การพัฒนาระบบสารสนเทศสำหรับกระบวนการรับคำสั่งซื้อของในโรงงานผลิตนั่งร้านและอุปกรณ์

นางสาว ภรณี ภาสภิญโญ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
สาขาวิชาการจัดการทางวิศวกรรม ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต
คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2551

INFORMATION SYSTEM DEVELOPMENT FOR ORDER RECEIVING PROCESS OF A SCAFFOLDING AND ACCESSORIES MANUFACTURER

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Engineering Management
The Regional Centre for Manufacturing Systems Engineering
Faculty of Engineering
Chulalongkorn University
Academic Year 2008

Thesis Title	INFORMATION SYSTEM DEVELOPMENT FOR ORDER RECEIVING PROCESS OF A SCAFFOLDING AND ACCESSORIES MANUFACTURER
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Field of study	Engineering Management
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ภรณี ภาสภิญโญ : การพัฒนาระบบสารสนเทศสำหรับกระบวนการรับคำสั่งซื้อของในโรงงานผลิตนั่งร้านและอุปกรณ์. (INFORMATION SYSTEM DEVELOPMENT FOR ORDER RECEIVING PROCESS OF A SCAFFOLDING AND ACCESSORIES MANUFACTURER) อ. ที่ปรึกษาวิทยานิพนธ์หลัก : ผศ. ดร. ปวีณา เชาวลิตวงศ์ , 215 หน้า.

ลักษณะธุรกิจของโรงงานผลิตนั่งร้านและอุปกรณ์ ซึ่งในวิทยานิพนธ์ฉบับนี้จะขอกล่าวอ้างอิงเป็นโรงงานเอบีซี ค่อนข้างซับซ้อนเนื่องจากส่วนใหญ่ประมาณ 80% เป็นการให้เช่า ส่วนที่เหลืออีก 20% จึงเป็นการซื้อขาย ลักษณะธุรกิจดังกล่าวทำให้เกิดความซับซ้อนในกระบวนการผลิตและระบบควบคุมสินค้าคงคลัง กระบวนการผลิตประกอบด้วย 2 ส่วน คือ กระบวนการซ่อมนั่งร้านและอุปกรณ์ที่คืนมาจากลูกค้าที่ให้เช่าไป และ กระบวนการผลิตนั่งร้านและอุปกรณ์ใหม่ ระบบสินค้าคงคลังของทางโรงงานประกอบด้วย สินค้าพร้อมส่ง ชิ้นงานระหว่างซ่อม/ผลิต สินค้ารอซ่อม และสินค้าที่ลูกค้าเช่าไป ความซับซ้อนของโรงงานดังเช่นที่กล่าวมานี้ทำให้มีข้อมูลหลายอย่างซึ่งจำเป็นต่อฝ่ายการตลาดเพื่อจัดการรับคำสั่งซื้อของในโรงงาน ปัจจุบันฝ่ายการตลาดยังขาดข้อมูลที่จำเป็นและยังไม่มีระบบสารสนเทศสำหรับกระบวนการรับคำสั่งซื้อ ซึ่งให้ทำการกำหนดวันส่งมอบสินค้าให้ลูกค้าเป็นไปอย่างไม่มีประสิทธิผลและประสิทธิภาพ และนำไปสู่ความล่าช้าในการจัดส่งของให้ลูกค้าและการยกเลิกคำสั่งซื้อของจากลูกค้าได้

วัตถุประสงค์ของวิทยานิพนธ์ฉบับนี้คือเพื่อพัฒนาระบบสารสนเทศสำหรับปรับปรุงกระบวนการรับคำสั่งซื้อของของฝ่ายการตลาดโรงงานเอบีซี ในขั้นแรกผู้จัดทำได้ศึกษากระบวนการรับคำสั่งซื้อของในปัจจุบันและวิเคราะห์ถึงปัญหาที่เกิดขึ้น จากนั้นข้อมูลที่จำเป็นและรูปแบบทางตรรกวิทยาของระบบสารสนเทศได้ถูกออกแบบขึ้น วิทยานิพนธ์ฉบับนี้ยังศึกษาเวลามาตรฐานของกระบวนการซ่อมและกระบวนการผลิตใหม่ของนั่งร้านและอุปกรณ์เพื่อหากำลังการผลิตซึ่งเป็นส่วนหนึ่งของข้อมูลที่จำเป็นสำหรับระบบสารสนเทศนี้อีกด้วย ในขั้นสุดท้ายระบบสารสนเทศถูกพัฒนาขึ้นโดยใช้โปรแกรม Visual Basic-based Excel Macro และถูกประเมินผลในแง่ของความสามารถของระบบสารสนเทศต่อการนำไปใช้งานได้จริง

ระบบสารสนเทศได้รับการประเมินการนำไปใช้งานได้จริงโดยผู้บริหารและฝ่ายการตลาด ซึ่งผลการประเมินคือระบบสารสนเทศได้รับการยอมรับเนื่องจากประกอบด้วยข้อมูลที่เพียงพอและรูปแบบทางตรรกวิทยาที่มีประสิทธิภาพที่จำเป็นต่อกระบวนการรับคำสั่งซื้อของเพื่อที่จะสนับสนุนฝ่ายการตลาดในการการกำหนดวันส่งสินค้าต่อลูกค้าได้แม่นยำมากขึ้นและสามารถต่อรองกับลูกค้าอย่างมั่นใจได้มากขึ้น นอกจากนี้ผลการทดสอบเบื้องต้นยังชี้ให้เห็นถึงแนวโน้มของการส่งสินค้าตรงเวลาที่พัฒนาขึ้นกล่าวคือการลดลงของปริมาณสินค้าที่ส่งล่าช้า 5% และการลดลงของจำนวนคำสั่งซื้อที่ส่งสินค้าล่าช้า 2% นอกจากนี้ผู้บริหารยังยอมรับถึงความสามารถในการนำไปใช้งานได้จริงและผลงานของระบบต่อการพัฒนาโรงงานในด้านอื่นๆจากเวลามาตรฐานและแผนการผลิตที่เป็นข้อมูลจากระบบสารสนเทศอีกด้วย

ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต ลายมือชื่อนิสิต.....

สาขาวิชา ...การจัดการทางวิศวกรรม..... ลายมือชื่อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....

ปีการศึกษา ...2551.....

497 16374 21 : MAJOR ENGINEERING MANAGEMENT
KEYWORDS: ORDER RECEIVING PROCESS / INFORMATION SYSTEM

PORANEE PHASPINYO: INFORMATION SYSTEM DEVELOPMENT FOR ORDER RECEIVING PROCESS OF A SCAFFOLDING AND ACCESSORIES MANUFACTURER. ADVISOR: ASST. PROF. PAVEENA CHAOVALITWONGSE, Ph.D., 215 pp.

The business model of scaffolding and accessories manufacturer studied in this thesis, hereinafter referred as ABC's company, is quite complicated as the majority of the products are to be rented – at approximately 80% of the time. The remaining 20% is where customers decide to purchase. This has resulted in the complexity of production process and inventory control. The production process is divided into two sectors – repairing products returned from renting customers and manufacturing of new products. In term of inventory, other than finished product inventory and work in process, there are 2 more inventories; waiting-for-repair items, and at-customer-location. This has resulted in many sets of information required for marketing department to process customers' orders. Currently, marketing department is still lack of certain data to be analyzed and information system to support order receiving process which subsequently results in an ineffective and inefficient designated deliverable date, which eventually leads to lateness in delivery and job cancellation

The purpose of this study is to develop the information system in order to improve order receiving process of ABC's marketing department. Fist, the author studies current order receiving process and analyzes its problems. Then, the information system is designed for required data and logical model. In this thesis, the products covered in the thesis' standard times of both production process sectors are studied to determine the process capacity which is one of the required data for the information system. Finally, the information system is developed by Visual Basic-based Excel Macro and evaluated for its validation.

