be useful for the repair in the future.

Finally, the data flow diagrams represent the overall described processes. The diagrams are attached in the appendix A. The next stage after the anaylsis of the business process in this chapter is the design process which is explained in chapter 4.

# CHAPTER IV

## *DATABASE DESIGN AND DEVELOPMENT*

## 4.1 Introduction

After the analysis process as described in the previous chapter, the causes of problems in the existing production and inventory processes were all declared. The users' requirements(appendix C) were clarified in order to identify the database components. The inappropriate documents system always cause the lenghty communication time of processing various activities between different departments. Thus, the aim of this thesis is to develop the database system for production and inventory which cover the major processes of the company in order to shorten the products development time as stated in chapter 1.

The problems analyzed from the data flow diagram and the users requirements set the direction of database design. The users' requirements were stated in the system feasibility study which was attached in Appendix C. The designed database concerned in eliminating some repetitive and obstructive data, processes, and data communication problems.

Finally, from the analysis of data flow diagram, the author found out that the developed database systems were not necessary to cover all production and inventory information in the factory. This would make the system too vast and may result the users confuse in the system. The developed database system cover only some major information and processes that strongly affect the processing time. The designed database boundaries are mentioned later.

## 4.2 The Design of BIP Production and Inventory Database.

The author intends to develop the database that consists of two major area : Order processing system and purchasing system. These two major systems cover almost production and inventory activities in the company.

### *4.2.1. Order processing system.*

The Order processing system in BIP is very critical to the operation in the company. It is the company's backbone or lifeblood that supports major order activities. It includes major processes to launch the production after the company receives the purchase order, and the flow of production order, until the shipment and invoicing of finished products to the customer. The below figure 4-1, is a system-level flowchart that shows the scope of order processing that the author intends to develop the database for. It shows developed systems and the information that flows between them. A rectangle represents a system, a line represents the flow of information from one system to another, and a circle denotes for the external entity. The database for order processing system in BIP cover these systems:

*4.2.1.1 Customer purchase order entry.*

*4.2.1.2 Production planning.*

*4.2.1.3 Production scheduling.*

*4.2.1.4 Injection order releasing.*

*4.2.1.5 Production control.*

*4.2.1.6 Inventory control(Product warehouse).*

4.2.1.7 *Delivery execution and invoicing.*

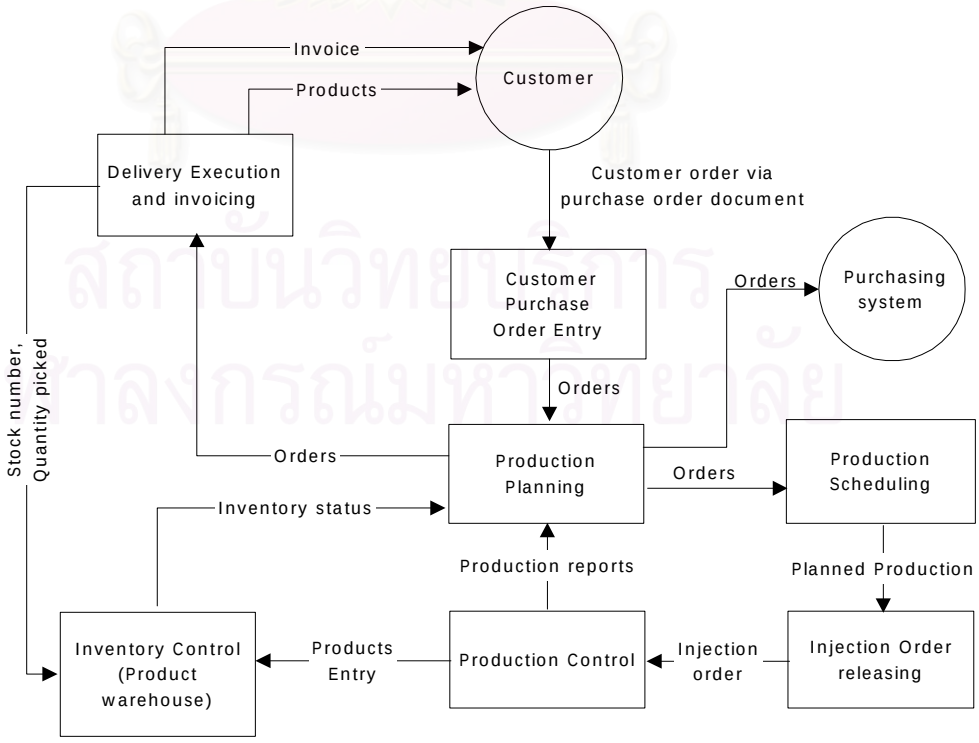



*Figure 4-1 : The system-level flowchart of BIP order processing.*

### *4.2.2 Order purchasing.*

The purchasing activities are also very critical for the company business. The improper designed of purchasing processes cause unwieldy processes and lengthen the lead time for procuring the purchased items. Major inventory of BIP is a raw material which is a Plastic resin. The developed database in purchasing transaction systems of the material of BIP is able to speed up the material procurement lead time, reduce the workload on the procurement staffs, and also assist the staff to monitor and control the level of inventory in stock efficiently.

The purchasing transaction processing systems of BIP include Material inventory control, Supplier purchase order processing, purchased items receiving, and the material withdrawal for usage in production. The purchase system is shown as the system-level flowchart that shows the scope of order purchasing that the author intends to develop the database for.

The database for order purchasing system in BIP cover these systems

*4.2.2.1 Material stock control.*

*4.2.2.2 Purchase order processing.*

*4.2.2.3 Receiving the items.*

*4.2.2.4 Material withdrawal for usage in production.*

The below figure 4-2 is a system-level flowchart that shows the scope of order purchasing that the author intend to develop the database for :

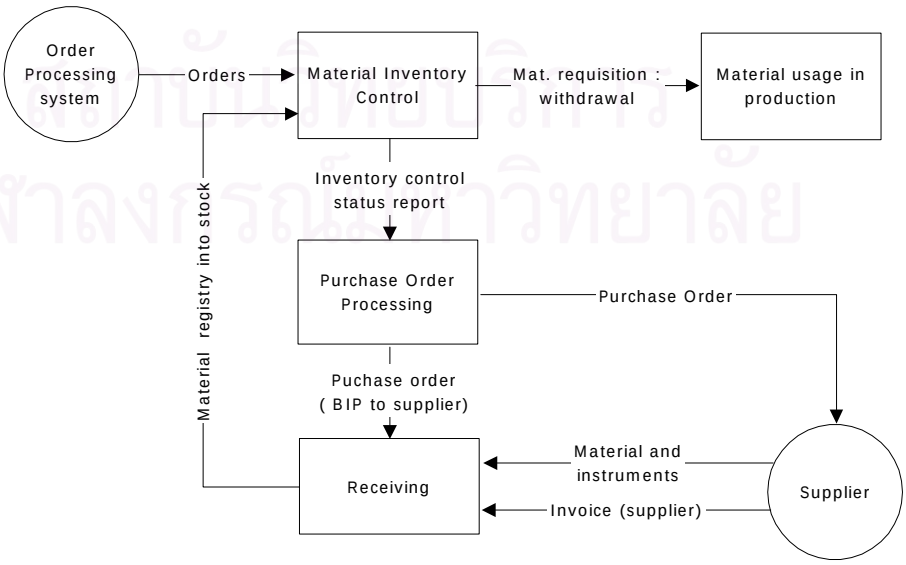



*Figure 4-2 : The system-level of order purchasing.*

## 4.3 Database Design Approach.

The database system design was applied with many techniques that were involved. These concepts and techniques consisted of the development of the following phases.

- *Conceptual design* : This phase was applied to determine the structure of information system for the database. This phase reflected to a big picture of the database system. This included the conceptual data model. The principal elements of the data model were objects and relationships. Objects represented things that the author intended to automate, in this case; the production and inventory transactions , as would be declared in later topic. Whereas the relationships linked two object sets. The conceptual data model hereby refered to the design of Entity Relationship Diagram (ERD) of the developed system, including the data dictionary. The ERD expressesed in terms of entities in the business environment, the relationship among those entities, and the attributes of both entities and their relationships. Whereas the data dictionay contained definition of record, data items, relations, and data objects that were used to describe the property of data.

- *Implementing design :* This phase described about the detail of each module from the conceptual design, the input/output user interface and workflow of each module that defined the job description of the production and inventory processes to match with the developed database system.

- *Physical design* : This phase composed of software and hardware configuration to support the database system. This database system was developed on personal computer platform, which used Microsoft Window environment and Microsoft Visual Basic as a developing tool to prepare the application and Microsoft Access 2000 as a database management system. This phase also included the hardware configuration that could describe the hardware specification and networking configuration.

## 4.4 Conceptual Design.

To represent the conceptual design, the data dictionary and the physical Entity Relationship Diagram of the BIP production and inventory system are designed as the followings :

### *4.4.1 Data dictionary for the developed BIP production and inventory system.*

- Entity/Table Name : TblProduct

Objective : The table contains the fundamental specification of the products that the company have to meet.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | ProductID | The identification code of the parts | Text | 15 |
| | ProductName | The name of the parts | Text | 30 |
| | UnitPrice | The unit price of part | Number | 5 |
| | MaterialID | The code of the part material: foreign key link to table Material | Text | 20 |
| | Weight | The weight of a part | Number | 5 |
| | Color | The color of the product | Text | 30 |
| | CycleTime | The cycle time of machine | Number | 5 |
| | MoldCode | The code of injection mold | Text | 20 |
| | MoldCavity | The number of cavities of the mold | Number | 2 |
| | Inspection | The methodology of the sampling inspection test to accept the products | Text | 150 |
| | RunnerWeight | The weight of a runner | Number | 3 |
| | QuantityInStock | The quantity left in warehouse | Number | 10 |

*Table 4-1 : The table tblproduct*

- **Entity/Table Name** : TblProductHouseDetail.

**Objective** : The table keeps records of the identification of product warehouse, because the company has many warehouse area. Each area contains several different finished products. In addition, each warehouse area provides several spaces to place the product (specified by the ProductHouseAddress). The warehouse code (ProductHouseID) is specified before the products enter in warehouse.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | ProductHouseID | The warehouse Identification code of the part | Text | 5 |
| X | ProductHousePositionID | The warehouse area of the product kept | Text | 3 |
| X | ProductID | The identification code of the parts | Text | 15 |

*Table 4-2 : The table TblProductHouseDetail.*

- **Entity/Table Name** : TblProductHouse

**Objective** : The table provides the position information of finished products which has been specified the warehouse code.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | ProductHouseID | The warehouse Identification code of the part | Text | 5 |
| | ProductHouseAddress | The position of the product kept | Text | 3 |

*Table 4-3 : The table TblProductHouse*

- **Entity/Table name** : Tbl OrderDetail.

**Objective** :To collect the information of the purchased product detail of the customer purchase order.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | OrderID | The Purchase Order code. | Text | 15 |
| | ProductID | The part code | Text | 15 |
| | OrderQuantity | The order quantity size of each ordered part | Number | 8 |
| | SalePrice | The unit price of the parts | Number | 4 |

*Table 4-4 : The table TblOrderDetail.*

- **Entity/Table name** : TblOrder

  **Objective** : To collect the information of the customer purchase order.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | OrderID | The Purchase Order code. | Text | 15 |
| | CustomerID | The customer identification number | Text | 6 |
| | OrderDate | The date the purchase order arrives. | Date/Time | |
| | ShippedDate | The delivery due date | Date/Time | |
| | CustomerName | The customer name | Text | 40 |

*Table 4-5 : The table TblOrder.*

- **Entity/Table name** : TblCustomer

  **Objective** : The table collects the information of each customer.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | CustomerID | The identification code of each customer | Text | 6 |
| | CustomerName | The customer name | Text | 40 |
| | CustomerAddress | The address of each customer | Text | 100 |
| | CustomerZipcode | The postal code of each customer | Text | 5 |
| | CustomerTelephone | The contact telephone of each customer | Text | 11 |

*Table 4-6 : The table TblCustomer*

- **Entity/Table name** : TblMaterial.

  **Objective** : To store the information of each material type which is kept in stock.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | MaterialID | The code of the part material: foreign key link to table Material | Text | 20 |
| | MaterialName | The name of the material type:Plastic resin. | Text | 30 |
| | QuantityInStock | The quantity left of each material type in stock | Number | 6 |
| | SupplierID | The identification code of the supplier of | Text | 6 |

| | | | | |
|---|---|---|---|---|
| | | where the material was bought. | | |
| | UnitPrice | The unit price of the material that was bought. (Last update) | Number | 5 |

*Table 4-7 : The table TblMaterial.*

- **Entity/Table name** : TblWarehouseDetail

**Objective** : The table keeps records of the identification of material stocks, because the company has many material stock areas. Each area contains several differrent kinds of material. In addition, each stock area provides several spaces to place the material. The material stock code (WareHouseID) is specified before the material enters in stock.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | WareHouseID | The material stock code | Text | 5 |
| X | WareHousePositionID | The stock area of the material kept | Text | 3 |
| X | MaterialID | The identification code of the material | Text | 15 |

*Table 4-8 : The table TblWarehouseDetail.*

- **Entity/Table Name** : TblWareHouse

**Objective** : The table provides the position information of finished products which has been specified the warehouse code.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | WareHouseID | The warehouse Identification code of the material | Text | 5 |
| | WareHouseAddress | The position of the material kept | Text | 3 |

*Table 4-9 : The table TblWareHouse.*

- **Entity/Table name :** TblSupplier

  **Objective :** The table collects the information of each supplier.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | SupplierID | The identification code of each supplier | Text | 6 |
| | SupplierName | The supplier name | Text | 40 |
| | SupplierAddress | The address of each supplier | Text | 100 |
| | SupplierZipcode | The postal code of each supplier | Text | 5 |
| | SupplierTelephone | The contact telephone of each supplier | Text | 11 |

*Table 4-10 : The table TblSupplier*

- **Entity/Table name :** TblMatOrder.

  **Objective :** To collect the information of the material purchase order of the company. The table only performs as a referable data source for checking the issued material purchase order, thus there is no relationship with the other entity/table.

| Primary key | Data Attribute Name | Description | Type | Size |
|---|---|---|---|---|
| X | MatOrderID | The material purchase order identification code of BIP | Text | 15 |
| | SupplierID | The identification code of each supplier | Text | 6 |
| | MatOrdererName | The issuer name of the material purchase order | Text | 20 |
| | ReceiveDate | The delivery due date of the material | Date/Time | 6 |
| | MaterialID | The code of the part material: foreign key link to table Material | Text | 20 |
| | QuantityOfOrder | The quantity of the material ordered | Number | 6 |
| | Total | The total amount of purchased material ( In Baht ) | Number | 7 |

Table 4-11 : The table TblMatOrder.

*4.4.2 Entity Relationship Diagram for the developed system.*

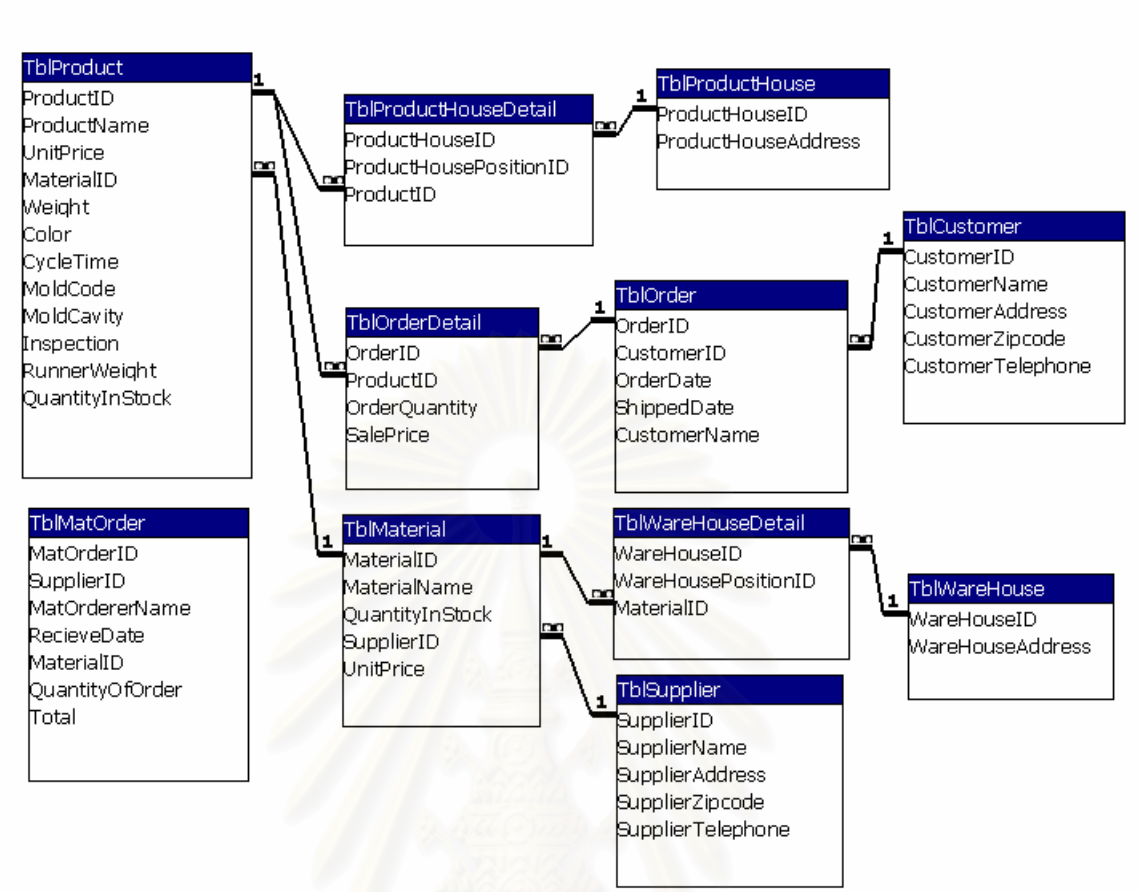



*Figure 4-3 : The Entity Relationship Diagram for the BIP production and inventory database system.*

Once the physical ERD and data dictionary, that described exactly how the database system would be built, had been already defined, then the author could focus on the rest of the design phase tasks and techniques that would be used to build the database application or software. The former information was enough for programming the database software during the design implementation.

## 4.5 Design Implementation.

### *4.5.1 System Programming.*

Programming was the process of translating conceptual design specification into software. For developing BIP production and inventory database system, the author used Microsoft Visual Basic 6 to develop the application program with the Microsoft access 2000 as a database system. The Visual Basic 6 (VB6) system was a complete, powerful, and integrated development environment tool. It was an ideal development environment for

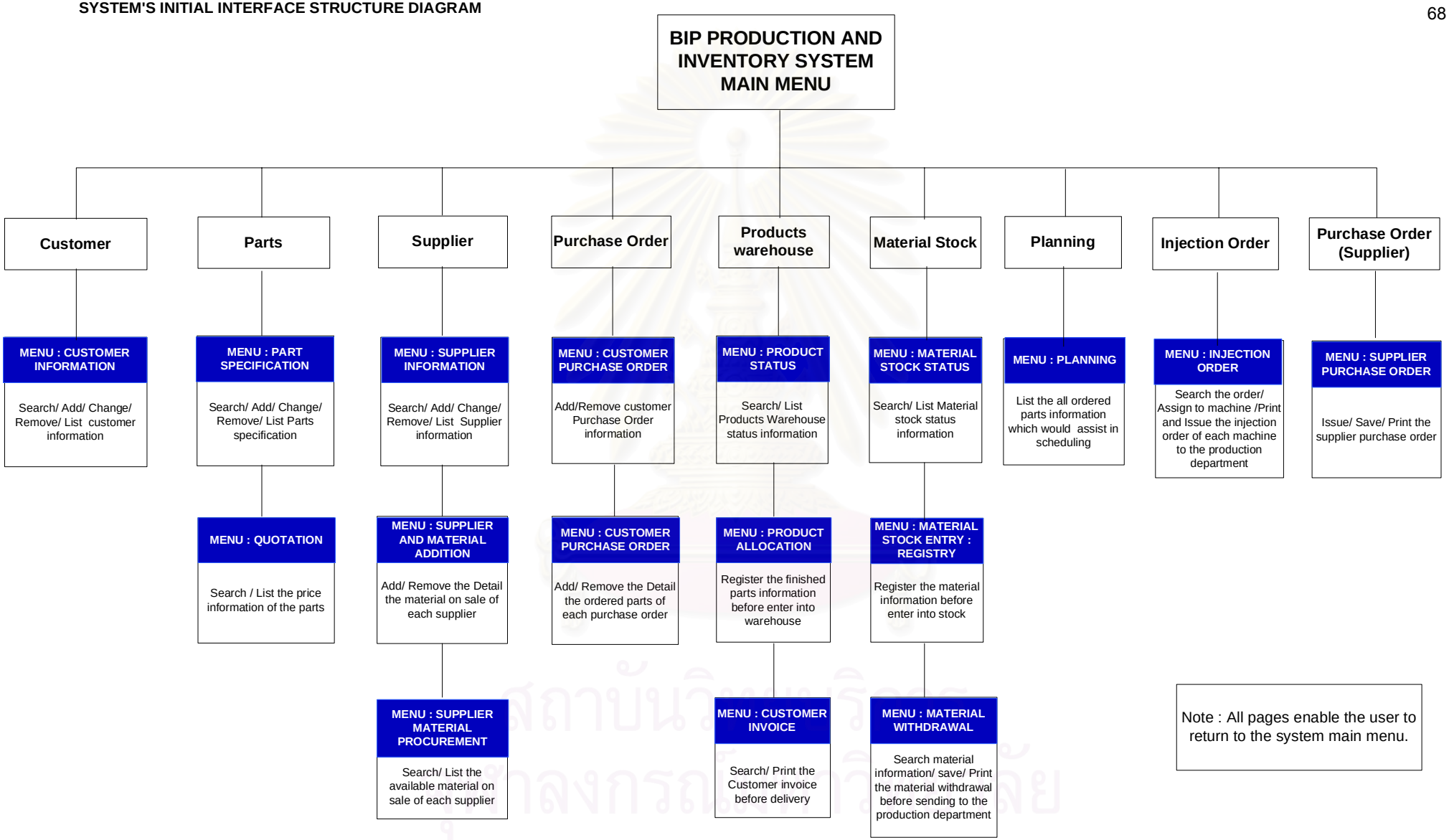
client/server and database applications due to its program features capabilities and easy to code. The VB6 included a project-based file system, a window creator that gave very easy access to event code, automated menu building, an integrated debugger which helped the author easily fix the bugs, a runtime environment, as well as access to outside features including plug-in components and the Windows Application Program Interface. The further addition of the database JET (Joint Engine Technology), which allowed complete database manipulation functions to manipulate a Microsoft Access database, made Visual Basic 6 was suitable for developing a Client/Server database. Whereas the Microsoft Access 2000 was one of the best database system because it was easy to use and also powerful. It was completely compatible with the JET engine used in VB6, so common database files could be used. It also provided security features that could be programmed the access by the VB6 so that made the database system sufficiently secured from the unauthorized access.

The programming procedures consisted of developing a numbers of forms and modules in VB6. Forms held the layout information of the window, code, and any controls that were to be displayed. Modules were files that contained only code with no visual component. Then the programming for the database access was done in order to acces numerous related tables designed in the Access database.

### *4.5.2 User interface design of the BIP database system.*

The developed BIP Production and Inventory Database programming was done togethter with the design of the user graphic interface. The interface design involved in the design of the layout of the screen, forms, and report. The author intended to design the interfaces that helped the users be aware of content and context. All interfaces were designed for pleased for looking and supported the non experience users or first time users were able to use easily. Finally, all interfaces attempted to minimize users effort to perform action or user friendly. The initial interface structure of the program BIP production and inventory database system is shown in figure 4-4.

**Figure 4-4 : BIP PRODUCTION AND INVENTORY SYSTEM'S INITIAL INTERFACE STRUCTURE DIAGRAM**



## 4.6 Program implementation.

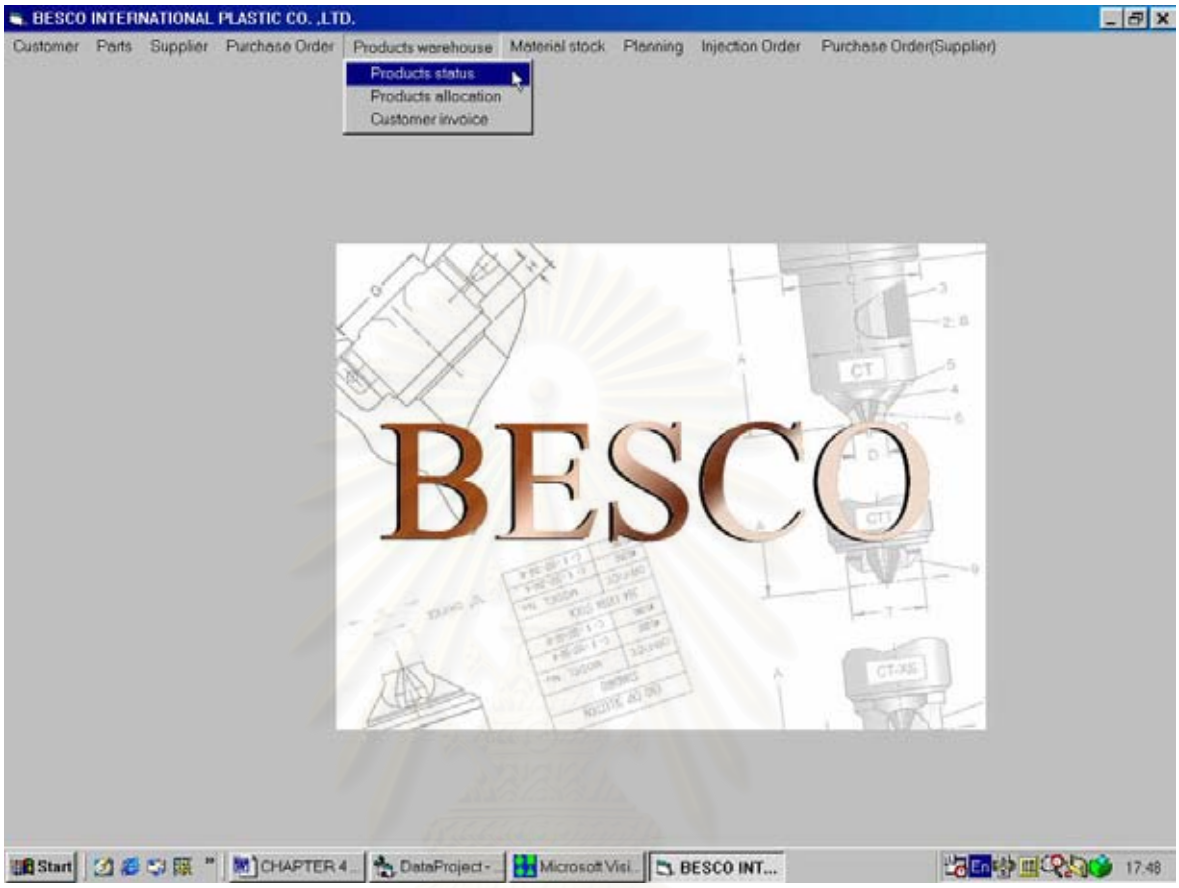



*Figure 4-5 : The main menu screen of the developed BIP production and inventory database*

### *4.6.1 Customer purchase order entry.*

The BIP customer order entry system captures the basic data needed to process a customer order. The process of order entry is done by the customer support section of the production planning division as it is showed in the DFD. Previously, after the receive the customer order, the managing director who is responsible for customer support, will distribute 4 copies of purchase order to the staffs in charge of processing the order, who are; the production scheduling unit, factory administration, production control, and the material stock. The purpose of use in a document is declared in the data dictionary in page 177 of appendix B. So, the developed database eliminates the use of these copies and speed up the purchase order processing.

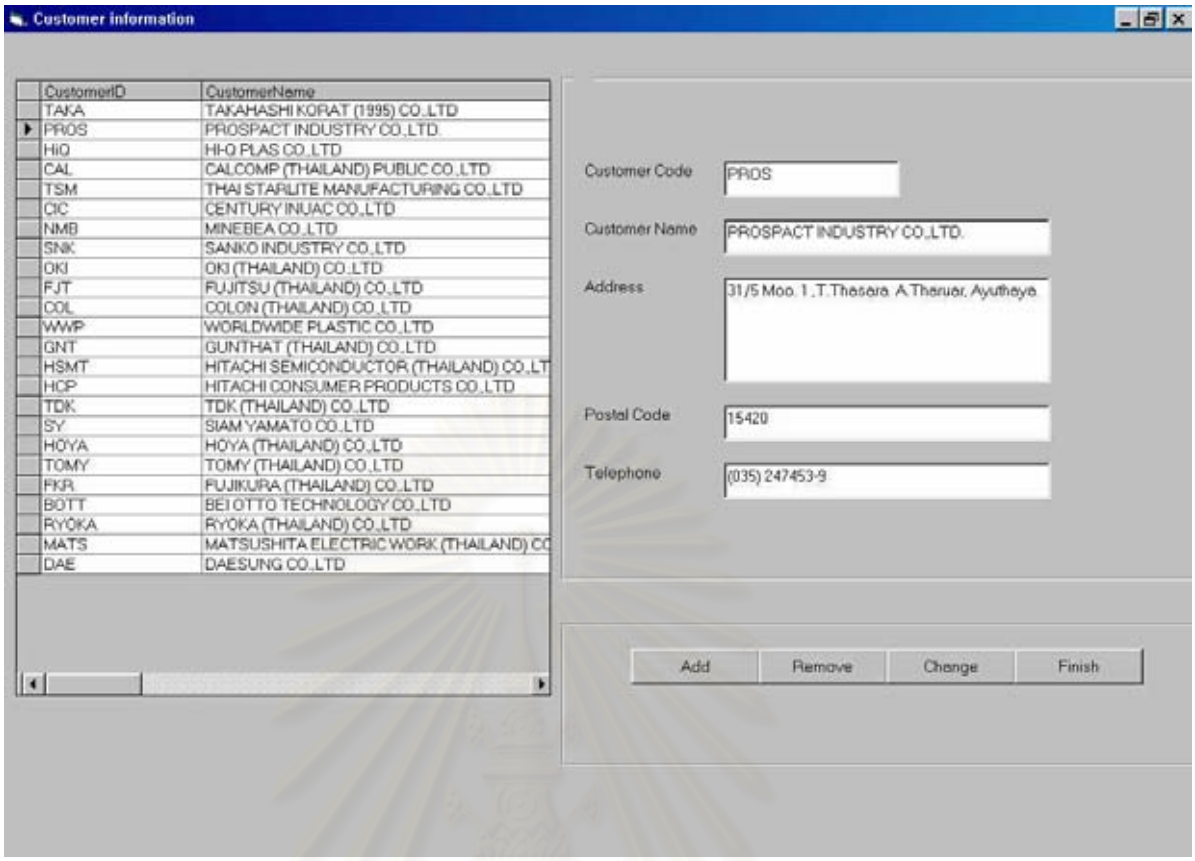



*Figure 4-6 : The input/output screen of customer information form.*

- When the customer has placed the purchase order, then the staff will check whether it is a new customer. If it is a new customer, the staff has to add the customer data in customer information form (see figure 4-6). The customer code is identified including the address information. But, if it is an existing one, the update is not proceeded. In the customer information screen, it lists all current BIP's customers sorted by the customer code, so that the users are able to search the customer information suddenly whenever they need. The program also allows the users to remove or change the present customer information as well.

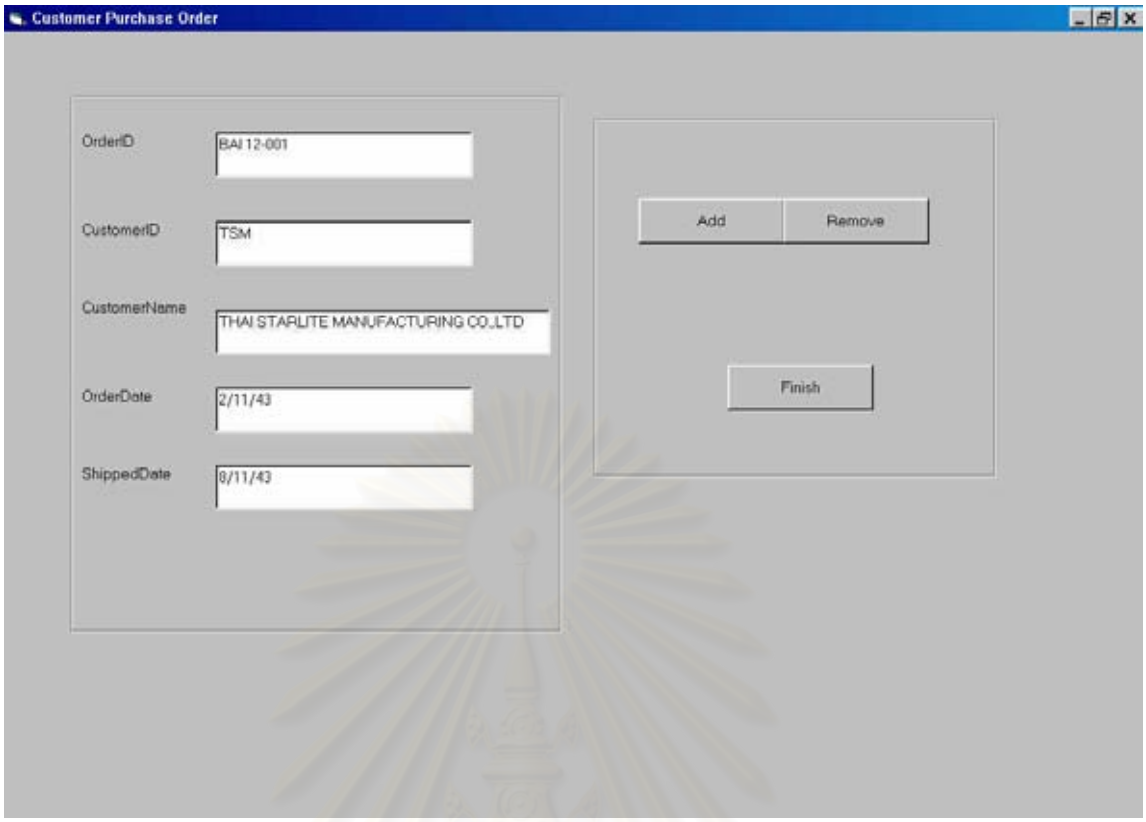



*Figure 4-7 : The Input screen of Purchase order form (customer)*

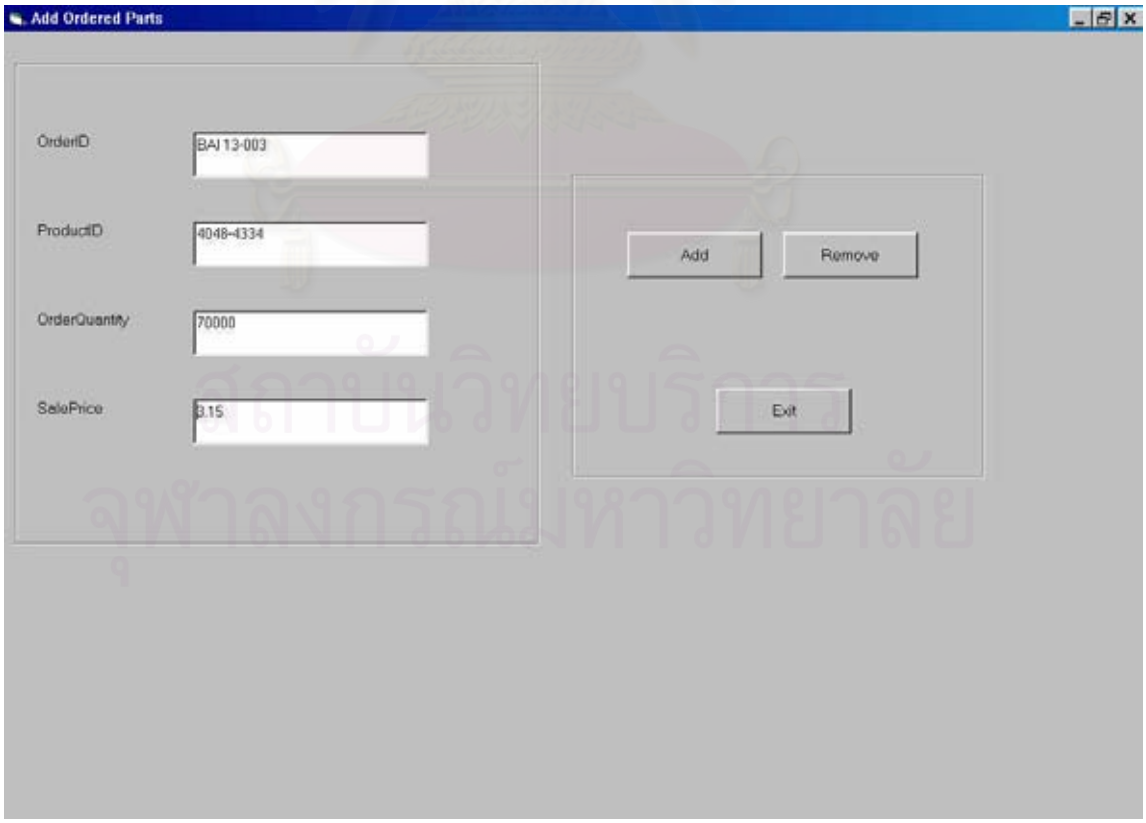



*Figure 4-8 : The input screen of the ordered parts in each customer purchase order.*

- After the update of the customer information, the staff has to input the details of purchase order in the customer purchase order form (figure 4-7). This form contains all necessary data of purchase orders. The purchase order number, the customer code, and the delivery agreements are added in. The information in this form will be shown in the planning screen ( see figure 4-11) which is then concurrently accessed by the multiple users in various parts in the factory; the production scheduling unit, factory administration, production control, and the inventory, as described earlier. The users are able to look the details of purchase order in the planning screen and print out the table. Anyway, the input of purchase order information is strictly controlled by the authorized person only, preventing from the improper change of data.

In one purchase order, it may contain several parts ordered by the customer, so that the users may have to add the parts ordered in the Add ordered parts input form (Figure 4-8), which automatically appears when the user clicks the add button of the customer purchase order input form.

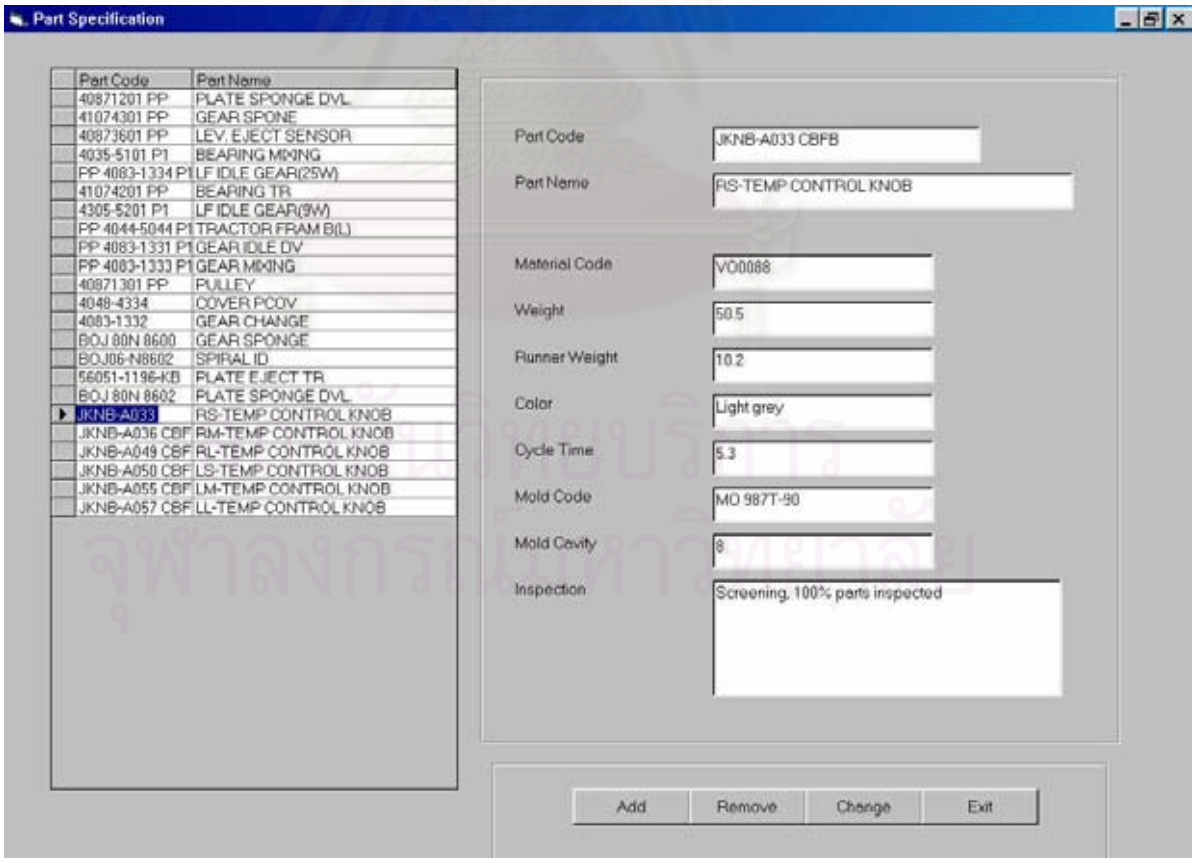



*Figure 4-9 : The input/ output screen of part specification form.*

- Then, the ordered product information will be input in the part specification form (figure 4-9), if it is a new part that the company has never been ordered. The source of data is from the part specification document attached with purchase order. But, if it is the part has been recorded then the update is not needed. The part specification is used by the machine set up technician in the machine set up process at the production control division.

There are thousand of parts produced on the 18 injection machines and the customer often orders the parts that has ever been ordered, and then they always do not attach the part standard specification documents. Therefore the part specification database is extremely useful for production when the part standard specification is absent or hard to seek. The set up technician is able to retrieve the parts specification immediately as the injection order arrives. So, it considerably speeds up machine set up process.