The information system is validated by ABC's top managements and marketing department. As a result, it is accepted for its sufficient data and efficient logical model which are required in order receiving process in order to support marketing department in designating more accurate available-to-promise date and proactively negotiating with customers. Furthermore, the preliminary evaluation results in the improving trend of on time delivery, that is, reduction of 5% units late and reduction of 2% error available-to-promise date. In addition, top managements also accept for its validations and contributions for further improvements since standard time and production plan are provided as well.

The Regional Centre for Manufacturing Systems Engineering Student's Signature:.....
Field of Study: ...Engineering Management..... Advisor's Signature:.....
Academic Year: ...2008.....

ACKNOWLEDGEMENTS

The author is very deeply appreciated for the knowledge guide, suggestions, valuable comments, and kindly support from Assistant Professor Paveena Chaovalitwongse, Ph.D., thesis advisor, throughout the research study.

Also, the author would like to express her sincerely grateful to Professor Dr. Sirichan Thongprasert, the chairman of thesis committee, Assistant Professor Manop Reodecha, Ph.D., the member of thesis committee, and Associate Professor Somchai Puangperksuk, the external member of thesis committee for their constructive suggestions and valuable comments toward this thesis.

Many thanks to Ms. Charernrat Tanaponpanit, vice president of the studied manufacturer, for her permission to conduct this thesis, her sacrificed times, and her valuable advice during the research. This thesis cannot be completed without your information support. Also, special thanks to Mr. Taveesilp Kiatichai for the computer support.

Finally, special thanks for her beloved parents, family, and friends for all their loves, willpower, and continuously supports that bring her to the completion of this thesis.

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CHAPTER I

INTRODUCTION

1.1 Background of the Research

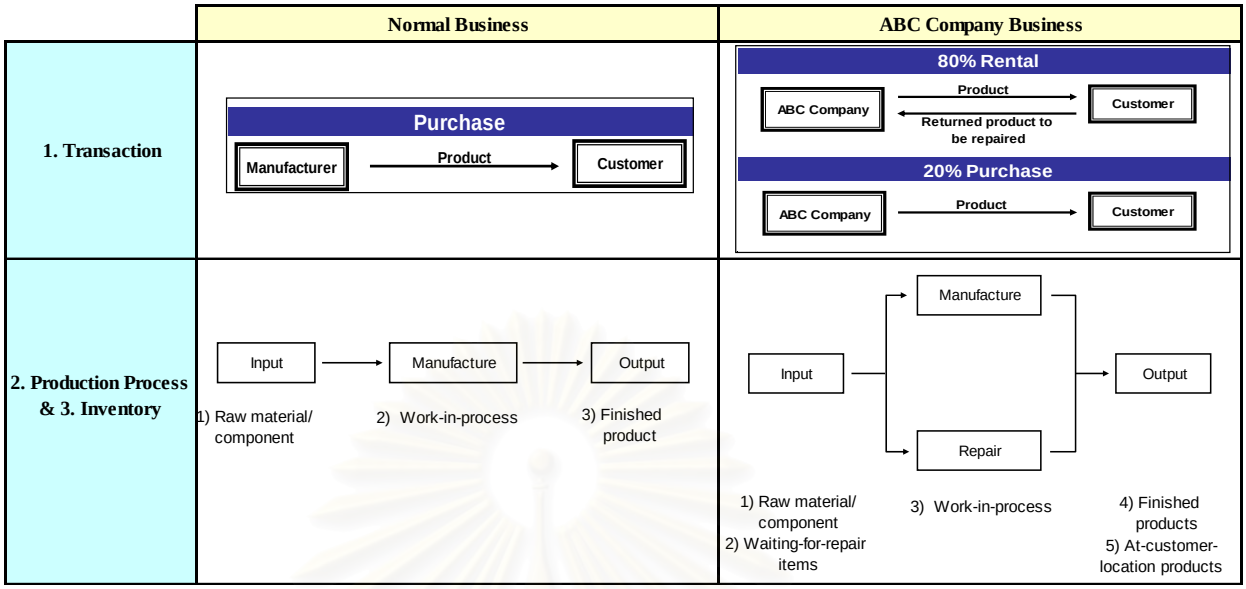
Current competitive business environment requires a company not only to be able to be survived in the market but also be able to go beyond its competitors. That is, it is important for the company to; for instance, maximum customers orders, rapidly response to customer requirements, eager for continuously improvement, and maintain current customers and attract new ones.

Construction industry is one of the growing industries in Thailand. The company studied in this thesis, referred as ABC Company, manufactures many kinds of scaffoldings and accessories used in the construction business of various scales. With the transferred technology from leading Japanese scaffolding manufacturer, ABC Company is the first and only scaffolding and accessories company in Thailand that has been awarded with the Certificate of Standard from Thai Industrial Standard Institute (TISI).

The business model of ABC Company is quite complex as the majority of the products, approximately 80%, are to be rented whereas the remaining 20% is where customers decide to purchase. As a consequence, it has resulted in the complexity of production process management and inventory control.

In term of production process, it is divided into 2 sectors. That is, in addition to normal manufacturing process, repairing process, which is a process of repairing products returned from customers, is another sector. In term of inventory, there are 2 more categories of product in inventory comparing with other businesses. The 2 more categories are waiting-for-repair items and at-customer-location products. The overall comparison between normal business and ABC company business is illustrated in table 1.1.

Table 1.1: Comparison between Normal Business and ABC Company Business



From table 1.1, it could be noticed that the complex of ABC business also results in the complex of information as well. One of the company's processes which requires a lot of information to be considered is order receiving process. When can we deliver the products?, How many units that can be delivered?, or Will we repair or will we manufacture? are examples of questions needed to be answered with adequate supporting information such as quantity of finished products, quantity of waiting-for-repair items, and both production process sectors' capacity (repairing process and manufacturing process). In other words, to be able to efficiently process customers' orders in terms of accurately promising product available date and quantity upon the company receives the orders, it is necessary for ABC to have adequate information in order receiving process.

1.2 Statement of Problems

The complexity of business, production process, and inventory result in many sets of information needed to be considered in order to achieve 3 company targets; on time delivery, fully capacity utilization, and repairing process maximization. One of the company's processes that requires sufficient information and also strongly impacts the achievement of company targets is order receiving process which is one of marketing department responsibilities. Without the adequate information providing at order receiving process, designate of product availability is ineffective and inefficient.

This eventually leads to late delivery, job cancellation, and more importantly, loosing customers' trusts.

Currently, upon marketing department's staffs receive orders from customers, they compare the order quantity with 2 kinds of inventory quantity recorded in paper sheets (finished product inventory and waiting-for-repair items). Then, in case of repairing returned products from customers or manufacturing products are required, marketing department discusses with production department and use their own experiences to estimate finished date from repairing process or manufacturing process. Eventually, marketing department informs product available-to-promise date based on staffs' experiences to customers which at times can be inaccurate and can result in lateness in delivery and job cancellation problems as ABC is currently facing with once customers have placed their orders.

Despite the fact that the business of ABC is complicated and that a lot of information is required, currently there is no information system supporting marketing department to efficiently process customers' orders in order to proactively negotiate and designate more accurate product available-to-promise date. Therefore, the development of an information system which can provide adequate required data to marketing department in order to improve current order receiving process is an essential part to the business growth and especially in the competitive business environment of ABC Company.

1.3 Purpose and Objective

To develop an information system in order to improve order receiving process.

1.4 Scope of the Research

This thesis covers scopes as follows:

1. The thesis does not include the study of demand forecasting.
2. The study of managing consumables inventory including gloves, paint, welding rod, gases, etc. are not within the scope of this thesis.
3. The products included in this thesis covers only main products of scaffolding and metal form which contributes to around 80% of total revenue.
4. The developed information system is running on Visual Basic-based Excel Macro.

5. The improvement of integrating the proposed information system to the order receiving process is evaluated based on two indicators:
    1) Reduction in %error in available-to-promise date
    2) Reduction of late delivery product (no. of pieces)

1.5 Benefits

1. Marketing Department can proactively negotiate with customers for available-to-promise date of product.
2. Actual production capacity is established for further utilization.
3. Daily production detail is provided for further production planning.

1.6 Methodology

First, the author starts with current ABC's order receiving process study at marketing department to analyze the process's flow and also the interaction with other processes and other departments. Then, information that customers require from marketing department when they place their orders and information that marketing department must have to response to those orders are analyzed. Then, cause and effects of lacking of supporting information system in order receiving process are determined.

The development of the information system in this thesis consists of 3 phases; design phase, development phase, and evaluation phase. First, the author analyzes which data are required to be input into the information system and which data are needed as the output from the information system. Then, the required data are developed and collected in the Microsoft Excel. Since ABC has never studied and collected standard production time, the author studies both production process sectors (repairing process and manufacturing process) and develops their standard times using time study technique in order to identify production process capacity which is one of the required input data for the information system. After the required data have been designed and developed, the assumptions related to both order receiving process and production process are determined and then the information system's logical models are designed and developed using Visual Basic-based Excel Macro. Finally, the information system is evaluated for its validation by the company's top management and marketing department. In addition, the author also preliminary evaluates the

information system using historical data to show an improving trend of 2 indicators; reduction in %error in available-to-promise and % unit late.

1.7 Research Schedule

	2008						2009		
	July	August	September	October	November	December	January	February	March
1. Study current order receiving process, examine problems, and determine causes of problems.	■	■	■						
2. Study related literatures and studies.		■	■						
3. Identify the developed information system objective and scope.		■	■						
4. Design required data and collect exist data for the information system.			■	■	■	■			
5. Study both production process sectors and develop standard time data.			■	■	■	■			
6. Determine assumptions, design, and develop the information system.				■	■	■	■	■	
7. Evaluate the information system, collect, and analyze the evaluation results.						■	■	■	
8. Summarize and report thesis.							■	■	■

1.8 Organization of Thesis

This first chapter briefly describes the overview of ABC business, the current situation of order receiving process, and what are problems in this process that ABC is currently facing with. Also, purpose and objective, scope, benefits, and methodology of the newly developed information system in this thesis are explained. Next, theoretical content and literature review related to this thesis are described in chapter 2. Then, the detail of ABC is elaborately described in chapter 3 to help understanding the business characteristic, complexity of production process, and complexity of inventory which result in the complexity of information required in order receiving process. Continuously from chapter 3, chapter 4 describes in details of ABC's current order receiving process, its problem due to the lack of information system, and its problem solution by developing the information system. Then, chapter 5 and chapter 6 explain the details of developing the information system from the design phase, development phase, and eventually evaluation phase. Finally, conclusion, recommendations, and also the future implementation plan of the developed information system for order receiving process in the thesis are described in the chapter 8 as the last chapter.

CHAPTER II

THEORETICAL CONSIDERATIONS AND LITERATURE REVIEW

This chapter covers 2 main sections: theoretical considerations and literature survey. Theories related to information system, work measurement and statistical analysis are firstly described. Then, previous researches related to this thesis are studied.

2.1 Information System

2.1.1 Overview of Information

"Information is data that have been put into a meaningful and useful context and communicated to a recipient who uses it to make decisions" [5]. It involves the communication and reception of intelligence or knowledge. It apprises and notifies, surprises and stimulates, reduces uncertainty, reveals additional alternatives, helps eliminate irrelevant, influences individuals, and stimulates them to action. Nowadays, the need for more information is increasing and a range of users is wider. For instance, investors need information about financial status, organization performance and future prospects, or government agencies need financial and operating activities report for purposes of taxation and regulation, or managements need strategic information for corporate takeover.

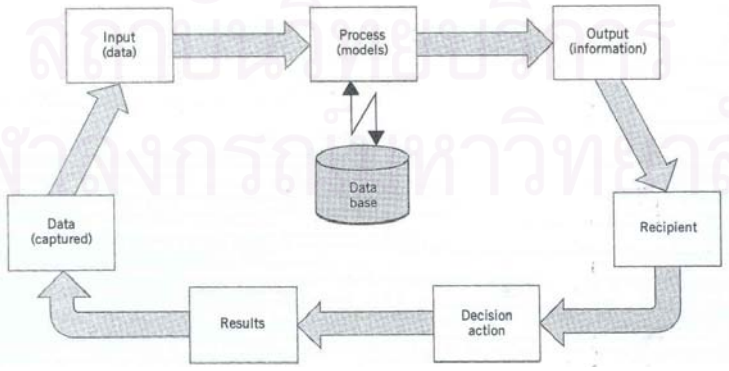


Figure 2.1: The Information Cycle

Source: Information Systems: Theory and Practice [5]

In the competitive environment, a company should be able to exploit the opportunity dimensions of informed management, product and service differentiation, and increase productivity. Obviously, information is the principal weapon that will help the company meet goals of winning managers, superior products and services, and higher productivity to eventually success. To produce the information, the building of information system is required.

2.1.2 Introduction to Information System

Information system is a system, automated or manual, involved with collecting, processing, and disseminating data to support users. It aims to provide relevant information to users at the right time, at the appropriate level of detail, and at the desired level of accuracy for the users. Figure 2.2 shows the basic components of the information system.

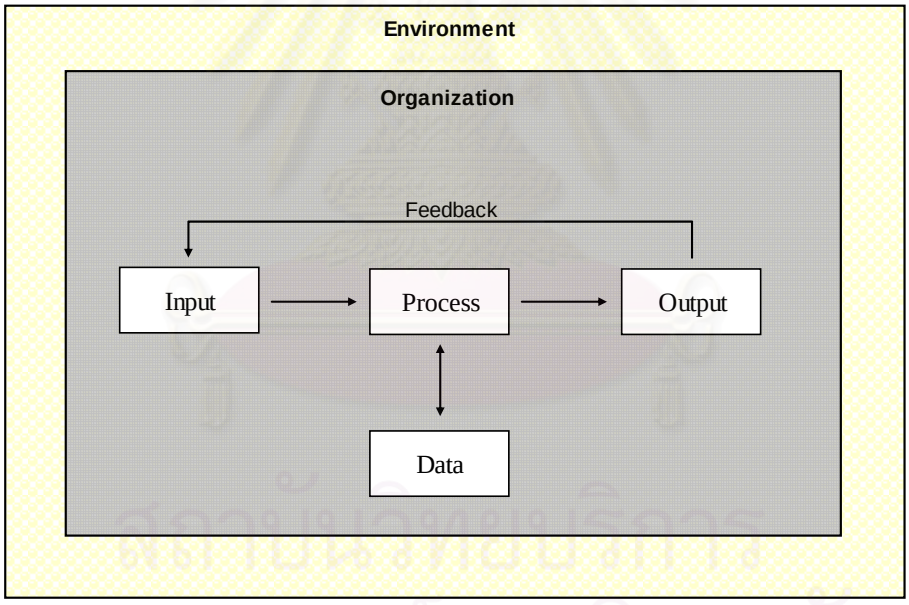


Figure 2.2: The Basic Components of the Information System

Understanding the data and developing the information system provide an opportunity for a company to exceed the company's competitors. The information system is used by many kinds of user such as managers, nonmanagers, professionals, nonprofessionals, and even people outside the company mainly for problem solving and decision making. The first information system is called transaction processing system. Then several information systems were produced such as a management of

information system (MIS) which aims to provide information more closely fit with users' needs, a decision support system (DSS) which aims to help users making particular decisions, and an enterprise resource planning (ERP) system which aims to integrate separated systems into one overall system to manage all operations in the company.