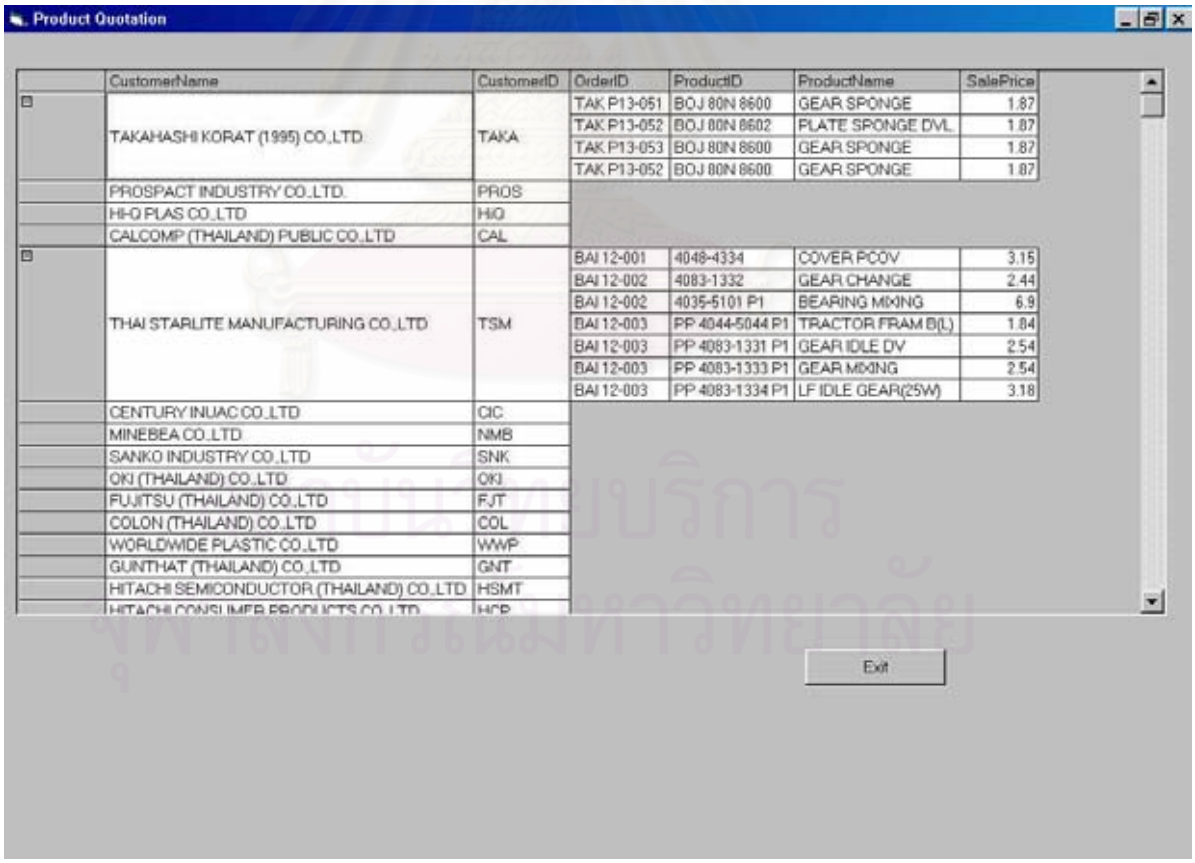



*Figure 4-10 : The output screen report of the price of customer ordered parts.*

- The unit price of product which is recorded in the Add Ordered parts (see figure 4-8), will be reported in the product quotation form (figure4-10). The report of parts price assists in issuing product quotation process. Previously, the unit price quotation process spends a vast amount of times and bases on the managing director judgement or the negotiation with customer.

Generally, when the customer places the order, the company has to check whether the parts have ever been produced first, if it does so, the part unit price would normally relies on the previous price in the quotation. But, if it is a new part, the company has to consider the most appropriate price depending on the part standard specification. The report of product quotation helps the users to retrieve the part price suddenly whenever the company has to make a quotation to the customers. Moreover, this would relief the load to the managing director in the unit price set up process as well.

### *4.6.2 Production planning system and Production scheduling.*

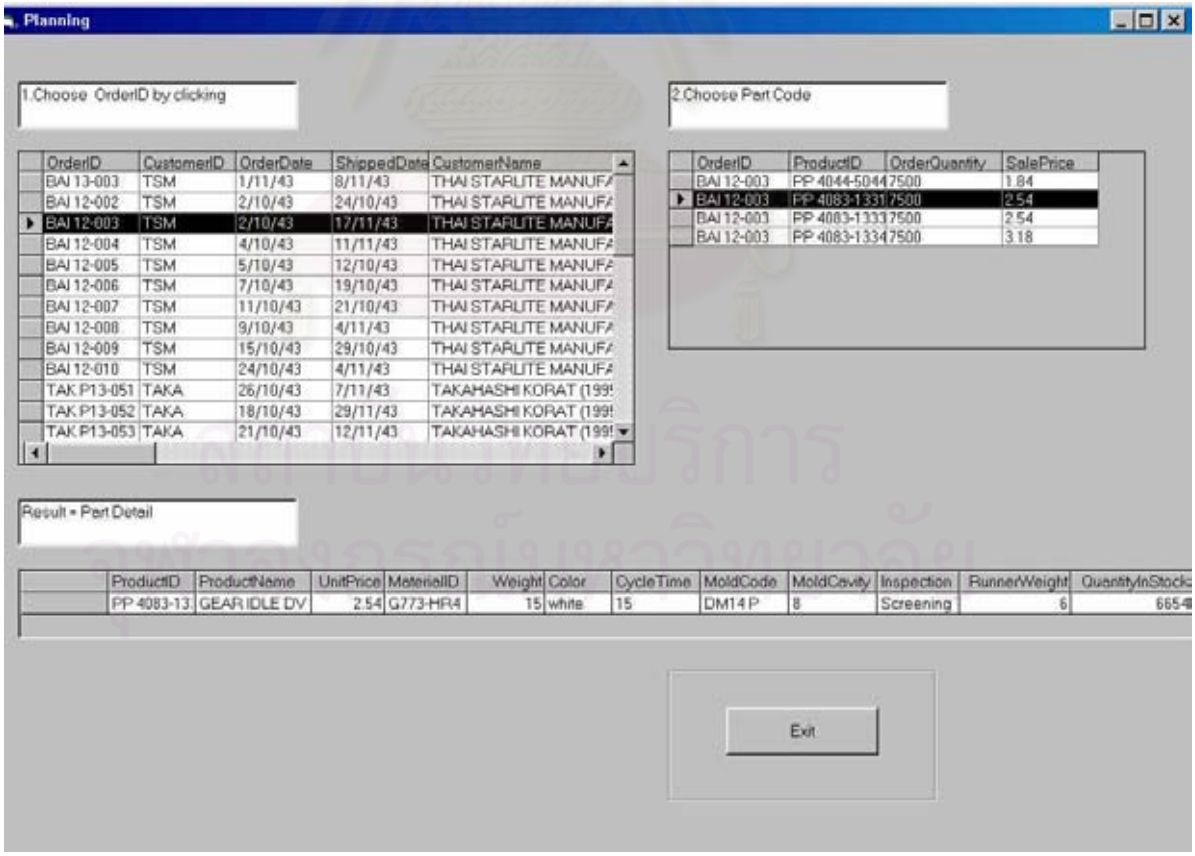



*Figure 4-11 : The planning output screen.*

- The planning output screen (figure 4-11) is the report of the current customer orders on hand (under the production process, excluding the closed out orders). The report shows all customer purchase orders information including the order date and the delivery due date. Several users access the report including the production planning who uses the report as a guide to schedule the production schedule and the product warehouse department who use the report in delivery planning process.

- Whereas, The scheduling of BIP concerns with the consideration of assigning the ordered parts to the machine and operators. The planner has to determine on which and when the ordered part to be produced or injected on which injection machine. The scheduling task of BIP is not too complex because there is only one production process ( Plastic Injecting process ) that the company deals with, but there are hundreds of ordered parts and the 18 different size injection machines that the planner has to sequence on. This is a parallel machine scheduling problem which concerns the same function of machine sitting on plant coping with several jobs. Currently, the planner manually plans the schedule by using the information from the customer purchase orders and then sequences the orders in the schedule paper form document. The planning screen ( figure 4-11) can assist the planner to easily schedule the orders because the planner can access the customer orders information in the database in very short time, instead of searching and sorting several paper customer purchase orders.

At present, the company is considering the production schedule commercial computer application helping the planner schedule the orders in short time and in more effective way. Anyway, the planning report still assists the planner to schedule the orders even the company use the commercial software package.

#### *4.6.3 Injection order releasing.*

After the production planner has already scheduled the jobs in the production schedule document, then the planner would use the schedule to as a reference information source to issue the injection order. Previously, the process of releasing of injection orders takes more than hours before handling to the machine operator at each machine. This is

because from the planner has to manually complete the injection order paper documents for the 18 machines, by which there are a lot assigned jobs on each machine. Therefore, this takes extremely highly effort and time to produce the injection orders.

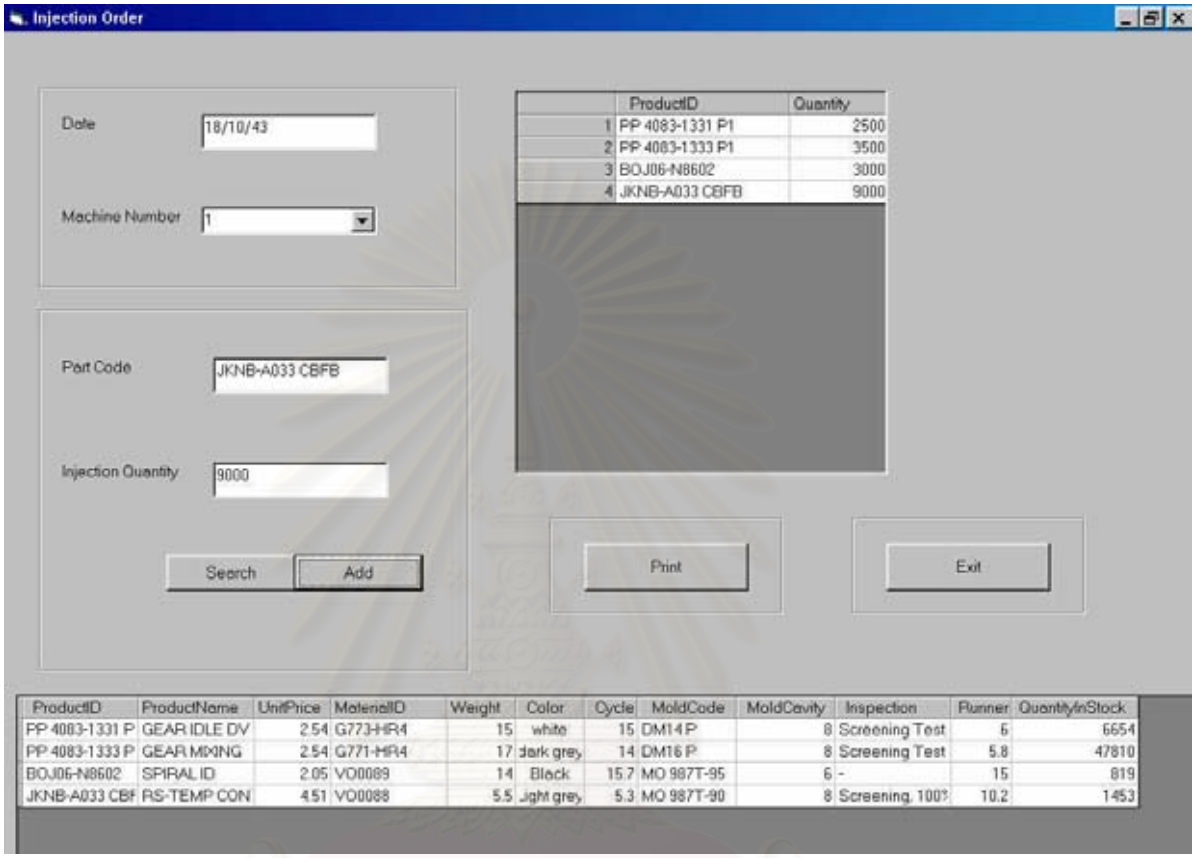



*Figure 4-12 : The Input/ Output of BIP Injection order*

The developed BIP production and inventory database provides the module that aid the planner to easily issue the injection order. The planner can easily search the parts to be produced from the database, select the machine to inject those parts, and specify the quantity to produce the parts, then the planner can print out the injection order suddenly. The part specification is retrieved into the injection order as well as a machine set up guide for each part. The injection order form is shown in figure 4-12.

### *4.6.4 Inventory control (finished product).*

For each product picked during the delivery execution process, a transaction providing the stock number and quantity picked is passed to the inventory control system. The computerized inventory records are updated to reflect the exact quantity on hand of

each product keeping unit. Thus, when the staff checks the inventory level of a product, they will receive current information. The product inventory processes of the developed database consist of :

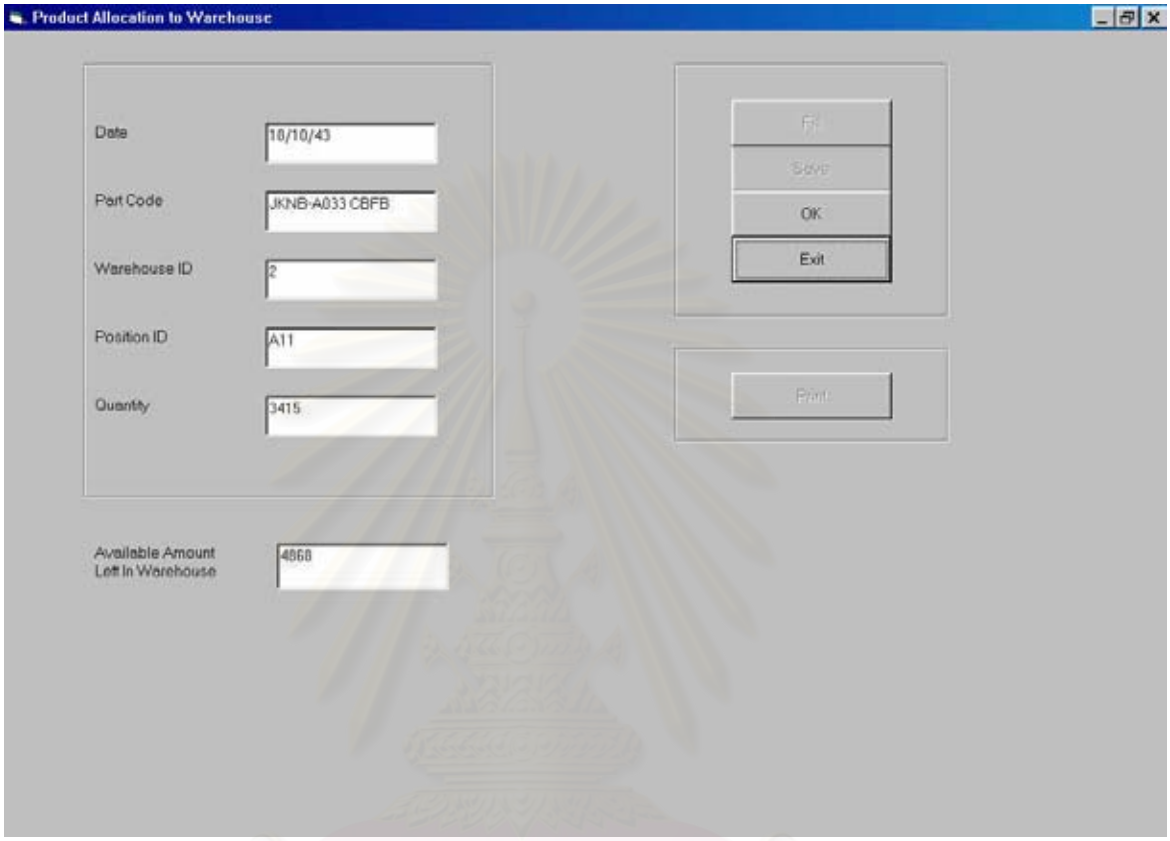



*Figure 4-13 : The input of product allocation form.*

#### 4.6.4.1 Product allocation.

After the parts have been already finished from the production department, then they will be kept in the product warehouse. The processes of keeping the products are shown in the DFD level 3 in the “packing and issue the finished product consignment or packing list” process(4.2.2) in of appendix A. The previous process need the injection staff to prepare the daily finished part information and packing list and issue them to the warehouse division. Then the “Products allocation” or “Rejected products allocation” documents will be recorded depending on their types of products (finished products or defects). The aim of use of these documents is to control the products or rejected product enter-in information.

For the developed database, before the products enter into stock, the stock staff has to record the products information in the “Products allocation to warehouse” form(figure 4-13) first. The form provides the necessary product identification showing the existence of the products in warehouse. Before positioning in the provided area, the “warehouse code and location” must be specified in the “ Warehouse ID and PositionID” in order to specify the number of warehouse and the location of that warehouse that the products will be kept. Currently, the company has 3 warehouse areas ( area A,B, and C) and each warehouse area contains several spaces or positions; such as A1 to A30, to keep the finished products.

The data recorded in the Products allocation to warehouse form will automatically update or add up the products balance quantity in the product warehouse status table and report as shown in figure 4-14.

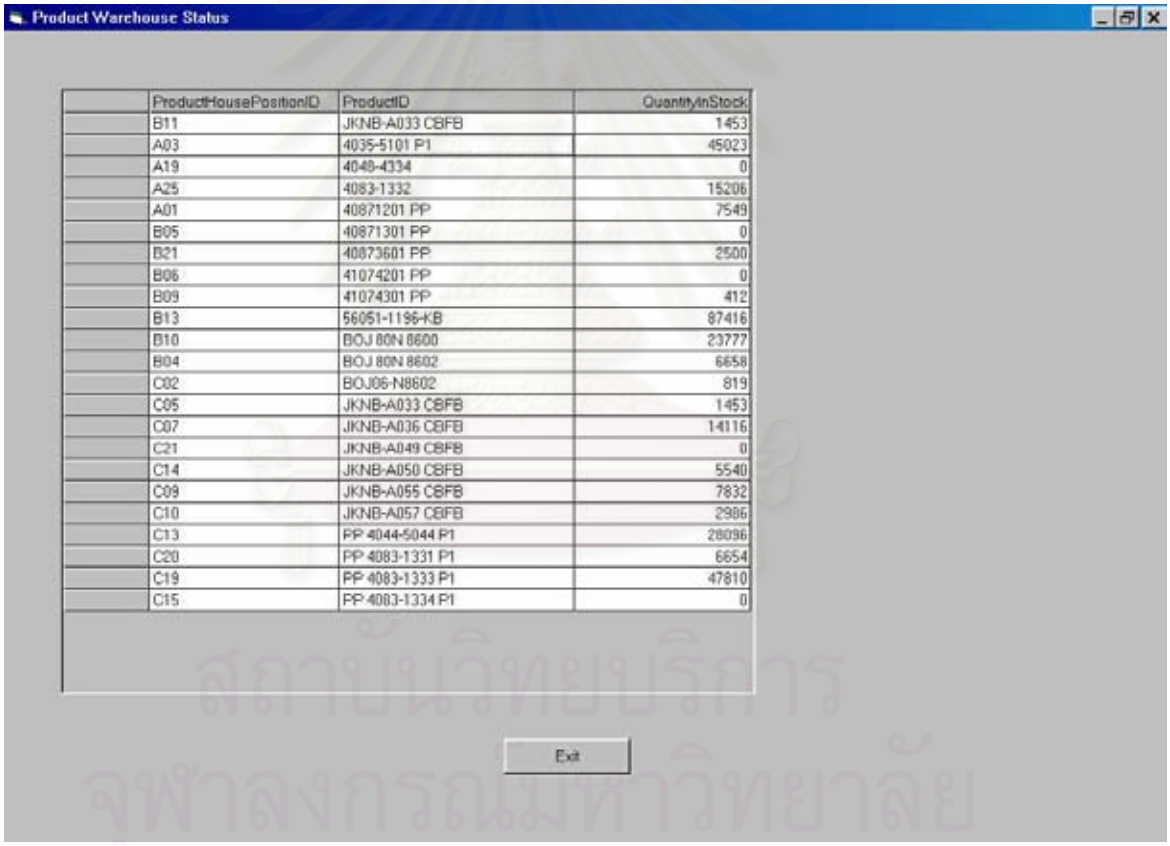



*Figure 4-14 : The output screen of the Product warehouse status.*

#### 4.6.4.2 Product warehouse status.

The product warehouse status (figure 4-14) shows the status of the products in the warehouse at a time. It declares the available balance quantity of products. In the new database, the automatic update of the available balance figure according from the data input

in “product allocation form and invoicing” form eliminate the manual manipulated update of the available quantity figure, and this reduces workload for the warehouse staff and eliminate the errors from human factor.

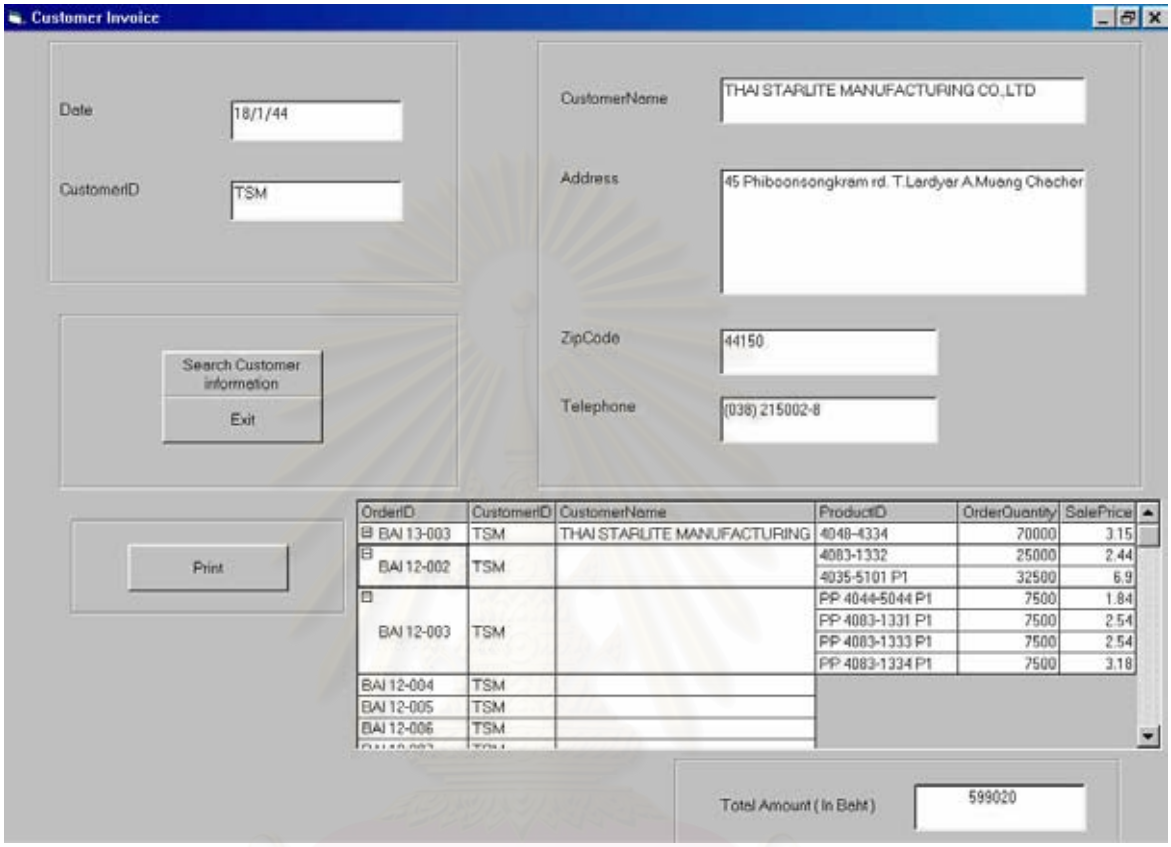



*Figure 4-15 : The input of BIP invoice.*

### *4.6.5 Customer Invoicing.*

Formerly, in the products delivery process DFD level 4 (2.1.2.3) as shown in page 119 in of appendix A, the delivery staff has to withdraw the products from the warehouse after he has received the delivery order and invoice of the delivered product from the production planning section. Then the delivery staff must prepare the product withdrawal form (page 153 in appendix B) in which is used to request for products retrieval from warehouse. Then, the product warehouse status is deducted manually from the warehouse staff.

In the developed database, when the time for delivery arrives, then the warehouse department will immediately issue the “invoice” by searching the customer purchase order information, that intends to issue the invoice, and then print out the invoice of the selected purchase order. The delivering products and invoices are then submitted to the drivers to

deliver to the customers. The data input in invoice form (figure 4-15) will automatically subtract the product available balance in product warehouse status. It is shown that the processes are adapted in order to simplify the processes and eliminate the redundancy processes and documents (product withdrawal form).

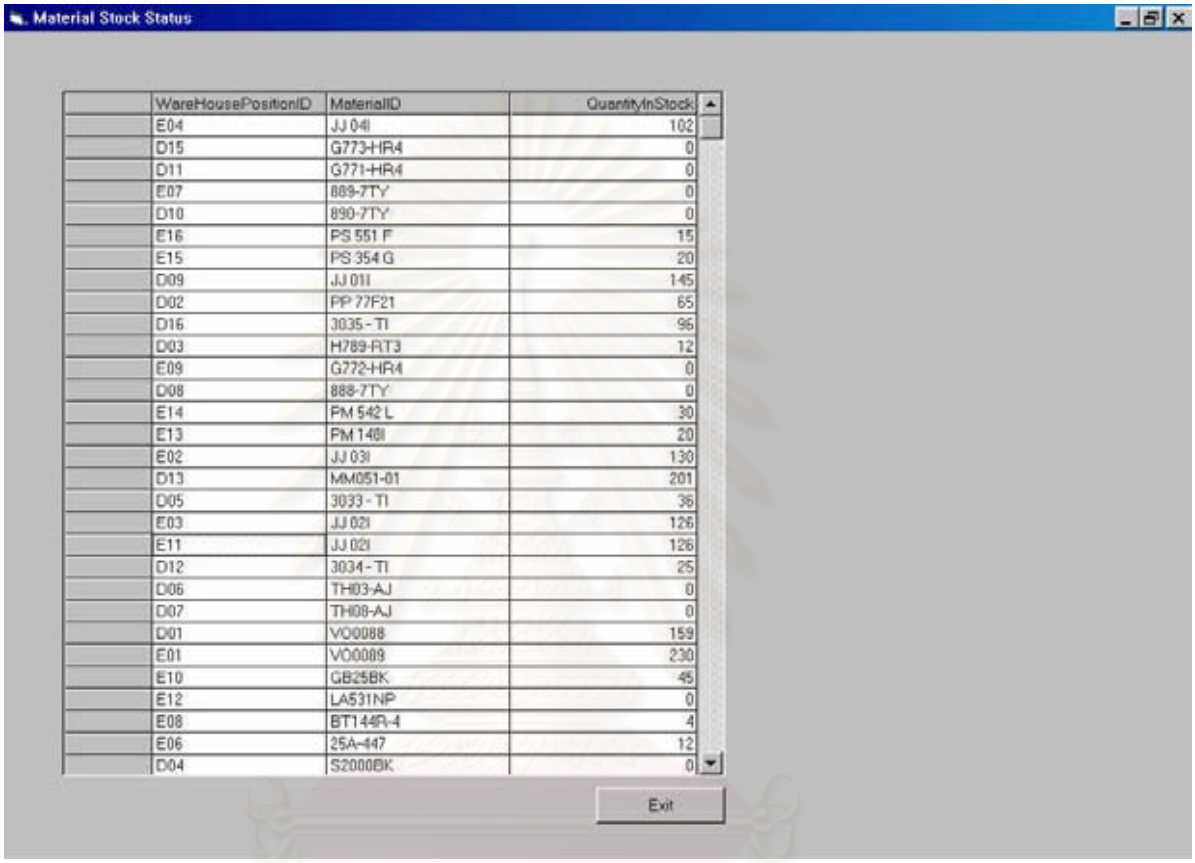



*Figure 4-16 : The output screen of the Material stock status.*

### *4.6.6 Material stock status.*

The Material stock status (figure 4-16) shows the status of the material in stock on hand at current time. Formerly, the stock staff has to check the stock status by looking in the Material and production instrument stock paper document(page172 of appendix B). The decision of purchasing item comes up when any of these two circumstances happen ; firstly, for the material in group 1 and 2 (page 46), the stock staff has checked the available material and found out that the material level has met the safety stock level, secondly, when the company has received the customer purchase order that the ordered parts made from material group3 (page46). Then the stock staff will request the procurement department to purchase the items by preparing the purchasing proposal and submit to the procurement

division. Then the purchase order is issued subsequently. The acknowledgement of the stock status quite consumes a long time because there are hundreds of different types of items in stock.

In the developed database, the stock staff is able to get the stock status easily from the output screen of “Material stock status”. It shows the status of the material in stock on hand at exact time. The stock status is updated automatically whenever there any changes in stock level; new purchased material, usage in production.

### *4.6.7 Supplier Purchase order processing.*

When the procurement division receives the purchasing proposal from the stock division then the purchasing staff has to prepare the purchase order on those proposed items. The developed database will shorten the purchase order processing time because the historic records of the purchase processing that would help the users in supplier selection decision come up much quicker. The purchasing staff is able to find out where to purchase the items from and compare the price of each supplier easily.

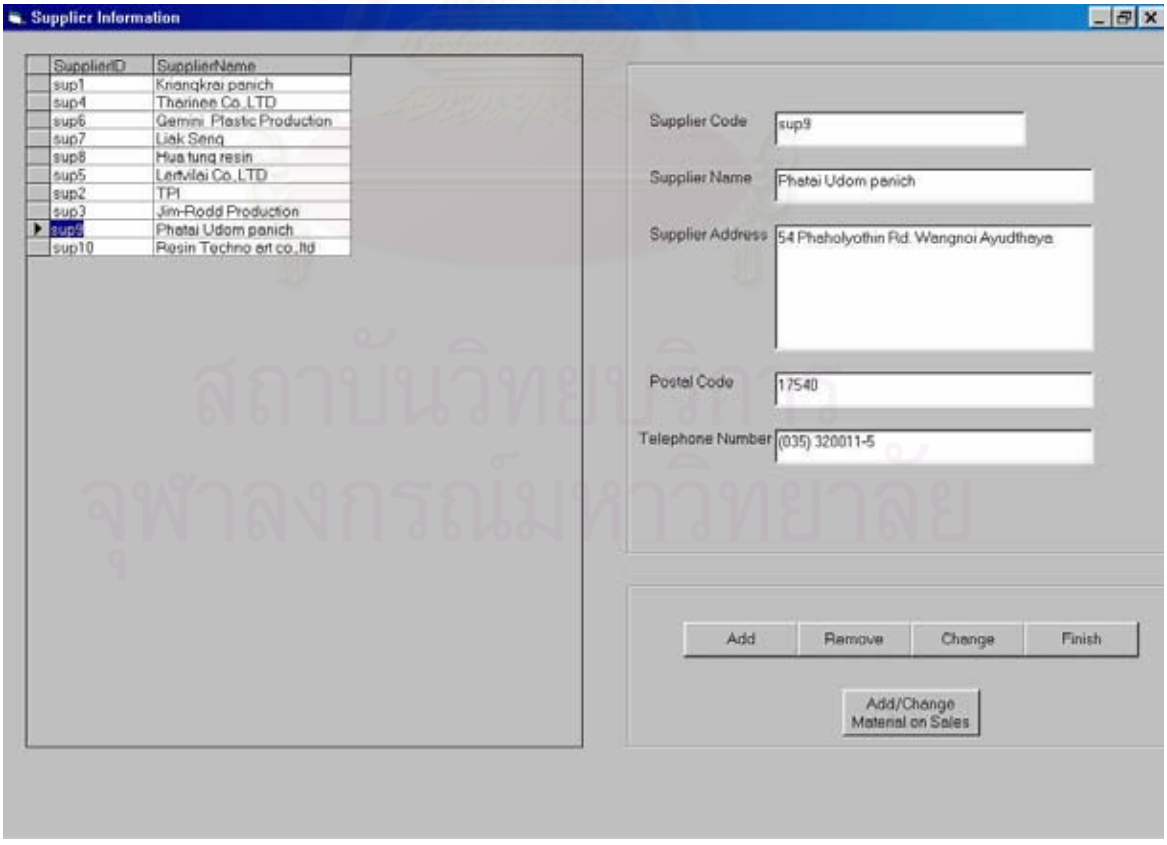



*Figure 4-17 : The input of supplier information.*

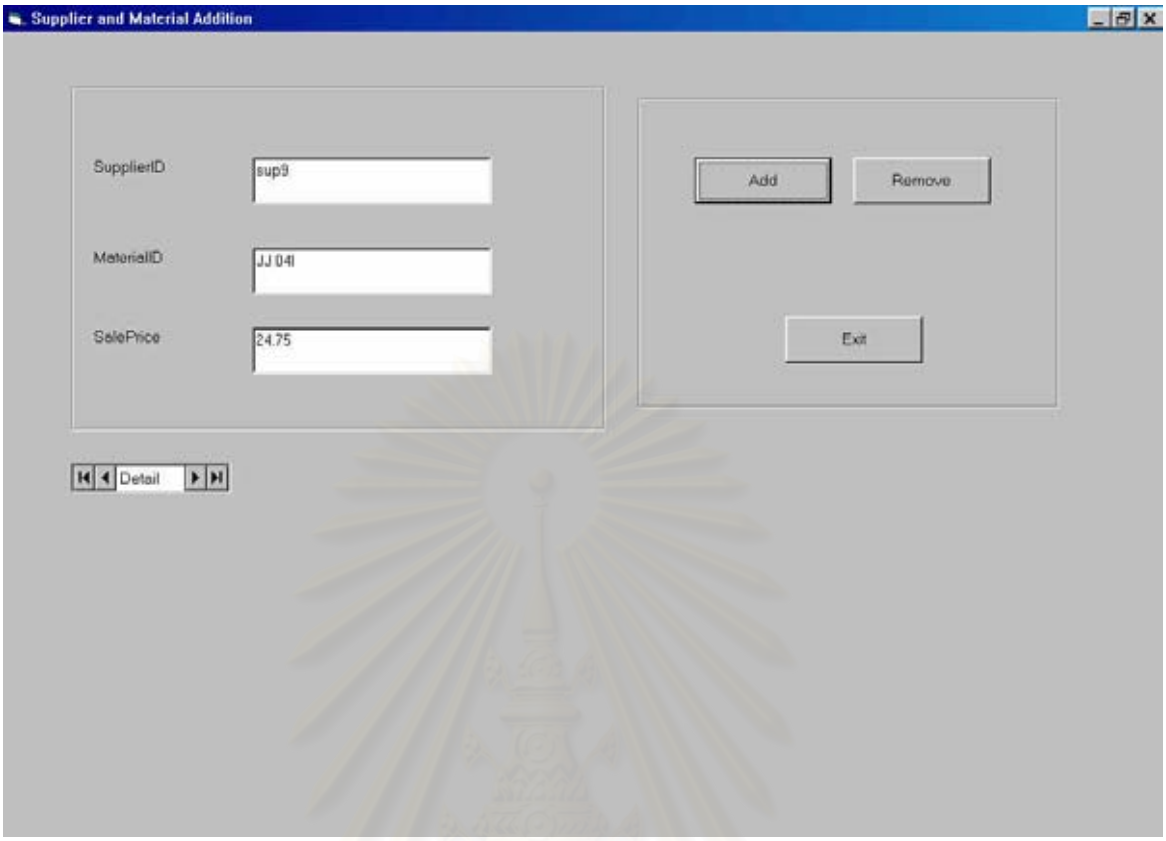



*Figure 4-18 : The input screen of the Supplier and Material addition form.*

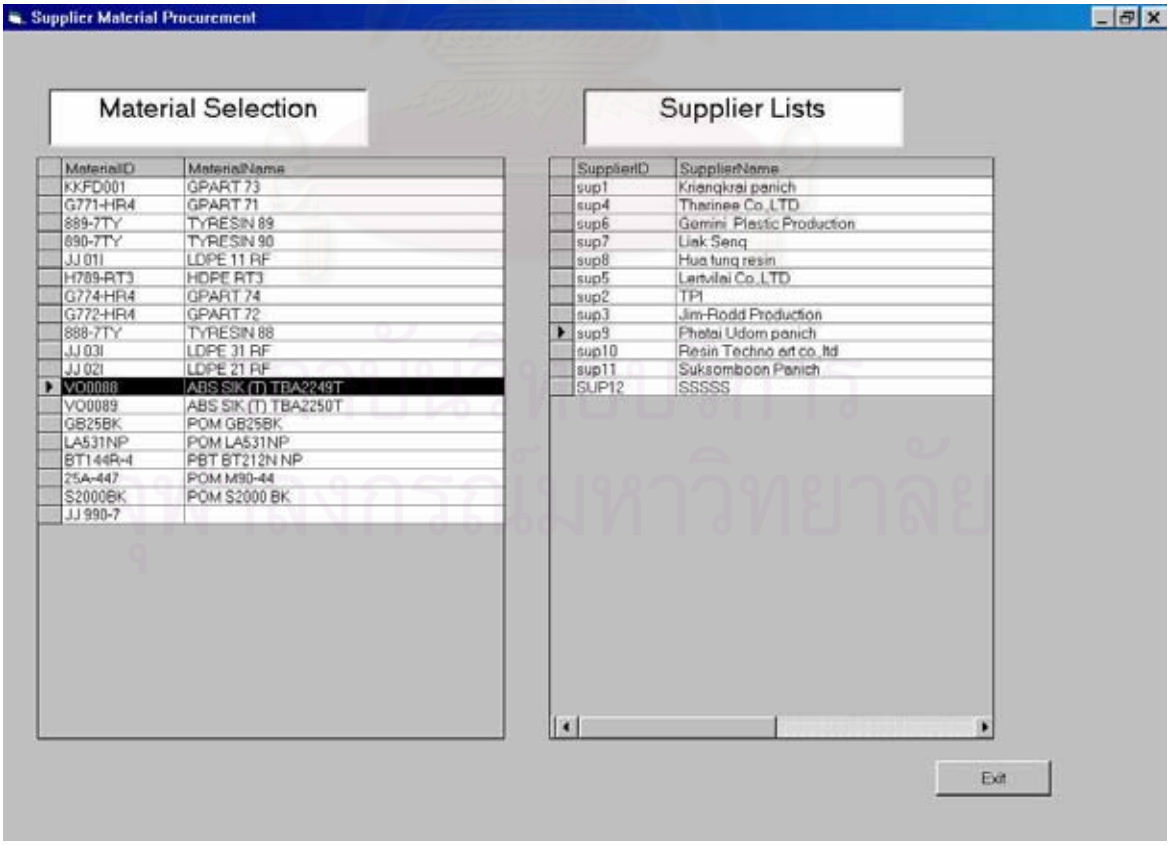



*Figure 4-19 : The output screen of supplier material on sales.*

#### 4.6.7.1 Supplier and Supplier material.

When the company requires to buy any items, the purchasing staff has to search for the supplier and its products information. Previously, it is done through the catalogue and price list of the suppliers sent to the procurement division. Otherwise, if these documents are not available, the purchasing staff will facsimile to a new supplier for the products and price information. Consequently, the supplier selection process continues with the price comparison of each supplier. The seek of these information spends quite long time.

The developed database assists in finding the right supplier in very short time. The records of supplier in which contains the supplier information and its address, along with the supplier products records storing the available items that the supplier sell and its latest prices assist in faster decision making. Whenever the purchase order is issued, these records will be updated, for example one supplier have a new product on sale or the change in supplier address, and etc. The forms of suppliers and their material information are shown in figure 4-17, 4-18 and 4-19.

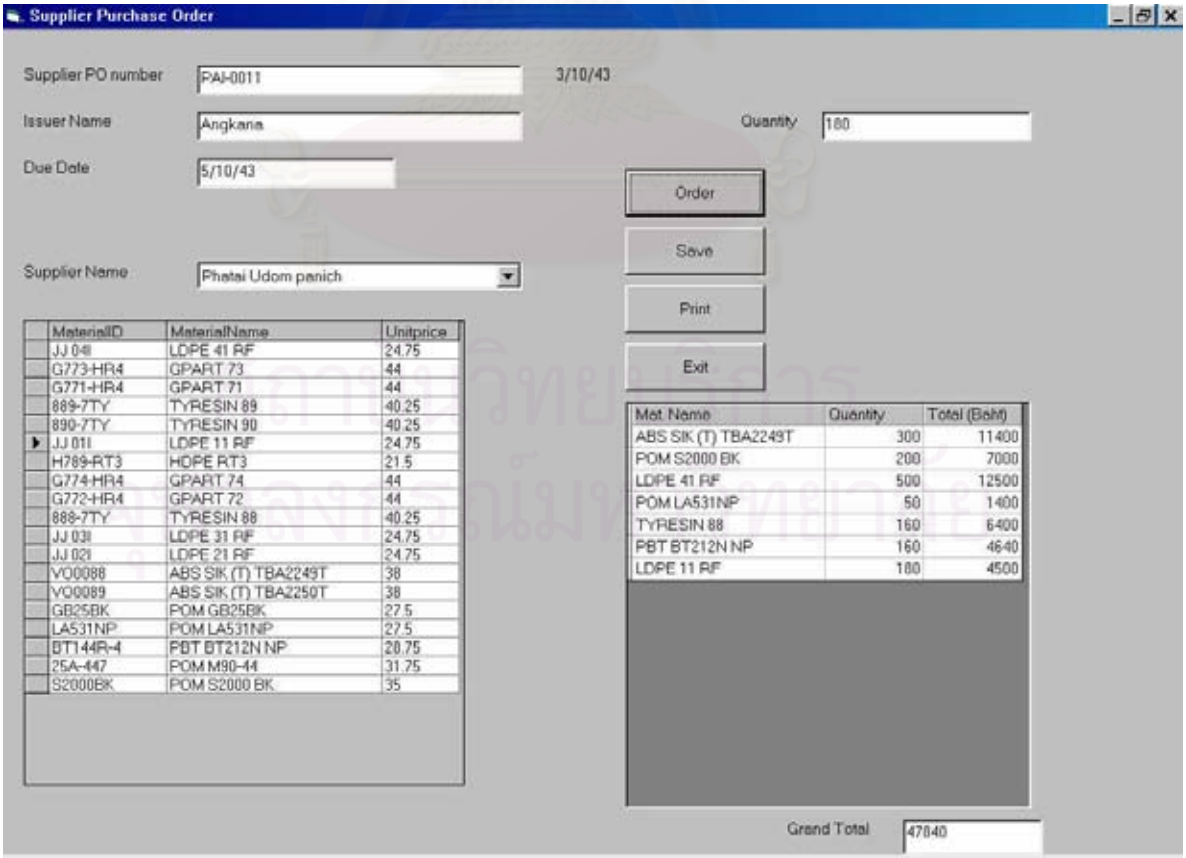



*Figure 4-20 : The input of supplier purchase order.*

#### 4.6.7.2 Issue Supplier Purchase Order.

When the purchasing staff has already decided on which items and supplier to be purchased, then the supplier purchase order is then released. The developed database enables the staff to select the purchasing material and order it in the supplier purchase order form (figure 4-20) and print the purchase order out immediately. The purchase order will be recorded in the database for the future reference usage in the next time purchase.

### *4.6.8 Receiving the items.*

The receiving process in the developed database does not change from the existing system. When the items are sent to the procurement division, the responsible staff has to check the products whether they are the right delivered items. The check depends on the information from the supplier purchase order and supplier invoice. When the items have been already checked, then the items will be kept in the Material and production instrument stock. But the items must be registered in the "material stock entry form: registry form (figure 4-21)" before positioning them in the stock area. The item registry form is simply designed. The form requires to the user to specify the stock code of the items and the location in stock where the items are kept. This record of the item location is useful for retrieving the items from the stock and it provides the faster process in retrieving items from stock than the previous paper document approach.

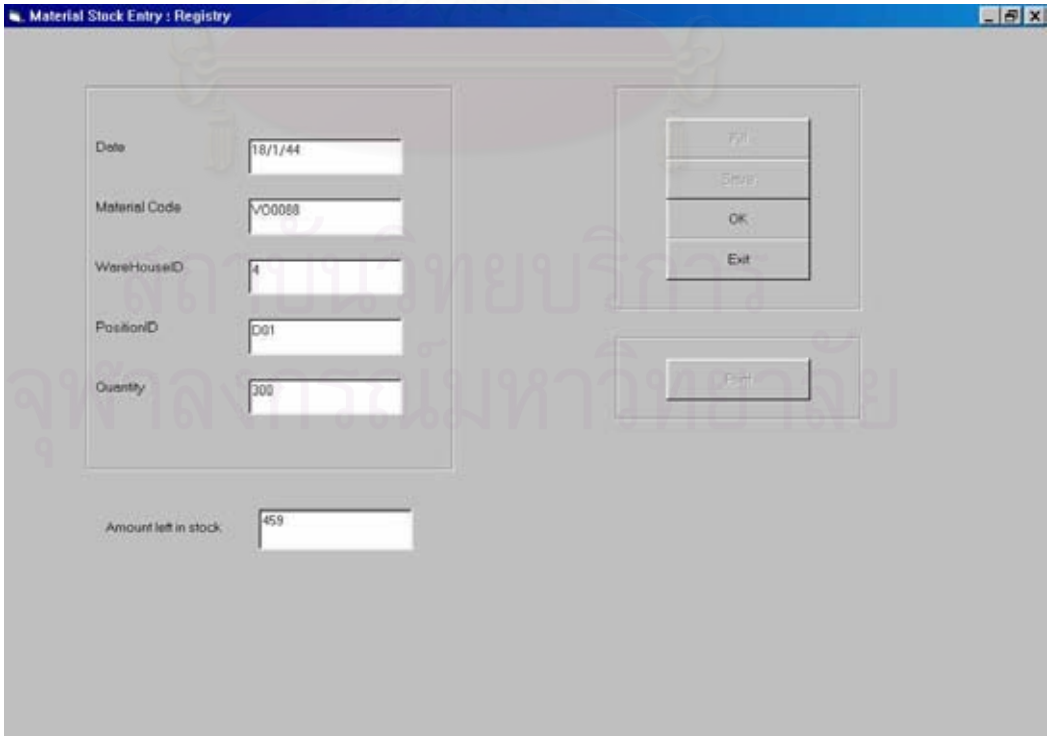



*Figure 4-21 : The input of the material and production instruments registry.*

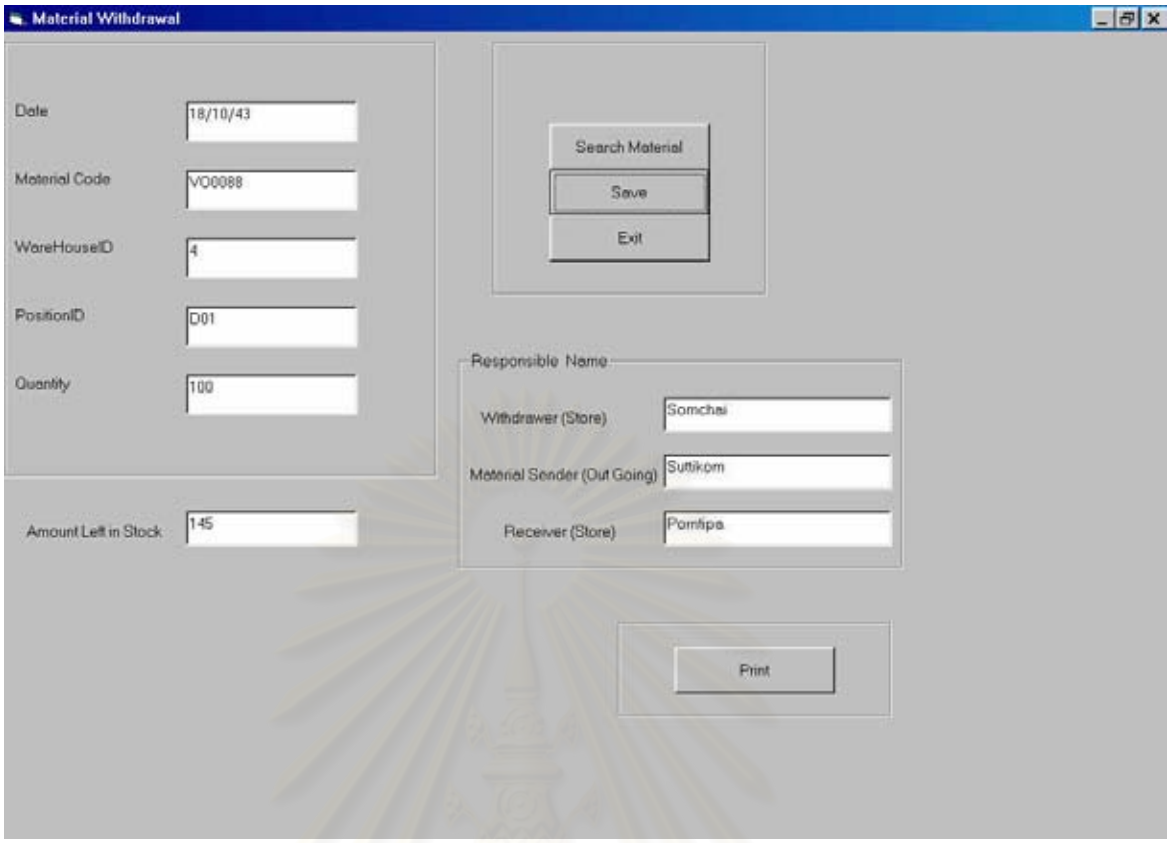



*Figure 4-22 : The input screen of the material withdrawal form.*

Finally, when the production department requests to withdraw the material from the material stock for the usage in production activities. Formerly, the production staff has to fill the item requisition form (page 158 of appendix B) and submit it to the material stock. The stock would then use the document to record in the material and production instrument stock (as shown in page 172 of appendix B) to update the stock status.

The developed database system eliminates the use of these documents. When the production staff requests to withdraw the material, the stock staff then has to record the withdrawal information in the material withdrawal form ( figure 4-22). The record saved in the form would then automatically update the material stock status as shown in the material stock status form (figure 4-16). The input of material withdrawal enables the stock staff to easily trace the position of material kept by the filling the material code and it also shows the current stock status (Amount left in stock) which will tell whether there is sufficient material for withdrawal as well.

## 4.7 Physical Design.

The physical design of the system composes of software and hardware configuration to support the database system.

### 4.7.1 Software Configuration.

From the developed database, the software configuration of the system consists of Operating System (OS) and the Database Application. The interface of this database system is default with Graphic User Interface (GUI).

This database system is developed on personal computer platform, which uses Microsoft Window environment as an Operating System and Microsoft Visual Basic as a developing tool to prepare user interface and Microsoft Access 2000 as a database management system. The database of this developed system sets SQL ( Structural Query Language) command as a standard command to query, manage, and communicate with each data item.

### 4.7.2 Hardware Configuration.

Hardware configuration in this developed system is based on Personal Computer platform (PC), which is operated with windows environment. Accessories of the Personal Computer in the system consist of printer and networking interface (LAN). Communication between each PC is default to TCP/IP protocol.

The detail of software and hardware configuration in the system is shown in table 4-12 and is illustrated in figure 4- 23.

| System components | Subject | Detail of applied application |
|---|---|---|
| Software | Operating System | MS-Window 2000 |
| | Database Application | MS-Access 2000 |
| | Database Command | SQL-Command |
| | User Interface | Ms-Visual Basic 6 with Graphical User Interface(GUI) |
| Hardware | Architecture | Personal Computer (PC) |
| | Input Device | Keyboard and Mouse |
| | Output Device | Display monitor and Printer |
| | Networking Device | Network Interface Card (NIC) |
| | Networking Protocol | TCP/IP |

*Table 4-12 : The software and hardware configuration in the BIP database system.*

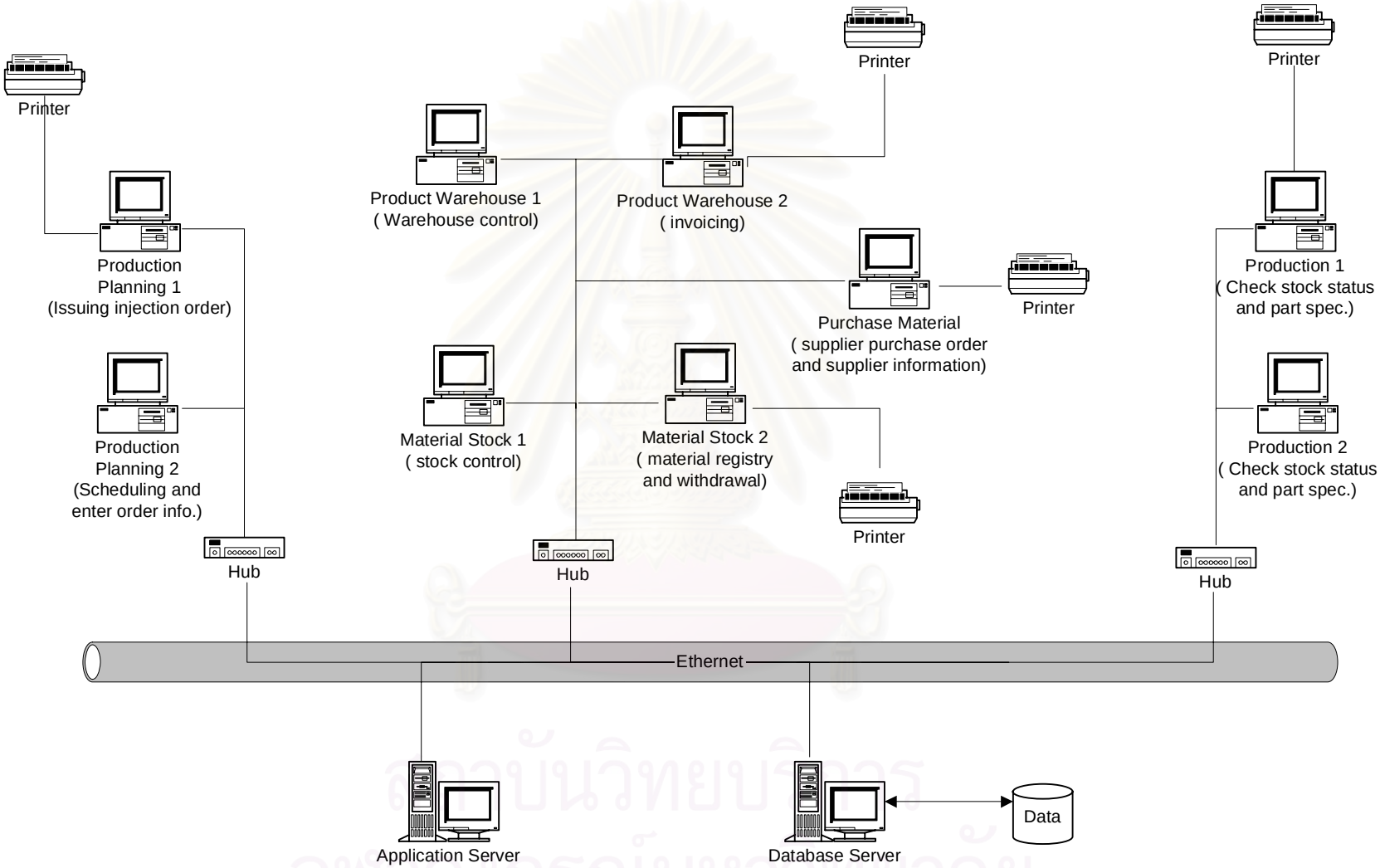



Figure 4-23 : The hardware network diagram for the developed production and inventory database of BIP

# CHAPTER V

## *DATABASE IMPLEMENTATION AND EVALUATION*

## 5.1 System implementation plan.

Before the developed database software was implemented in BIP, the implementation procedures had to be considered first. The procedures consisted of the " Test Plan" and "Documentation" were then carried out consecutively.

### 5.1.1 Test plan

The test plan defines a series of details of each test activity that would be conducted. The test is necessary for the program because it prevents the program occurring errors if it is used in real work. Every part of program must not be overlooked. Testing of BIP system was done systematically and the results were documented so that it enabled us to track and examine each phase of the developed program.

For BIP test plan, all components of software were tested together. There had been, the ***Requirements tests*** to ensure that all requirements stated in the users requirements were met. The users requirement tests were conducted from many concerned people. The tests were carried out by the author himself, including the external agents; an external systems analyst, the production manager, the stock and warehouse chief, and other concerned managements in the company. Moreover, the author requested some of the staffs who would work with the developed system to test so that the author would know whether the developed database system was exactly what they expected to be. In the tests, the author had got a lot of feed backs from the tested staffs and they were extremely useful information that the author used to adapt and improve the program to exactly meet the users' requirements.

After the users requirements had been approved, then the security test was then carried on. The ***security test*** was done by enabling the external security agents attempt to break the system. The security of system is very critical for the application, so that it prevents from any illegal operations that may be occurred during the use. This would produce a terribly loss for the company if there were any parts of software were not secured and the users detected it and used it to corrupt the company. So, the security test was done several

times and repeatedly. For the security test, the author was favored by the external expert in system analysts to inspect the security condition of the developed database program.

Finally, the ***Acceptance Test*** was conducted in the system. The acceptance test was done by the marked users who would be actually used the system. The goal was to confirm that the system was completed and was acceptable to the users. Acceptance test was done in the manner of the common commercial software which were done in two stages: alpha testing and beta testing. Firstly, the staffs tested the program by using a sample data or made up data in order to convince the system would work properly. Then, the staffs began to the system with real data but were carefully monitored for errors.

### 5.1.2 Developing documentation.

There were two fundamental types of documentation were developed in BIP system. Firstly, the "***System Documentation***" which was intended to help the system developer understand the application software and enabled to build it or maintained it after the system had been installed. System documentation was a byproduct of the systems analysis and design phase. The system documentation hereby refered to the developed ***Data Flow Diagram, Data Dictionary, and Program source code***.

The other necessary documentation was the "***User Documentation***" which was designed to help the user operate the system. For BIP system, because the project size was rather small, so the paper based documentation in form of ***User manual*** was developed. The user manuals described how to perform business tasks (e.g., taking a customer order, printing report, and etc.). The paper based manual would be simpler to use because it was more familiar to users, especially for BIP staffs who were almost beginner staffs and had less computer experience and it would guide the staffs through a task that required several functions or steps in the system. The users manual was shown in appendix D.

### 5.1.3 System Installation.

Once the system had been already tested and was to be installed to the company. The author decided to use a pilot project to implement the system. In the switch between the old and new system or the system conversion which was the process of the new developed database replacing the old system. The author used the parallel conversion style.

As stated earlier, the company had 18 injection machines on plant. Eight machines were all in same model 100 tons size. Four machines were adopted as part of a pilot test machines while the rest machines were still implemented the old paper documents system.

The reason that the author used the parallel conversion style, which the new system was operated side by side with the old system, was to prevent the company from suffering problems if the system did not perform. In addition, the author was able to evaluate the new system of four machines by the comparing the result with the old system in the rest machines.

Finally, The project implementation plan had started since November,27, 2000 to December,22, 2000

| *System implementation activities* | *Start date* | *End Date* | *Responsibility* |
|---|---|---|---|
| *Test Plan* | | | |
| - Requirements Test | 11/27/2000 | 12/03/2000 | - Program Developper, Management, and Users |
| - Security Test | 12/04/2000 | 12/05/2000 | - External agent System analyst. |
| - Acceptance test | 12/06/2000 | 12/14/2000 | - Actual End Users |
| *Documentation* | | | |
| - System documentation | 12/11/2000 | 12/18/2000 | - Program Developper |
| - User documentation | 12/19/2000 | 12/22/2000 | - Program Developper |
| *System Installation* | 12/15/2000 | 12/22/2000 | - All concerned staffs |

*Table 5-1 : The adopted system implementation activities.*

## 5.2 System Evaluation.

Finally, the goal of the system evaluation was to understand how successful of implementing the system. The major evaluation criteria consisted of production development time and the material purchase processing time.

### 5.2.1 Production development time.

The production development time for BIP is referred as an overall interval of time spent on producing the plastic parts since the customer purchase order entry, injecting, until

the finished product delivery. The time is very critical to the business, as described in Chapter 1, that BIP has encountered quite long development time. Hence, it always causes the lateness of production and delay in products delivery as a consequent.

The production development time is highly related to the raw material inventory management policy. As the company realizes that the raw material (plastic resin), which is used in very large amount, ties up a huge capital, uses storage space, deteriorates, and can be stolen and sometimes is lost. So the company does not prefer to hold too much raw material inventory. At present, two cases in material inventory decision are adopted.

***Case 1 :*** For the raw materials that are often used: Material Group 1 and 2 as described in chapter 3 on page 46, the company holds some moderate amount of them in stock for the use. The " Fixed Order Quantity" lot size decision rule is implemented. This include a Polystrylene (PS), ABS, Polypropylene(PP), LDPE (Low Density Polyethylene), HDPE( High Density Polyethylene) , and etc. This means these materials are ordered for a specific number of weight each time an order is placed when the inventory level meet the safety stock level. Thus, the materials in stock are ready for use at any time the production division requires and there is no lead time for purchasing these materials. The production development time of the parts made from these materials does not include the purchasing lead time.

***Case 2 :*** For the special materials that are rarely used: Material group 3, the company does not hold any of them in stock. The company would purchase these materials only when the customer places an order of parts made from this material type.

**The production development time of each case is different. It is explained in table 5-2 and 5-3.**

**5.2.1.1 Production development time components.**

From the BIP processes, the development time can be divided into 3 major intervals :

1 *Machine set up lead time*; which is the time period since the purchase order arrives the company until the machine is ready for set up to produce the parts.

2 *Injecting time*; which is the time spent on injecting the plastic resin into finished plastic parts until the parts have been already packed.

3 *Delivery processing time*; which is the time spent on releasing delivery order until releasing invoices.

The components of the production development time intervals are illustrated in table 5-2, 5-3 and figure 5-1, 5-2.

The Production development time is based on the material of parts ordered which divided into two cases :

***5.2.1.1.1 Production development time in case of parts made from conventional material ( Case 1 )consists of :***

| Process | Process Description | Immediate Process |
|---|---|---|
| A | Purchase order entry. | - |
| B | Distribute Purchase order copies to production planning division for scheduling and to procurement division for procuring material. | A |
| C | Scheduler issue injection order. | B |
| D | Production request for material and instrument from stock and The items have been supplied to production control division. | C |
| H | Injection Machine set up. | B |
| I | Injecting and removing mold from machine. | H |
| J | Quality processes and packing. | I |
| K | Delivery planning and issue delivery order | J |
| L | Invoicing and shipment. | K |

*Table 5-2 : The production development time components of producing parts from ABC material(Case1).*

***5.2.1.1.2 Production development time in case of parts made from special material (Case 2) consists of :***

| Process | Process Description | Immediate Process |
|---|---|---|
| A | Purchase order entry. | - |
| B | Distribute Purchase order copies to production planning division for | A |

| | | |
|---|---|---|
| | scheduling and to procurement division for procuring material. | |
| C | Scheduler issue injection order. | B |
| D | Production request for material and instrument from stock and<br>The items have been supplied to production control division. | C |
| E | Procurement division decide to purchase material after receive PO. | B |
| F | Supplier selection and Issue purchase order. | E |
| G | Receive the items register and take in stock. | F |
| H | Injection Machine set up. | D |
| I | Injecting and removing mold from machine. | H |
| J | Quality processes and packing. | I |
| K | Delivery planning and issue delivery order | J |
| L | Invoicing and shipment. | K |

*Table 5-3 : The production development time components of producing parts from MRP material(Case2).*

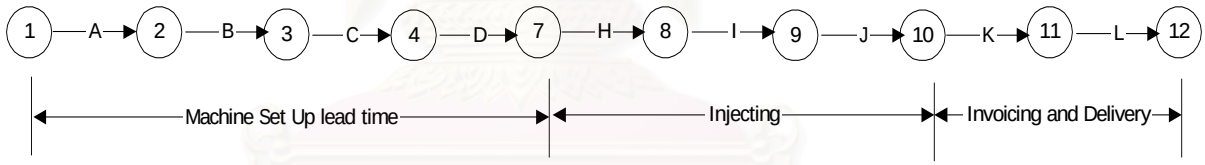



*Figure 5-1 : Overall Production development time of BIP ( Case 1).*

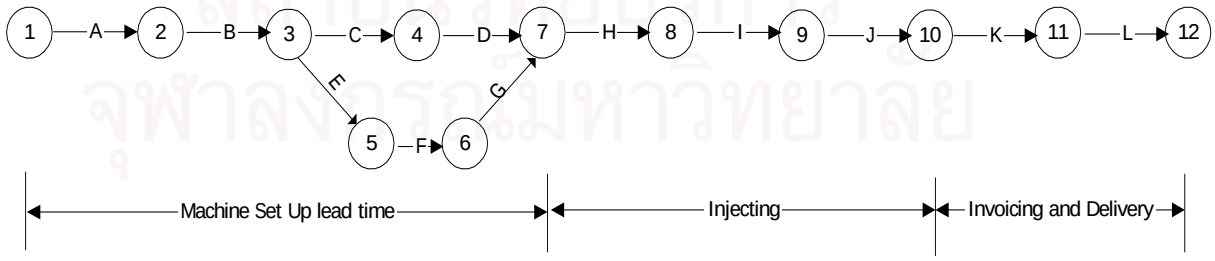



*Figure 5-2 : Overall Production development time of BIP (Case 2).*

***The injecting time*** depends on parts standard specification and order lot size; for instances, the cycle time of injecting set up condition, the quantity of parts to be produced, the machine breakdown time, quality processing time, and etc. The shorter of this time period, the more significant effected the overall production development time. ***If the production lot size is small, then the injecting time would be short proportionally, in this case the machine set up lead time and delivery processing time play a significant role in production development time.***

As described earlier in the chapter 1, nowadays the customers always place a small order sizes because of their JIT policy. So, the machine set up lead time and delivery processing time are critical for development time. The shorter machine set up lead time and delivery processing time will also shorten production development time.

***The machine set up lead time and the delivery processing time*** is non volume related, so that the time is independent from the quantity of parts to produce, no matter how large or small of ordered lot size, the size does not impact to the machine set up lead time.

Therefore, for the small order volume, the machine set up leadtime and the delivery processing time highly affect to the over production development time. Most customers always force the company to deliver the order as fast as the company can do.

So, the developed database objective is to reduce these 2 time periods. Therefore, The author intend to assess these 2 lead time interval, firstly since process A to D, which is the time period since the purchase order arrive until the machine set up to produce the parts. Secondly, the time spent on delivery planning and invoicing, or process K to L.

#### 5.2.1.2 Production development time evaluation methodology.

The evaluation of production development time was done after the 2 weeks system implementation. The staffs got acquaint with the new system and it was run steadily. The production development time was assessed by these procedures :

5.2.1.2.1 Select 40 parts ordered by the customers. The selected parts were in small lot size order (less than 2500 pcs per order). All parts were made from high and moderate usage value plastic resin(page 46) so that the company was able to use the material in stock promptly and had not to purchase these material

before production. 20 parts were the parts that run in the developed database system and the rest 20 parts were adopted in the old paper document system.

5.2.1.2.2 Measure the process time spent on each activities tied up to the production development time on each system. The measurement was done on the principle of the work measurement method which the author observed the work of operators on the actual work and measured the time in minute units. The results of the measurement are shown in table 5-4 and 5-5.

5.2.1.2.3 Calculate the machine set up lead time of each part in both system. ( Sum of time Interval A, B, C, and D)

5.2.1.2.4 Calculate the injecting time of each part in both system. ( Sum of time Interval H,I and J)

5.2.1.2.5 Calculate the delivery processing time of each part in both system. ( Sum of time Interval K and L)

5.2.1.2.6 Assess the improvement on the machine set up lead time and the delivery processing time of each system.

### 5.2.1.3 *Production development time results.*

The comparison of production development time of the old systems and new developed database system is shown as following :

***5.2.1.3.1 The production development time of the new developed database system.***

| Part Code | M/C No. | Cycle time | Lot Size | Process | | | | | | | | | | M/C set up lead time | Injecting Time | Delivery & invoice | Total development time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | C | D | | H | I | J | K | L | | | | |
| 4035-5101 P1 | 2 | 4 | 2000 | 6 | 5 | 2 | 5 | | 16 | 150 | 35 | 2 | 1 | 18 | 201 | 3 | 222 |
| 40871201 PP | 3 | 3 | 1400 | 5 | 4 | 2 | 5 | | 21 | 95 | 27 | 2 | 1 | 16 | 143 | 3 | 162 |
| 40871301 PP | 3 | 6 | 2300 | 7 | 5 | 2 | 4 | | 14 | 250 | 37 | 3 | 1 | 18 | 301 | 4 | 323 |
| 40873601 PP | 1 | 4 | 2200 | 7 | 5 | 1 | 5 | | 20 | 160 | 30 | 1 | 1 | 18 | 210 | 2 | 230 |
| 41074201 PP | 4 | 7 | 1500 | 7 | 5 | 2 | 6 | | 16 | 195 | 29 | 2 | 1 | 20 | 240 | 3 | 263 |
| 4104310 PP | 1 | 2 | 2450 | 6 | 4 | 1 | 5 | | 15 | 105 | 36 | 2 | 1 | 16 | 156 | 3 | 175 |
| 4305-5201 P1 | 4 | 8 | 1500 | 6 | 5 | 1 | 8 | | 16 | 215 | 28 | 2 | 1 | 20 | 259 | 3 | 282 |
| JKNB-A033 CBFB | 2 | 6 | 1200 | 9 | 3 | 2 | 5 | | 20 | 135 | 25 | 2 | 1 | 19 | 180 | 3 | 202 |
| JKNB-A036 CBFB | 2 | 6 | 1750 | 7 | 5 | 1 | 5 | | 15 | 190 | 29 | 2 | 1 | 18 | 234 | 3 | 255 |
| JKNB-A049 CBFB | 2 | 3 | 1700 | 7 | 5 | 2 | 5 | | 14 | 100 | 30 | 3 | 1 | 19 | 144 | 4 | 267 |
| JKNB-A050 CBFB | 3 | 1.5 | 1600 | 8 | 5 | 2 | 5 | | 14 | 55 | 38 | 2 | 2 | 20 | 107 | 4 | 131 |
| JKNB-A055 CBFB | 4 | 1.5 | 1650 | 9 | 6 | 1 | 5 | | 17 | 50 | 29 | 2 | 1 | 21 | 96 | 3 | 120 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JKNB-A057 CBFB | 1 | 2 | 1475 | 7 | 8 | 2 | 4 | | 21 | 60 | 24 | 3 | 1 | 21 | 105 | 4 | 130 |
| BOJ06-N8602 | 1 | 5 | 1520 | 7 | 5 | 2 | 6 | | 16 | 140 | 25 | 2 | 1 | 20 | 181 | 3 | 204 |
| M-781888 | 2 | 3 | 1800 | 8 | 4 | 2 | 5 | | 12 | 100 | 28 | 3 | 2 | 19 | 140 | 5 | 164 |
| M-781856 | 4 | 1.5 | 1600 | 7 | 5 | 1 | 5 | | 21 | 55 | 28 | 2 | 1 | 18 | 104 | 3 | 125 |
| M-781886 | 3 | 2 | 1500 | 9 | 3 | 1 | 5 | | 15 | 60 | 27 | 2 | 1 | 18 | 92 | 3 | 113 |
| M-781473 | 4 | 2 | 1200 | 11 | 5 | 2 | 5 | | 15 | 55 | 25 | 2 | 1 | 23 | 95 | 3 | 121 |
| M-781476 | 2 | 3 | 1850 | 8 | 5 | 1 | 6 | | 18 | 100 | 28 | 2 | 1 | 20 | 146 | 3 | 169 |
| M-781880 | 1 | 4 | 1750 | 8 | 7 | 2 | 5 | | 16 | 125 | 28 | 3 | 1 | 22 | 169 | 4 | 195 |

*Table 5-4 : The result of the production development time of the new developed database system*

### *5.2.1.3.2 The production development time of the old systems.*

| Part Code | M/C No. | Cycle time | Lot Size | Process | | | | | | | | | | M/C set up lead time | Injecting Time | Delivery & invoice | Total development time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | C | D | | H | I | J | K | L | | | | |
| 4048-4334 | 5 | 7 | 2000 | 25 | 10 | 4 | 5 | | 18 | 250 | 33 | 3 | 5 | 44 | 301 | 8 | 353 |
| 4083-1332 | 7 | 5 | 1450 | 19 | 15 | 4 | 8 | | 18 | 130 | 25 | 3 | 7 | 46 | 173 | 10 | 229 |
| PP 4044-5044 P1 | 7 | 2 | 1750 | 23 | 11 | 3 | 9 | | 19 | 70 | 25 | 5 | 8 | 46 | 114 | 13 | 173 |
| PP 4083-1331 P1 | 8 | 1.5 | 800 | 40 | 9 | 4 | 8 | | 18 | 35 | 20 | 3 | 8 | 61 | 73 | 11 | 145 |
| PP 4083-1333 P1 | 2 | 1.5 | 1135 | 31 | 11 | 4 | 8 | | 25 | 45 | 24 | 4 | 8 | 64 | 94 | 12 | 170 |
| PP 4083-1334 P1 | 3 | 2 | 2200 | 10 | 15 | 3 | 10 | | 21 | 90 | 22 | 4 | 7 | 38 | 133 | 11 | 182 |
| 3034-TI | 2 | 3 | 2100 | 19 | 14 | 4 | 9 | | 21 | 125 | 23 | 5 | 8 | 46 | 169 | 13 | 228 |
| 3035-TI | 1 | 5 | 900 | 32 | 10 | 4 | 8 | | 17 | 100 | 20 | 5 | 7 | 54 | 137 | 12 | 193 |
| 56051-1196-KB | 1 | 6 | 650 | 19 | 8 | 4 | 8 | | 17 | 85 | 20 | 4 | 6 | 39 | 122 | 10 | 171 |
| TSM-F1101 | 4 | 9 | 2600 | 24 | 13 | 4 | 8 | | 19 | 405 | 38 | 3 | 9 | 49 | 462 | 12 | 523 |
| TSM-F1113 | 3 | 5 | 1200 | 26 | 13 | 4 | 9 | | 20 | 125 | 24 | 5 | 6 | 52 | 169 | 11 | 232 |
| TSM-F1105 | 3 | 3 | 2450 | 26 | 10 | 5 | 9 | | 21 | 135 | 30 | 4 | 7 | 50 | 186 | 11 | 247 |
| TSM-F110-99 | 2 | 3 | 1950 | 35 | 9 | 4 | 9 | | 24 | 120 | 33 | 5 | 7 | 57 | 177 | 12 | 246 |
| S898 0199 | 4 | 2 | 2250 | 31 | 15 | 4 | 8 | | 19 | 105 | 35 | 6 | 7 | 58 | 159 | 13 | 230 |
| OE 4ED 1107-1 | 1 | 4 | 1500 | 30 | 11 | 4 | 8 | | 20 | 115 | 24 | 3 | 8 | 53 | 159 | 11 | 223 |
| OE 4ED 1107-2 | 2 | 4 | 2200 | 29 | 16 | 4 | 10 | | 20 | 165 | 29 | 4 | 11 | 59 | 214 | 5 | 278 |
| 701 WPA0298 | 3 | 7 | 1500 | 41 | 9 | 4 | 7 | | 24 | 200 | 21 | 5 | 9 | 61 | 245 | 14 | 320 |
| S898 0204 | 2 | 3 | 1900 | 21 | 10 | 4 | 11 | | 19 | 115 | 27 | 3 | 8 | 46 | 161 | 11 | 218 |
| 735WPAA052 | 3 | 7 | 1250 | 36 | 10 | 4 | 8 | | 20 | 165 | 23 | 5 | 7 | 58 | 208 | 12 | 278 |
| 2E4D 7791-1 | 1 | 4 | 1400 | 30 | 14 | 4 | 8 | | 19 | 105 | 23 | 4 | 7 | 56 | 147 | 11 | 214 |

*Table 5-5 : The result of the production development time of the existing documents system*

From table 5-4 and 5-5, the author can summarize the assessment of time in the tables and allocate them in table 5-6. The figures in table 5-4 and 5-5 are calculated into the average number of each time interval and put in table 5-6. The table 5-6 shows the change of time interval basing on the old and new developed database system comparison.

*5.2.1.3 Production development time analysis.*

| Process | Developed Database | Existing document system | Percent change (%) |
|---|---|---|---|
| A | 7.45 | 27.35 | - 72.76% |
| B | 4.95 | 11.65 | - 57.5 % |
| C | 1.6 | 3.95 | - 59.49% |
| D | 5.2 | 8.4 | - 38.10% |
| Average Machine set up lead time (A+B+C+D) | 19.2 | 51.35 | - 62.61% |
| K | 2.2 | 4.15 | - 46.99% |
| L | 1.1 | 7.5 | - 85.33% |
| Average Delivery processing time(K+L) | 3.3 | 11.65 | - 71.67% |
| Injecting time | 170.15 | 179.65 | |
| Average Production development time | 192.65 | 242.65 | - 20.61% |

*Table 5-6 : The Production development time analysis* Note ; Process time in minutes

From the result in table 5-6, it can be concluded that the production development time tremendously reduces in very high percent in the developed database system. The machine set up lead time shorten for 62.61% on average, whereas the delivery time also decrease for 71.67%. There are several reasons supporting the improvement of the production development time, for examples:

- The database eliminated the duplication the paper documents; such as the customer purchase order in the existing system, including the transmission of the document from one department to the other department. The database resulted in the hugely decrease of the machine set up time.
- The share of information of database caused the rapid communication among the departments.
- The retrieve and search of the information were easily done in the database.
- The convenience of issuing some documents which were integrated as the special functions in the database such as printing the injection order and etc.
- The database assisted and simplified the scheduling activities.

In summary, *the reduction in machine set up lead time and delivery processing time result to the reduction of the total production development at* ***20.61%.*** The shorter the development time means the faster delivery to the customer in the same amount of time and thus means the more customer satisfaction.

The other benefits of the reduction in the production development time is the improvement machine and man power utilization which highly effect to the productivity. In the existing document system, during the paper documents are under processed, the machine operators have to wait for the injection order from the production planner, so the longer the machine set up lead time cause the longer idle time of machine. Whereas the shorter the staffs spend on the non-value-added activities (NVA), such as duplicating document, transfering documents, searching information as stated earlier, the longer the staffs are able to do the other beneficial tasks.

### 5.2.2 The Material purchase processing time.

As stated earlier in topic 5.2.1, some ordered parts are made from special material that the company does not hold in stock (material group 3: MRP system, page 46). So, the company has to procure that material from the external suppliers. The processes in procuring material concern to the decision to buy the material, the supplier and material selection, the purchase order preparation, the receive of material from material and take in stock, which are shown in figure 5-1 (Process E,F,and G).

The time spent in material purchase processing time ( sum of process E, F, and G time) slightly effects to the total production development time because when the company has placed the supplier purchase order to the supplier, then the company has to wait for the purchased material for a certain period of time which is the material lead time that is quite long. Hence, company can not schedule and issue the injection order to produce the parts immediately when the customer purchase order arrives because the company has to wait for the purchased material.

Although the developed database may not significantly improve the production development time in this case, but it would facilitate the users to purchase the material much

easier than previous system. This reflects to the reduction in material purchase processing time.

**5.2.2.1 Material purchase processing time evaluation methodology.**

The evaluation of material purchase processing time was done in the similar manner of the evaluation of the production development time. But the author selected only 20 parts ordered by the customers. All parts were made from special plastic resin so that the company was not able to use the material in stock promptly and had to purchase these material before production. 10 parts were the parts that run in the developed database system and the rest 10 parts were adopted in the old system. The measurement the process time spent on each activities tied up to the material purchase processing time on both system ( Process E, F, and G) were then carried on. The results of the measurements are shown in table 5-7 and 5-8.

**5.2.2.2** ***Material purchase processig time results.***

The comparison of material purchase processing time of the old systems and new developed database system is shown as following :

***5.2.2.2.1 The result of material purchase processing time from the new developed database system.***

| Part Code | M/C No. | Cycle time | Lot Size | Process | | | | | | | | | | | Total Material Procurement time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | C | D | E | F | G | H | I | J | K | L | |
| PT-581801 | 4 | 3 | 2000 | | | | | 3 | 2 | 2 | | | | | | 5 |
| PT-581803 | 1 | 5 | 7410 | | | | | 3 | 1 | 2 | | | | | | 6 |
| PT-581804 | 1 | 2.4 | 5300 | | | | | 3 | 1 | 2 | | | | | | 6 |
| EON-T080 | 3 | 7 | 1000 | | | | | 4 | 2 | 2 | | | | | | 8 |
| EON-T087 | 4 | 6 | 1000 | | | | | 3 | 2 | 2 | | | | | | 7 |
| TR 2QD 1102-5 | 1 | 9 | 1450 | | | | | 3 | 1 | 2 | | | | | | 6 |
| TR 2QD 1102-6 | 4 | 5 | 1450 | | | | | 5 | 3 | 2 | | | | | | 10 |
| TR 2QD 1102-7 | 3 | 5 | 3000 | | | | | 3 | 1 | 2 | | | | | | 6 |
| JKNB-A090 KOFB | 2 | 4 | 4500 | | | | | 3 | 2 | 2 | | | | | | 7 |
| JKNB-A092 KOFB | 4 | 6 | 2600 | | | | | 3 | 2 | 2 | | | | | | 7 |

*Table 5-7 : The result of the material purchase processing time of the new developed database system.*

*5.2.2.2.2 The result of material purchase processing time from the new developed database system.*

| Part Code | M/C No. | Cycle time | Lot Size | Process | | | | | | | | | | | Total Material Procurement time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | C | D | E | F | G | H | I | J | K | L | |
| 3312-PL 60 | 5 | 4 | 12000 | | | | | 4 | 10 | 5 | | | | | | 19 |
| 3312-PL 60 B | 7 | 2 | 4500 | | | | | 4 | 11 | 5 | | | | | | 20 |
| APR 568 HOP | 8 | 1.5 | 2600 | | | | | 5 | 12 | 6 | | | | | | 23 |
| TSM –F5580 | 5 | 6 | 7500 | | | | | 4 | 9 | 5 | | | | | | 18 |
| TSM-F6547 | 6 | 4 | 2300 | | | | | 5 | 8 | 5 | | | | | | 18 |
| TSM-F4187 | 6 | 4 | 1450 | | | | | 4 | 9 | 5 | | | | | | 18 |
| 3312-PL 75 | 5 | 4 | 1200 | | | | | 6 | 11 | 5 | | | | | | 22 |
| JKNB-A0097 KOFB | 8 | 5 | 2500 | | | | | 4 | 9 | 6 | | | | | | 19 |
| S-3945-5 | 7 | 3 | 1000 | | | | | 4 | 9 | 5 | | | | | | 18 |
| S-2945-5 | 7 | 6 | 1150 | | | | | 3 | 10 | 5 | | | | | | 18 |

*Table 5-8 : The result of the material purchase processing time of the existing documents system*

From table 5-7 and 5-8, the author can summarize the assessment of material purchase processing time in the tables and allocate them in table 5-9. The figures in table 5-7 and 5-8 are calculated into the average numbers of each time interval and put in table 5-9. The table 5-9 shows the change of time interval basing on the old and new developed database system comparison.

*5.2.2.3 Material purchase processing time analysis.*

| Process | Developed Database | Existing document system | Percent change (%) |
|---|---|---|---|
| E | 3.3 | 4.3 | - 23.26 % |
| F | 1.5 | 9.8 | - 84.69% |
| G | 2 | 5.2 | - 61.54% |
| **Average Material purchase processes time (E+F+G)** | **6.8** | **19.3** | **- 64.77%** |

*Table 5-9 : The material purchase processing time analysis* Note ; Process time in minutes

From the result in table 5-9, it can be concluded that the material purchase processing time considerably reduces in high percent in the developed database system. The material purchase processing time reduce by 62.61% on average. However, it does not mean the company is able to procure the material faster than the previous system, nor

shorten the production development time. The improved figures only tells that the staffs spent less time in material purchase transaction. So, the developed database system facilitated the stock staffs to complete the purchase transactions. Thus, this means the developed database system can enhance the workpower utilization of stock staffs, so that the staffs have more time to do other beneficial tasks for the company.

## 5.3 Evaluation summary.

From the evaluation, it was found out that the developed system remarkably improved in the production development time and also facilitated the users to work in simpler way. There are other benefits of the implementation of the developed production and inventory database system that the author did not evaluate. These cover the data accuracy improvement and the customer delivery timeliness which the author strongly believed that the developed database system would also enhance the efficiency of these issues.

# CHAPTER VI

## *CONCLUSION AND RECOMMENDATIONS.*

## 6.1 Conclusion.

The production and inventory database for BIP had been developed in purpose of shortening the production development time and facilitating the users in production and inventory management tasks. The developed database based on the Transaction processing system (TPS) which coped fundamental business operations of the company such as a customer order processng, supplier purchase order processing, invoicing, production planning and etc. The information record kept in the developed database were tremendously useful for the company staffs, especially in the production and inventory management activities.

In developing the database, the System Analysis and Design approach had been applied following the Systems Development Life Cycle (SDLC). The development began with the Preliminary investigation, which expressed the problem statements that defined the deficiencies in the information system and the what was to be improved. Then the study of the existing business process was carried out through the Systems analysis phase, so that it declared exactly what happened in the current system and what was the users' requirements. Thereafter, the development of the application software database was constructed, basing on the modern and powerful database engine software and program development application such a Microsoft Access 2000 and Microsoft Visual Basic 6.0, in the design and development phase. Finally the finished application database was implemented in the actual work at BIP and then was evaluated so that enabled to know how successful the database application in the company.

The results were shown remarkably positive. From the evaluation, it showed the substantial improvement in term of the shortening of production development time, including resulted in the more expediences in production and inventory processes.

## 6.2 Recommendations.

The developed production and inventory database system was the first generation of automating the fundamental data in the company. So, the database based on the TPS system. It was necessary for the company that had not yet exploited the computerized database system.

For the developed TPS database system, it sped the processing of business activities and reduced clerical costs. The data stored in the database were valuable that would be used to help manager make better decisions in their respective business areas in a certain level. The company should consider how to further utilize the data stored in the database in more meaningful way. So the development of the Management Information System(MIS) or the Decision Support System (DSS) was an appropriate choice.

Let's recommend two possible interesting computer applications in the areas that may potentially improve the performance of the production and inventory activities. They are Material Requirement Planning system or MRP software system and the production scheduling software application.

As mentioned earlier, the tasks of scheduling the production is also very critical for the company. The company should consider to implement the suitable technology in assisting the scheduling tasks rather than using the paper document manipulation which always causes errors and inefficiency. A MRP system is able to handle the scheduling tasks in case of there are production and purchase lead times.

The Material Requirement Planning of MRP is a computer-based information system for scheduling production and purchases of dependent demand items. It uses information about end product demands, production and purchase lead times, and currently inventory levels to develop cost-effective production and purchasing schedules. The MRP may be made in house or buy from the external software suppliers. Currently several of high capability commercial MRP systems are now available which are sold in reasonable price.