2.1.3 Information System Building Blocks

Usually, information system is made up of 6 basic building blocks: input, models, output, technology, data base, and controls.

Input Block

Input consists of transactions, requests, queries, instructions, and messages. It represents all data, text, and images entering the information system. The common ways of entering transaction and text are bar codes, laser, and keyboard.

Model Block

Model block consists of logical-mathematical models which operate input and stored data to produce the desired output. Some modeling techniques such as decision tables, decision trees, data flow diagram (DFD), flowchart, and prototyping are used to design and document system specification.

Output Block

The product of the information system is output; for instance, financial reports, answers to queries, results of programmed decision making. It can be produced on computer screens, audio devices, or printers. The output should be the quality information for all users both inside and outside the company. The quality of output depends on its accuracy, timeliness, and relevancy.

Technology Block

This block is considered as a toolbox of information system work. It takes the input, runs the models, stores and accesses the data, produces and delivers the output, and helps control the total information system. 3 main components are combined in this block: a computer and auxiliary storage, telecommunications, and software.

Data Base Block

This block is where all necessary data are stored to serve the needs of all users. 2 viewpoints of data base are considered: physical viewpoint and logical viewpoint. Physical viewpoint relates with how data are stored whereas logical viewpoint relates with how to search for, associate, and retrieve the stored data to meet users' specific information.

Control Block

Control block is designed to ensure the protection, the integrity, and the smooth operation of the information system. To overcome a variety of threats such as system failures, errors, sabotages, hackers, natural disasters, incompetent employees, inadequate operation procedures, and poor management, the controls like records management system, hardware and software monitors, backup systems and offsite storages, and security devices are required.

Information system designers also need to consider 10 forces that may have impacts on the system. Those 10 forces are integration, user/system interface, competitive forces, information quality and usability, systems requirements, data processing requirement, organizational factors, cost-effectiveness requirements, human factors, and feasibility requirements (see figure 2.3)

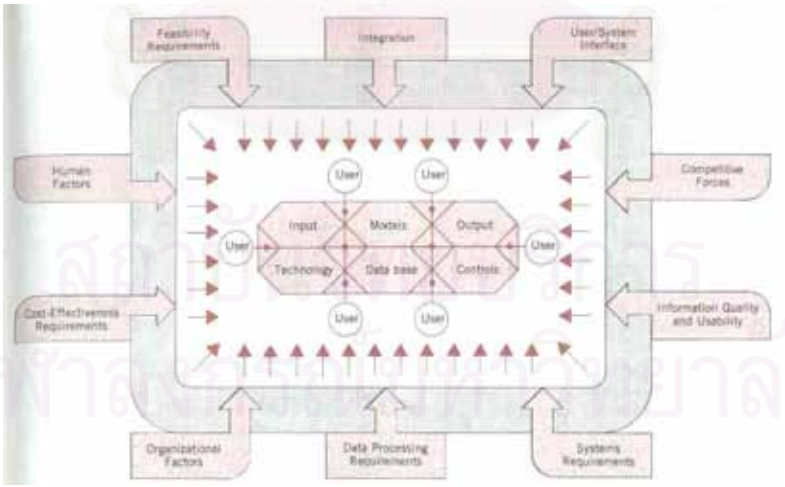


Figure 2.3: Forces Impacting on the Information System Building Blocks

Source: Information Systems: Theory and Practice [5]

Integration

The information system should be implemented in the company with connectivity and communication among departments. In other words, it should be just as important on the shop floor as in the office.

User/System Interface

The better the interface between users and the system, the better the information flow. The richness of this force depends on the strength and variety of building blocks capabilities. Input block will allow users to communicate with the system. Model block will help in transactional tasks and will be coupled with data base to serve more as a knowledge base especially during management dialogues. Output will provide the informational needs for users. Technology block will result in time and space reduction. And finally, control block will provided authorized users with a dependable system.

Competitive Forces

To survive in the world of significant change and competition, the company must be able to design the system that enhances management, product and service differentiation, and productivity.

Information Quality and Usability

It is necessary to provide information that is accurate, timely, usable, and relevant with users' requirements.

System Requirements

The requirements of information system are as follow:

1) reliability - how dependably a resource performs its function.

2) availability – the system is accessible to users.

3) flexibility – the system is able to change or adapt regarding to user requirements change.

4) installation schedule – the period of time between the need for the system and its result.

5) life expectancy and growth potential – the ability to meet requirements for a reasonable time and the ability to grow even if needs change.

6) maintainability – the ability to maintain the system since malfunctions have to be solved, or general system improvements have to be made.

Data Processing Requirements

The requirements of data processing deal with 4 issues.

1) the volume of relevant data – the amount of data that must be processed to meet information goals.

2) complexity – a number of intricate data operations to be performed to achieve information goals.

3) time constraints – the amount of time permitted between when data are available and the information is required.

4) computational demands – a combination of the former 3 issues for a specific information requirement.

Organizational Factors

The nature, type, size, structure, and management style of a company have a great effect on how the information system is designed and will serve users.

Cost-Effectiveness Requirements

It is necessary to identify benefits to be derived from developing the information system. In addition, the amount of money spent on the information system development has a direct impact on its design.

Human Factors

The information system should work compatibly with users, not against them. The system should be easy to use, friendly, and natural. Also, it should be able to adapt with like, dislikes, habits, skills, and tasks of users.

Feasibility Requirements

There are 5 categories of feasibility analysis.

1) technical feasibility – determination of the level of access to technology for information system development.

2) economic feasibility – availability of the funds for designing, developing, and implementing the system.

3) legal feasibility – no conflicts exist between the information system and legal obligations.

4) operational feasibility – the requirements involves with developing and operating the system.

5) schedule feasibility – the ability of the newly developed information system to operate within the given time frame.

2.1.4 Information System Development

Because of the differences in work procedures and requirements of each company, a development method is variable. However, generally the development of information system consists of 6 stages: preliminary investigation, analysis, design, preliminary construction, user review, final construction, and system test and installation (see figure 2.4).

Preliminary Investigation

System developers, users, as well as all other involved people firstly conduct an analysis to define the newly developed information system objectives, scope, constraints, and risks to evaluate system feasibility and obtain the users feedbacks.

Analysis

System developers define users' needs and analyze their requirements for each system module using a variety of information collecting techniques and gather them into the form of process, data, and object models. In addition, the information processing procedures are analyzed and documented in detail.

Design

System developers review all requirements and study design alternatives. The exact logic to be followed in processing must be determined. Also, the system developers must design specifications, components, and interfaces of each system module using various kinds of modeling techniques.

Preliminary Construction

System developers construct and test each module software and data of the system. The programs required for processing logic operation are written. Furthermore, acquiring user feedback is needed for adjustment.

Final Construction

Each module software is integrated into the complete information system and tested along with data. Hardware is tested, facilities are constructed, and users are trained.

System Test and Implementation

System developers test the newly developed information system including software, data, and all other information resources such as hardware, facilities, and procedures. In addition, after the information system has been implemented for some time, periodically review, maintenance, and auditing should be conducted to ensure that the system still meets users' requirements.