The other attractive alternative choice is the exploiting the performance production scheduling application. The application would comfort the production planner to schedule the jobs on each machine easier than the manual manipulation and also increase the utilization on the machines. For BIP, the company establishes daily production and work schedules, but as problems occur and customer demands change, the schedules are always revised on or more times during the day. So, if the company is able the right production scheduling software then it would relief these scheduling troubles

*Finally, this project had made all managements including operators to be awareness of the use of the suitable technology to improve the work processes. It had demonstrated the managements how significance of computer utilization. The author also hoped that this project would trigger the managements to invent the another technology such as a MRP system or Scheduling application, as recommended in previous topic, and exploited it in the most meaningful ways in the future.*

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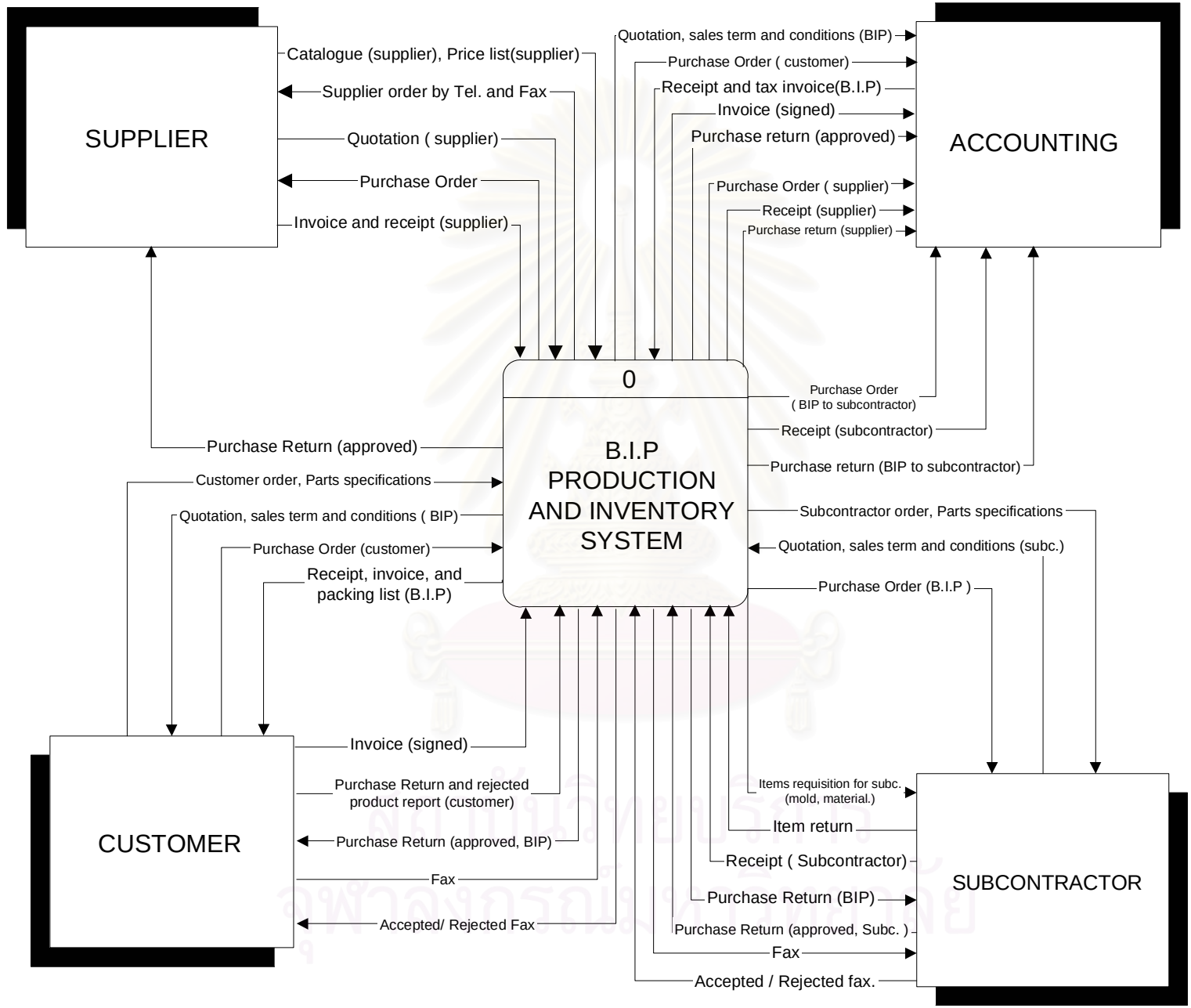
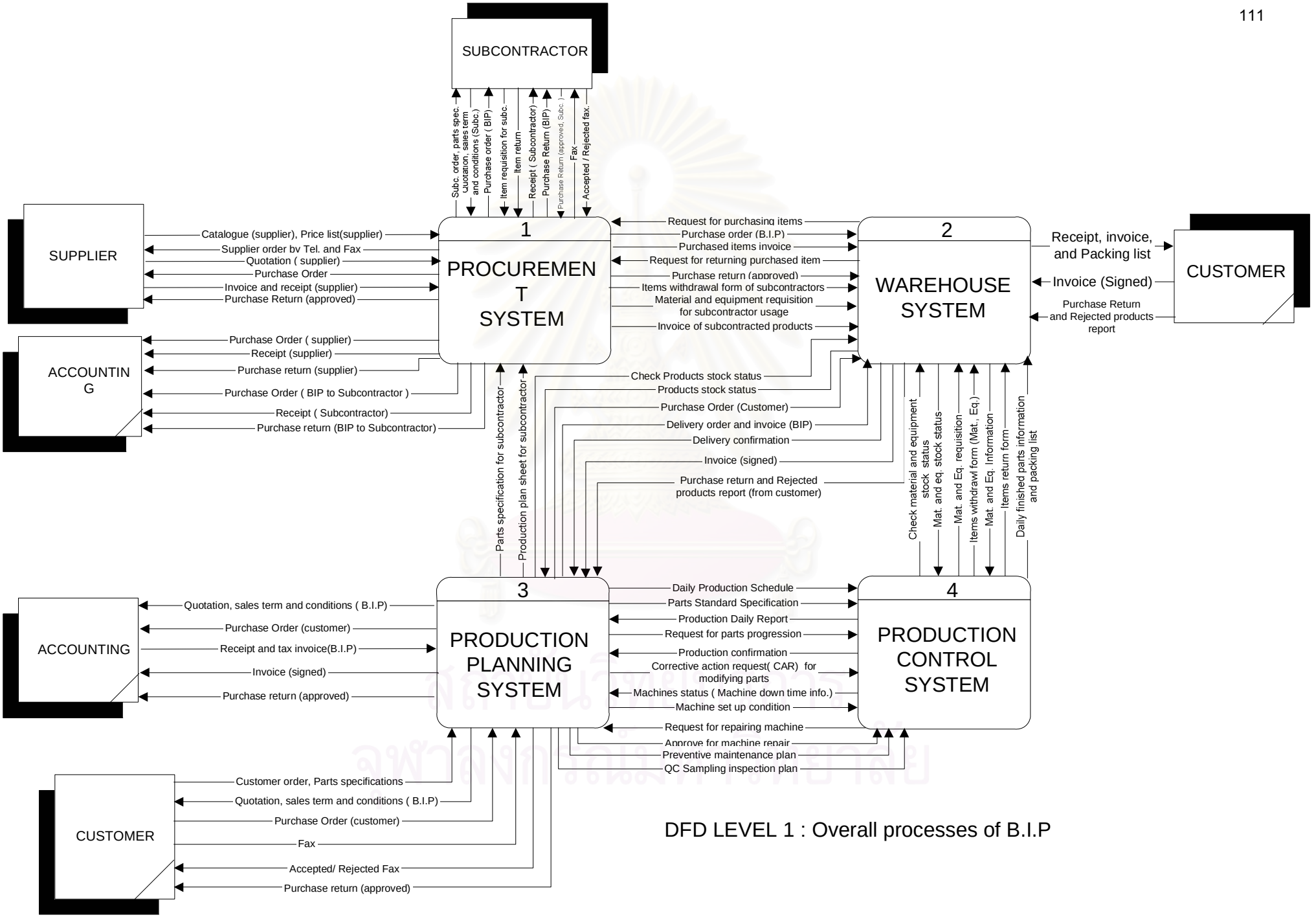
# APPENDICES

# APPENDIX A

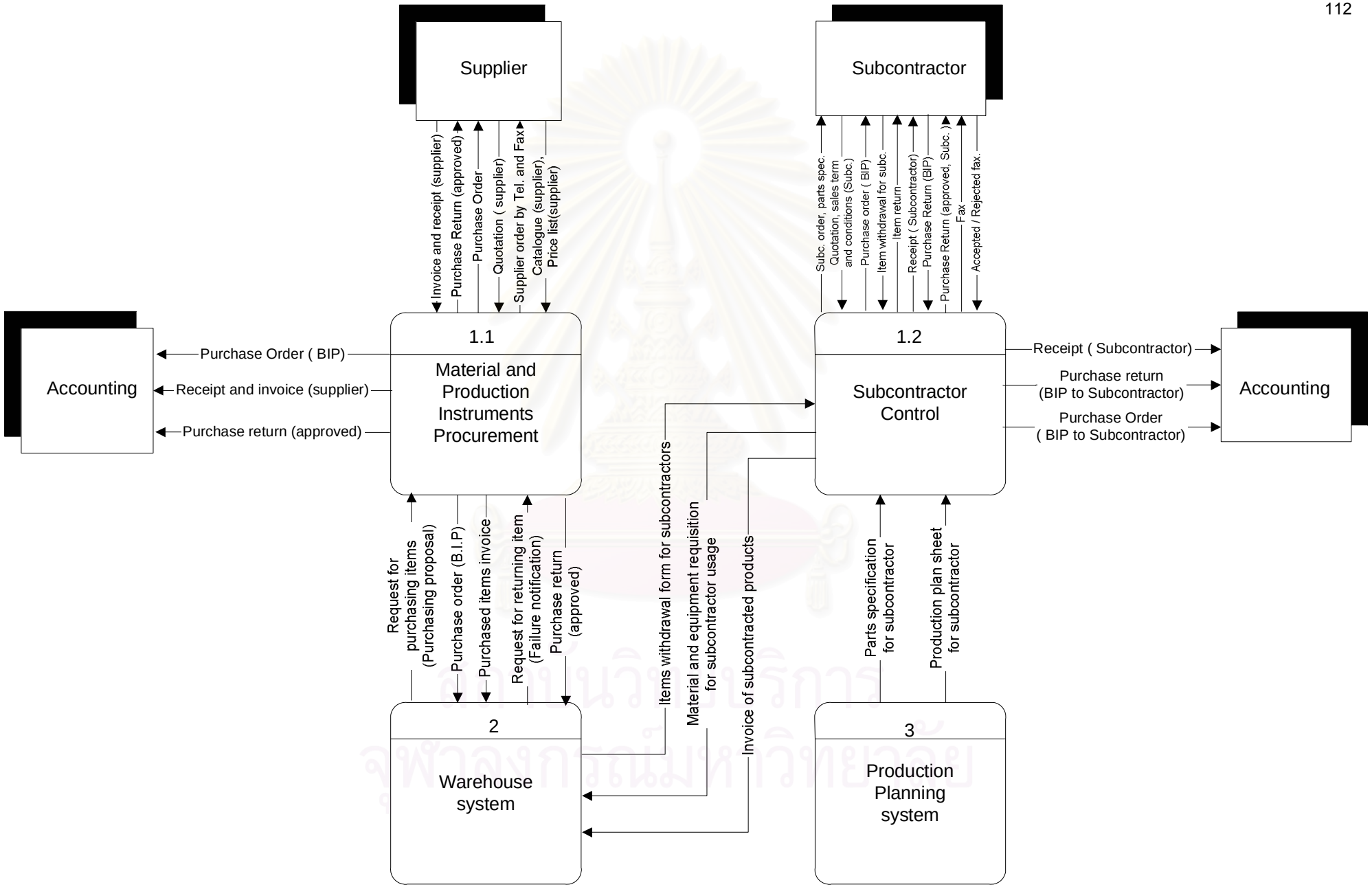
## DATA FLOW DIAGRAM FOR OVERALL PROCESS IN PRODUCTION AND INVENTORY MANAGEMENT OF B.I.P



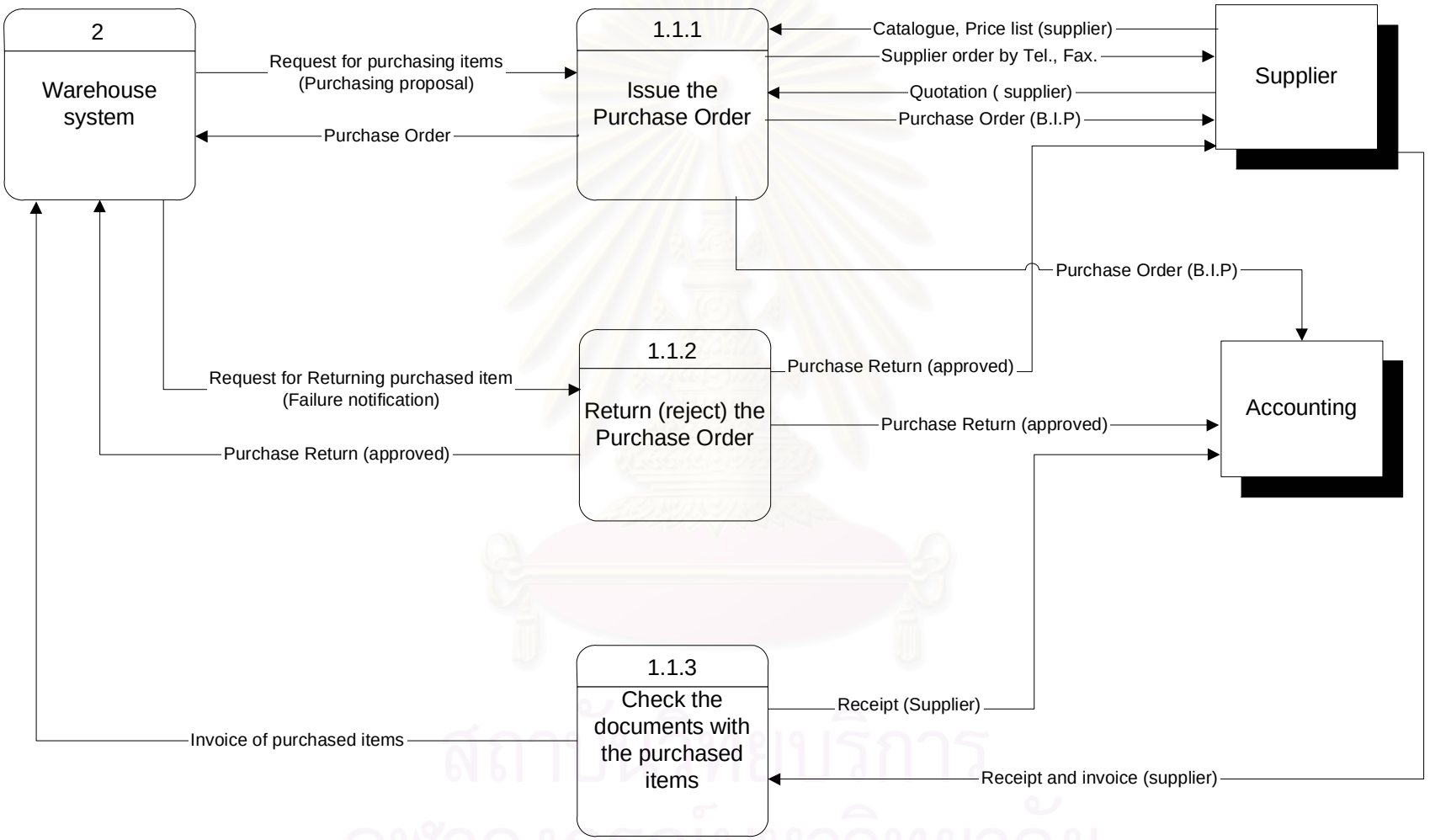

CONTEXT LEVEL DATA FLOW DIAGRAM FOR
B.I.P



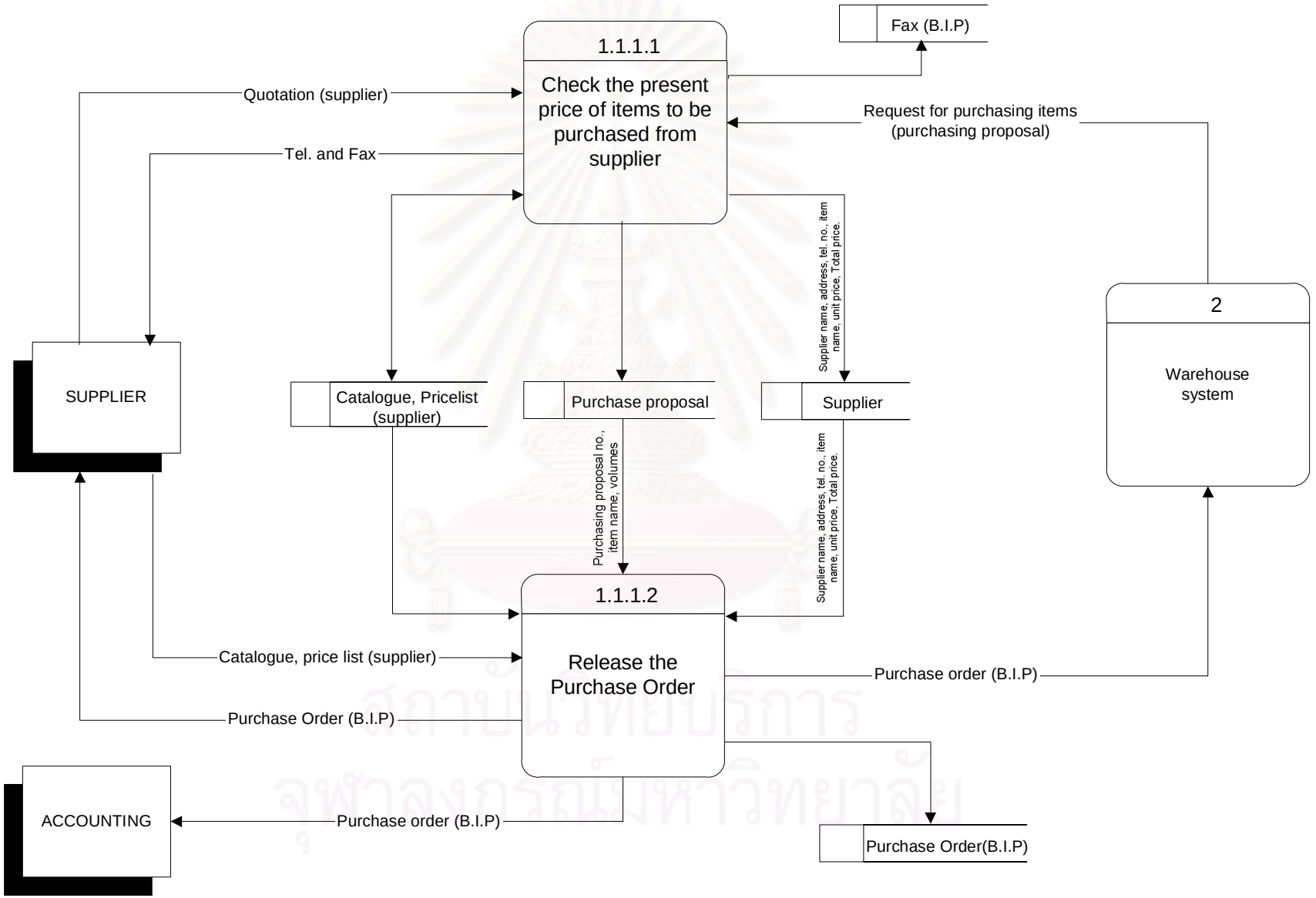

DFD LEVEL 1 : Overall processes of B.I.P



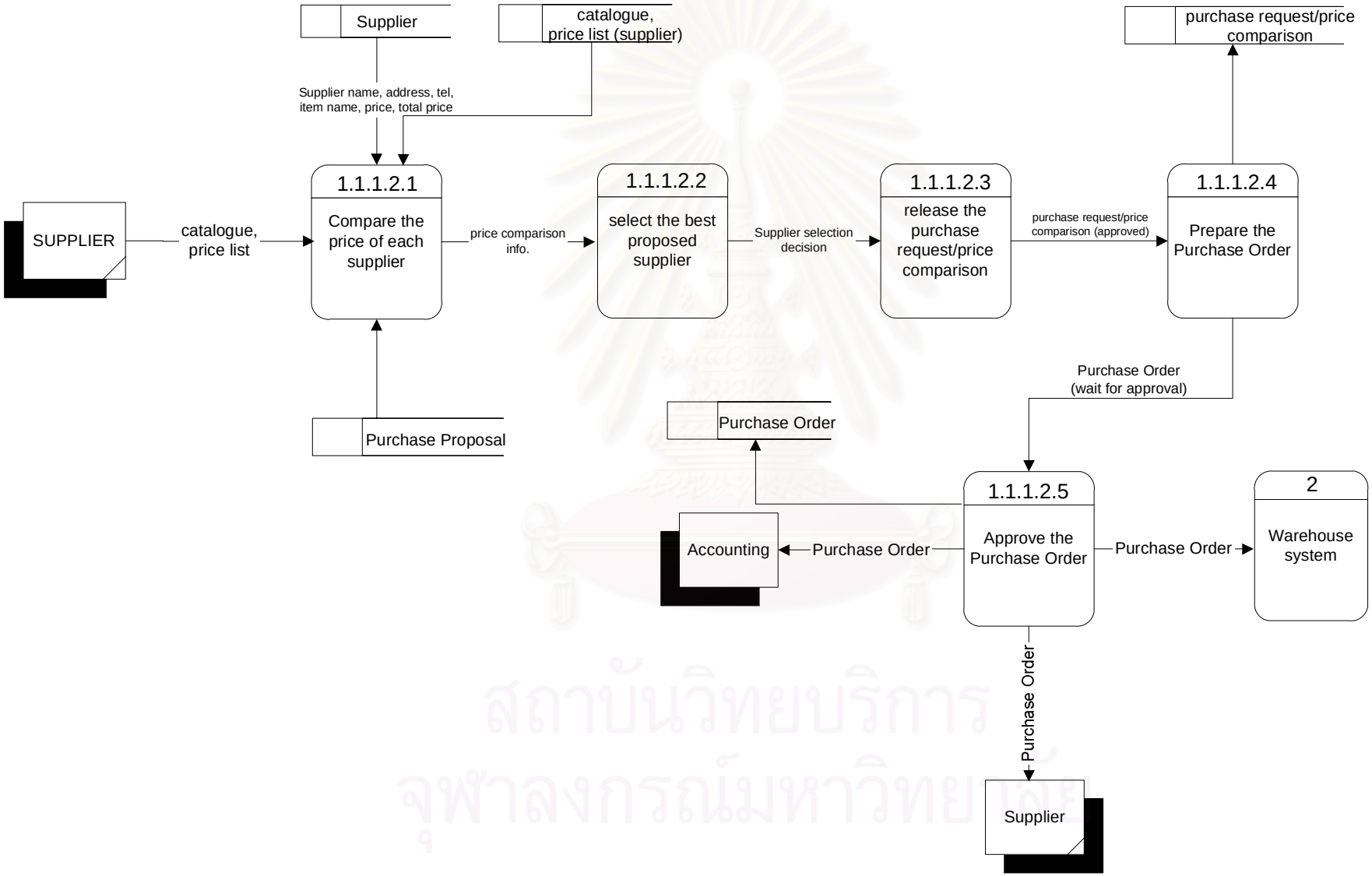

DFD Level 2 : Procurement system (1)



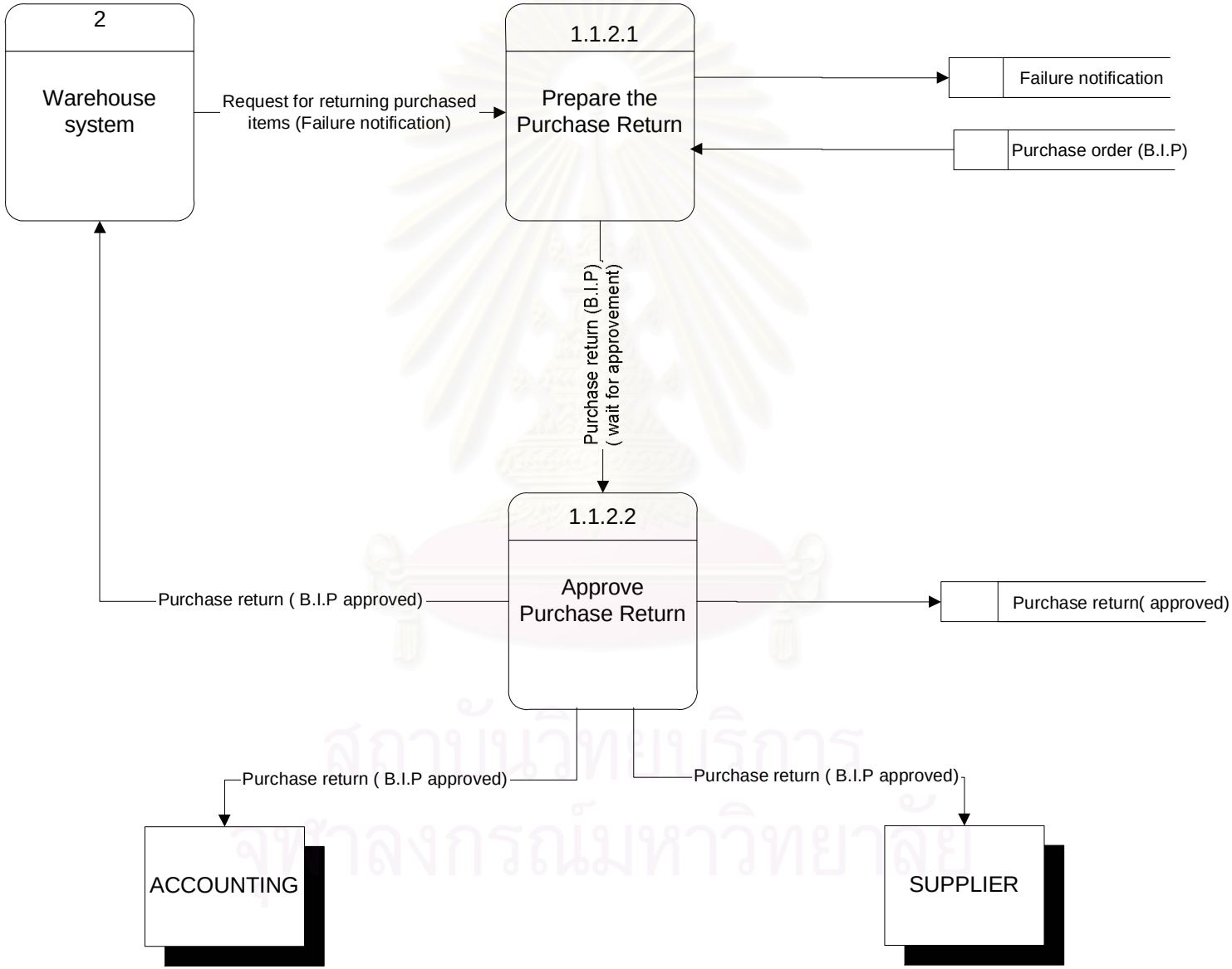

DFD Level 3 : Material and Production Instruments Procurement (1.1)



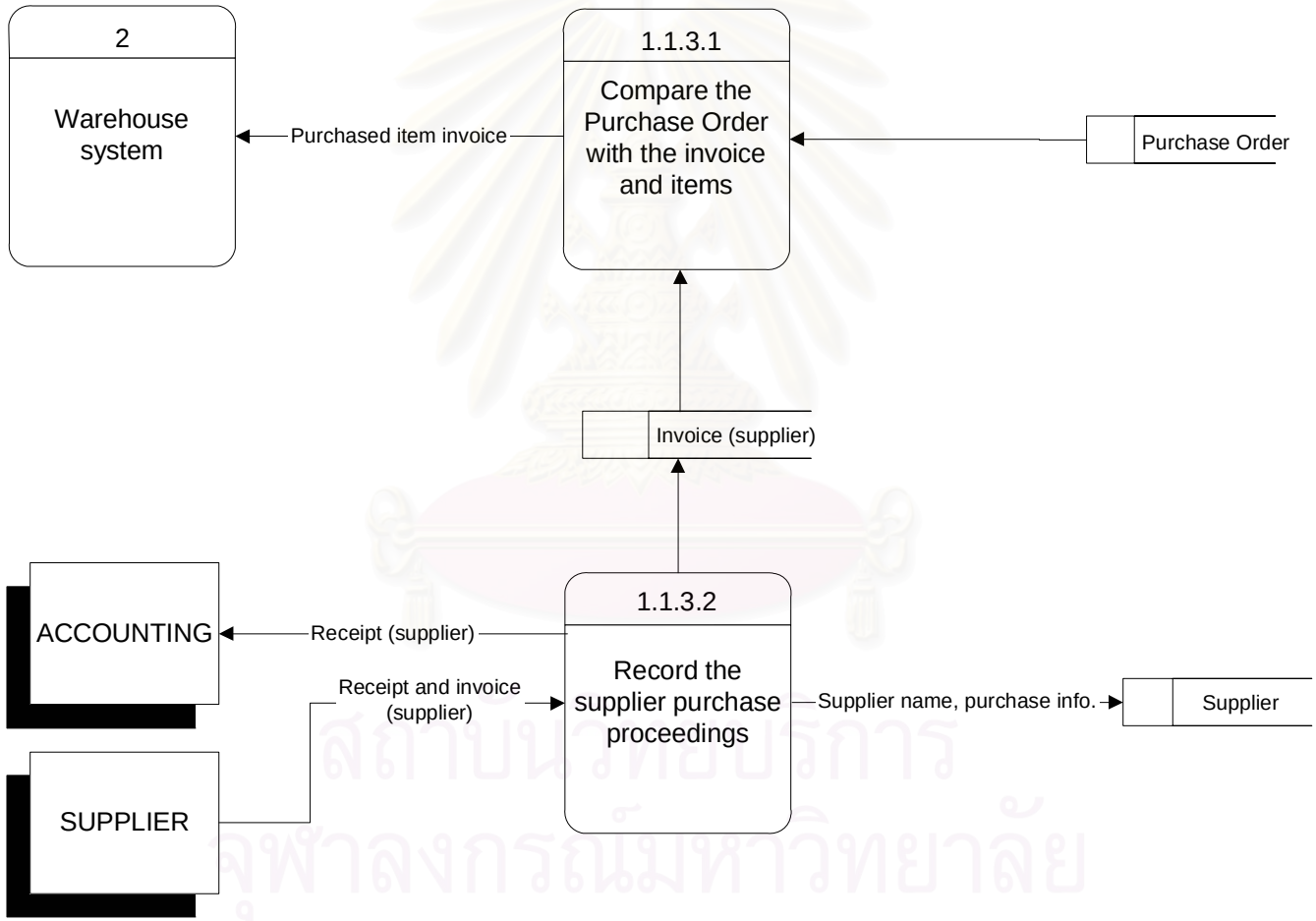

DFD Level 4 : Issue the BIP purchase order (1.1.1)



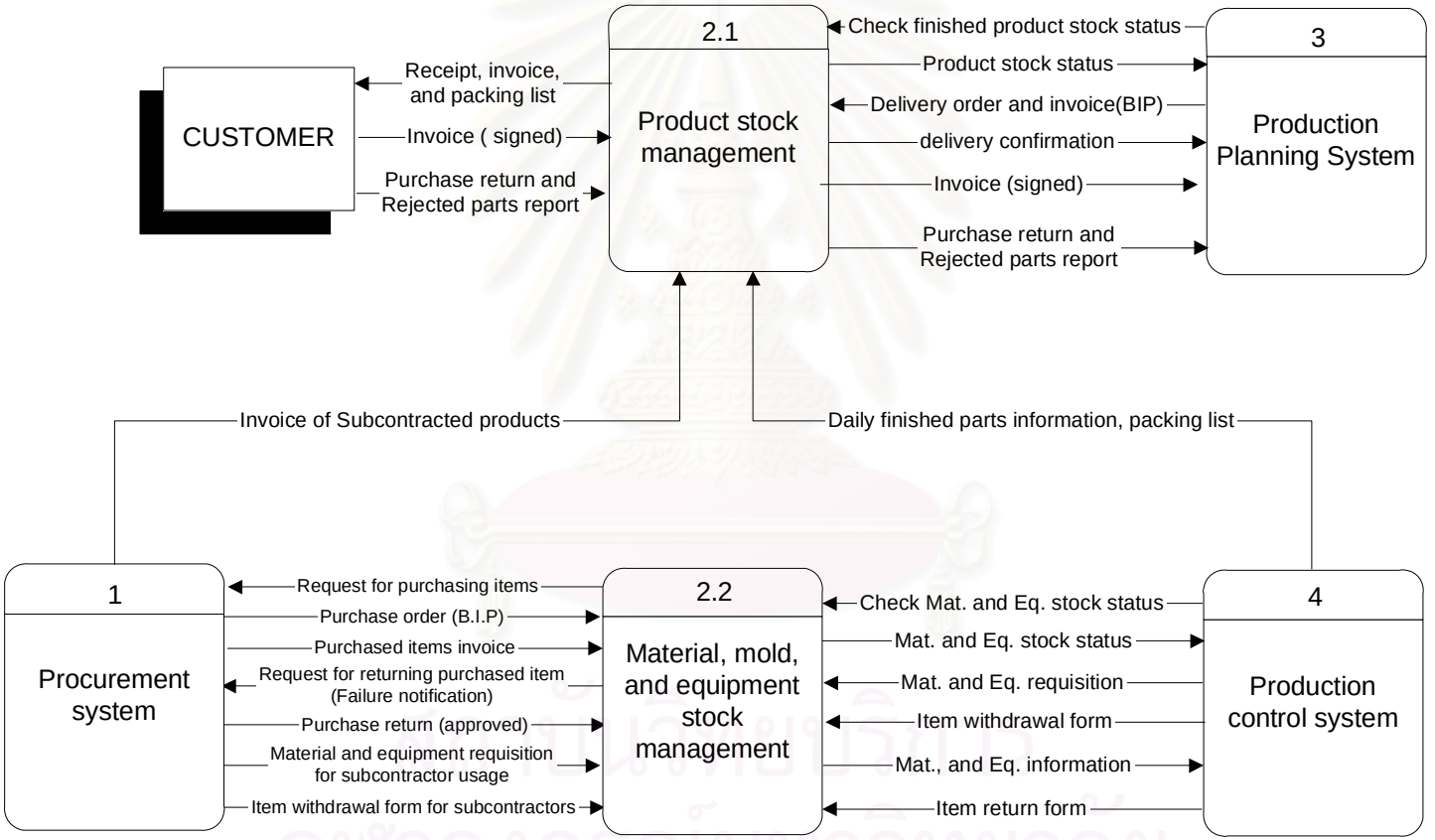

DFD Level 5 : Release the Purchase Order (1.1.1.2)



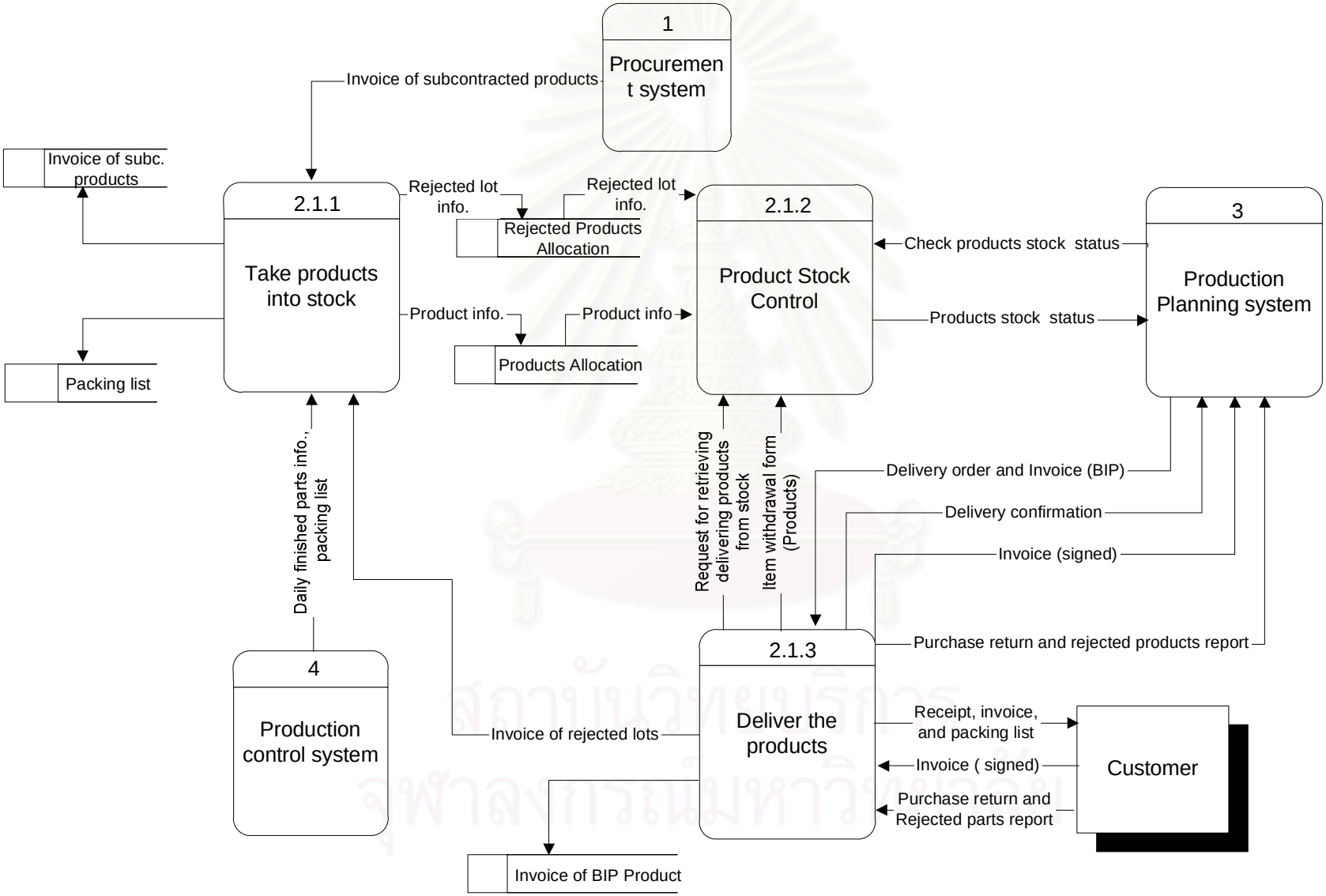

DFD Level 4 : Return the purchase order (1.1.2)



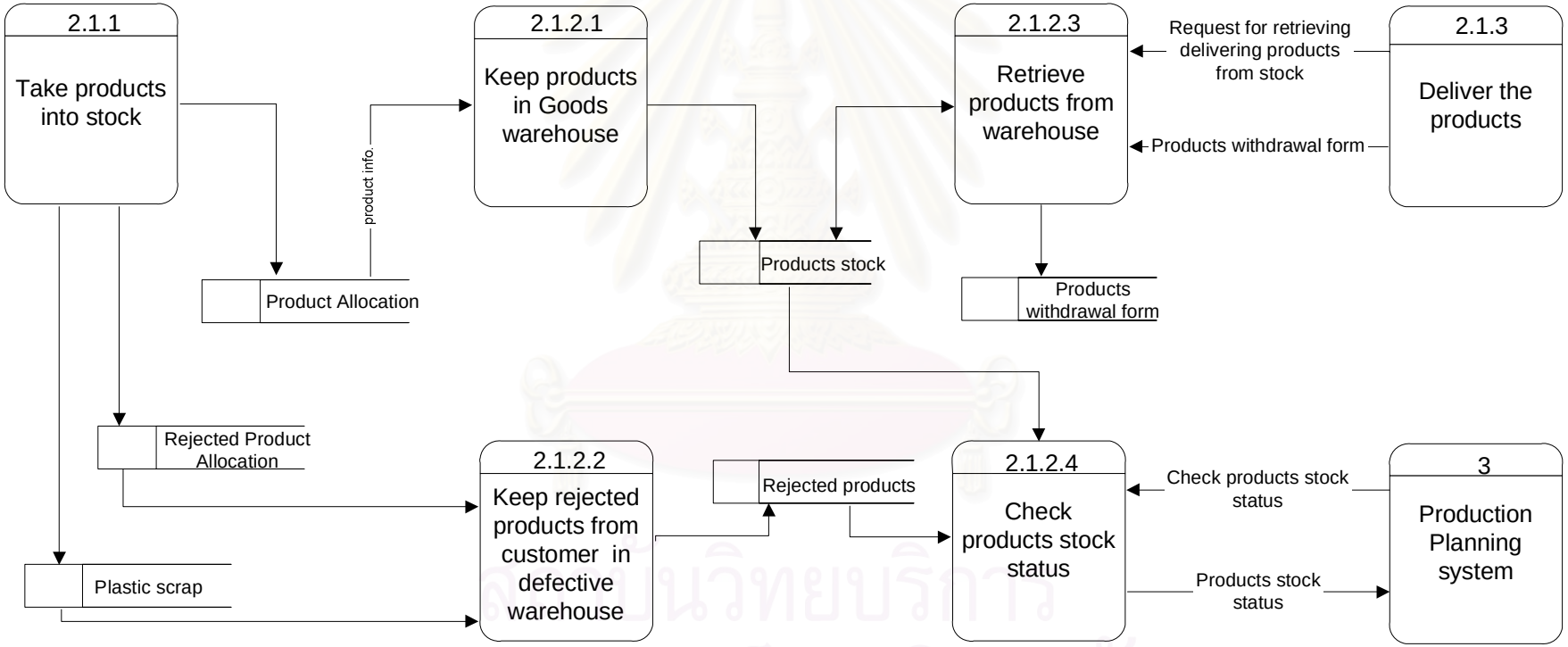

DFD Level 4 : Check the documents with items (1.1.3)



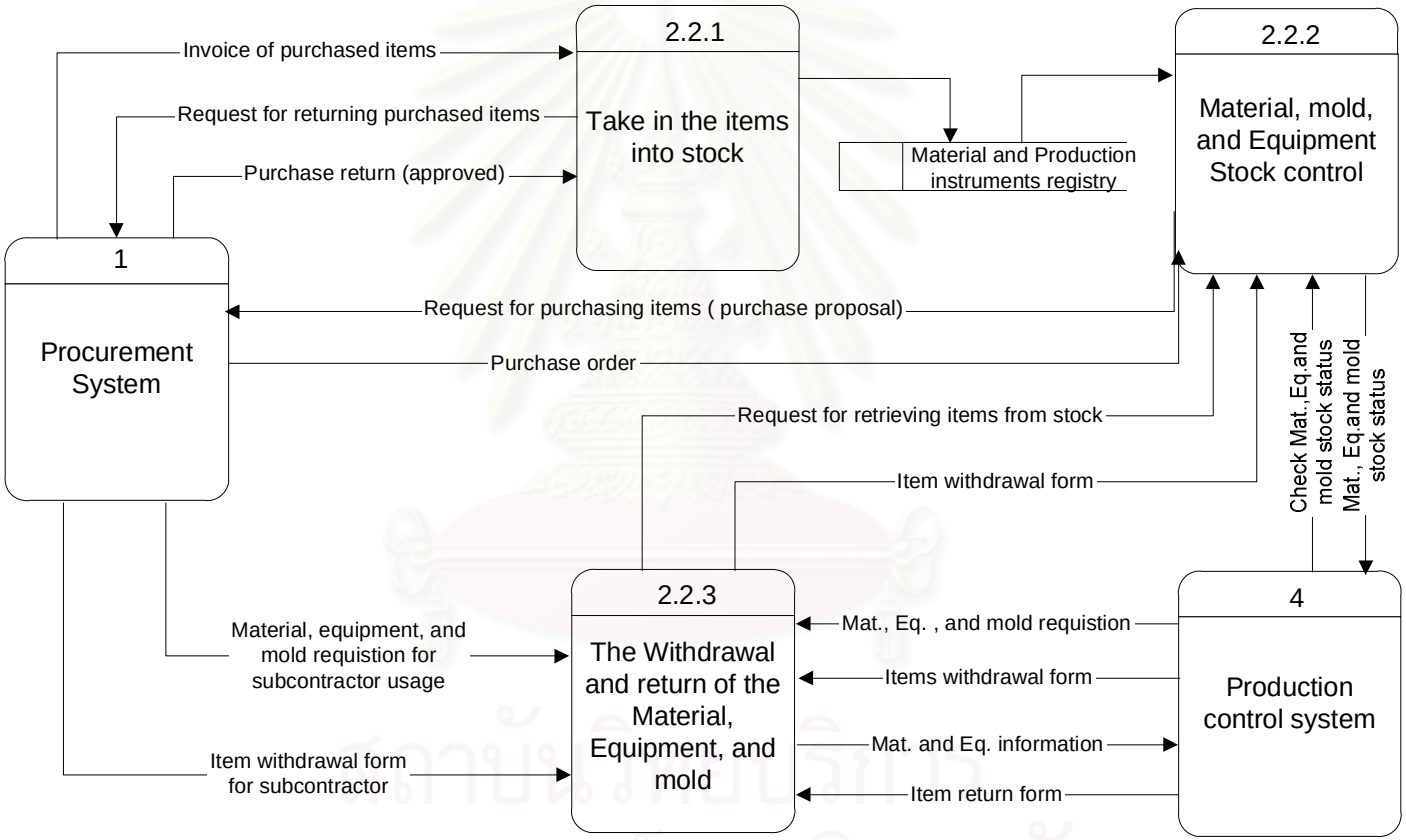

DFD Level 2 : Warehouse system



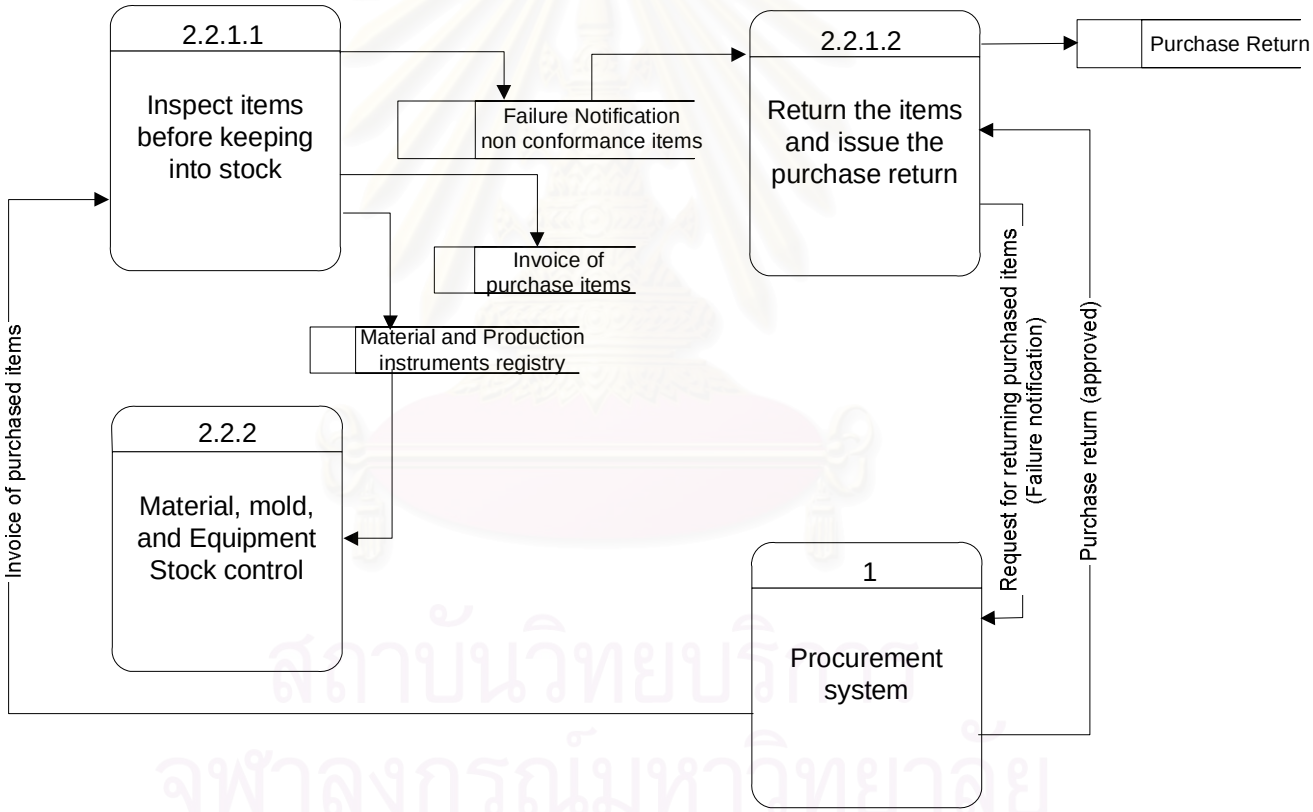

DFD Level 3 : Products stock management (2.1)



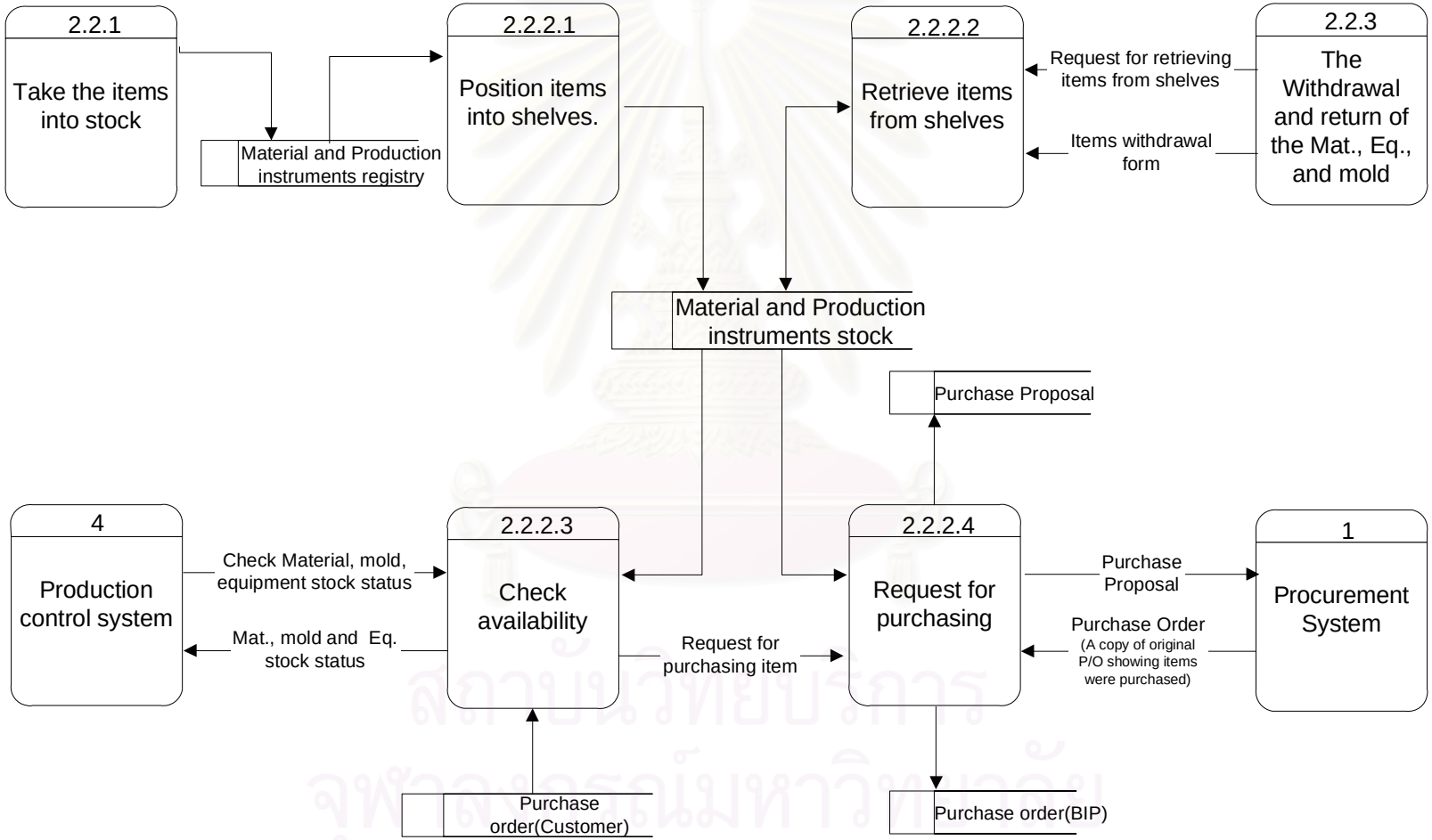

DFD Level 4 : Product stock control (2.1.2)



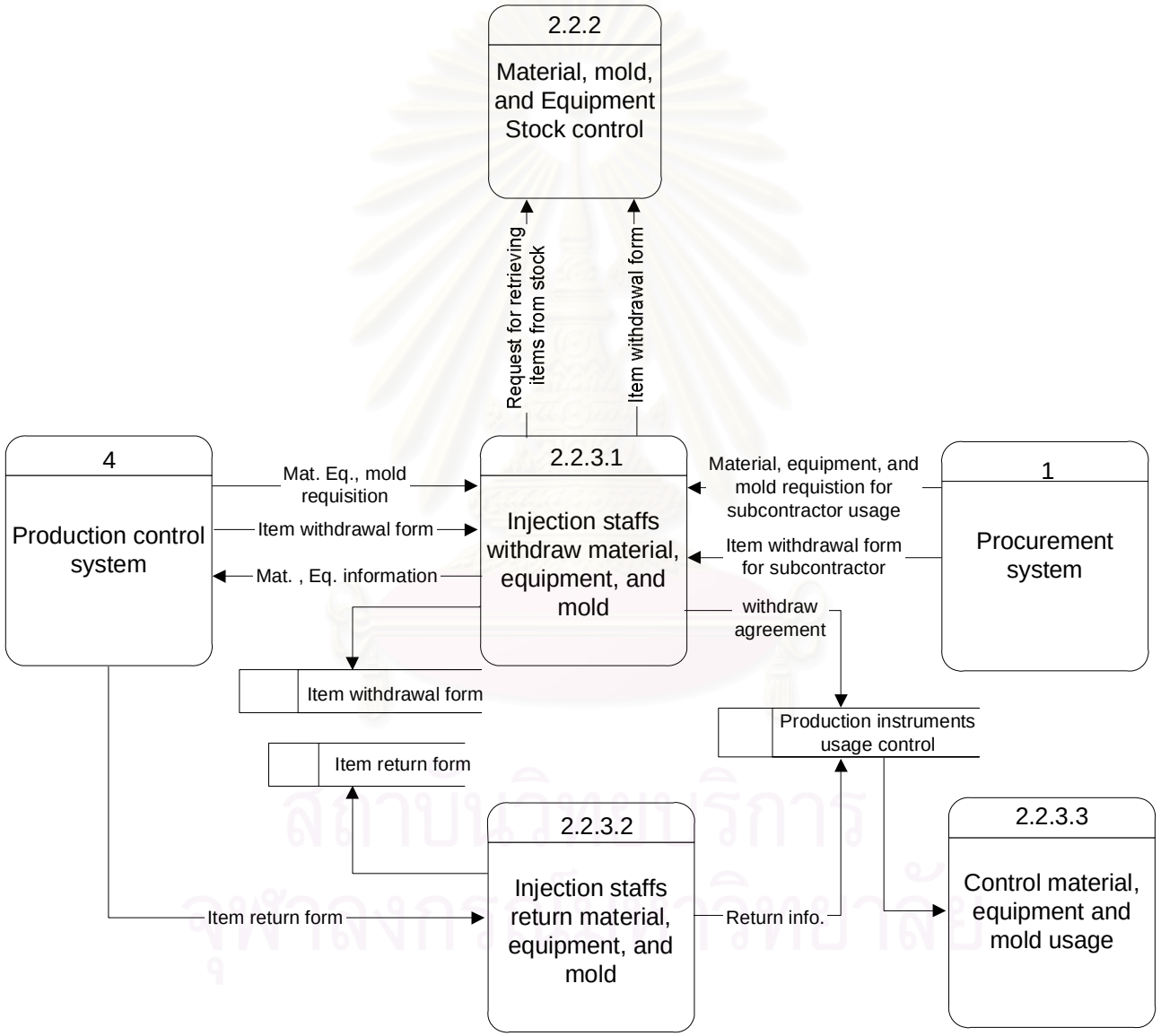

DFD Level 3 : Material, equipment, and mold stock management (2.2)



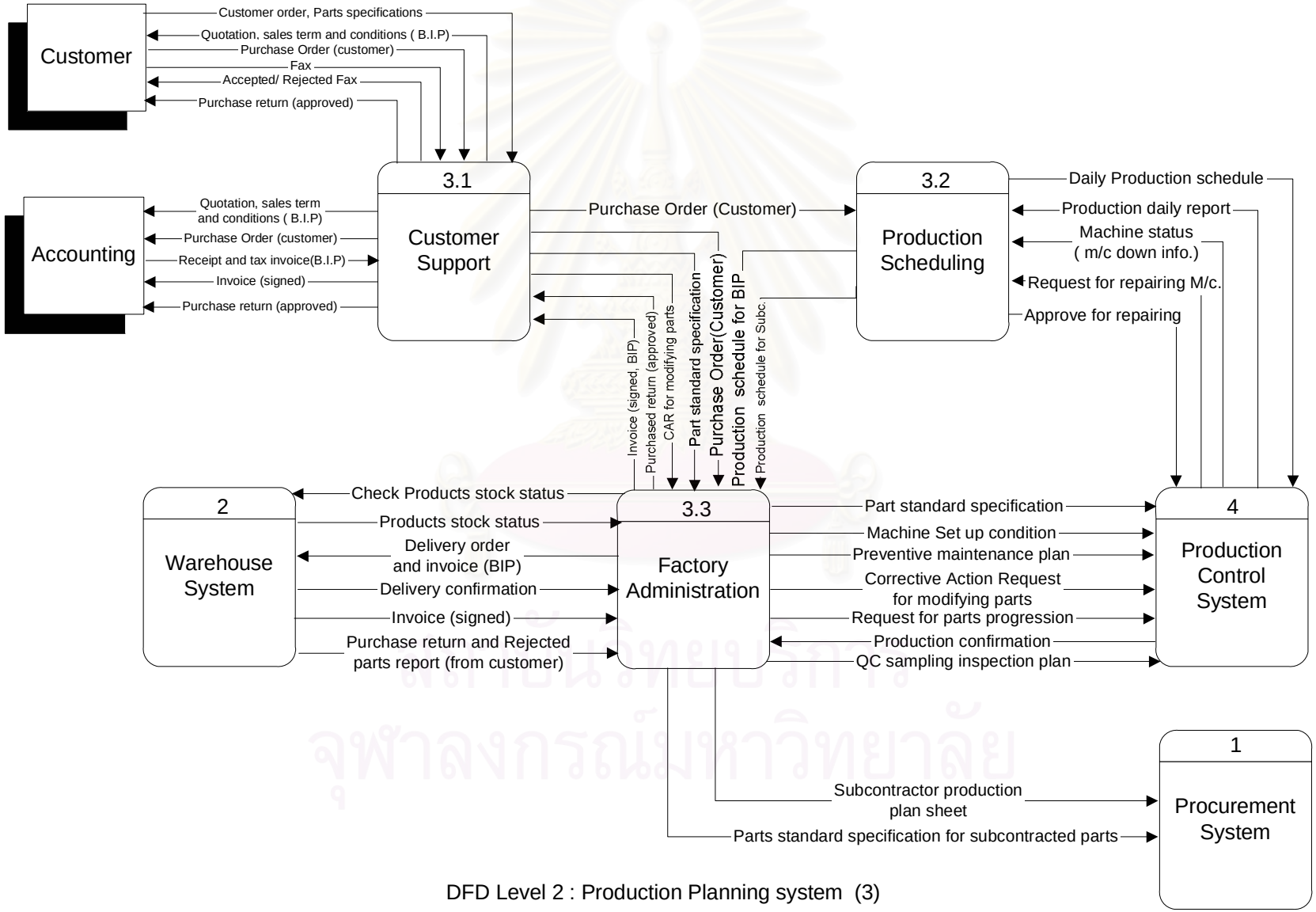

DFD Level 4 : Take in the items into stock (2.2.1)



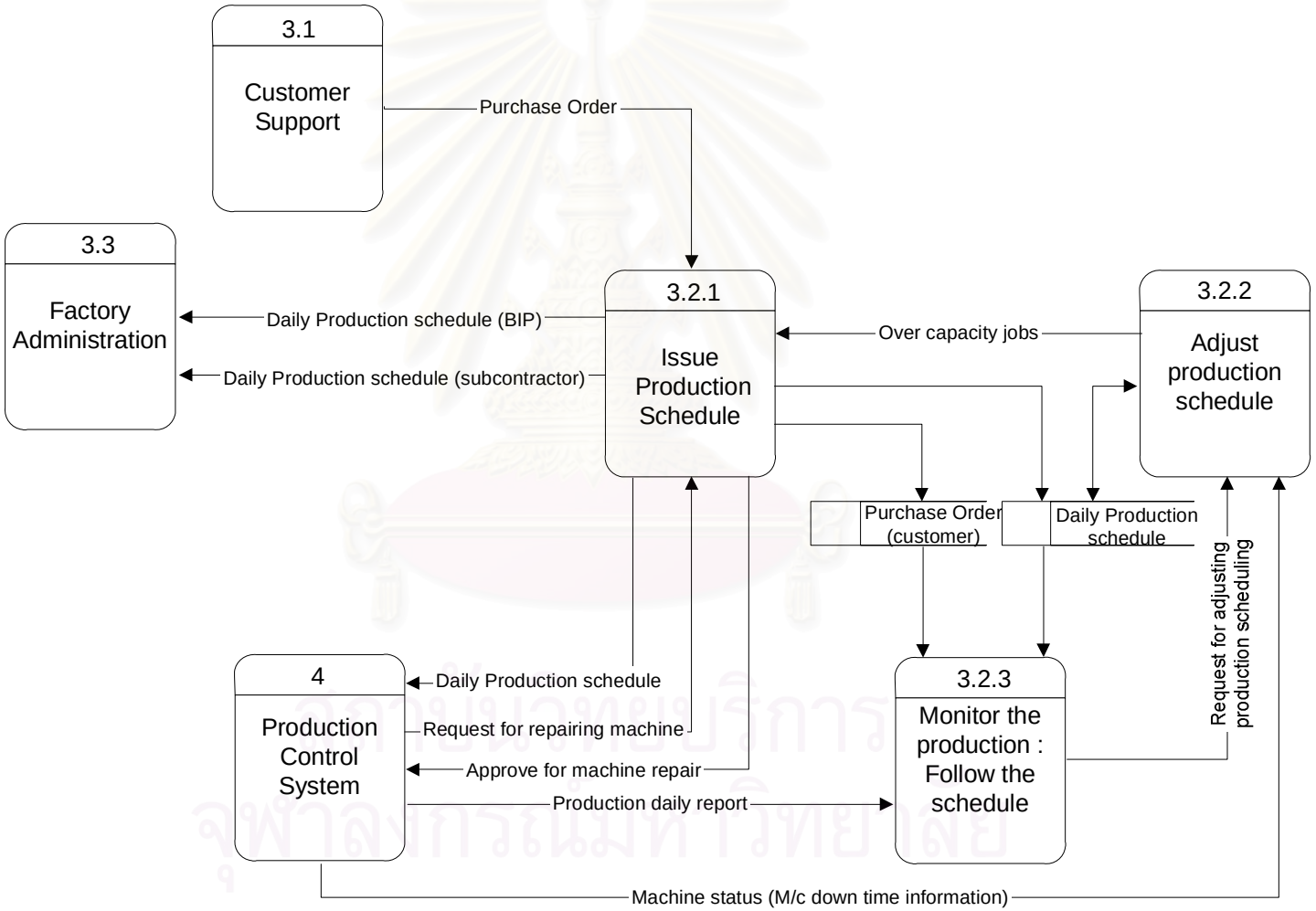

DFD Level4 : Material, mold and Equipment stock control (2.2.2)



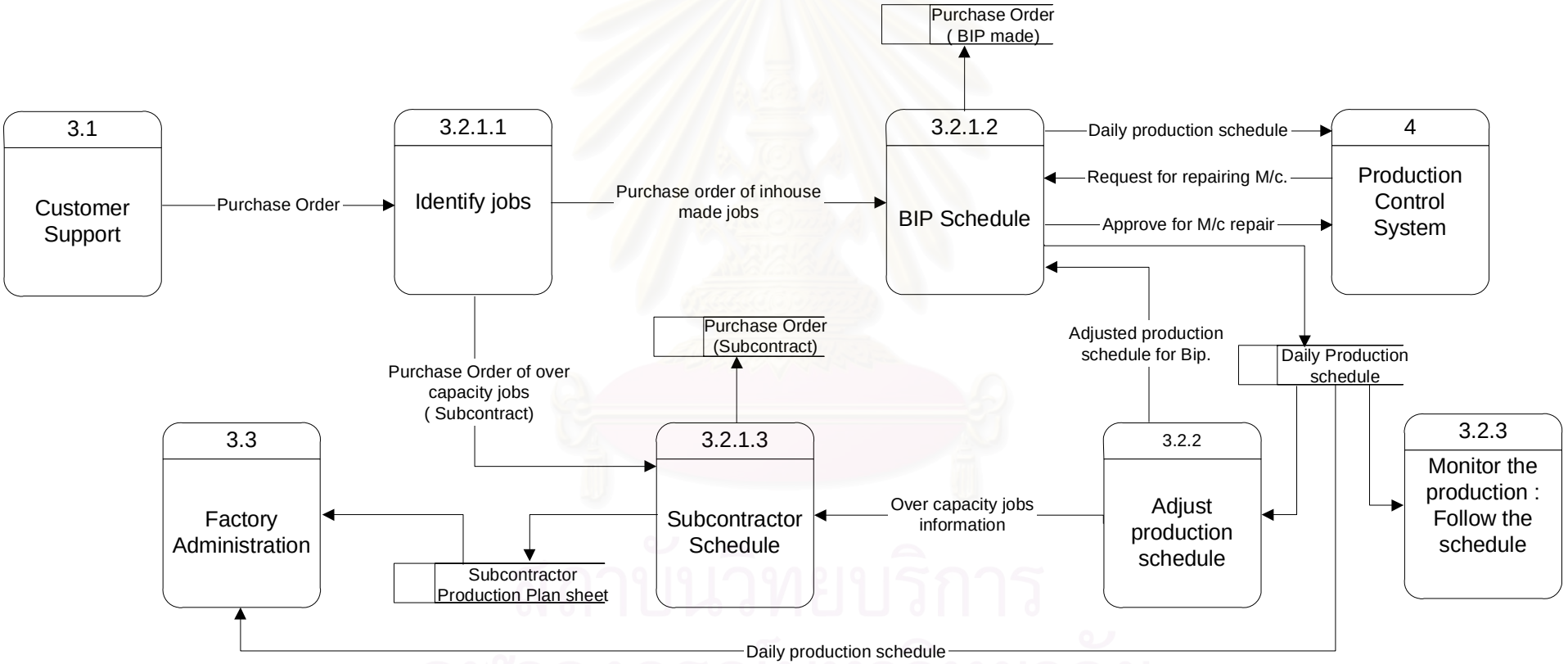

DFD Level 4 : The withdrawal and return of mat., eq., and mold (2.2.3)



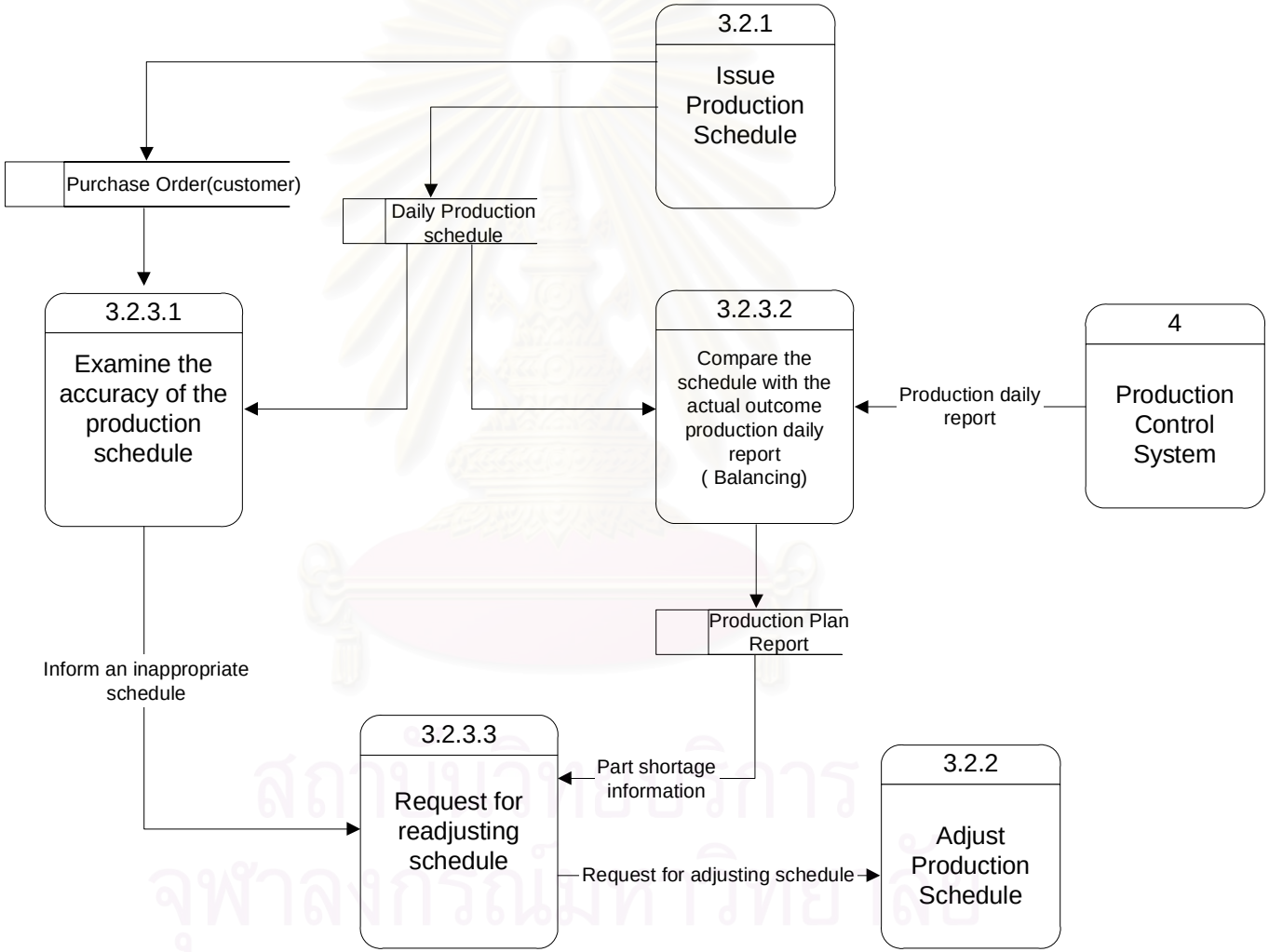

DFD Level 2 : Production Planning system (3)



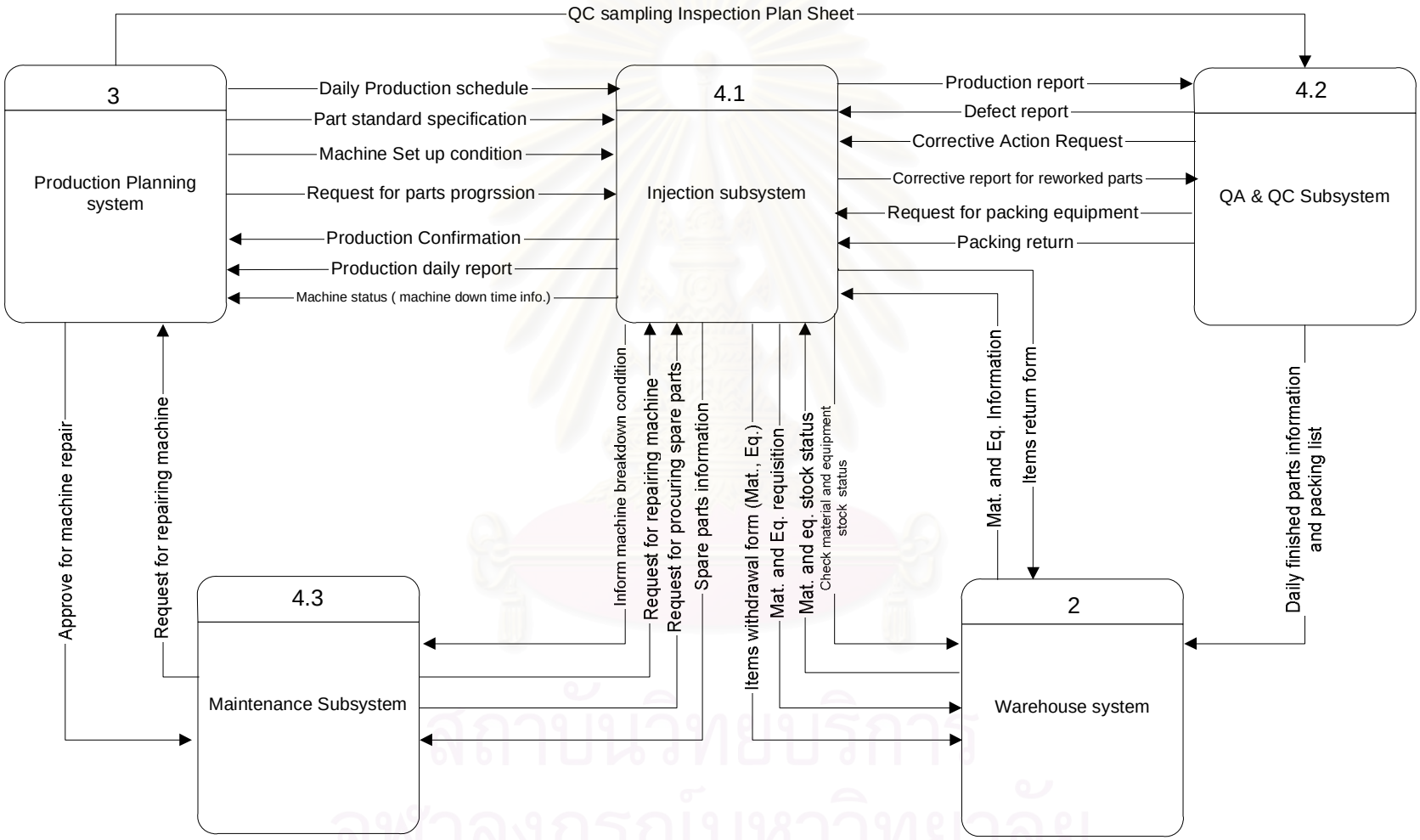

DFD Level 3 : Production scheduling (3.2)




DFD Level 4 : Production schedule (3.2.1)

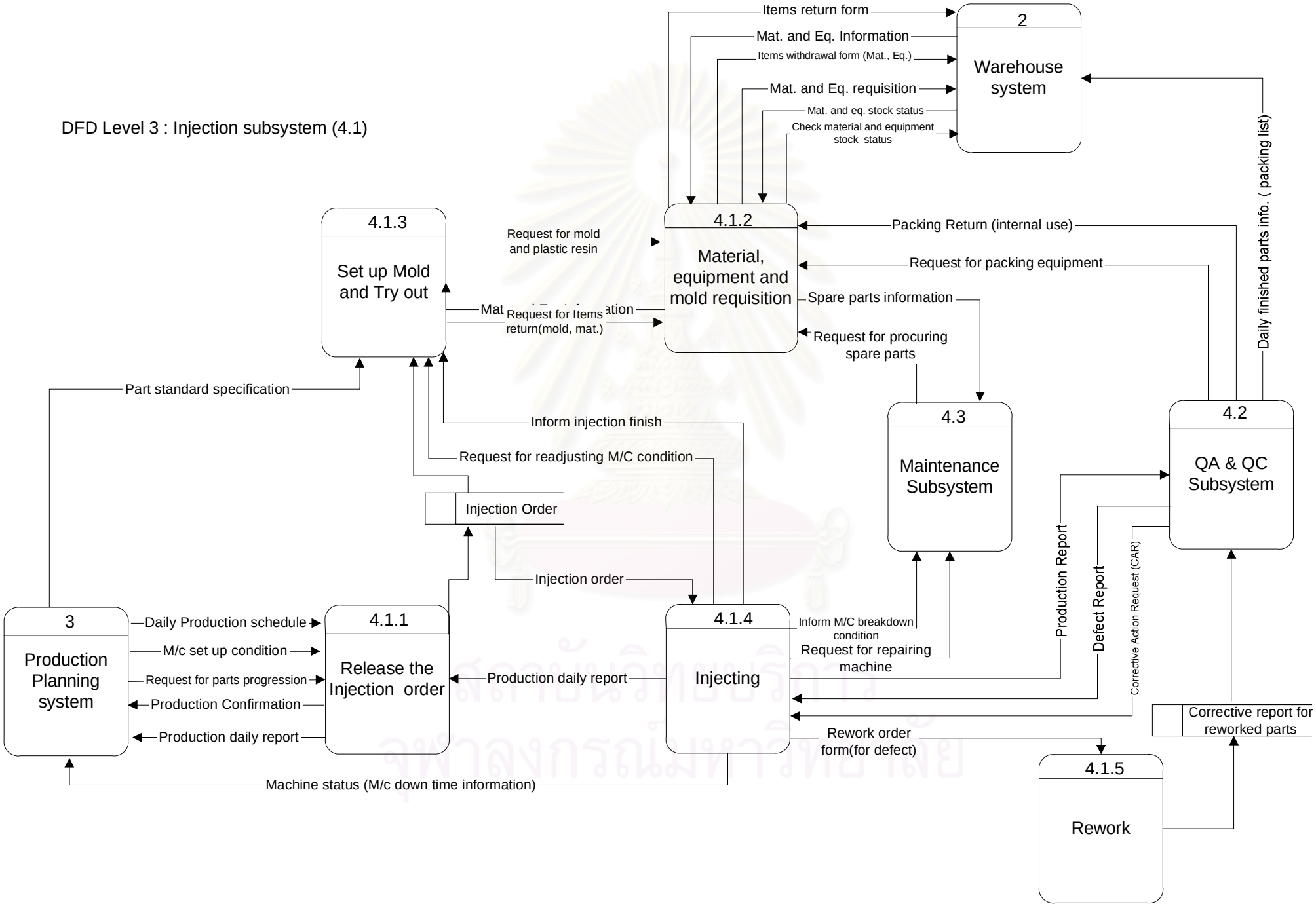


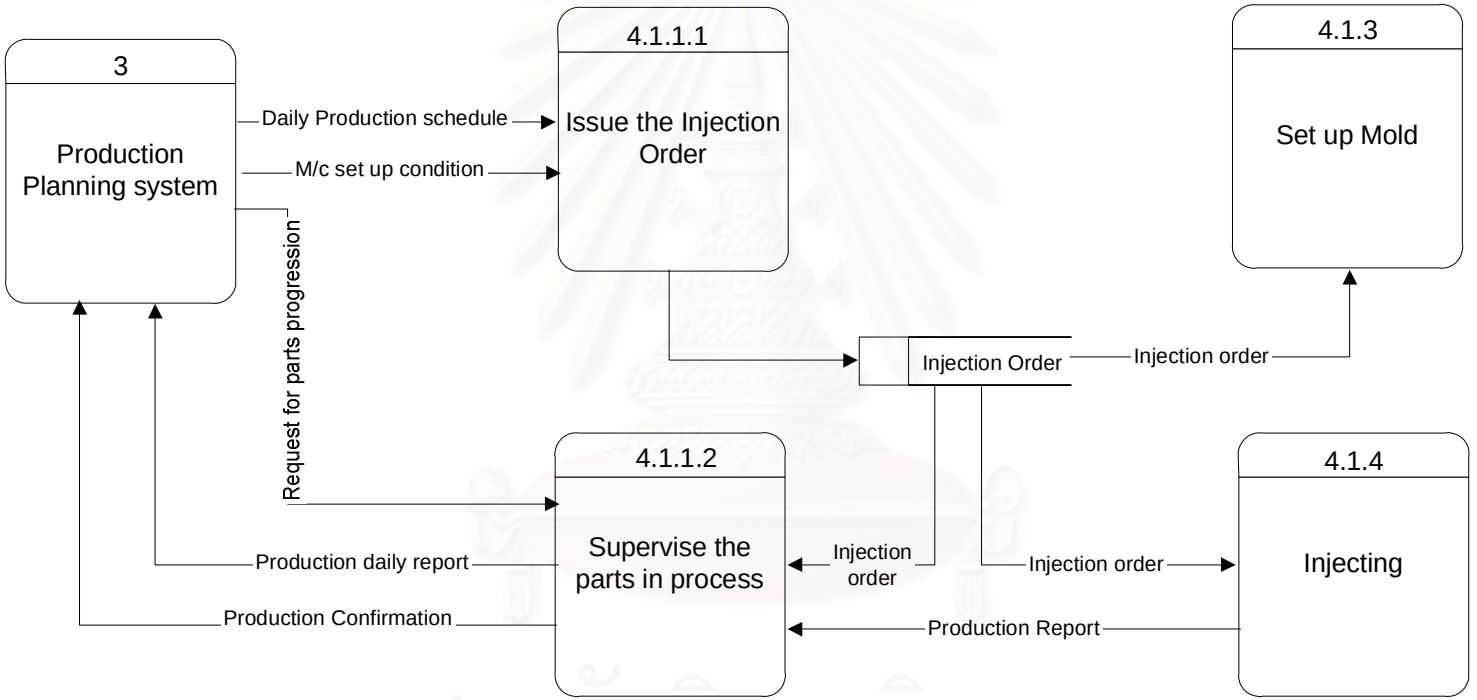

DFD Level 4 : Monitor the schedule (3.2.3)



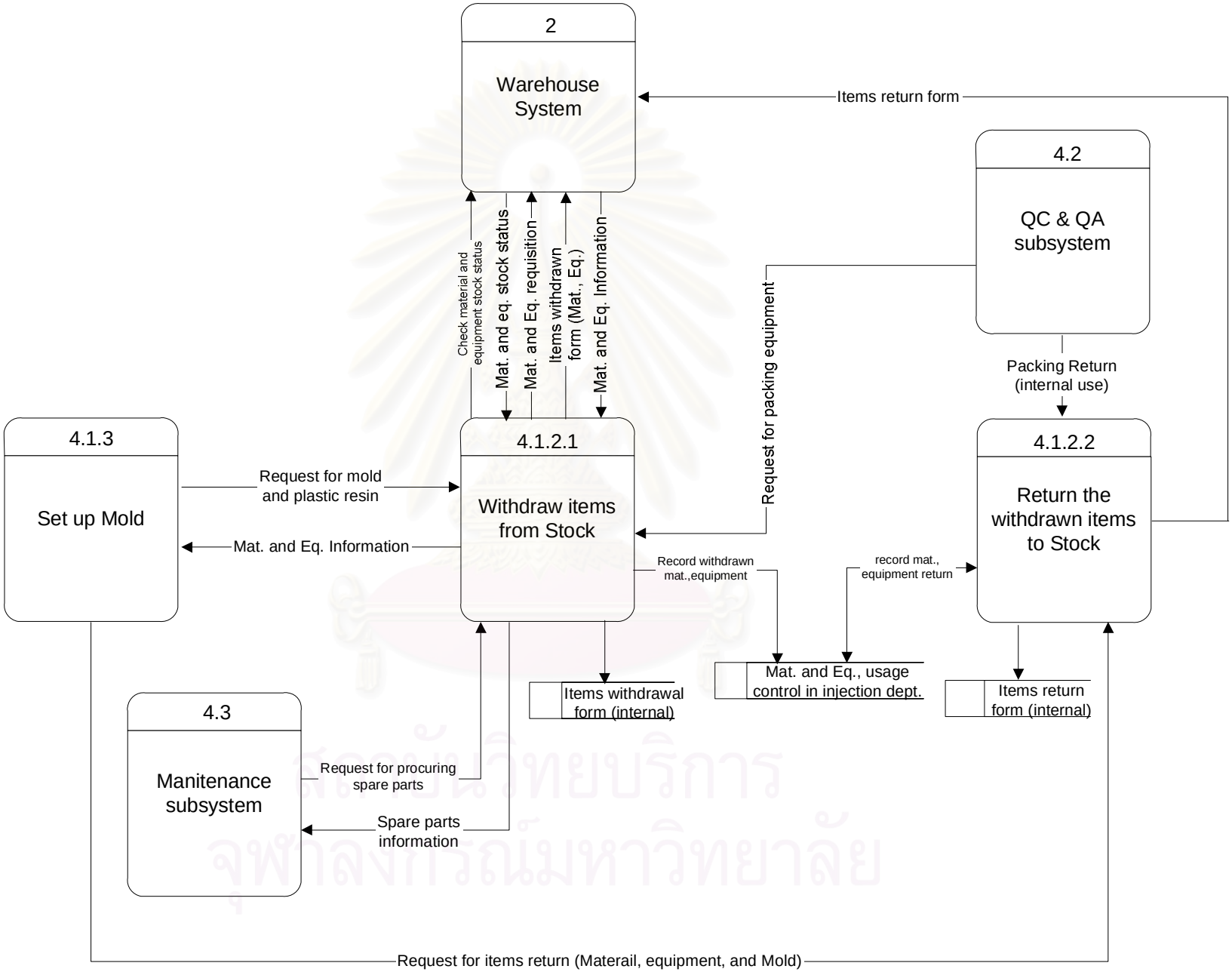

DFD Level 2 : Production control system (4)

DFD Level 3 : Injection subsystem (4.1)