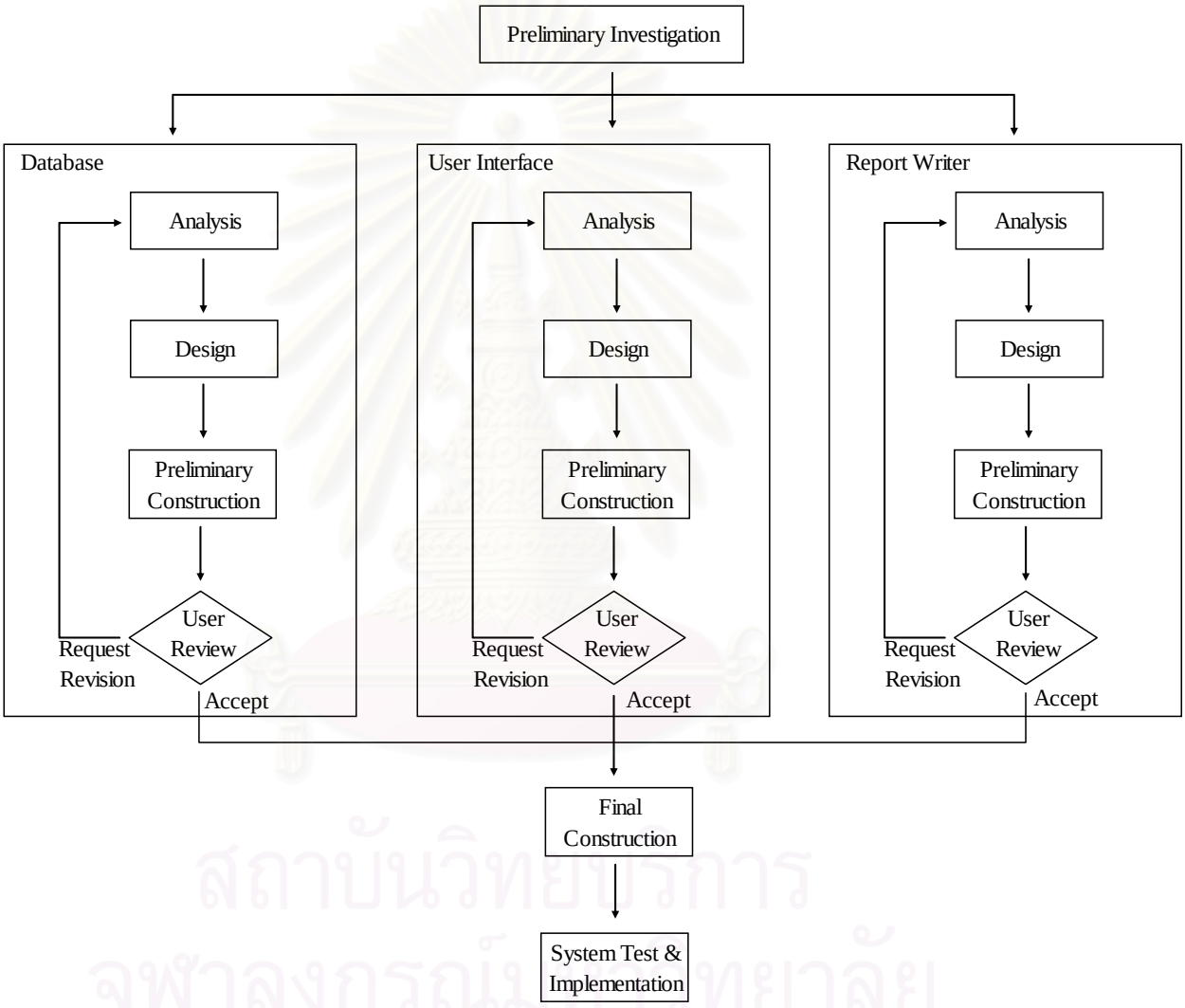


Figure 2.4: Information System Development Phases

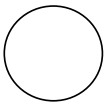
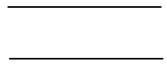
Source: Management Information System [27]

2.1.5 Data Flow Diagram (DFD)

Data flow diagram (DFD), one of the system development tools, graphically represents how data flows through interconnected process in a system by using 4 symbols (see table 2.1). DFD enhances the ability of analyst to understand the system

easier, the ability to communicate at all levels, the possibility to examine the system in overview and at a detailed level, and the ability of analyst to specify the system at the logical level.

Table 2.1: Data Flow Diagram Symbols

Symbol	Definition
	Environmental Elements: Both the source of data and where the system terminates are represented by a rectangle.
	Data Flow: It consists of a group of logically relevant data that goes from one point or one process to another. The arrow symbol is used to illustrate the flow direction of data.
	Process: A process is something that transforms input into output. Each process symbol is identified with a label.
	Data Storage: Data storage, a repository of data, is represented by an open-ended rectangle or an oval as well.

Source: Management of Information Systems [27]

2.1.6 The Role of Information in Problem Solving

The problem itself can be divided into 3 types based on its structure.

1) Structured Problem: The problem that its elements and relationship among elements are understood by problem solver.
2) Unstructured Problem: Opposite to the structured problem, problem solver may not understand this kind of problem at all. Elements and their relationships are unknown.
3) Semi-Structured Problem: Most of problems are neither clearly understood nor completely unstructured. This kind of problem consists of some elements or their relationships that are understood and some that are not.

Problem solving could be considered as a key activity of both management and non-management in a company. The result of problem solving is solution and in

order to get the solution, problem solver needs information. According to Herbert A. Simon, there are 4 stages of problem solving (see figure 2.5) [27]. The first stage is intelligence activity in which information in term of environment condition calling for a solution is gathered. The second stage is design activity. This stage involves with inventing, developing and analyzing all possible courses of actions or solutions. Then the next stage is choice activity which is the stage of selecting the solution. Finally, the forth stage, the review activity is performed to assess the past selected solution.

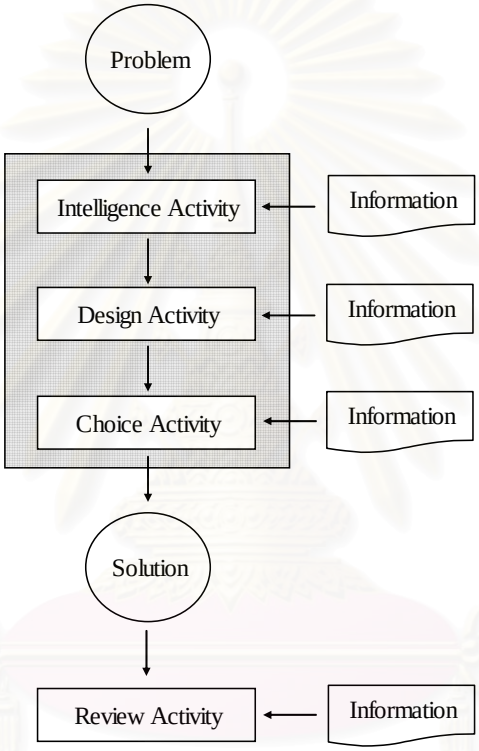


Figure 2.5: Information Supports Each Problem Solving Stages

Source: Management Information Systems [27]

2.1.7 Decision Support System

Decision support system (DSS) is a system that can help human by integrating various sources of information, structuring the decision model, and supporting in making the optimal choices. DSS does not make a decision itself; rather managements or users are the one who makes decision based on choices supported by DSS. DSS consists of 3 mains components: data management, model management, and dialog

management or user interface. Data management system or DBMS consists of necessary relevant data and information. Model management system or MBMS contains one or more models for analysis the performing system. Dialog management is the interface between the system and decision makers or users.

Decision itself can be divided into 3 types.

1) Structure Decision: A decision that relevant data, process, and evaluation can be well specified and finally the decision can be evaluated in a structured way.
2) Unstructured Decision: A decision that consists of a little agreement on relevant data, process, and evaluation nature. Generally, an unstructured decision is not made regularly or it is made in situations in which the environment is not well understood.
3) Semi-Structured Decision: A decision which is in the middle of the former 2 types of decision. There is not much structured in relevant data, process, and evolution and human based judgment still involves. This is the type of decision that DSS focuses on.

There are 3 main important procedures of making a decision.

1) Need Identification: A process of determining why a decision has to be made.
2) Alternative Analysis: Alternatives are analyzed according to variable constraints. At this stage, a what-if analysis is a tool that has been widely used.
3) Decision: The final process is decision making. Decision makers such as DSS users, or managements make a decision that is practical and gives the best desired result by considering the provided alternatives.

2.2 Order Receiving Process

The effectiveness and efficiency of processing customer orders not only ensure market success but also affect overall profitability of a company [14]. Simultaneous with the customer order information is the coordinated information

among departments within the company such as marketing department, accounting department, or production department (see figure 2.6).

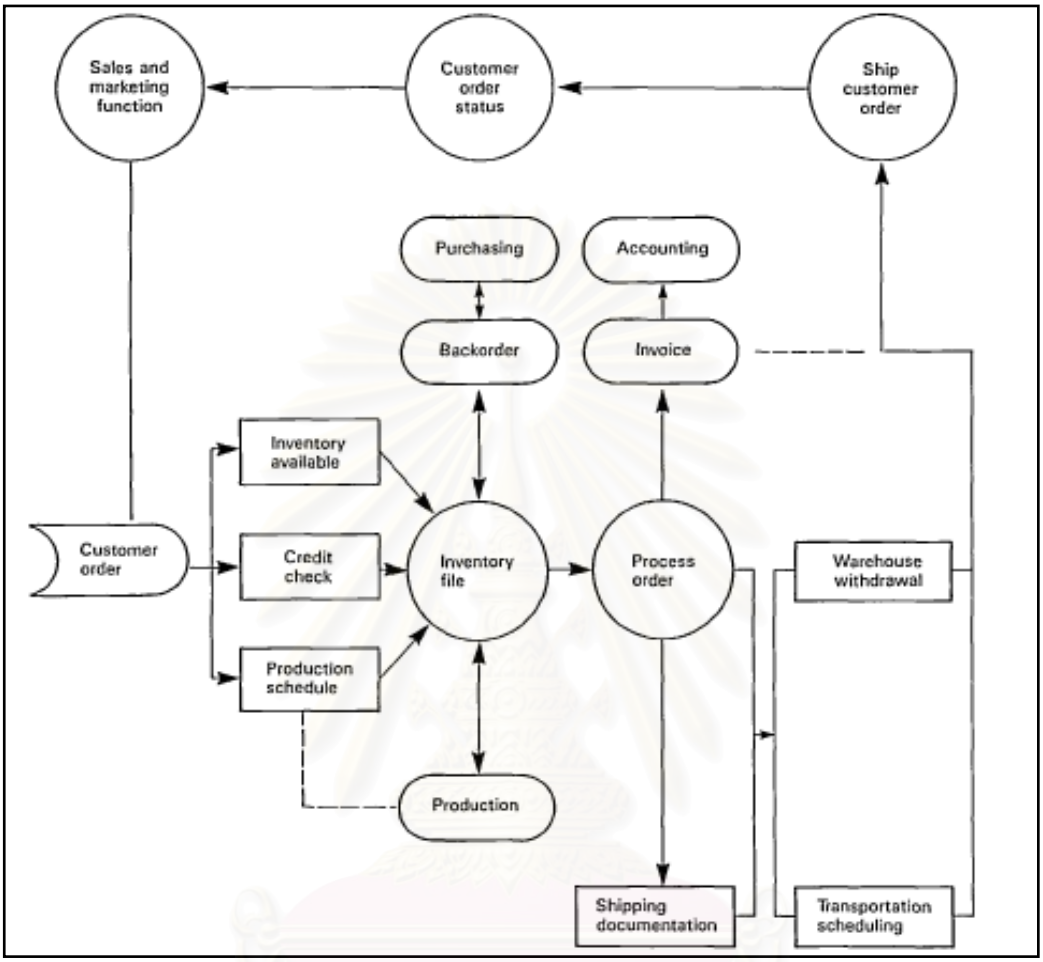


Figure 2.6: The Order Receiving Process Flow Chart

Source: Effective Logistics Management: How Should We Process Orders? [14]

Generally, the order receiving process starts when customer places an order, then company receives, processes the order, and finally delivers the order as the last step. The common approach to view this concept from order placement to order receipt is traditional order cycle depicted in figure 2.7.

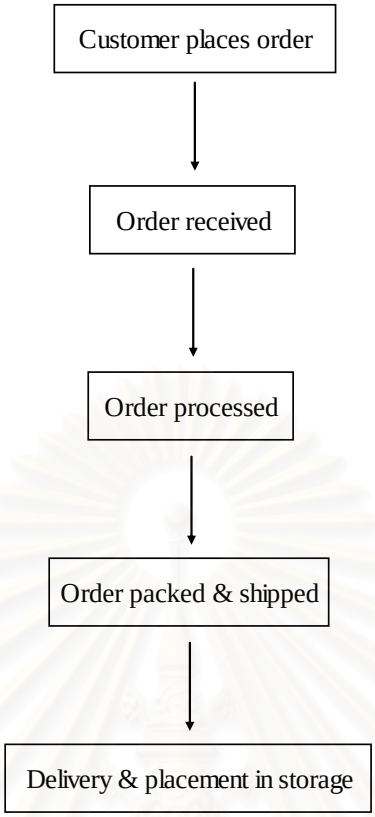


Figure 2.7: Traditional Order Cycle

Source: JIT Needs an Information System [10]

According to John Gattorna *et al*. [14], there are 4 activities to process customer's order.

(1) Order acquisition: No other activity is able to take place until an order is received. The acquisition of customer's order can be divided into 3 stages; order generation, order data recording, and order data transmission. Several ways for recording and transmitting an order to a company are provided once the order is generated. Direct phone calls from customers still the most popular way of transmitting orders. Although many companies record received order into a computer program, some continue to record the order on conventional order form.

(2) Order entry: At present, customer's order entry interfaces with computerized program. Entering an order is interactive and can be immediately accessed by an operator.

(3) Order document processing: There is no identical document processing system. The characteristic of this system depends on the company background, available products, production lines, customer behaviors, and internal data system. In this activity, the document is processed by 2 methods; sequential system or parallel system. The following activity can not be performed until the preceding one is finished in the former system whereas some operations can be performed in parallel in the latter system. Obviously, the major issue of the strict sequential system is that the delays in the early activity create further delays later on.

(4) Order status information: The order status information could be considered as one element of customer service. Expected delivery date, estimated delivery lead time, or revised detail of items cannot be delivered report could be regularly or routinely submitted to customer.

Order receiving process is also important application of cooperative information system because of its relevant with other important business processes such as inventory control, production management, or supply chain management. Figure 2.8 illustrates the order receiving process and its interfaces with other processes.