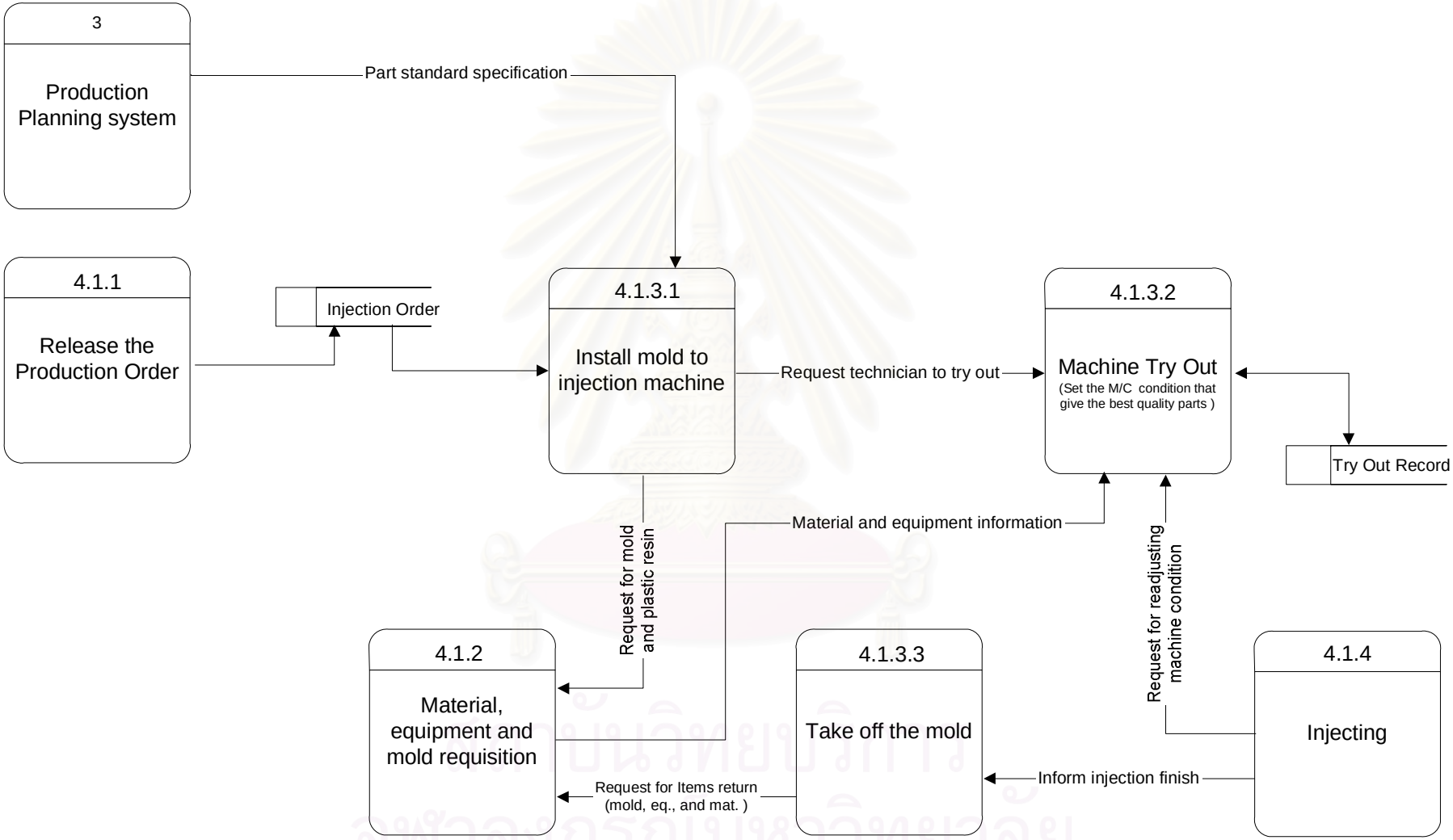




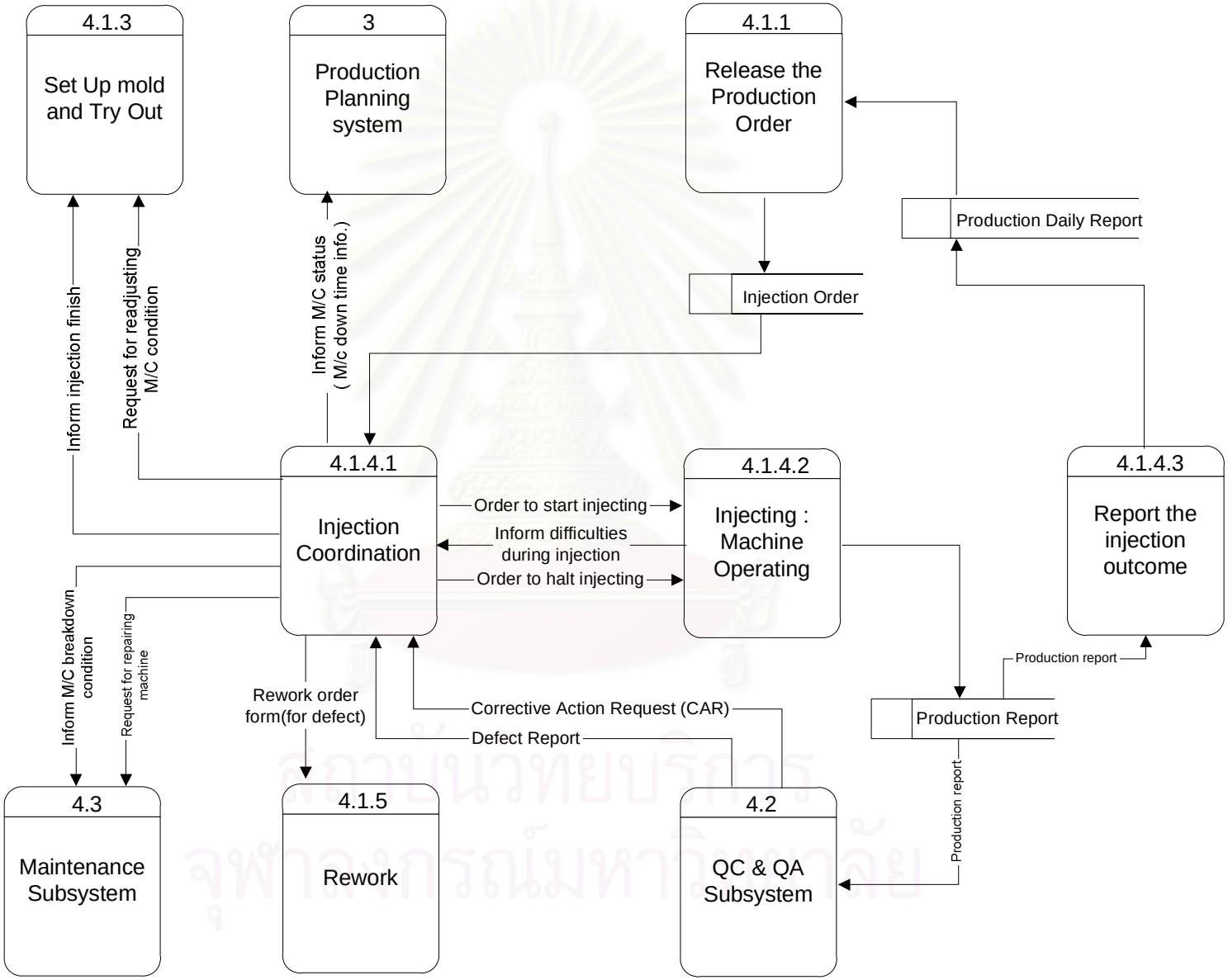

DFD Level 4 : Release Injection order (4.1.1)



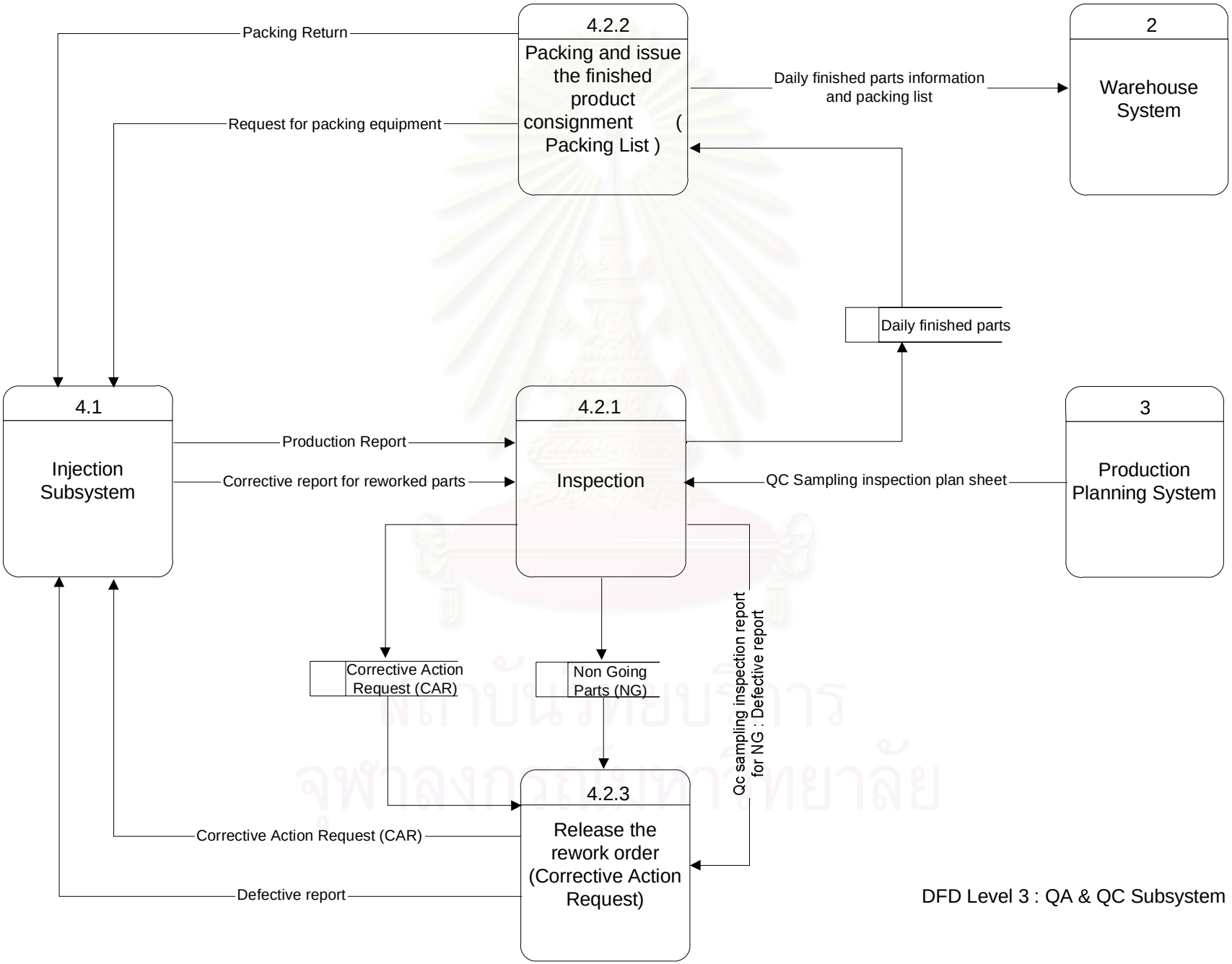

DFD Level 4 : Material, equipment, and mold requisition (4.1.2)



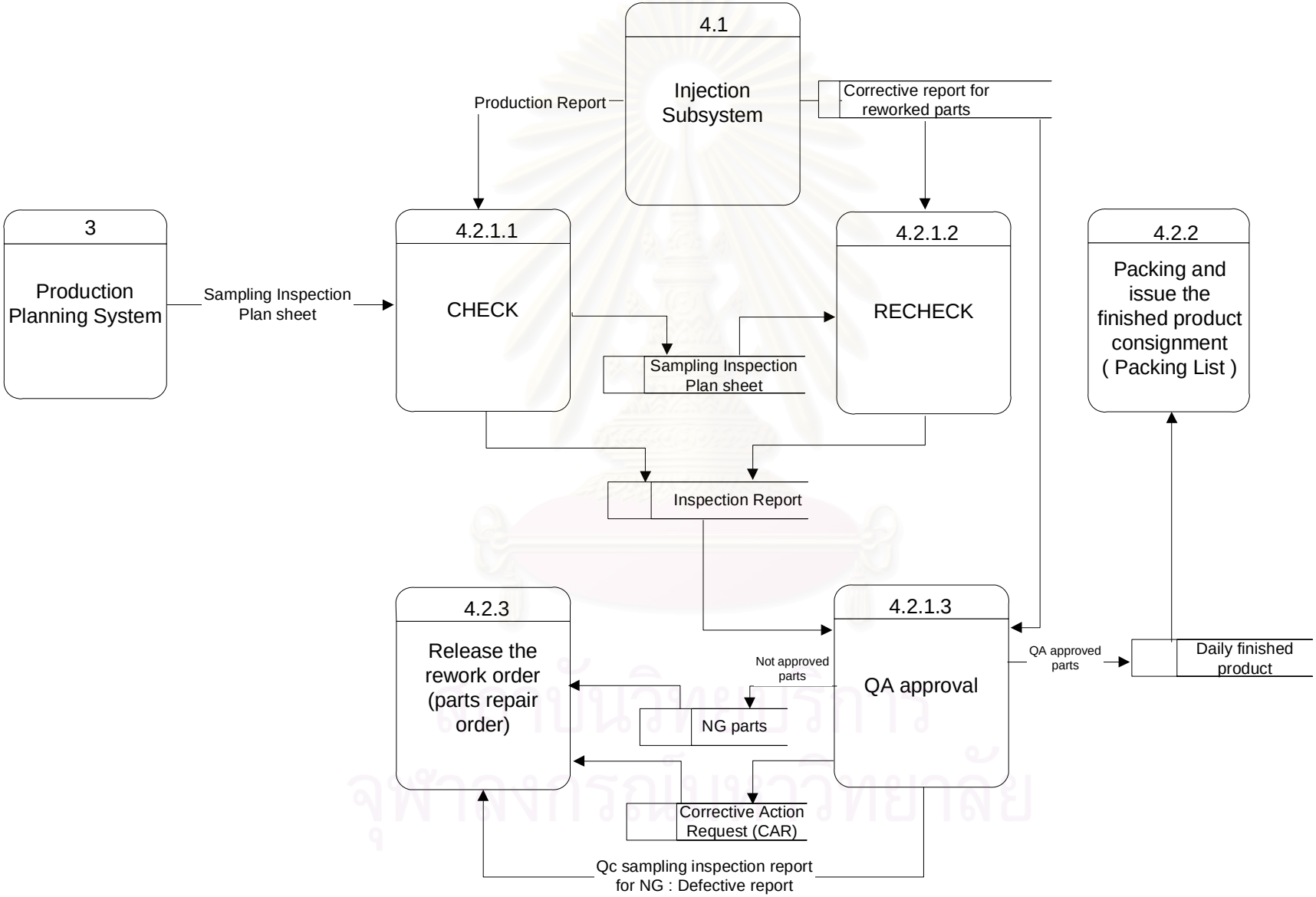

DFD level 4 : Set Up Mold (4.1.3)



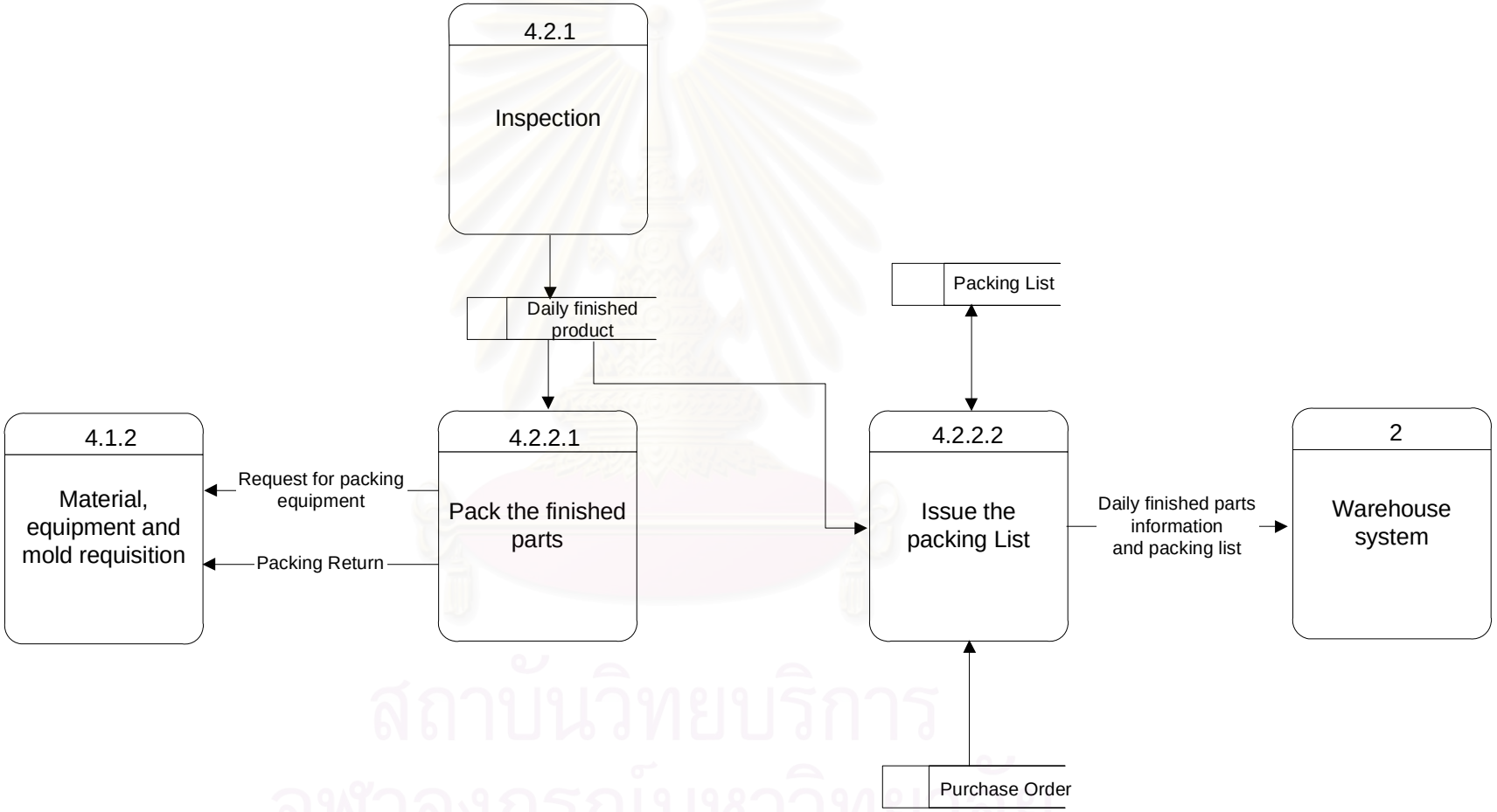

DFD Level 4 : Injecting (4.1.4)



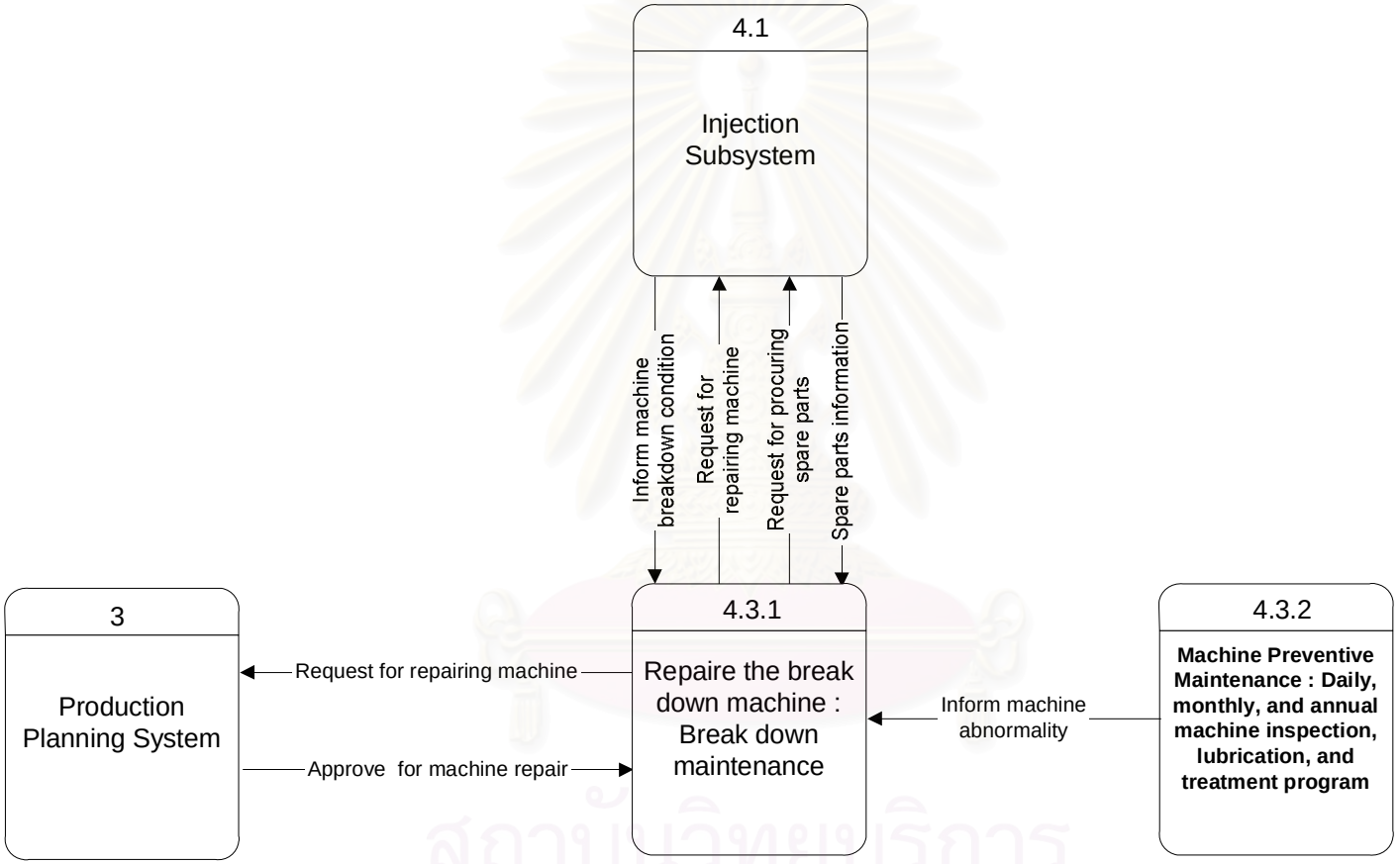

DFD Level 3 : QA & QC Subsystem



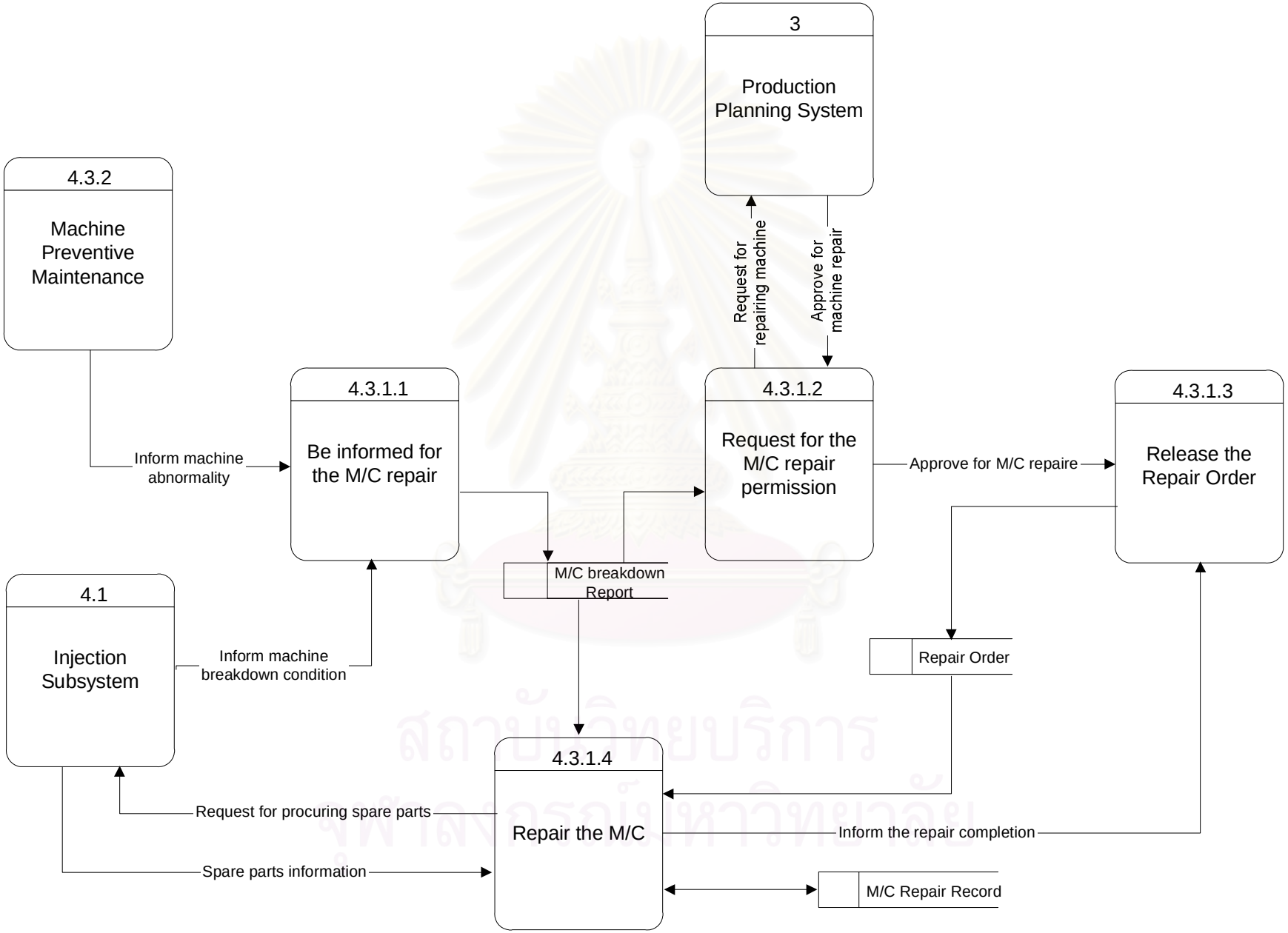

DFD Level 4 : Inspection (4.2.1)



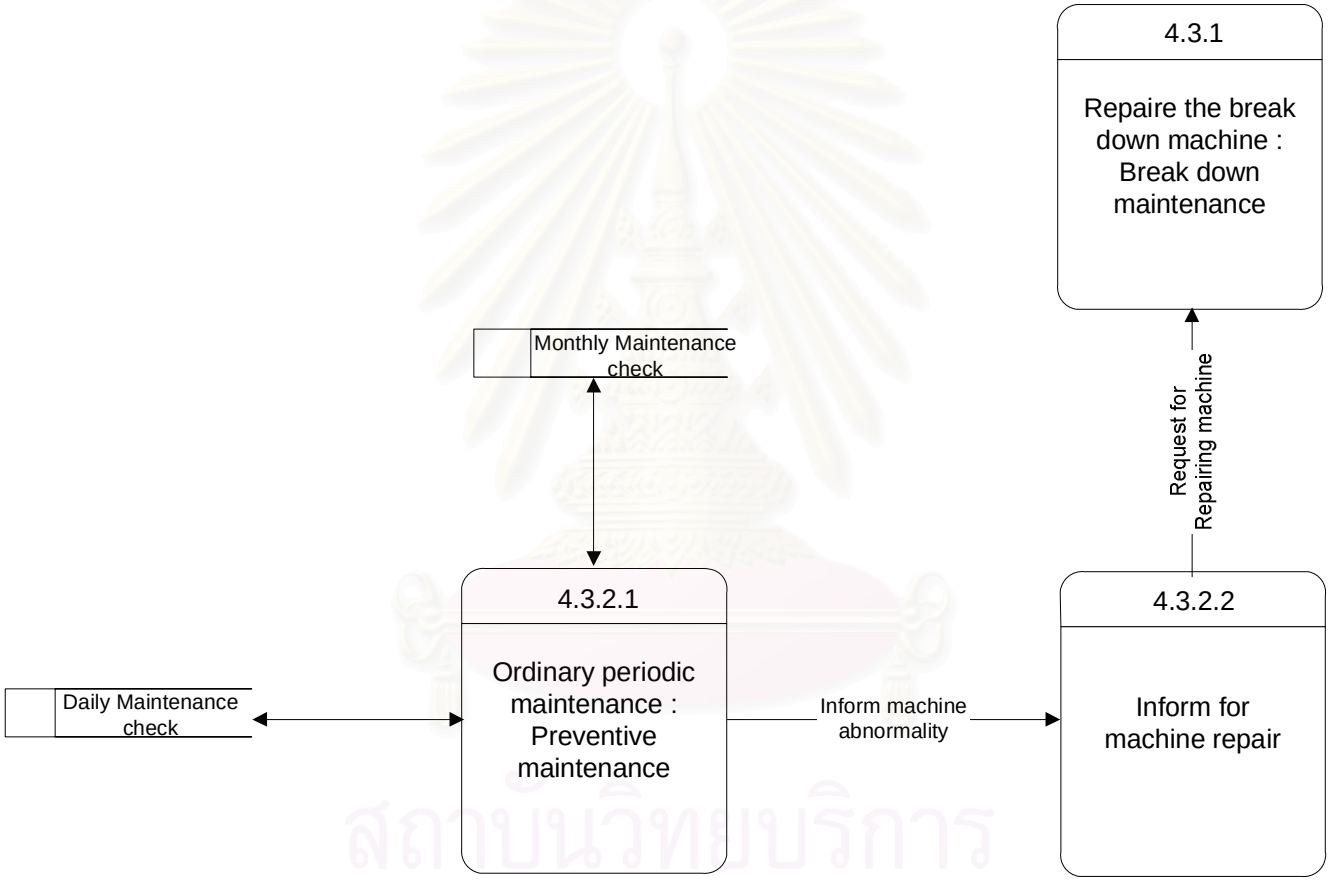

DFD Level 4 : Packing 4.2.2




DFD Level 3 : Maintenance subsystem (4.3)




DFD Level 4 : Break down Maintenance (4.3.1)




DFD Level 4 : Preventive maintenance (4.3.2)

# APPENDIX B

## EXISTING DOCUMENTS USED IN B.I.P REVIEWED IN DATA DICTIONARY FORM

| Document name | Page |
|---|---|

# DOCUMENTS REVIEW IN DATA DICTIONARY FORM

**Document name :** PURCHASE ORDER

**Source of origin :** PROCUREMENT DEPARTMENT

**Usage description :** The purchase order is prepared when the material and equipment left in stock meet the safety stock level. The document is issued when the procurement department has already made a deal with a supplier.

**Number of copies :** 3 copies.

**Objective of usage :**

Original document : Issue purchase order to supplier for purchasing items.

Copy 1 : Procurement department keep it as a documentary evidence.

Copy 2 : Pass to accounting department as an evidence in expense accounting.

Copy 3 : Pass to warehouse department as an evidence showing the items, that warehouse required, had been purchased.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | PO_No | Number of purchase order | Number | 7 | |
| 2 | Quotation_No | Number of Quotation | Number | 7 | |
| 3 | PO_Date | Purchase order issue date | Date/Time | | |
| 4 | Supplier_Name | Supplier name | Text | 30 | |
| 5 | Supplier_Address | Supplier address | Text | 70 | |
| 6 | Due_date | Delivery due date for items | Date/Time | | |
| 7 | Item | Order of listed items | Number | 7 | |
| 9 | Product_ID | The identification of items | Number | 7 | The ID of supplier's products |
| 10 | Product_Description | The description of purchased items | Text | 70 | |
| 11 | Quantity | Purchase volume | Number | 7 | |
| 12 | Price_Per_Unit | Price per unit | Currency | | Unit : Baht |
| 13 | Total | The total price of all items | Currency | | Unit : Baht |
| 14 | Manager_Sign | The signature of purchase department manager | Text | 25 | |
| 15 | Board_Of_Director_Sign | The signature of managing director | Text | 25 | |

**Document name :** CATALOGUE

**Source of origin :** SUPPLIER

**Usage description :** The catalogue is used when the supplier has sent it to the company. It is sent to BIP when BIP has facsimiled the purchase requisition to the supplier.

**Number of copies :** -

**Objective of usage :** It is used as a purchased guide book in purchasing decision.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Book_Name | The name of cataloge book | Text | 20 | |
| 2 | Product_ID | The identification of supplier's product | Number | 7 | |
| 3 | Product_Picture | The product picture | Image | | |

**Document name :** PRICE LIST

**Source of origin :** SUPPLIER

**Usage description :** The price list is a supplementary document enclosed with catalogue which contains supplier's product prices.

**Number of copies :** -

**Objective of usage :** It is used as a purchased guide in purchasing decision.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Product_ID | The identification of supplier's product | Number | 7 | |
| 2 | Price_Per_Unit | Price per unit | Currency | | Unit : Baht |

**Document name :** PURCHASING PROPOSAL

**Source of origin :** WAREHOUSE DEPARTMENT

**Usage description :** The purchasing proposal is made by the warehouse department and it is used for requesting the procurement department for purchasing material and equipment in case of an unavailability.

**Number of copies :** 1

**Objective of usage :** Original Document : The warehouse department keeps as a documentary evidence.

Copy 1 : The warehouse pass it to the procurement department for the consideration of issuing purchase order.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Proposal_No | The number of purchasing proposal | Number | 7 | |
| 2 | Proposal_Date | The date issuing the proposal | Date | | |
| 3 | Due_Date | The date that need the items acquired. | Date | | |
| 4 | Description | The name of items and its description. | Text | 80 | |
| 5 | Quantity | Volume required | Number | 7 | |
| 6 | Proposal_sign | The signature of proposed person | Text | 25 | |

**Document name :** SUPPLIER

**Source of origin :** PROCUREMENT DEPARTMENT

**Usage description :** The “supplier” document is prepared by the procurement department in order to list the information of different suppliers. It assist the procurement manager for the purchase in selecting the best supplier.

**Number of copies :** -

**Objective of usage :**

Original Document : The procurement department keep it for internally use.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Supplier_Code | Supplier identification code | Text | 7 | |
| 2 | Supplier_Name | Supplier name | Text | 50 | |
| 3 | Supplier_Address | Supplier address | Text | 70 | |
| 4 | Supplier_Tel | The supplier’s telephone number | Text | 9 | |
| 5 | Supplier_Credit | The credit agreement terms | Text | 30 | |

**Document name :** FAX ( BIP )

**Source of origin :** PROCUREMENT DEPARTMENT

**Usage description :** The company faximile to the supplier for the detail of supplier’s products.

**Number of copies :** 1 Copy.

**Objective of usage :**

Original Document : The procurement department keep it as a documentary evidence.

Copy 1 : Transmit to the supplier.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Fax_Date | Supplier name | Text | 50 | |
| 2 | Supplier_Name | Supplier address | Text | 70 | |
| 3 | Supplier_Address | The supplier’s telephone number | Text | 9 | |
| 4 | Supplier_Tel | List of purchased items name | Text | 50 | |
| 5 | Description | The name of items and its description. | Text | 80 | |
| 6 | Quantity | Volume required | Number | 7 | |
| 7 | Price | Supplier’s product price | Currency | 10 | Unit : Baht |

**Document name :** PURCHASE RETURN (BIP)

**Source of origin :** PROCUREMENT DEPARTMENT

**Usage description :** The purchase return (BIP) is issued when the warehouse department has inspected the purchased items condition before entering into the stock and found out that those items are wrong specification or are not in good condition. Then the warehouse department send the items back to the procurement department and request for returning the items to the supplier.

**Number of copies :** 3 copies.

**Objective of usage :**

Original document : Send to the supplier.

Copy 1 : Procurement department keep it as an evidence.

Copy 2 : Pass to accounting department as an evidence in expense accounting.

Copy 3 : Pass to warehouse department as an evidence showing the items, that warehouse denied, had been returned.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Return_No | Number of purchase return | Number | 7 | |
| 2 | Supplier_Name | Supplier name | Text | 50 | |
| 3 | Invoice_No | Invoice number of return items | Number | 7 | |
| 4 | Return_Date | The date items returned | Date | | |
| 5 | Item | Order of listed items | Number | 7 | |
| 6 | Product_Description | The description of purchased items | Text | 70 | |
| 7 | Quantity | Return volume | Number | 7 | Unit : Kgs, Tons, Pcs. |
| 8 | Price_Per_Unit | Price per unit | Currency | | Unit : Baht |
| 9 | Total_Each_Product | The total price of each item | Currency | | Unit : Baht |
| 10 | Total | The total price of all items | Currency | | Unit : Baht |
| 11 | Total_Alphabet | The total price in alphabet | Text | 70 | |
| 12 | Receiver_Sign | The signature of receiver | Text | 25 | |
| 13 | Board_Of_Director_Sign | The signature of managing director | Text | 25 | |

**Document name :** INVOICE (SUPPLIER)

**Source of origin :** SUPPLIER

**Usage description :** The invoice is attached document to purchased products declaring the detail of the purchased items.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : The procurement department keep it as an evidence when receive the items from supplier.

Copy 1 : Pass it to the warehouse department in order to be a document before keeping the items in stock.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Invoice_No | Invoice number of return items | Number | 7 | |
| 2 | Invoice_Date | The date issuing invoice | Date/Time | | |
| 3 | Buyer_Name | Buyer name | Text | 50 | |
| 4 | Buyer_Address | Buyer address | Text | 70 | |
| 5 | Item | Order of listed items | Number | 7 | |
| 6 | Product_ID | The identification of items | Number | 7 | |
| 7 | Product_Description | The description of purchased items | Text | 70 | |
| 8 | Quantity | Purchase volume | Number | 7 | Unit : Kgs, Tons, Pcs. |
| 9 | Price_Per_Unit | Price per unit | Currency | | Unit : Baht |
| 10 | Total | The total price of all items | Currency | | Unit : Baht |
| 11 | Receiver_Item_Sign | The signature of receiver (BIP) | Text | 25 | |
| 12 | Sender_Sign | The signature of sender (supplier) | Text | 25 | |

**Document name :** MATERIAL AND PRODUCTION INSTRUMENT REGISTRY

**Source of origin :** MATERIAL AND PRODUCTION INSTRUMENT STOCK MANAGEMENT.

**Usage description :** This document indicates the Textacteristic of the individual items. It declares the information of the item that will be kept in the material and instrument stock such as the location where the item is kept.

**Number of copies :** -

**Objective of usage :**

Original document : The document is kept at the production and material instrument stock as an evidence showing the existence of those items.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Stock_Code | Stock code | Text | 5 | |
| 2 | EQ_Cat | The category code of the items ( A= Material, B=mold, C= packing, D=instrument) | Text | 1 | |
| 3 | Eq_No | The number of the material, equipment, and mold. | Number | 7 | |
| 4 | Eq_Name | The name of the items | Text | 30 | |
| 5 | Product_Description | The description of purchased items | Text | 70 | |
| 6 | Invoice_No | Invoice number of purchased items | Number | 7 | |
| 7 | Supplier_Name | Supplier name | Text | 50 | |
| 8 | Eq_Stock_location | The location of shelves store that items | Text | 3 | |
| 9 | Eq_Stock_sign | The signature of the stock control staff | Text | 25 | |

**Document name :** FAILURE NOTIFICATION OF NON CONFORMANCE ITEMS.

**Source of origin :** MATERIAL AND PRODUCTION INSTRUMENT STOCK MANAGEMENT.

**Usage description :** The document is made for reporting the deficiency condition of the purchased items to the procurement department. The warehouse department use this document for requesting the procurement department to return those items to the supplier.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : It is sent to the procurement department in order to issue the purchase return.

Copy 1 : Keep it as an evidence in the material and production instrument stock.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | NG_No | The number of notification document. | Number | 7 | |
| 2 | NG_Item | The item number of the deficient material, equipment, and mold. | Number | 7 | |
| 3 | Product_ID | The identification of items | Number | 7 | |
| 4 | Product_Description | The description of purchased NG items | Text | 70 | |
| 5 | NG_Quantity | The volume of NG items | Number | 7 | |
| 6 | Supplier_Name | Supplier name | Text | 50 | |
| 7 | PO_No | Number of purchase order | Number | 3 | |
| 8 | Invoice_No | Invoice number of purchased items | Number | 7 | |
| 9 | Failure_Note | The description of the Deficiency of items | Text | 80 | |
| 10 | Eq_Stock_sign | The signature of the stock control staff | Text | 25 | |

**Document name :** PRODUCTS STOCK

**Source of origin :** PRODUCTS STOCK MANAGEMENT.

**Usage description :** The document is used to monitor the products stock status. It shows the available amount of products sitting in stock. It is recorded everytime that the products enter into or go out of the stock. The product stock document is summarized day by day. It is needed the management to check and sign once a day at the end work time of shift 1 (day shift) to prevent any mistake.

**Number of copies :** -

**Objective of usage :**

Original document : The document is securely keep in product stock control section.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | WH_Code | The warehouse code | Text | 5 | |
| 2 | Stock_Date | The date that the stock is recorded | Date/Time | | |
| 3 | Part_Code | The Identification code of the product | Text | 10 | |
| 4 | Part_name | The name of the product | Text | 30 | |
| 5 | Customer_Name | The customer name | Text | 30 | |
| 6 | Part_In_Qty | The Quantity of products enter-in | Number | 7 | Unit : Pcs. |
| 7 | Part_Out_Qty | The Quantity of products out-going | Number | 7 | Unit : Pcs. |
| 8 | Part_Balance | The balance of products in stock | Number | 7 | Unit : Pcs. |
| 9 | Lot_size | The parts quantity ordered. | Number | 5 | Unit : Pcs. |
| 10 | Qty_Box | The quantity of parts in one carton | Number | 5 | Unit : Pcs. |
| 11 | Product_Stock_Sign | The signature of product stock control staff | Text | 25 | |
| 12 | General_Sign | The signature of the general manager | Text | 25 | |

**Document name :** PRODUCTS ALLOCATION

**Source of origin :** PRODUCTS STOCK MANAGEMENT.

**Usage description :** The document is recorded before the finished products are kept in the product stock. It declare the information of the enrolled products such as a location where products are kept.

**Number of copies :** -

**Objective of usage :**

Original document : The document is kept at the products stock management section for internal use.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | WH_Code | The warehouse code | Text | 5 | |
| 2 | Part_Code | The number of the product | Text | 10 | |
| 3 | Part_name | The name of the product | Text | 30 | |
| 4 | Customer_Name | The customer name | Text | 30 | |
| 5 | Part_PO_No | The purchase order number of the product | Number | 7 | |
| 6 | Part_In_Qty | The Quantity of products enter-in | Number | 7 | Unit : Pcs. |
| 7 | Lot_size | The parts quantity ordered. | Number | 5 | Unit : Pcs. |
| 8 | Qty_Box | The quantity of parts in one carton | Number | 5 | Unit : Pcs. |
| 9 | Part_Stock_Location | The location of stock where the products are kept | Text | 3 | |
| 12 | Product_Stock_Sign | The signature of product stock control staff | Text | 25 | |

**Document name :** REJECTED PRODUCTS ALLOCATION

**Source of origin :** PRODUCTS STOCK MANAGEMENT.

**Usage description :** The document is recorded before the defective BIP products which has been rejected from the customers before those defective products will be kept in the stock. It declares the information of the enrolled defective products such as a location where the defective products are kept.