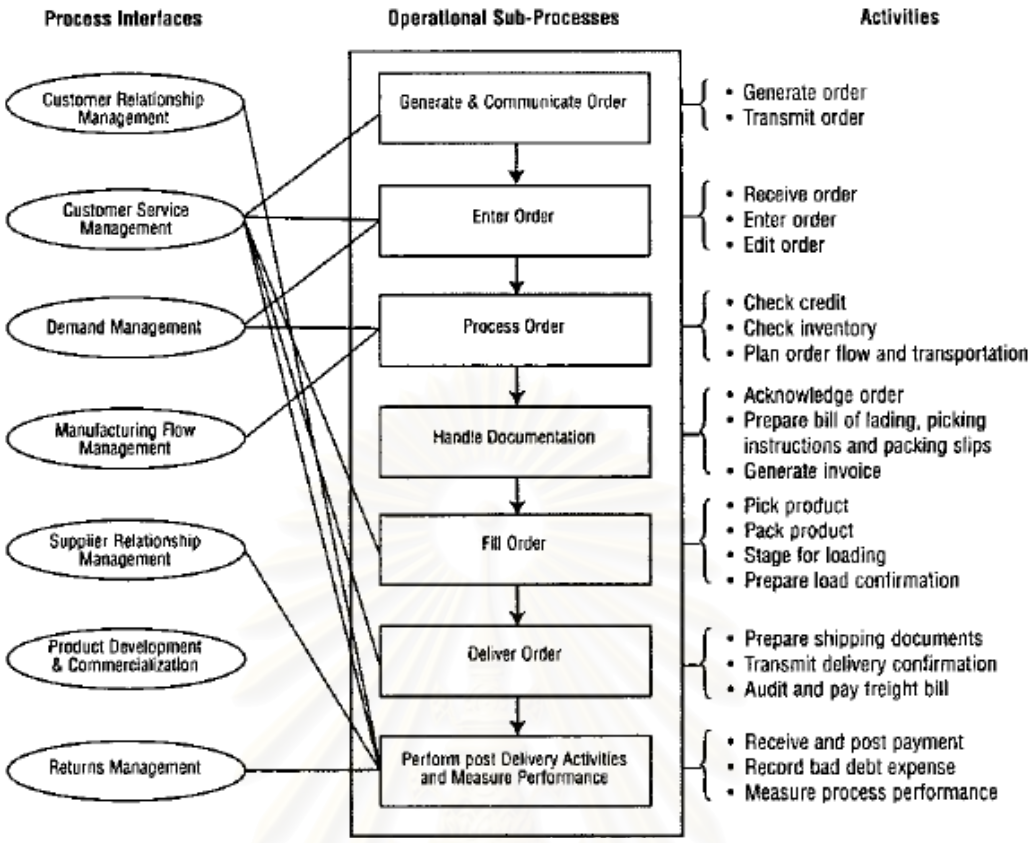


Figure 2.8: The Operational Order Fulfillment Process

Source: The Order Fulfillment Process [9]

From figure 2.8, it could also be implied that the larger quantity of information exchanged, the better the order receiving process's performance should be. Upon a company receives an order from a customer, both internal and external information are generated. Order detail, payment method, inventory level, production capacity, transportation, or delivery time is an example of order receiving process's information. Unreliability of this information also means uncertainty to the customer. Therefore, to measure the quality of order receiving process information, the variables of in time, accurate, convenient to access, and reliable are used.

- In time – arrives in the agree time or before lead time is frozen
- Accurate – free from obvious mistakes
- Convenient to access – easy access without further processing
- Reliable – the probability that an order remains unchanged

Variable	Definition – order information quality	Definition – forecast information quality	Source (order information quality)
In time	Arrives in the agreed time – before lead time is frozen	Arrives in the agreed time – within the supplier's planning horizon	English (1999), Lindau (1995)
Accurate	Free from obvious mistakes	Free from obvious mistakes	Byrne and Markham (1991), Croxton (2003), English (1999), Petersen (1999), Whipple *et al.* (2002)
Convenient to access	Easy access without further processing	Easy access without further processing	Closs *et al.* (1997), English (1999), Keebler *et al.* (1999), Moberg *et al.* (2002), Petersen (1999),
Reliable	The probability that an order remains unchanged	The probability that a forecast remains unchanged	Mattsson (2002), Moberg *et al.* (2002)

Figure 2.9: Variables to Measure Information Quality

Source: Measuring Information Quality in the Order Fulfillment Process [13]

2.3 Work Measurement

2.3.1 Introduction to Work Measurement

Work measurement is one technique of work study which is a valuable tool of management for systematically raising the productivity of a plant or an operating unit.

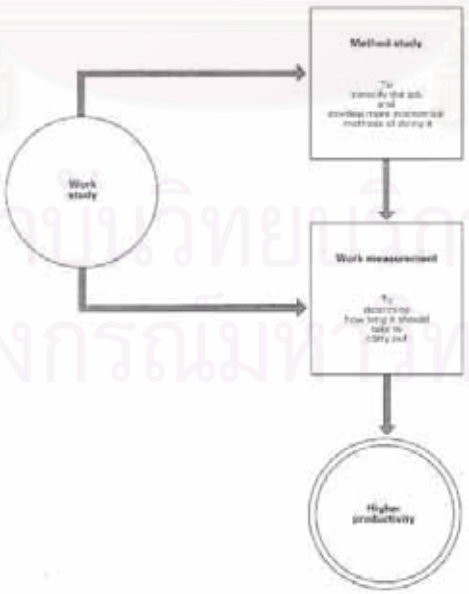


Figure 2.10: Work Study Techniques: Method Study and Work Measurement

Source: Introduction to Work Study [23]

The definition of work measurement according to the British Standards Institution is “the application of technique designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance”. It involves with determining the length of time it should take to finish the work and establish that time into standards. Setting standard time is vital for further analysis of; for instance, capacity planning, process design, scheduling, estimate labor costs, and budgeting. Richard Chase *et al* [6] and George Kanawaty [23] described that standard time is necessary for several reasons.

1) To schedule work and allocate capacity.

2) To provide an objective basis for motivating the workforce and measuring a worker’s performance.

3) To evaluate performance of existing contracts.

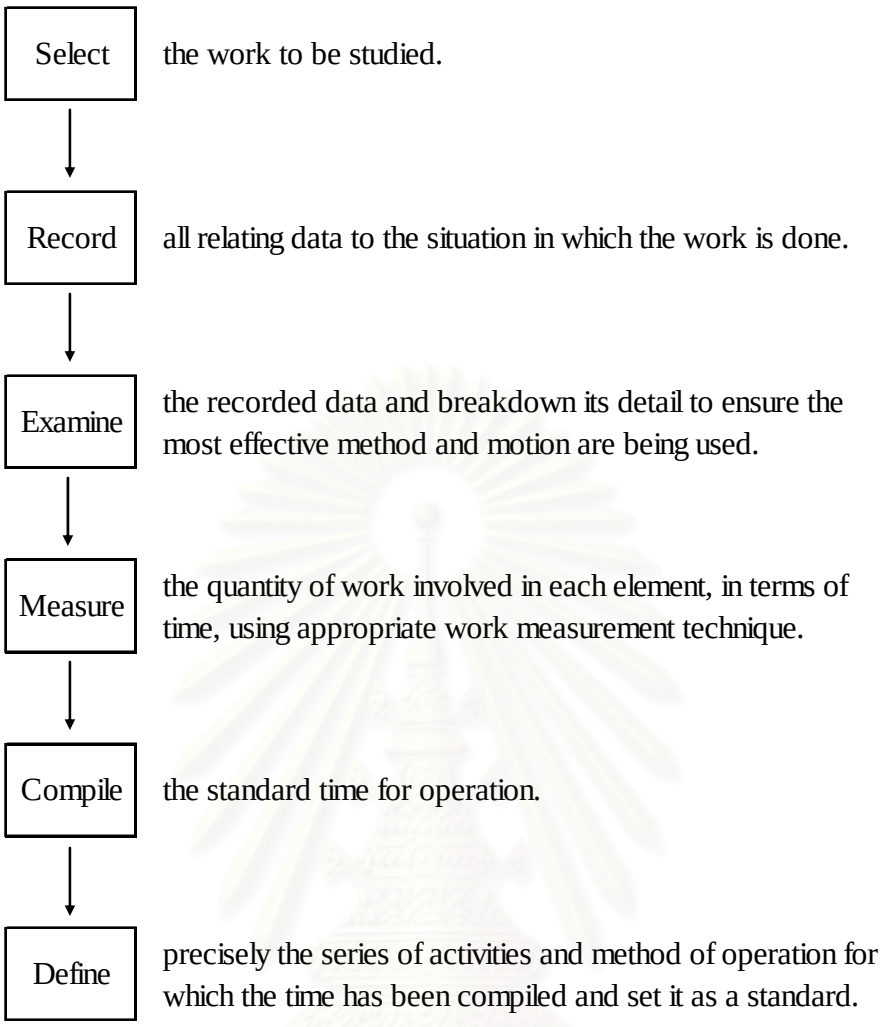
4) To provide benchmark for improvement.