**Number of copies :** -

**Objective of usage :**

Original document : The document is kept at the products stock management section for internal use.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Def_WH_Code | The defect warehouse code of rejected product enter-in | Text | 5 | |
| 2 | Part_Code | The identification code of the rejected product | Text | 10 | |
| 3 | Part_name | The name of the rejected product | Text | 30 | |
| 4 | Customer_Name | The customer name | Text | 30 | |
| 5 | Part_PO_No | The purchase order number of the rejected product | Number | 7 | |
| 6 | Part_Invoice_No | The invoice number of the rejected product | Number | 7 | |
| 7 | Defect_In_Qty | The Quantity of rejected products enter-in | Number | 7 | Unit : Pcs. |
| 7 | Defect_Lot_Size | The parts quantity in the order | Number | 5 | Unit : Pcs. |
| 8 | Defect_Qty_Box | The quantity of parts in one carton | Number | 5 | Unit : box |
| 9 | Defect_Stock_Location | The location of stock where the rejected products are kept | Text | 3 | |
| 12 | Product_Stock_Sign | The signature of product stock control staff | Text | 25 | |

**Document name :** PRODUCT WITHDRAWAL FORM

**Source of origin :** PRODUCTS STOCK MANAGEMENT, DELIVERY SECTION.

**Usage description :** The document is issued by the delivery section in order to retrieve the products from the stock in order to send to the customers. It is issued right after the delivery section receive the delivery order from the production planning.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : The delivery section send the original document to the product stock control, then the stock control would use the document to update the products stock data consequently.

Copy 1 : The delivery section keep one copy as a documentary evidence.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Product_Out_No | The item number of delivered products | Number | 5 | |
| 2 | Product_Draw_Date | The date the products are withdrawn | Date/Time | | |
| 3 | Part_Code | The identification code of the withdrawn product | Text | 10 | |
| 4 | Part_name | The name of the delivered product | Text | 30 | |
| 5 | Customer_Name | The customer name | Text | 30 | |
| 6 | Part_PO_No | The purchase order number of the delivered product | Number | 7 | |
| 7 | Product_Out_Qty | The Quantity of delivered products | Number | 7 | Unit : Pcs. |
| 8 | Lot_Size | The total parts quantity in the order | Number | 7 | Unit : Pcs. |
| 9 | Deliver_Qty_Box | The quantity of cartons delivered | Number | 5 | Unit : box |
| 10 | Vehicle_ID | The Vehicle Identification plate number | Text | 5 | |
| 11 | DO_No | The delivery order number | Number | 7 | |
| 12 | Destination | The delivery destination | Text | 50 | |
| 13 | Delivery_Remark | The complementary note | Text | 50 | |
| 14 | Product_Stock_Sign | The signature of product stock control staff | Text | 25 | |
| 15 | Outgoing_Sign | The signature of products drawer | Text | 25 | |
| 16 | Driver_Sign | The signature of driver | Text | 25 | |
| 17 | General_Sign | The signature of the general manager | Text | 25 | |

**Document name :** REJECTED PRODUCTS STOCK

**Source of origin :** PRODUCTS STOCK MANAGEMENT.

**Usage description :** The document is used to monitor the rejected products stock status. It shows the available amount of the rejected products sitting in stock. It is recorded everytime that the rejected products enter into or go out of the stock.

**Number of copies :** -

**Objective of usage :**

Original document : The document is securely keep in product stock control section.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Def_WH_Code | The defect warehouse code of rejected product | Text | 5 | |
| 2 | Def_Stock_Date | The date that the defect stock is recorded | Date/Time | | |
| 3 | Part_Code | The identification code of the rejected product | Text | 10 | |
| 4 | Part_name | The name of the rejected product | Text | 30 | |
| 5 | Customer_Name | The customer name | Text | 30 | |
| 6 | Defect_In_Qty | The Quantity of rejected products enter-in | Number | 7 | Unit : Pcs. |
| 7 | Defect_Out_Qty | The Quantity of rejected products out-going | Number | 7 | Unit : Pcs. |
| 8 | Defect_Balance | The balance of rejected products in stock | Number | 7 | Unit : Pcs. |
| 9 | Defect_Per_Carton | The quantity of rejected products in one carton | Number | 5 | Unit : Pcs./ carton |
| 10 | Defect_Lot_size | The total rejected products quantity | Number | 7 | Unit : Pcs. |
| 11 | Product_Stock_Sign | The signature of product stock control staff | Text | 25 | |
| 12 | General_Sign | The signature of the general manager | Text | 25 | |

**Document name :** PACKING LIST

**Source of origin :** Quality Assurance Unit, PACKING SECTION.

**Document description :** The Packing list is a paper slip issued when the parts have been packed in a carton. It is an indentification of the product in the carton which contain some necessary information. When the packing list has been already prepared, then it will be attached at a side of a carton.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : Attach at a side of a carton .

Copy 1 : The packing section keep it as a documentary evidence.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Carton_No | The item number of the carton | Number | 7 | |
| 2 | Pack_Date | The date issuing the packing list | Date/Time | | |
| 3 | Pack_Shift | The shift issuing the packing list | Text | 10 | Day/night |
| 4 | Customer_Name | The customer name | Text | 30 | |
| 5 | Part_Code | The identification code of the product | Text | 10 | |
| 6 | Part_name | The name of the packed product | Text | 30 | |
| 7 | Par_Mat_Name | The name of the product material | Text | 20 | |
| 9 | Part_Mat_Code | The code of the product material | Text | 15 | |
| 10 | Part_Color | The color of the product | Text | 10 | |
| 11 | Lot_Size | The total quantity of the product lot | Number | 7 | Unit : Pcs. |
| 12 | Qty_Per_Carton | The quantity of parts per carton | Currency | | Unit : pcs./ carton |
| 13 | Part_PO_No | The purchase order number of the packed product | Number | 7 | |

**Document name :** INJECTION ORDER

**Source of origin :** PRODUCTION DEPARTMENT, ASSISTANT FACTORY MANAGER

**Usage description :** The injection order is issued daily to the production shift supervisor. Then, the supervisor will distribute the order to the staffs who are responsible for the injection process which comprise of a machine set up technician and an assigned machine operator.

**Number of copies :** 2 copies.

**Objective of usage :**

Original document : The factory manager keep the original injection order, so that he is able to keep track the injection progress of each machine.

Copy 1 : The shift supervisor keep the copy 1 of injection order, so that he is able to follow to control the injection process.

Copy 2 : The machine operator keep the copy 2 of injection order as a work instruction.

Copy 3 : The machine set up technician keep the copy 3 of injection order as a data for machine set up condition.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | IO_No | The number of the injection order | Number | 5 | |
| 2 | Machine_No | The number of machine | Number | 2 | |
| 3 | IO_Date | The date issuing the injection order | Date/Time | | |
| 4 | IO_Shift | The shift issuing the injection order | Date/Time | | |
| 5 | Part_Code | The identification code of the injected part | Text | 10 | |
| 6 | Part_name | The name of the injected product | Text | 30 | |
| 7 | Customer_Name | The customer name | Text | 30 | Unit : Pcs. |
| 8 | Qty_Order | The quantity of parts to produce | Number | 7 | |
| 9 | Inj_Start_Time | The Start time schedule of injecting | Date/Time | | |
| 10 | Inj_End_Time | The End time schedule of injecting | Date/Time | | |
| 11 | Cycle_Time | The cycle time of machine | Number | 2 | Unit : Second |
| 12 | Mold_Code | The code of injection mold | Text | 7 | |
| 13 | Part_Mat_Name | The name of the product material | Text | 20 | |
| 14 | Part_Mat_Code | The code of the product material | Text | 15 | |
| 15 | Part_Color | The color of the product | Text | 10 | |
| 16 | Part_Weight | The weight of a part | Number | 5 | Unit : Grams |
| 17 | Runner_Weight | The weight of a runner | Number | 5 | Unit : Grams |
| 18 | Total_Mat_Weight | The total weight of material used | Number | 7 | Unit : KGs |
| 19 | Oper_Name | The assigned machine operator name | Text | 25 | |
| 20 | IO_Sign | The signature of injection order issuer | Text | 25 | |
| 21 | Shift_SV_Sign | The signature of shift supervisor | Text | 25 | |

**Document name :** TRY OUT RECORD

**Source of origin :** PRODUCTION DEPARTMENT, MACHINE SET UP TECHNICIAN

**Usage description :** The document is used by the machine set up tachnician. It contain machine set up condition that the technician feed in the machine controller. The record is a historical data for the machine set up because the technician is able to use the data refer to the past proximity condition for the next time machine set up.

**Number of copies :** -

**Objective of usage :**

Original document : The machine set up technician keep it as a set up guide in a cproduction control room.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Part_Code | The identification code of the part set up | Text | 10 | |
| 2 | Part_name | The name of the product | Text | 30 | |
| 3 | Customer_Name | The customer name | Text | 30 | |
| 4 | Machine_No | The number of machine | Number | 2 | |
| 5 | Machine_Model | The model of machine | Text | 7 | |
| 6 | Part_Mat_Name | The name of the product material | Text | 20 | |
| 7 | Part_Mat_Code | The code of the product material | Text | 15 | Unit : Pcs. |
| 8 | Part_Color | The color of the product | Text | 10 | Unit : box |
| 9 | Part_Weight | The weight of a part | Number | 5 | |
| 10 | Try_Out_Date | The date technician try out | Date/Time | | |
| 11 | Cycle_Time | The cycle time of machine | Number | 2 | Unit : Second |
| 12 | Mold_Code | The code of injection mold | Text | 7 | |
| 13 | Mold_Cavity | The number of cavities in the mold | Number | 2 | |
| 14 | Set_BP | Set up condition at the controller | Number | 3 | |
| 15 | Set_TRH1 | Set up condition at the controller | Number | 3 | |
| 16 | Set_TRH2 | Set up condition at the controller | Number | 3 | |
| 17 | Set_TRH3 | Set up condition at the controller | Number | 3 | |
| 18 | Set_SRN | Set up condition at the controller | Number | 3 | |
| 19 | Set_INJECT | Set up condition at the controller | Number | 3 | |
| 20 | Set_COOL | Set up condition at the controller | Number | 3 | |
| 21 | Set_INT | Set up condition at the controller | Number | 3 | |
| 22 | Set_PH1 | Set up condition at the controller | Number | 2 | |
| 23 | Set_PH2 | Set up condition at the controller | Number | 2 | |
| 24 | Set_PH3 | Set up condition at the controller | Number | 2 | |
| 25 | Set_PH4 | Set up condition at the controller | Number | 2 | |
| 26 | Set_LS4 | Set up condition at the controller | Number | 3 | |

| | | | | | |
|---|---|---|---|---|---|
| 27 | Set_LS4A | Set up condition at the controller | Number | 3 | |
| 28 | Set_LS4B | Set up condition at the controller | Number | 3 | |
| 29 | Set_LS4C | Set up condition at the controller | Number | 3 | |
| 30 | Set_LS4D | Set up condition at the controller | Number | 3 | |
| 31 | Set_LS5 | Set up condition at the controller | Number | 3 | |
| 32 | Set_LS10 | Set up condition at the controller | Number | 3 | |
| 33 | Set_HN | Set up condition at the controller | Number | 3 | |
| 34 | Set_H1 | Set up condition at the controller | Number | 3 | |
| 35 | Set_H2 | Set up condition at the controller | Number | 3 | |
| 36 | Set_Hopper_Temp | Set up condition at the controller | Number | 3 | |
| 37 | Set_approve_Sign | The signature of the try out technician | Text | 25 | |

**Document name :** ITEM REQUISITION FORM

**Source of origin :** PRODUCTION DEPARTMENT, PRODUCTION COORDINATION

**Usage description :** The document is used when any production staffs require to withdraw a material or production instrument from the stock. The company do not allow the production staffs to draw the items directly from the stock, which means the staffs hace to draw from the production coordination section, so that the production department is able to trace the use of those material and instrument within the production department.

**Number of copies :** 1 copy

**Objective of usage :**

Original document : The production coordination section keep it as an evidence

Copy 1 : Send to the material and production instrument stock.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Req_No | The item requisition form number | Number | 7 | |
| 2 | Req_Date | The requsistion date | Date/Time | | |
| 3 | Req_Item_No | The item requsited number | Number | 2 | |
| 4 | Req_Item_Description | The description of item | Text | 25 | |
| 5 | Req_Item_Qty | The quantity of requisited item | Number | 5 | |
| 6 | Req_Item_Remark | The remark of requisited item | Text | 30 | |
| 7 | Drawer_Sign | The signature of staff who draw item | Text | 25 | |
| 8 | Shift_SV_Sign | The signature of shift supervisor | Text | 25 | |

**Document name :** ITEM RETURN FORM

**Source of origin :** PRODUCTION DEPARTMENT, PRODUCTION COORDINATION

**Usage description :** The document is used when any production staffs return to a material or production instrument to the stock. Similarly to the requistion process, the staffs have to return the items to the production coordination section.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : The production coordination section keep it as a documentary evidence

Copy 1 : Send to the material and production instrument stock.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Ret_No | The item return form number | Number | 7 | |
| 2 | Ret_Date | The return date | Date/Time | | |
| 3 | Ret_Item_No | The item return number | Number | 2 | |
| 4 | Ret_Item_Description | The description of item | Text | 25 | |
| 5 | Ret_Item_Qty | The quantity of retrun item | Number | 5 | |
| 6 | Ret_Item_Remark | The remark of return item | Text | 30 | |
| 7 | Return_Sign | The signature of staff who return item | Text | 25 | |

**Document name :** CORRECTIVE ACTION REQUEST (CAR)

**Source of origin :** PRODUCTION DEPARTMENT, Quality Assurance Section

**Usage description :** The document is used for the rework requisition for the non going parts(NG).

The document is issued to the production department to the rework section.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : QA section sent it to the rework section.

Copy 1 : QA section keep it as a documentary evidence.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | CAR_No | The CAR item number | Number | 5 | |
| 2 | CAR_Date | The date issued CAR | Date/Time | | |
| 3 | CAR_To | The person CAR sent to | Number | 2 | |
| 4 | CAR_From | The CAR issue person | Text | 25 | |
| 5 | Part_Code | The identification code of the part requested | Text | 10 | |
| 6 | Part_name | The name of the product | Text | 30 | |
| 7 | Customer_Name | The customer name | Text | 30 | |
| 8 | Problem_Title | The topic of CAR | Text | 30 | |
| 9 | Problem_Detail | The detail of the problem | Text | 50 | |
| 10 | Problem_Fix_objective | The objective of solving problem | Text | 50 | |
| 11 | CAR_Sign | The signature of QA leader | Text | 25 | |

**Document name :** CORRECTIVE ACTION REPORT

**Source of origin :** PRODUCTION DEPARTMENT, REWORK SECTION.

**Usage description :** The document is the report on the Corrective Action Request(CAR). It contains the solution that the rework section has applied to attack the problem as listed on CAR. The corrective action report is the same paper of CAR, but there are some additional fields for the rework section to fill the retification data.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : Rework section send the document to the QA section

Copy 1 : Rework section keep it as an evidence.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | CAR_No | The CAR item number | Number | 5 | |
| 2 | CAR_Date | The date issued CAR | Date/Time | | |
| 3 | CAR_To | The person CAR sent to | Number | 2 | |
| 4 | CAR_From | The CAR issue person | Text | 25 | |
| 5 | Part_Code | The identification code of the part | Text | 10 | |
| 6 | Part_name | The name of the product | Text | 30 | |
| 7 | Customer_Name | The customer name | Text | 30 | |
| 8 | Problem_Title | The topic of CAR | Text | 30 | |
| 9 | Problem_Detail | The detail of the problem | Text | 50 | |
| 10 | Problem_Fix_objective | The objective of solving problem | Text | 50 | |
| 11 | CAR_Sign | The signature of QA leader | Text | 25 | |
| 12 | Cause | The cause of the problem | Text | 50 | |
| 13 | Countermeasure | Solutions acted on attacking problem | Text | 95 | |
| 14 | Check_Date | The date finished on the rework | Date/Time | | |
| 15 | Rework_Sign | The signature of the issuer | Text | 25 | |

**Document name : NG PARTS RECORD**

**Source of origin :** PRODUCTION DEPARTMENT, QA SECTION

**Usage description :** The document is a record of the NG parts which are sent to rework in the production department.

**Number of copies :** -

**Objective of usage :**

Original document : QA section keep it for internally used for following and monitoring the NG parts.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | NG_Item_No | The item number of NG parts | Number | 5 | |
| 2 | NG_Date | The date of recording NG parts | Number | 2 | |
| 3 | Part_Code | The identification code of the NG part | Text | 10 | |
| 4 | Part_name | The name of the product | Text | 30 | |
| 5 | Customer_Name | The customer name | Text | 30 | |
| 6 | Part_PO_No | The purchase order number of the NG | Number | 7 | |
| 7 | Problem_Title | Problem topic from CAR | Text | 30 | |
| 8 | NG_Lot_Size | The total quantity of the NG lot | Number | 7 | Unit : Pcs. |
| 9 | NG_Carton_Qty | The quantity of NG cartons | Number | 3 | |
| 10 | Production_Date | The production date of NG | Date/Time | | |
| 11 | QA_Sign | The signature of QA staff | Text | 25 | |

**Document name : DAILY FINISHED PRODUCT**

**Source of origin :** PRODUCTION DEPARTMENT, QA SECTION

**Usage description :** The document is a daily record of the finished parts which will be packed and deliver to the customer. The record is used to control the parts that are already inspected and approved by QA section.

**Number of copies :** 2 copies.

**Objective of usage :**

Original document : QA section keep it for internally used for monitoring the finished parts

Copy 1 : Send to the packing section as an information for packing the parts.

Copy 2 : Send to the warehouse as an information for receiving products into stock.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Outcome_Date | The date that issuing the document | Date/Time | | |
| 2 | Part_Item_No | The item number of product | Number | 5 | |
| 3 | Part_Code | The identification code of the finished products | Text | 10 | |
| 4 | Part_name | The name of the product | Text | 30 | |
| 5 | Customer_Name | The customer name | Text | 30 | |
| 6 | Part_PO_No | The purchase order number of the NG | Number | 7 | |
| 7 | Production_Date | The production date of NG | Date/Time | | |
| 8 | Lot_Size | The total quantity of the parts in a lot | Number | 7 | Unit : Pcs. |
| 9 | Part_Qty | The quantity of parts in one carton | Number | 5 | Unit : Pcs/carton |
| 10 | Carton_Qty | The number of cartons | Number | 3 | |
| 11 | QA_Sign | The signature of QA staff | Text | 25 | |

**Document name : MACHINE REPAIR RECORD**

**Source of origin :** PRODUCTION DEPARTMENT, MAINTENANCE UNIT

**Usage description :** The document is recorded whenever there are a machine repair. It is helpful as a historical reference data for the machine repair for the next time repair.

**Number of copies :** -

**Objective of usage :**

Original document : Maintenance unit keep it for internally used.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Repair_Item_No | The repair item number | Number | 5 | |
| 2 | Machine_No | The number of the machine | Number | 2 | |
| 3 | Machine_Model | The machine model | Text | 7 | |
| 4 | Repair_Date | The date the repair end | Date/Time | | |
| 5 | RO_No | The number of Repair Order | Number | 5 | |
| 6 | Symptom_Title | The title of the M/C problem condition | Text | 30 | |
| 7 | Repair_Process | The description of repair process | Text | 300 | |
| 8 | Repair_Time | The time spend on the repair | Text | 20 | |
| 9 | Repair_Remark | The remark of the repair process | Text | 30 | |
| 10 | Repair_Sign | The signature of technician who repair | Text | 25 | |

**Document name : MACHINE BREAKDOWN REPORT**

**Source of origin :** PRODUCTION DEPARTMENT, MAINTENANCE UNIT

**Usage description :** When the machine is out of order, or ther are any part of the machine do not work properly which potentially cause severe machine damage, the staffs who are in Textge of observing the machine ( machine operator and technician) will inform the maintenance technician supervisor Then this machine breakdown report, which contain the break down symptom, will be prepared. The document trigger the repair process to continue.

**Number of copies :** -

**Objective of usage :**

Original document : Maintenance unit keep it for a guide document for repairing machine.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Out_Report_No | The report number | Number | 5 | |
| 2 | Machine_No | The machine number | Number | 2 | |
| 3 | Out_Date | The date machine break down | Date/Time | | |
| 4 | Symptom_Title | The title of the M/C problem condition | Text | 30 | |
| 5 | Symptom_Description | The description of the M/C problem condition | Text | 100 | |
| 6 | Out_Cause | The cause of the M/C problem condition | Text | 30 | |
| 7 | Out_Remark | The remark of the break down | Text | 30 | |
| 8 | Out_Sign | The signature of operator, technician | Text | 25 | |

**Document name :** REPAIR ORDER

**Source of origin :** MAINTENANCE UNIT

**Usage description :** The repair order is prepared when the machine break dwon is reported to the technician supervisor. The repair order contain a repair inoformation such as an assigned technician, the procurement of spare parts, and etc.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : The document is released to the assigned technician.

Copy 1 : The maintenance unit keep it as an repair evidence.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | RO_No | The Repair Order number | Number | 7 | |
| 2 | Machine_No | The machine number | Number | 2 | |
| 3 | Machine_Model | The machine model | Text | 7 | |
| 4 | RO_Issue_Date | The repair order issue date | Date/Time | | |
| 5 | Symptom_Title | The title of the M/C problem condition | Text | 30 | |
| 6 | RO_Urgent | The urgent of repair task | Boolean | | |
| 7 | RO_Start_Date | The start date of machine repair | Date/Time | | |
| 8 | RO_Start_Time | The start time of machine repair | Date/Time | | |
| 9 | RO_Expect_End_Date | The expected end date of repair | Date/Time | | |
| 9 | RO_Expect_Period | The expected time spent on repair | Number | 3 | Unit : Hours |
| 11 | Sparepart_Req | The list of spare parts required to repair | Text | 50 | |
| 12 | Repair_Technician | The assigned technician name | Text | 25 | |
| 13 | RO_Issue_Sign | The signature of repair order issuer | Text | 25 | |
| 14 | RO_Technician_Sign | The signature of the assigned technician | Text | 25 | |
| 15 | Main_SV_Sign | The signature of the maintenance technician supervisor | Text | 25 | |

**Document name :** DAILY MAINTENANCE CHECK

**Source of origin :** MAINTENANCE UNIT

**Usage description :** The document is daily used by the injection machine technician. One paper of document contains 31 days ( 1month ) columns, so that it is used for the whole month. It is a part of the factory preventive maintenance program that the company currently implement. The data in the document is helpful for investing an appropriate maintenance program.

**Number of copies :** -

**Objective of usage :**

Original document : The maintenance unit keep it as a documentary evidence showing that the machine has been already checked in a day.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Machine_No | The number of machine | Number | 2 | |
| 2 | Machine_Model | The model of machine | Text | 7 | |
| 3 | Check_Date | The date the machines is checked | Date/Time | | |
| 4 | Check_Clean | Check the cleanness around the machine | Boolean | | |
| 5 | Check_Ebutton | Check the condition of an emergency button | Boolean | | |
| 6 | Check_Safety | Check 5 safety points of the machine | Boolean | | |
| 7 | Check_Heater | Check the heater line condition | Boolean | | |
| 8 | Check_Thermo | Check the thermocouple condition | Boolean | | |
| 9 | Check_Mold | Check mold condition | Boolean | | |
| 10 | Check_Control | Check the cleanness of controller | Boolean | | |
| 11 | Check_line | Check the major electrical lines condition | Boolean | | |
| 12 | Check_Door | Check the both sides of M/C door condition | Boolean | | |
| 13 | Check_Coolant | Check the mold coolant temperature | Boolean | | |
| 14 | Check_Thermo | Check the hooper coolant temperature | Boolean | | |
| 15 | Check_Lubricant | Check the temperature of lubricant at 45 C | Boolean | | |
| 16 | Check_Hydraulic | Check the level of hydraulic oil | Boolean | | |
| 17 | Check_Motor | Check the motor screw condition | Boolean | | |
| 18 | Check_Leak | Check for any oil leak condition | Boolean | | |
| 19 | Check_Pressure | Check the level of pressure gauge | Boolean | | |
| 20 | Check_Thermo | Check the thermocouple condition | Boolean | | |
| 21 | Check_Grease | Check the grease for lubrication condition | Boolean | | |
| 22 | Check_Sound | Check motor and pump sound condition | Boolean | | |
| 23 | Technician_Sign | The signature of teachnician checker | Text | 25 | |

**Document name :** MONTHLY MAINTENANCE CHECK

**Source of origin :** MAINTENANCE UNIT

**Usage description :** The document is monthly checked by the injection machine technician.

**Number of copies :** -

**Objective of usage :**

Original document : The maintenance unit keep it as a documentary evidence showing that the machine has been already checked in a month.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Machine_No | The number of machine | Number | 2 | |
| 2 | Machine_Model | The model of machine | Text | 7 | |
| 3 | Check_Month | The month the machines is checked | Text | 10 | |
| 4 | Check_Year | The year the machines is checked | Number | 4 | |
| 5 | Check_Exchanger | Clean the heat exchanger | Boolean | | |
| 6 | Report_Exchanger | Report on the heat exchanger condition | Text | 100 | |
| 7 | Check_Filter | Check filter life and order parts | Boolean | | |
| 8 | Report_Filter | Report on the filter life and order parts | Text | 100 | |
| 9 | Check_Air | Clean air and oil filters | Boolean | | |
| 10 | Report_Air | Report on the Clean air and oil filters | Text | 100 | |
| 11 | Check_Calibrate | Calibrate thermocouple and controller | Boolean | | |
| 12 | Report_Calibrate | Report on the Calibration of thermocouple and controller | Text | 100 | |
| 13 | Rep_M/C_Problem | Report of problem in any parts of machine | Text | 150 | |
| 14 | Technician_Sign | The signature of teachnician checker | Text | 25 | |

**Document name :** QC SAMPLING INSPECTION REPORT

**Source of origin :** QC SECTION, INSPECTION UNIT.

**Usage description :** The document is used for inspecting the finished parts from the injection process. The frequency and the sample size of the inspection depends on the sampling inspection plan.

**Number of copies :** -

**Objective of usage :**

Original document : The document provides a fundamental data for the QA section, so that QA section is able to decide to accept or reject the parts from the process later on.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Inspect_No | The number of inspection report | Number | 7 | |
| 2 | Check_Recheck | The inspection is the new finished parts check or reworked parts recheck | Boolean | | |
| 3 | Part_Code | The identification code of the finished products | Text | 10 | |
| 4 | Part_name | The name of the product | Text | 30 | |
| 5 | Part_Color | The color of the product | Text | 10 | |
| 6 | Part_Mat_Name | The name of the product material | Text | 20 | |
| 7 | Production_Date | The date of production | Date/Time | | |
| 8 | Inspection_Date | The date of inspection | Dat/Time | | |
| 9 | Inspection_Time | The time of inspection | Date/Time | | |
| 10 | Customer_Name | The customer name | Text | 25 | |
| 11 | Sample_Size | The sample size of parts inspected in one carton | Number | 3 | |
| 12 | Lot_Size | The lot size quantity of inspected parts | Number | 7 | |
| 13 | Sample_Carton | The number of cartons inspected | Number | 3 | |
| 14 | Carton_Number | The item number of carton inspected | Number | 3 | |
| 15 | Ins_Weldline | The points of weldlines found | Number | 2 | |
| 16 | Ins_Shining | The points of shining found | Number | 2 | |
| 17 | Ins_Sinkmark | The points of sinkmarks found | Number | 2 | |
| 18 | Ins_Blackdot | The points of black dots found | Number | 2 | |
| 19 | Ins_Burnt | The burnt points found | Number | 2 | |
| 20 | Ins_Bending | The points of bending found | Number | 2 | |
| 21 | Ins_Short | The points of short mold found | Number | 2 | |
| 22 | Ins_Bubble | The points of bubbles found | Number | 2 | |
| 23 | Ins_Pinmark | The points of marked pins found | Number | 2 | |
| 24 | Ins_Broken | The points of broken pins found | Number | 2 | |
| 25 | Ins_Flowmark | The points of flow marks found | Number | 2 | |
| 26 | Ins_Silverline | The points of lilverlines found | Number | 2 | |
| 27 | Ins_Matflow | The points of over flow of material | Number | 2 | |

| | | | | | |
|---|---|---|---|---|---|
| 28 | Ins_Scratch | The points of scratches found | Number | 2 | |
| 29 | Ins_Nick | The points of nicks found | Number | 2 | |
| 30 | Ins_Oilmark | The points of oil marks found | Number | 2 | |
| 31 | Ins_Overcut | The points of over cut found | Number | 2 | |
| 32 | Ins_Dirty | The points of dirtiness found | Number | 2 | |
| 33 | Ins_Contaminate | The points of contamination found | Number | 2 | |
| 34 | Ins_Color | The points of wrong color found | Number | 2 | |
| 35 | Ins_Crack | The points of cracks found | Number | 2 | |
| 36 | Ins_Weight | The number of parts in wrong weight | Number | 2 | |
| 37 | Ins_Note | The note of the inspection | Text | 50 | |
| 38 | Inspectors_Sign | The signature of the inspector | Text | 25 | |

**Document name :** PRODUCTION REPORT

**Source of origin :** PRODUCTION DEPARTMENT, MACHINE OPERATOR

**Usage description :** The document is daily recorded by the operator who work at each machine. The report; a summary of each machine output in a day, is prepared at the end time of each shift.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : It is used for preparing a production daily report, done by a shift supervisor later on, which is a reprot of overall products in a day.

Copy 1 : Send to QA&QC section as a consideration data for quality inspection.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Inj_Date | The date reporting the injection output | Date/Time | | |
| 2 | Machine_No | The number of machine | Number | 2 | |
| 3 | Machine_Model | The model of machine | Text | 7 | |
| 4 | Shift | The shift reporting the injection output | Text | 1 | A or B |
| 5 | IO_No | The injection order number | Number | 7 | |
| 6 | Part_Code | The identification code of the finished products | Text | 10 | |
| 7 | Part_Name | The name of the product | Text | 30 | |
| 8 | Customer_Name | The customer name | Text | 30 | |
| 9 | Act_Start_Time | The actual start time of injection | Date/Time | | |
| 10 | Act_End_Time | The actual end time of injection | Date/Time | | |
| 11 | Qty_Order | The quantity of parts to produce | Number | 7 | |
| 12 | Qty_Output | The actual output parts produced | Number | 7 | |
| 13 | Oper_Sign_Name | The signature of machine operator | Text | 25 | |

**Document name :** PRODUCTION DAILY REPORT

**Source of origin :** PRODUCTION DEPARTMENT, SHIFT SUPERVISOR

**Usage description :** The document is a production output summary of overall machines in the factory in a day. The shift supervisor is responsible to collect the production report from every machine and then record in the production daily report. The production daily report is then sent to the production planning department and the injection order release unit which will be used as a data for adjusting the production schedule.

**Number of copies :** 2 copies.

**Objective of usage :**

Original document : It is sent to the injection order release unit as a feed back data of the issued injection order.

Copy 1 : Send to production planning department as a feed back data of the production schedule adjustment.

Copy 2 : The shift supervisor keep the document as a proof document.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Inj_Date | The date reporting the injection output | Date/Time | | |
| 4 | Shift | The shift reporting the injection output | Text | 1 | A or B |
| 5 | IO_No | The injection order number | Number | 7 | |
| 6 | Part_Code | The identification code of the finished products | Text | 10 | |
| 7 | Part_Name | The name of the product | Text | 30 | |
| 8 | Qty_Output | The actual output parts produced | Number | 7 | |
| 9 | Qty_Order | The output required in the injection order | Number | 7 | |
| 10 | Order_Bal | The balance of outputs | Number | 7 | |
| 11 | Shift_SV_sign | The signature of the shift supervisor | Text | 25 | |

**Document name :** MATERIAL AND PRODUCTION INSTRUMENTS STOCK

**Source of origin :** MATERIAL AND PRODUCTION INSRTUMENTS STOCK CONTROL SECTION

**Usage description :** The document is used for controling the usage of material and prouction instruments in the stock. It will declare the stock status or how much the items left in the stock.

**Number of copies :** -

**Objective of usage :**

Original document : The document is internally used in the warehouse department to control the material and production instrument.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Stock_Code | Stock code | Text | 5 | |
| 2 | EQ_Stock_Date | The date recording the document | Date/Time | | |
| 3 | EQ_Cat | The category code of the items ( A= Material, B=mold, C= packing, D=instrument) | Text | 1 | |
| 4 | EQ_No | The registered number of the items | Number | 7 | |
| 5 | EQ_Name | The name of the items | Text | 30 | |
| 6 | EQ_In_Qty | The quantity entry to the stock | Number | 7 | |
| 7 | EQ_Out_Qty | The quantity exit from the stock | Number | 7 | |
| 8 | EQ_Balance | The available quantity of the items | Number | 7 | |
| 9 | EQ_Stock_Sign | The signature of the stock control staff | Text | 25 | |

**Document name :** PRODUCTION INSTRUMENTS USAGE CONTROL

**Source of origin :** MATERIAL AND PRODUCTION INSRTUMENTS STOCK CONTROL SECTION

**Usage description :** The document is recorded everytime the injection staffs draw or return the items from the stock. The document is used to monitor the usage of these instruments, so that the stock control staff is able to trace where the instrument is currently used.

**Number of copies :** -

**Objective of usage :**

Original document : The document is internally used in the warehouse department to monitor the usage of the production instruments.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | PIU_No | The document number | Number | 7 | |
| 2 | PIU_Date | The record date and time | Date/Time | | |
| 3 | PIU_Item_No | The item number of instruments | Number | 3 | |
| 4 | Req_No | The item requistion form number (from item requistion form) | Number | 7 | |
| 5 | Req_Item_No | The item requisited number | Number | 2 | |
| 6 | Req_Item_description | The description of item | Text | 25 | |
| 7 | Req_Item_Qty | The quantity of requisted items | Number | 5 | |
| 8 | Ret_Due_Date | The return due date | Date | | |
| 9 | Drawer_Name | The drawer name | Text | 25 | |
| 10 | Ret_No | The return number (from item return form) | Number | 7 | |
| 11 | Ret_Item_No | The item return number | Number | 2 | |
| 12 | Ret_Item_Qty | The quantity of returned items | Number | 5 | |
| 13 | Item_left | The left quatity in usage ( will be returned later) | Number | 5 | |
| 13 | Return_Name | The name of returned staff | Text | 25 | |

**Document name :** DAILY PRODUCTION SCHEDULE

**Source of origin :** PRODUCTION PLANNING DEPARTMENT

**Usage description :** The daily production schedule is prepared when the purchase order of customer arrive to the company. It contains the jobs allocation of all machines in day by day. The schedule is planned for one month in advance, however, the schedule may be adjusted if the production output do not coorrespond to the schedule such as there may be a machine break dwon or any difficulties that delayed the production activities. The document specifies the part to be produced on which machine and when to produce that part in a time period.

**Number of copies :** 3 copies.

**Objective of usage :**

Original document : The production planning keep it for internally use such as change or adjust the plan.

Copy 1 : The document is sent to the factory adminstration section which is used to control to the injection department to closely follow the production as planned.

Copy 2 : The document is sent to the production department as an information for issuing the Injection Order.

Copy 3 : The shift supervisor keep the production schedule for the schdule evaluation by the end of each day (production plan report preparation).

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Schedule_No | The number of schedule | Number | 7 | |
| 2 | Plan_Date | The date in the schedule | Date/Time | | |
| 3 | Machine_No | The number of the machine | Number | 2 | |
| 4 | Machine_Model | The model of the machine | Text | 7 | |
| 5 | Part_Code | The identification code of the finished products | Text | 10 | |
| 6 | Part_Name | The part name | Text | 30 | |
| 7 | PO_No | The purchase order number | Number | 7 | |
| 8 | PO_Qty | The order quantity in the purchase order | Number | 7 | |
| 9 | Plan_Qty | The quantity of part to produce in that date | Number | 7 | |
| 10 | Plan_Name | The name of production planner | Text | 25 | |
| 11 | Plan_approve_sign | The signature of the approval management | Text | 25 | |

**Document name :** PRODUCTION PLAN REPORT

**Source of origin :** PRODUCTION PLANNING DEPARTMENT, ASSISTANT PRODUCTION MANAGER

**Usage description :** The document is a report prepared from the daily production schedule and the production daily report. The report summarizes the comparison of the plan scheduled quantity with the actual output of parts (from the production daily report), which will be a major information to adjust the plan in order to serve the production to customer right on time with the right quantity in the most efficient way.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : The assistant production manager, who prepared the report, keep it as a documentary document.

Copy 1 : Send it to the production planner, who issue the produciton schedule, as an information to consider the schedule adjustment.

| No | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Schedule_No | The number of schedule | Number | 7 | |
| 2 | Plan_Date | The date in the schedule | Date/Time | 2 | |
| 3 | Machine_No | The number of the machine | Number | 2 | |
| 4 | Machine_Model | The model of the machine | Text | 7 | |
| 5 | Part_Code | The identification code of the finished products | Text | 10 | |
| 6 | Part_Name | The part name | Text | 30 | |
| 7 | PO_No | The purchase order number | Number | 7 | |
| 8 | PO_Qty | The order quantity in the purchase order | Number | 7 | |
| 9 | Plan_Date | The date in the schedule | Number | 2 | |
| 10 | Plan_Qty | The quantity of parts to produce in that date | Number | 7 | |
| 11 | Qty_Output | The actual output of the production in the day | Number | 7 | |
| 12 | Daily_Qty_balance | The balance of the part quantity in the day [schduled quantity (9) – actual output(10)] | Number | 7 | |
| 13 | Accum_Qty_Balance | The accumulative balance until that day | Number | 7 | |
| 14 | Mc_Down _report | The machine break down report | Text | 40 | |
| 15 | Plan_Report_Name | The staff who made the report | Text | 25 | |
| 16 | Report_Appv_Name | The staff who approved the report | Text | 25 | |
| 17 | Plan_Name | The name of production planner | Text | 25 | |
| 18 | Plan_approve_sign | The signature of the approval management | Text | 25 | |

**Document name :** SUBCONTRACTOR PRODUCTION PLAN SHEET

**Source of origin :** PRODUCTION PLANNING DEPARTMENT

**Usage description :** The subcontractor production plan sheet is a production schedule for the over capacity jobs that will be assigned to the subcontractors. The document specifies the parts to be employed by the assigned subcontractor and the time period to finish the jobs.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : The production planning department keep the original document for internally use such as changing or adjusting the plan.

Copy 1 : The production planning department sent the copied document to the procurement department who is in Textge with dealing with the subcontractor.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Sub_Schedule_No | The number of subcontractor schedule plan | Number | 7 | |
| 2 | Sub_Plan_Date | The date in the schedule | Date/Time | | |
| 3 | Part_Code | The identification code of the subcontracted parts | Text | 10 | |
| 4 | Part_Name | The part name | Text | 30 | |
| 5 | PO_No | The purchase order number | Number | 7 | |
| 6 | PO_Qty | The order quantity in the purchase order | Number | 7 | |
| 7 | Subc_Name | The name of subcontractor who is hired in that order | Text | 30 | |
| 8 | Subc_Code | The subcontrator code | Text | 4 | |
| 9 | Subc_Plan_start | The start date of outsource the order | Number | 2 | |
| 10 | Subc_Plan_End | The date subcontractors deliver parts to the company | Number | 2 | |
| 11 | Plan_Name | The name of production planner | Text | 25 | |
| 12 | Plan_approve_sign | The signature of the approval management | Text | 25 | |

**Document name :** PURCHASE ORDER ( CUSTOMER )

**Source of origin :** CUSTOMER

**Document description :** The purchase order is issued by the customer that order the company to produce the products.

**Number of copies :** 2 copies.

**Objective of usage :**

Original document : The origianl customer purchase order is kept at the production planning department in the production scheduling unit.

Copy 1 : The first copy of purchase order is released to the factory administration who coordinate the production and production planning department.

Copy 2 : The second copy of purchase order is released to the production department as as information of issuing injection order and packing list.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Cus_PO_No | Number of customer purchase order | Number | 7 | |
| 2 | BIP_Quotation_No | Number of BIP Quotation | Number | 7 | |
| 3 | Cus_PO_Date | Customer Purchase Order issue date | Date/Time | | |
| 4 | Cus_Buyer_Name | Buyer name : B.I.P | Text | 50 | |
| 5 | Cus_Buyer_Address | Buyer address : B.I.P address | Text | 70 | |
| 6 | Cus_Due_date | Delivery due date for products | Date/Time | | |
| 7 | Cus_Item | Order of listed items | Number | 7 | |
| 9 | Part_Code | The identification code of the parts | Text | 10 | |
| 10 | Part_Name | The name of the parts | Text | 30 | |
| 11 | Part_Quantity | Products volume | Number | 7 | |
| 12 | Price_Per_Unit | Price per unit | Currency | | Unit : Baht |
| 13 | Total | The total price of all items | Currency | | Unit : Baht |
| 14 | Cus_Manager_Sign | The signature of customer company's manager | Text | 25 | |
| 15 | Cus_Board_Of_Director_Sign | The signature of customer's company director | Text | 25 | |

**Document name :** PURCHASE ORDER ( BIP to SUBCONTRACTOR )

**Source of origin :** PROCUREMENT DEPARTMENT

**Document description :** The subcontractor purchase order is issued by the procurement department that order the subcontractor company to produce the BIP products.

**Number of copies :** 2 copies.

**Objective of usage :**

Original document : The original document of subcontractor purchase order is kept at the procurement department who has issued this document.

Copy 1 : The first copy of the document is sent to the production planning department in the production scheduling unit as a prood evidence.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Subc_PO_No | Number of subcontractor purchase order | Number | 7 | |
| 2 | Subc_Quotation_No | Number of subcontractor Quotation | Number | 7 | |
| 3 | Subc_PO_Date | Subcontractor Purchase Order issue date | Date/Time | | |
| 4 | Subc_Name | Subcontractor name | Text | 30 | |
| 5 | Subc_Address | Subcontractor address | Text | 70 | |
| 6 | Subc_Due_date | Delivery due date for products | Date/Time | | |
| 7 | Subc_Item | Order of listed items | Number | 7 | |
| 9 | Part_Code | The identification code of the subcontracted parts | Text | 10 | |
| 10 | Part_Name | The name of the parts | Text | 30 | |
| 11 | Part_Quantity | Products volume | Number | 7 | |
| 12 | Price_Per_Unit | Price per unit | Currency | | Unit : Baht |
| 13 | Total | The total price of all items | Currency | | Unit : Baht |
| 14 | Procurement_Manager_Sign | The signature of BIP procurement manager | Text | 25 | |
| 15 | Board_Of_Director_Sign | The signature of BIP's company director | Text | 25 | |

**Document name :** PART STANDARD SPECIFICATION

**Source of origin :** CUSTOMER

**Document description :** The Part standard specification is issued from the customer company. It is an attachment with the purchase order. The document indicate the fundamental specification of the products that the company have to meet, otherwise the products may be rejected later on.

**Number of copies :** 1 copies.

**Objective of usage :**

Original document : The original document of part standard specification is kept at the production planning department.

Copy 1 : The copy of the document is sent to the production department as a reference information for the production.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Part_Code | The identification code of the parts | Text | 10 | |
| 2 | Part_name | The name of the product | Text | 30 | |
| 3 | Part_Mat_Name | The name of the product material | Text | 20 | |
| 4 | Part_Mat_Code | The code of the product material | Text | 15 | Unit : Pcs. |
| 5 | Part_Color | The color of the product | Text | 10 | Unit : box |
| 6 | Part_Weight | The weight of a part | Number | 5 | |
| 7 | Runner_Weight | The weight of a runner | Number | 5 | Unit : Grams |
| 8 | Cycle_Time | The cycle time of machine | Number | 2 | Unit : Second |
| 9 | Mold_Code | The code of injection mold | Text | 7 | |
| 10 | Mold_Cavity | The number of cavities in the mold | Number | 2 | |
| 11 | Qty_Per_Carton | The quantity of parts per carton | Number | 5 | Unit : pcs. per carton |
| 12 | Inspection_Spec | The methodology of the sampling inspection test to accept the products | Text | 50 | |
| 13 | Spec_Approve_name | The name who specified the spec. | Text | 25 | |

**Document name :** SAMPLING INSPECTION PLAN SHEET

**Source of origin :** PRODUCTION PLANNING DEPARTMENT

**Document description :** The sampling inspection plan sheet is based on the techniques of sampling inspection plan of the different customers. Each customer has their own different sampling methodology, therefore, BIP holds on the inspection principle basing on each customer's inspection method.

**Number of copies :** 1 copy.

**Objective of usage :**

Original document : The origianl sampling inspection plan sheet is kept at the production plan department.

Copy 1 : The copy of the document is kept as a reference inspection guide for the QC section of production department.

| No. | ID | Description | Type | Size | Remark |
|---|---|---|---|---|---|
| 1 | Customer_Code | The customer code | Text | 4 | |
| 2 | Customer_Name | The customer name | Text | 30 | |
| 3 | Inspection_Description | The description on the inspection methodology | Text | 50 | |
| 4 | Sample_Size | The sample size of inspection | Number | 3 | Unit : Pcs. |
| 5 | Accept_Size | The minimum accept size of parts in the inspection sample size | Number | 3 | Unit : Pcs. |
| 6 | Inspection_Frequency | The frequency of inspecting part | Number | 2 | Unit : Times/ Hrs. |
| 7 | Inspection_Comment | The comment on the inspection method | Text | 70 | |
| 8 | Ins_Plan_Name | The name of staff inventing the plan | Text | 25 | Unit : Grams |

# APPENDIX C

# FEASIBILITY STUDY

## FEASIBILITY STUDY.

The feasibilty study is undertaken in order to determine if the selected project is feasible. The feasibility is assessed in three principal ways :

1. Operational feasibility.
2. Technical feasibility.
3. Economical feasibility.

## Operational feasibility.

It is the consideration of the readiness of all staffs that will accept and support the developed system. The study relates on the human resources availability for the new system whether the system will operate and be used if it is installed. If the staffs are virtually attached with the current information system. They think there is no problem with the current work and do not request for anything new, thus, the resistance to the implementation of the new system would be strong.

But for BIP, according to the information of interview, after the author had proposed the idea to implement the new computerized production and inventory database system, there was a positive feedback from almost staffs. All staffs, including management, agreed with the idea This may because from the current absolutely deficient of the the current system that no longer satisfy the staffs and it resulted in a lot of problems.

The author used two criteria to assess the operational feasiblity :

1. The existing production and inventory difficulties are improvable and worth for improvement.
2. The opinions of the staffs on the new proposed system.

### *Management's opinions.*

From the interviews, the management express their opinion that the current problems are significant and deserve for improvement. The current system cause :

- The productivity of production process is less than what it should be. This is from the time consuming and lateness of production processes.

- The production and inventory data is hard to access. For examples, when the managing director request to know the material stock status, he must request the stock staffs to search to data from the paper stock documents and then manipulate the stock report for the director. So, it is seen that it takes a lot of process to get the stock status known which spend a huge amount of time. This also happened to the other data access process in the other departments.

- Slow order process. The order from the management to the operational staffs spend too long time. Consequently, it cause the low productivity and delay in delivery.

- The current system do not support the production expansion in the future. By the next year, the company plan to expand the machine numbers form 18 to 25 machines to support the increasing customer order volumes.

- Low accuracy of data on the report.

- The low utilization of workpower and equipment which cause high cost and high non performing activities happened.

- The ambiguity of data communication processes.

From the managements perspective, they require the system with easy data access and improve data accuracy, minimize errors.

*The operational staff's opinion.*

From the interviews of staffs, the results show that the staffs do not prefer to record too much of data in a current forms provided. A lot of paper forms are not designed properly and thus result in the staffs to fill a lot of duplicate, unnecessary, and redundant information. For instance, in the production report, it enforces the machine operator to fill a huge amount of data while some data is not significant and should not be included in such as some part specification data. That cause the operators get bored to do paper works and always generate errors.

In summary, all level of management feel positive way in developing a new system and hence it is a good timing the develop production and inventory database to facilitate these staffs. So, the operational aspect of developing productionand inventory database is positively feasible.

## Technical feasiblity.

It is important to assess the technical feasibility of the project. The feasibility is in essence a technical risks analysis that study the potential to build up the system. The major risk that can endanger the successful completion of the project is the familiarity with the application and the technology. When the developed system base on the technology that has not been used before within the company.

For BIP, the production and warehouse department still work completely with manual system or paper work. However, if the computer database technology is applied in the department, It may take time for a while to get the staffs acquainted to it. That's the reason why the project start as a pilot project or with only four injection machines at first phase. The training course is necessary for a period as well.

Anyway, from the interview, the staffs feel confident that they are able to adapt themselves to understand the use the computer database if the database is not too complicate. The technical aspect of developing productionand inventory database is quite feasible with a slightly risky condition.

## Economical feasiblity.

The final feasibility analysis is to perform an economical feasibility analysis that identifies the financial costs and benefits associated with the project.

*Expected economical benefits.*

- Improved customer service.
- Reducing penalties costs.

The major financial benefit of implementing the database is the cut off of the penalties charged by the customer when the company is not able to deliver the products on time. The late delivery costs a company. The certain costs  are the penalties which are the actual cost that the customer charged the company as shown in the trade agreement. Thus the company has to pay this amount of penalty to the customer on an exact amount of money.

However, the penalties should not include only the actual penalties, but it should include the invisible cost such as the estimated cost of the decline of customer loyalty and reputation. These invisible cost figures are roughly estimated by the information from the BIP management. Every year, the company is charged the penalties in large amount which is approximately several hudreads of thousand Baht.

The author strongly believes that the developed database is able to cut off over 50% of the current penalties charged in a year. That makes the project worth to launch in term of economical pay back.

| Delivery: Late | Average penalties | Invisible costs | Total costs |
|---|---|---|---|
| On time | - | - | - |
| 1-5 Hrs. late | 0.25% of order value | 1% of order value | 1.25% of order value |
| 1 Days late | 4.5% of order value | 5% of order value | 19.5% of order value |
| 2 Days late | 7.5% of order value | 10% of order value | 17.5% of order value |
| 3 Days late | 15% of order value | 15% of order value | 30% of order value |
| 4-5 Days late | 35% of order value | 70% of order value | 105% of order value |
| 5-7 Days late | 50% of order value | 100% of order value | 150% of order value |
| More than 7 days late | 100% of order value | 150% of order value | 250% of order value |

Table C-1 : the consideration of penalties costs computed in percent of Purchase order value charged by customers which is appraised by the managements of BIP. The information is based on trade agreement of customers and the managements group assessment.

# APPENDIX D

## User Documentation : User Manual

# User Documentation : User Manual

## D-1 : Standard Requirements :

| | |
|---|---|
| **Computer/Processor :** | Personal Computer with a Pentium 90 MHz or higher processor. |
| **Memory :** | 32 MB RAM. |
| **Hard Disk :** | 200 MB of available disk space ( 23.5 MB needed for installation ) |
| **Operating System :** | Ms Windows 9X or 2000 with ODBC ( Open Database Connectivity). |
| **Disk drives :** | CD-ROM Drive and Floppy Disk Drive. |
| **Peripherals :** | Keyboard, Dot matrix printer and Mouse. |
| **Display :** | Super VGA resolution monitor (800x600) or above. |

## D-2 : System Installation.

1. Insert “BIP Production and Inventory system CD” into a CD-ROM Drive.
2. Chose ***run*** command from ***Start*** menu.
3. Click ***Browse*** button.
4. Select the CD-ROM Drive that contains the CD.
5. Choose ***BIP system\ VB\ package directory***.
6. Double click ***setup.exe*** file.
7. The BIP Production and Inventory system set up installation screen will be displayed, click **Next**.
8. Click “Change Directory” button to select your Destination Directory to install the program files, then click **Next**.
9. Select your Program Folder, then click **Next**.
10. Submit the installation information and agreements, then click **Next**.
11. The BIP Production and Inventory system is then being installed into the computer.
12. Restart the computer to enable the new settings.

## D-3 : Starting the system.

1. Start the windows and Click the “***start***” menu on the task bar.
2. Move the cursor to the “***Programs***” menu.

3. Move the Cursor to BIP system and Select the ***BIP production and inventory system***.
4. Then the system begins with the “Main menu” display screen.

## D-4 : System Menus, Forms, and Usage Description.

After the installation is completed, the user starts the program to the system main menu. The BIP Production and Inventory system main menu composes of 16 sub-menus for recording, monitoring, and ordering the system. The main menu of the system is shown in figure D.1. From the main menu, the users can select to any submenus for executing the database.

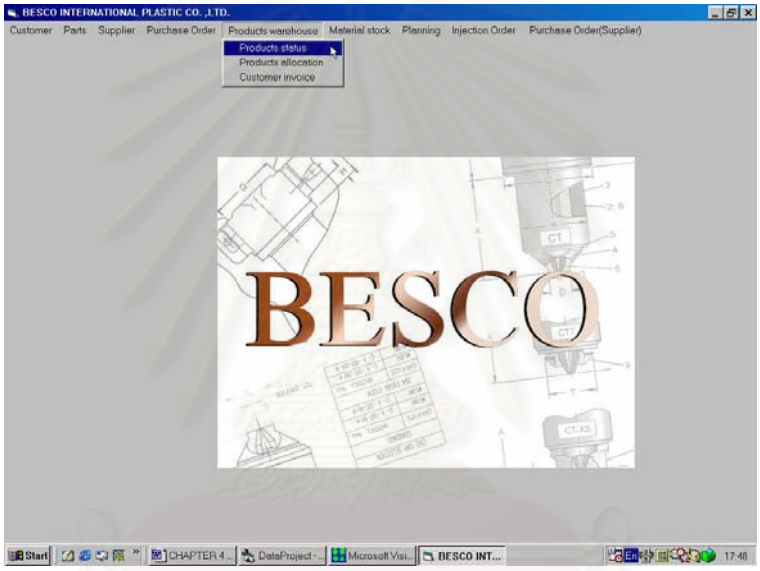



*Figure D.1 : The main menu screen of the BIP production and inventory database.*

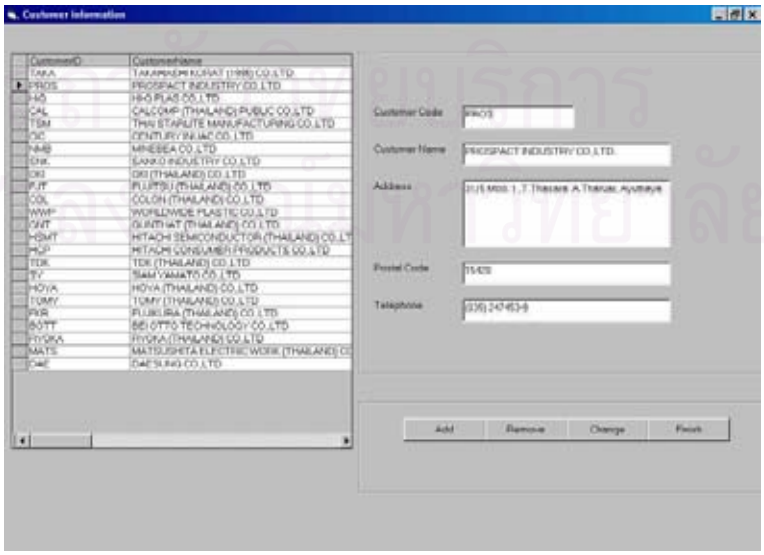


*Figure D.2 The customer information form.*

The *"Customer"* Menu is on the top left of the main menu. The menu brings the user to the *"Customer Information"* form for adding, deleting, or changing data of the customer information in the database. The user can record the customer information by submitting the *"ADD"* menu button. The customer code has to be identified and all customer information must be filled otherwise the program reject the add request. The remove and change of the existing customer information can also be done by selecting the *" Remove"* and *" Change"* menu buttons respectively. The user has to move the cursor to the selected customer and select it by clicking the left button of the mouse. Then the user clicks "remove or change" buttons and edits the customer information in the text box, then enters the *"Finish"* menu to exit the form. The customer information is now already updated. The task of filling customer information is done by the assistant production planner after achieving the purchase order.

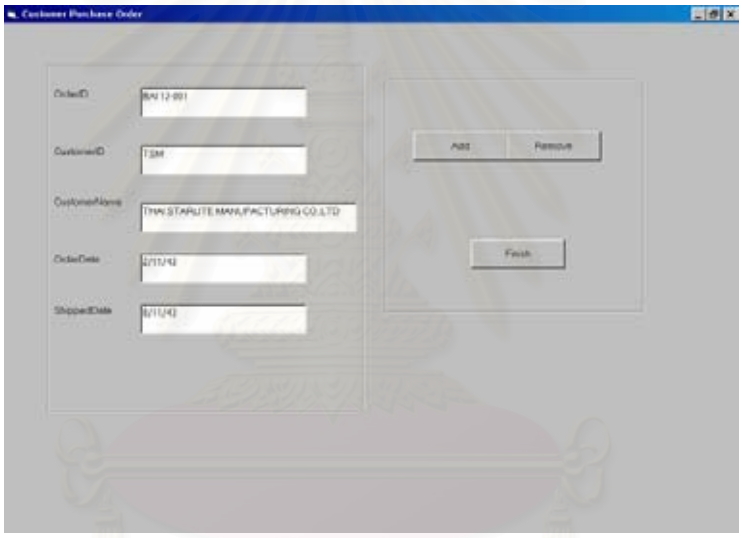


*Figure D.3 : The Purchase order form (customer).*

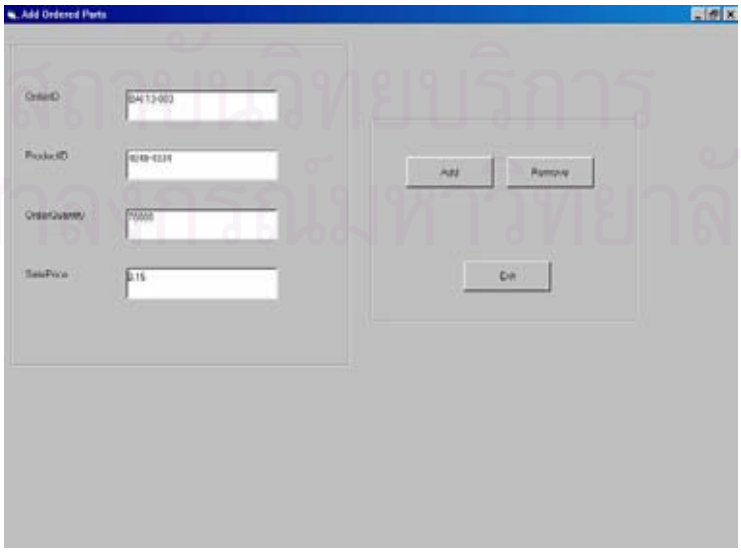


*Figure D.4 : The added ordered parts form.*

The *"Purchase Order"* menu brings the user to the customer purchase order form. The user; the assistant production planner, has to complete all the details of purchase order in the form. Then when the user fills in the purchase order information, the user has to click *"Add"* button in order to record the ordered parts information in the database. The *"Add ordered parts input form "*(Figure D.4) will then be shown when the user clicks the add button of the customer purchase order input form. After complete all information of the purchase order then click *"Finish"* button to exit to the main menu.

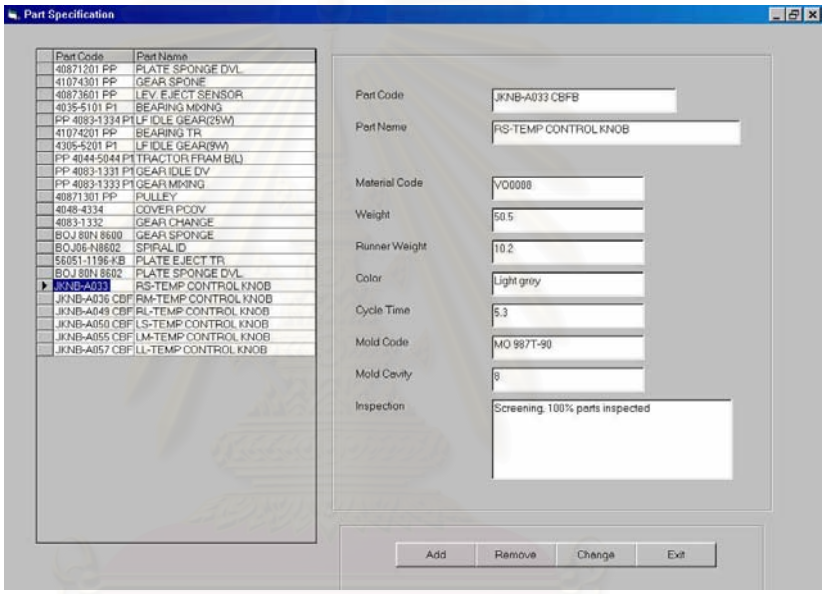



*Figure D.5 : The parts specification form.*

The *"Parts"* menu leads the user to the "*Part specification"* form. The assistant production planner has to record in the parts specification form from the part specification document attached with purchase order. But, if it is the part has been recorded then the update is not needed. The user is able to ***add, remove, or change*** the parts specification information by entering the provided menus at the bottom of the page.The production section by the machine set up technician is able to search for the parts specification for the machine set up process at the PCs of production control division.

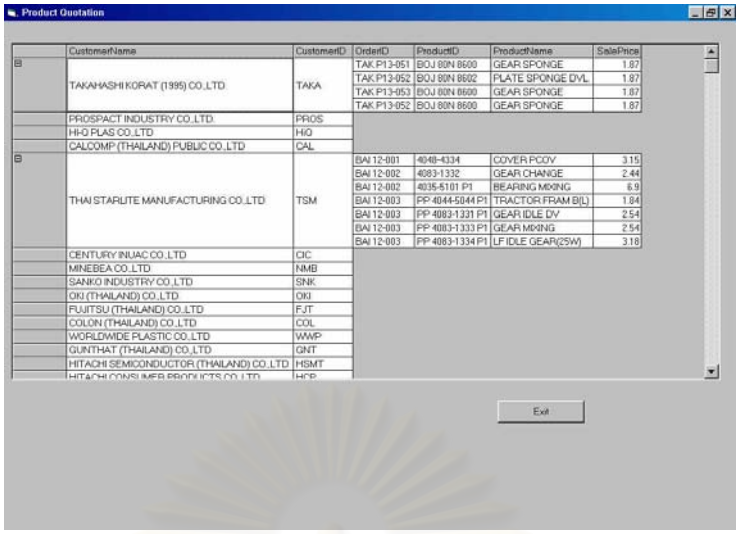



*Figure D.6 : The output screen report of the price of customer ordered parts.*

The ***"Product quotation"*** submenu brings the user to the ***product quotation*** report. The report shows the past information of the unit price of ordered parts sold to the customer. The report of parts price assists the management decision in issuing product quotation process.

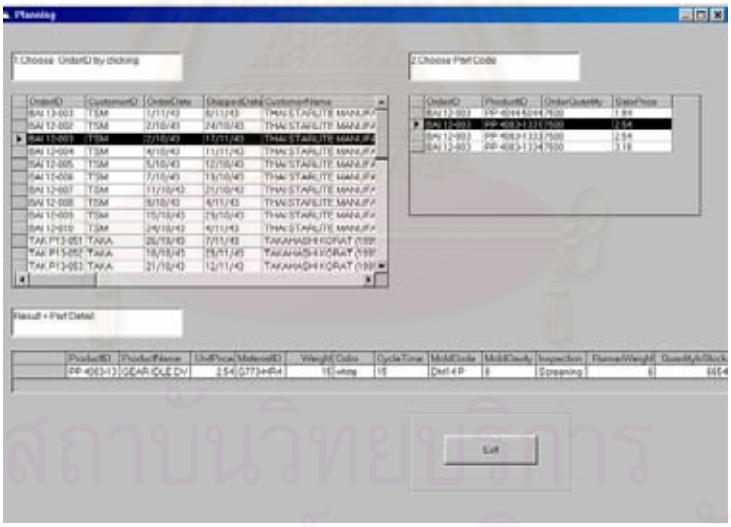



*Figure D.7 : The planning output report.*

The ***"Planning"*** submenu accesses the user to the ***planning output report*** (figure D.7). The report shows all customer purchases order information including the order date and the delivery due date. The report is accessed by the production planner who uses it as a guide to schedule the production schedule and by the product warehouse staff who uses the report in the delivery planning process.

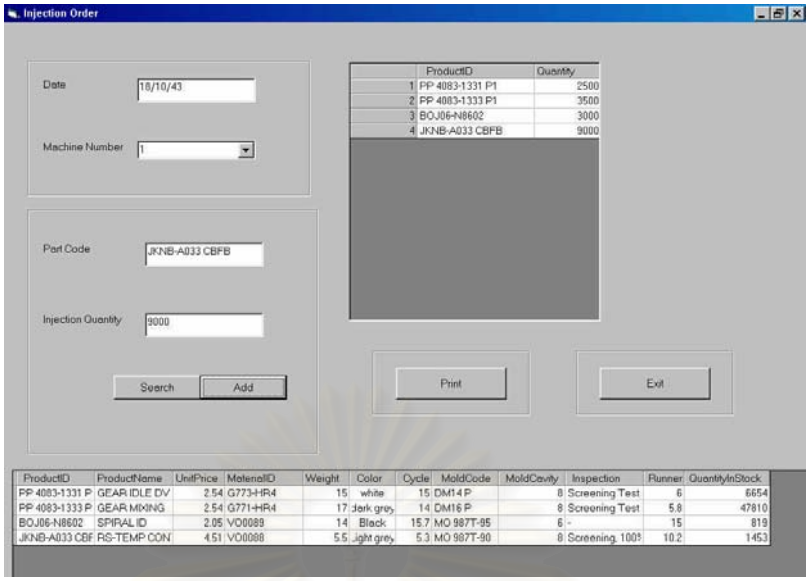



*Figure D.8 : The Injection order form.*

The *"Injection"* submenu is accessed by the production planner. The planner has to specify ***the date, the machine, the parts, and the quantity*** to be produced. When the planner has already filled out the information in the text box, then he is able to retrieve the information of the injected parts from clicking the *"Search"* menu Button, then the part information will be shown in the ***grid*** at the bottom of the form. The planner may issue the injection order of many parts on one machine by clicking the *"Add"* menu button, then the new parts information has to be filled in. When all informations are already completed, the planner has to click the *"Print"* menu button to print order the injection order and send the order to the machine set up technician.

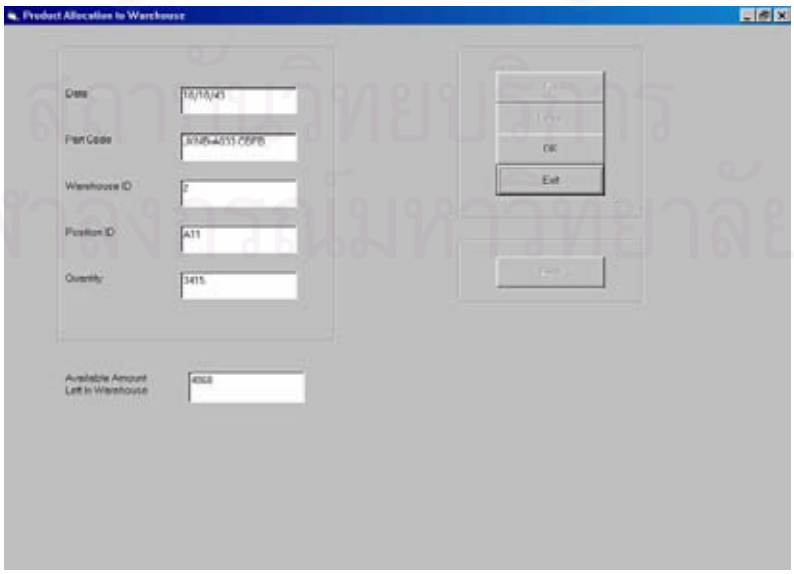



*Figure D.9 : The product allocation form.*

The *"Products allocation"* submenu enters the user to the "***product allocation to warehouse"*** form. The warehouse control staff takes account of registering the finished product from the production processes before entering into warehouse.The warehouse staff has to record the products information in the "Products allocation to warehouse"form first and then position in the provided area. In the form, the "warehouse code and location" must be specified in the *" Warehouse ID and PositionID"* text boxes in order to specify the number of warehouse and the location of that warehouse that the products are kept. The data recorded in the form automatically update the products balance quantity in the product warehouse status report. Then the user has to click "OK" menu button to confirm the record and click the *"Exit"* menu button to return the main menu.

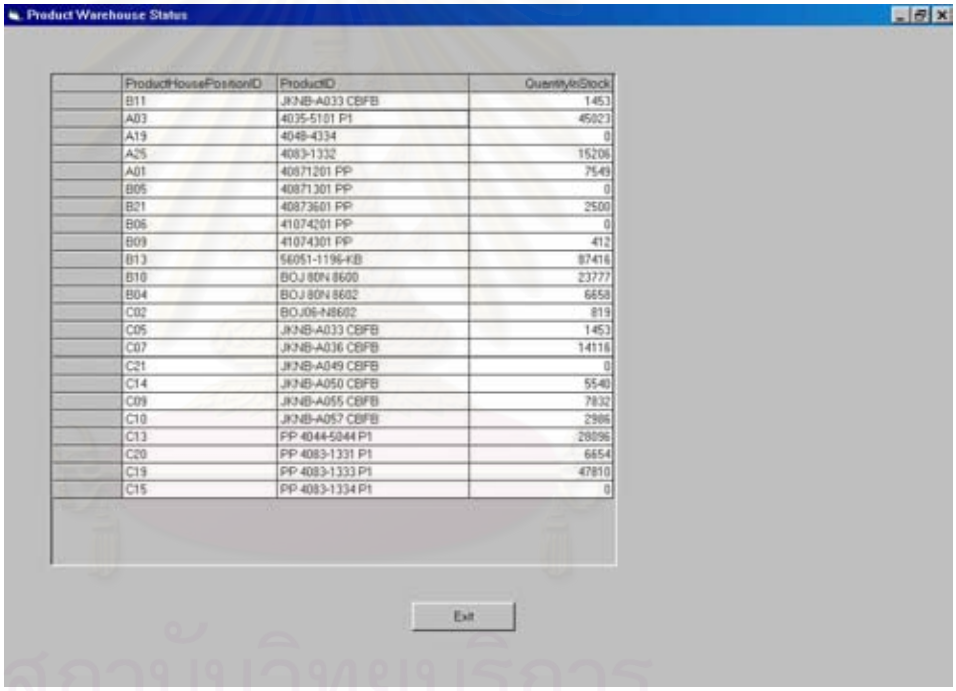



*Figure D.10 : The output report of the Product warehouse status.*

The *"Product Status"* submenu brings the user to the product warehouse status report. The report is accessed by the warehouse control staff in order to monitor the warehouse status.

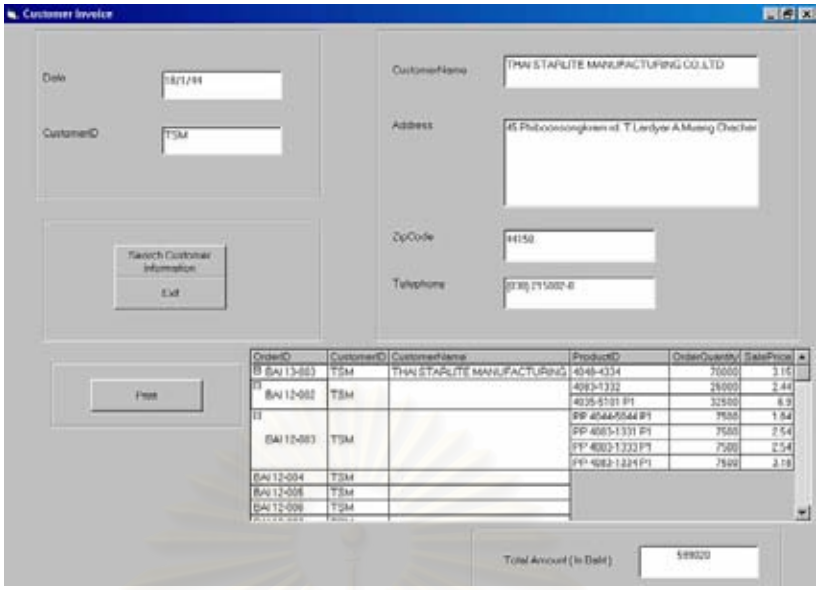



*Figure D.11 : The customer invoice form.*

The *"**Customer Invoice**"* submenu enables the warehouse staff to issue the customer invoice before delivering to the customer. Firstly, the user has to check the product delivery information in the planning output report (figure D.7), then the user will know that what product has to be delivered.

Thereafter, the user issues the "customer invoice" by searching the customer purchase order information and ***double clicks at the Purchase Order Code*** (of the delivered products) at the first column of the grid at the bottom of the form and then print the invoice by clicking the *"**Print**"* menu button. After the invoices have already printed out, the user submit on the *"**Exit**"* menu to return to the main menu page.

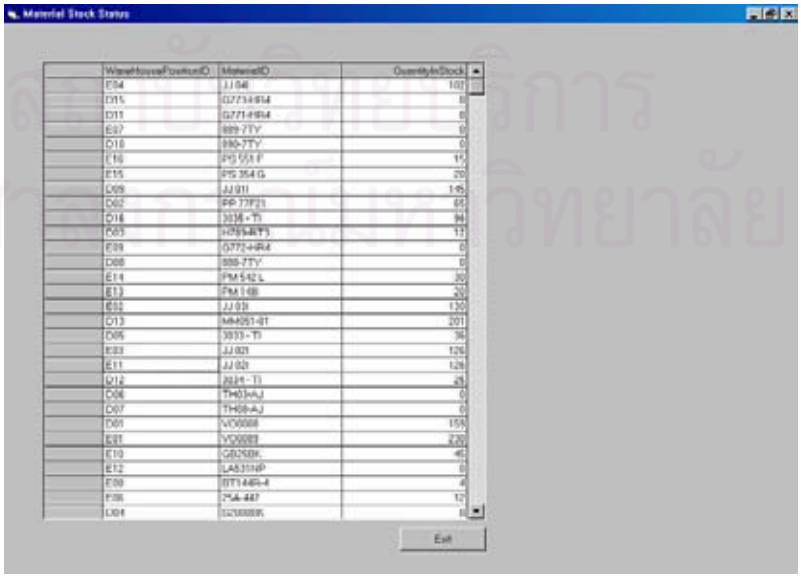



*Figure D.12 : The output report of the Material stock status.*

The “Material stock” submenu brings the user to the material stock status report. The report is accessed by the stock control staff in order to monitor the material status.

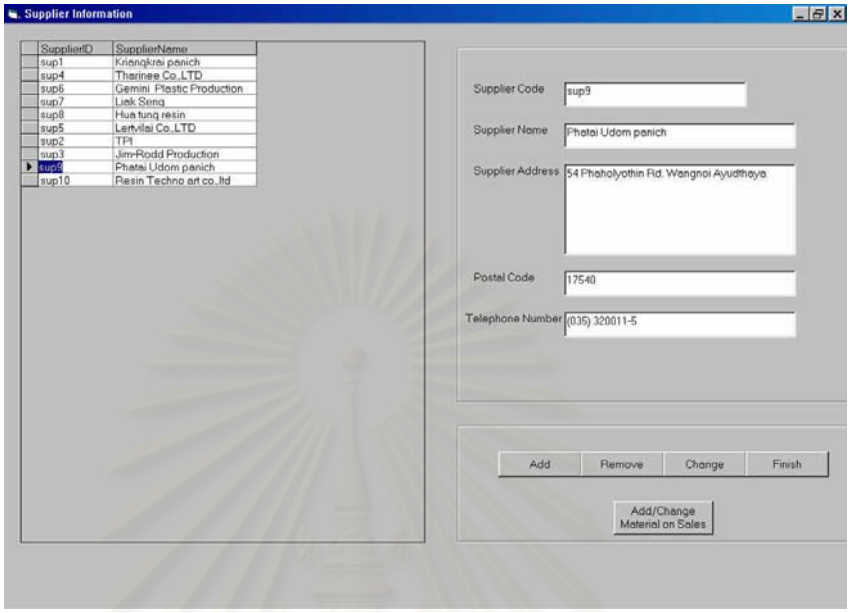



*Figure D.13 : The form of supplier information.*

The function of the ***“Supplier Information”*** submenu leads the user to the ***supplier information*** form. The function of the form is similar to the “Customer information” submenu in figure D.2.The user can record the supplier information by submitting the ***“ADD”*** menu button. The ***supplier code*** has to be identified and all supplier information must be filled otherwise the program reject the add request. The remove and change of the existing customer information can also be done by selecting the ***“ Remove”*** and ***“ Change”*** menu buttons respectively. The task of filling supplier information is done by the purchase department.

The additional function of the form is the record of the available material on sales of each supplier. When the user click the ***“Add/Change Material on Sales”*** menu button, it will bring the user to the “Supplier and Material Addition” form. The user has to fill the material information that has been purchased from the supplier. The user is also able to ***add*** or ***remove*** the record of the material on sales of each supplier by clicking the ***“Add or Remove”*** menu button.

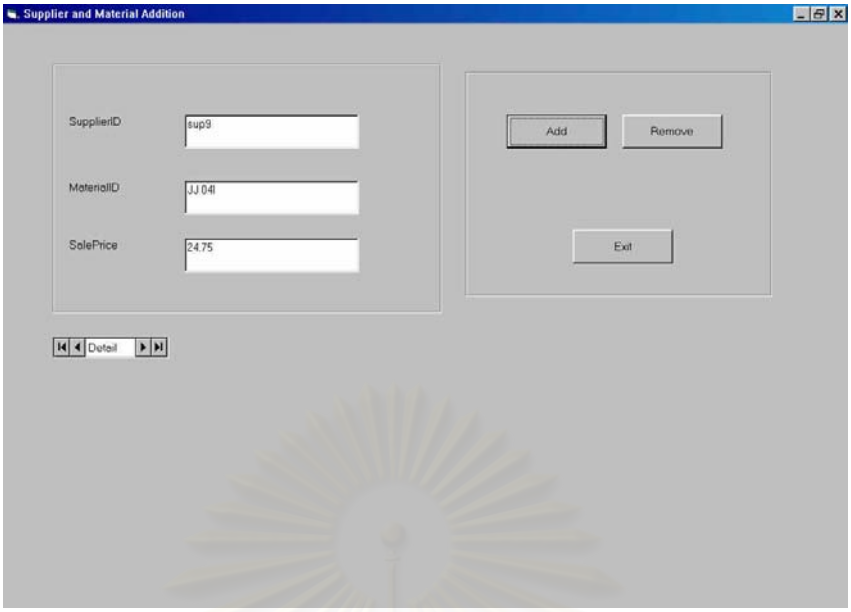



*Figure D.14 : The Supplier and Material addition form.*

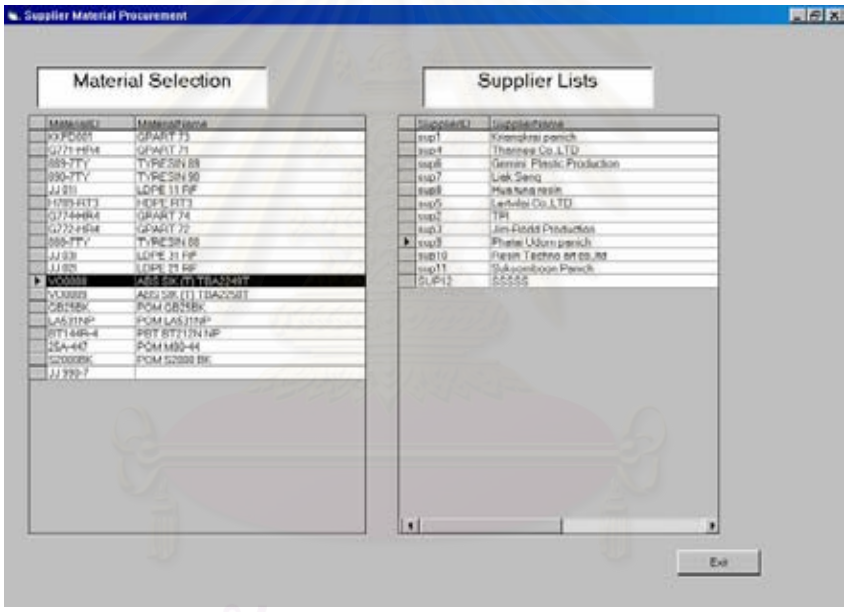



*Figure D.15 : The report of supplier material on sales.*

The ***"Material on sales"*** menu brings the user to the ***report of the material*** of each supplier that is available. The purchase staff is responsible for monitoring this information.

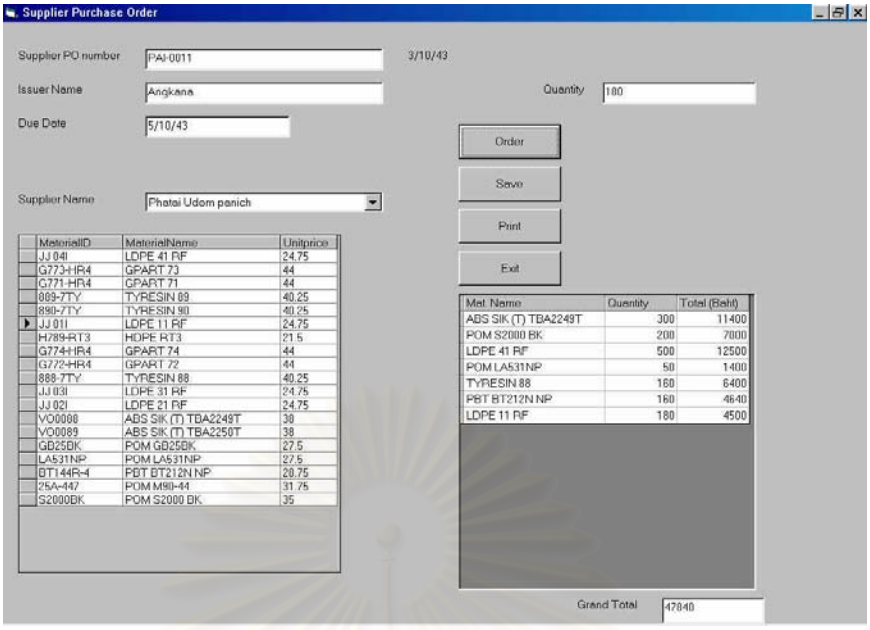



*Figure D.16 : The supplier order form.*

The *"Purchase Order(supplier)"* submenu enables the user to issue the supplier purchase order from the *"supplier purchase order"* form. The task of issuing the supplier purchase order is responsible for the purchase manager. Firstly, the user has to identify the ***supplier Purchase Order code, the responsible name, and the due date of the material***. Then, the list of available material of each supplier is shown out in the left bottom grid of the form when the user selects the supplier from the ***"Supplier name" list box***. The user has to select the purchased material from the grid by ***select the material code***, ***fill the quantity*** of material to be purchase, and then click the *"Order"* menu button, then the purchase information, including the price, will be shown in the right bottom grid of the form.

The user is able to purchase many material in one purchase order by doing the same procedures. When all purchase information has been already completed, the user has to save the purchase information in the database by clicking the *"Save"* menu button and finally print out the supplier purchase order by clicking the *"Print"* menu button.

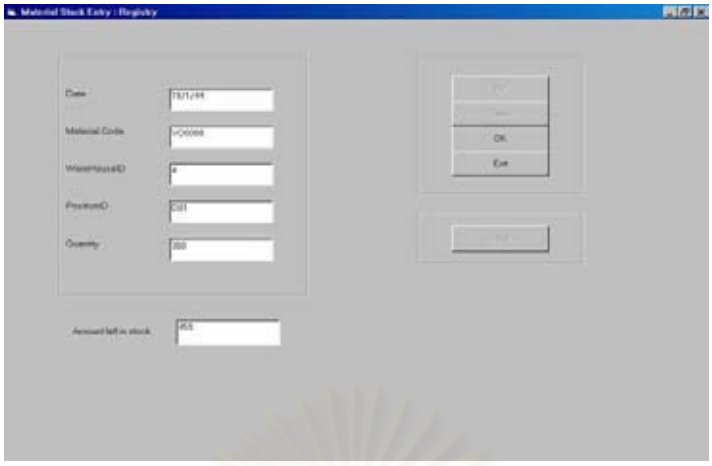


*Figure D.17 : The material and production instruments registry form.*

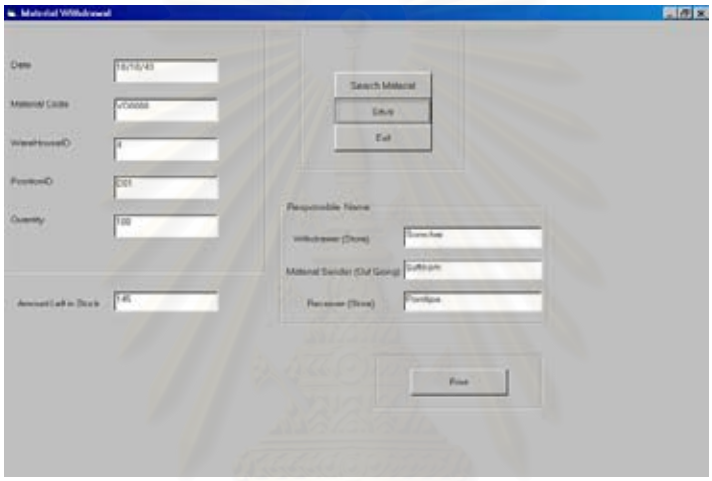


*Figure D.18 : The material withdrawal form.*

The ***"Material Registry"*** menu enables the material stock staff to the ***"Material Stock Entry: Registry"*** form. The form has to be recorded when receive the purchased material from the supplier. The ***material code, warehouse position, quantity, and the responsible staffs*** have to be filled in the provided text boxes, and then ***save*** the information before keeping the items in the stock.

The ***"Material Withdrawal"*** menu brings the user to the ***"Material withdrawal"*** form. When the production department requests to withdraw the material from the material stock, the stock staff has to search the requested material from stock. The user has to fill the material code and click the ***"Search Material"*** button, then the information of the material; position and quantity left, would come out in the text boxes. Then, the user has to record the quantity of withdrawn material and the responsible name and save the information. The recorded information of the material withdrawal form will update the material stock status in figure D.12.

# BIOGRAPHY

Teera Jungthirapanich was born on October, 18, 1976 in Bangkok, Thailand. He was graduated in the Bachelor's Degree of Engineering in Industrial Engineering from Chulalongkorn University in 1998. In the year after, he continued studying for the Master Degree in Engineering Management at the Regional Centre for Manufacturing Systems Engineering, Chulalongkorn University and University of Warwick. At present, he is working for Besco International Plastic Co.,Ltd. as an engineer in the production department.