5) To provide the basis for production planning and control.

6) To provide information for production cost and labor-cost control and to enable standard costs to be fixed and maintained.

7) To provide information that can enable selling price and delivery date estimation.

To carry out work measurement, there are 6 basic procedures:



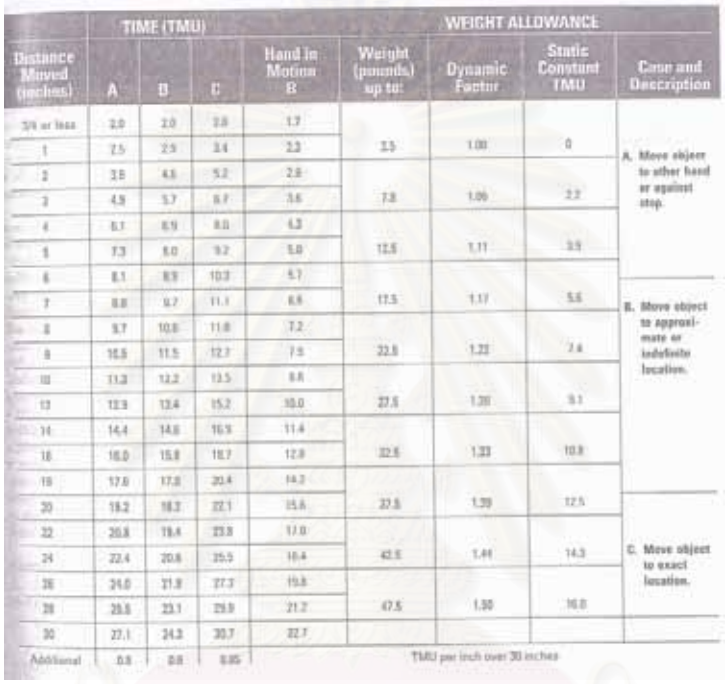
2.3.2 Work Measurement Techniques

Generally, there are 4 basic techniques which are commonly used for measuring work and setting standards. The 4 basic techniques are predetermined time standards, standard element times, work sampling and time study. The first two techniques are considered as indirect method while the latter two are considered as direct method. The appropriate choice of techniques depends on the level of desired detail and the nature of the work itself. Generally, highly detailed and repetitive work is usually measured by time study or predetermined time standard. When work is performed with fixed-processing-time equipment, standard element time method is used. And when task involves with a long cycle time, work sampling is the choice.

(i) Predetermined Time Standards: This technique either uses generic movement times generated in laboratory or utilizes previous published and widely accepted standard element times. One of the most widely used systems throughout the

world is Methods Time Measurement (MTM) which is based on a research of basic elemental motions and times. By this approach, the work must be divided into its basic elements or motions, rated for the difficulty, and then compare with the appropriate MTM data table for assigning time measurement units (TMUs) to finally obtain the standard time for each element or motion.

Table 2.2: Example of Method Time Measurement (MTM) Table



Distance Moved (inches)	TIME (TMU) A	B	C	Hand in Motion B	WEIGHT ALLOWANCE Weight (pounds) up to:	Dynamic Factor	Static Constant TMU	Case and Description
3/4 or less	2.0	2.0	2.0	1.7				
1	2.5	2.9	3.4	2.3	2.5	1.00	0	A. Move object to other hand or against stop.
2	3.6	4.6	5.2	2.9				
3	4.9	5.7	6.7	3.6	7.5	1.06	2.2	
4	6.1	6.9	8.0	4.3				
5	7.3	8.0	9.2	5.0	12.5	1.11	3.9	
6	8.1	8.9	10.3	5.7				
7	8.9	9.7	11.1	6.5	17.5	1.17	5.6	B. Move object to approximate or indefinite location.
8	9.7	10.6	11.8	7.2				
9	10.5	11.5	12.7	7.9	22.5	1.22	7.4	
10	11.3	12.2	13.5	8.6				
12	12.9	13.4	15.2	10.0	27.5	1.28	9.1	
14	14.4	14.6	16.9	11.4				
16	16.0	15.8	18.7	12.8	32.5	1.33	10.8	
18	17.6	17.0	20.4	14.2				
20	19.2	18.3	22.1	15.6	37.5	1.39	12.5	
22	20.8	19.4	23.8	17.0				
24	22.4	20.6	25.5	18.4	42.5	1.44	14.3	C. Move object to exact location.
26	24.0	21.8	27.3	19.8				
28	25.5	23.1	29.0	21.2	47.5	1.50	16.0	
30	27.1	24.3	30.7	22.7				
Additional	0.8	0.8	0.85	TMU per inch over 30 inches				

Source: Operations Management [37]

Predetermine time standards method has several advantages. First, they are established in a laboratory where the actual activities are not interrupted by direct observation. Next, since the standards are set prior to the work is performed, it is useful for planning. Third, there is no need for performance rating. Finally, they are based on large numbers of workers under controlled environments. However, there is one important disadvantage of this technique: that is, it is necessary to have a skillful and well trained analyst. This technique is particularly useful for very short repetitive time cycles such as assembly work in the electronics industry.

(ii) Standard Element Times: The times established from this technique derived from the historical study data. The following steps are the procedure of using standard element times technique.

1) Analyze the work to identify its elements.

2) Check the historical records, and record them. Use time study to obtain others, if necessary.

3) Modify record times, if necessary.

4) Sum the times of all elemental works to obtain the normal time, and factor in allowances to obtain standard time.

There are several advantages of this technique. One of them which can be obviously noticed is the potential of cost and effort saving since there is no need to conduct a completely new time study for each work. Next advantage, which is similar to predetermine time standards method, is the less disruption of actual operation. Another advantage is that there is no need for performance rating since the times are generally averaged. However, one important disadvantage of this technique according to William Stevenson [37] is that the times may not exist for enough standard elements to make it worthwhile.

(iii) Work Sampling: Work sampling also known as activity sampling is another work measurement technique which was developed by L. Tippet in the 1930s. This technique estimates the proportion or percent of time that a worker or a machine spends on each work by sampling. The random observations are done to record each work that a worker or a machine performs. This technique focuses on determining how workers allocate their times among various activities. The results are counts of a number of times of both activity and non-activity. Work sampling estimates include some degree of error. Hence, management must decide on the desired confidence level and accuracy. In work sampling technique, the most commonly used is 95% confidence level. The procedure of work sampling can be summarized into 5 steps:

1) Cleary identify workers and machines to be studied. And inform the workers and their supervisors the purpose of the studied to avoid awakening of suspicions.

2) Perform a preliminary sample to obtain an estimate of the parameter value (such as percent of time a worker is busy).

3) Calculate the sample size required. Formula below gives the sample size for a desired confidence and accuracy:

$$n = \frac{z^2\, p(1-p)}{h^2}$$

n = required sample size

Z = number of standard normal deviations for the desired confidence level

p = estimated value of sample proportion (of time worker is observed busy or idle)

h = acceptable error level, in percent

An easier way to determine sample size is the read off the number of observations needed directly from a Nomogram as in figure 2.11.

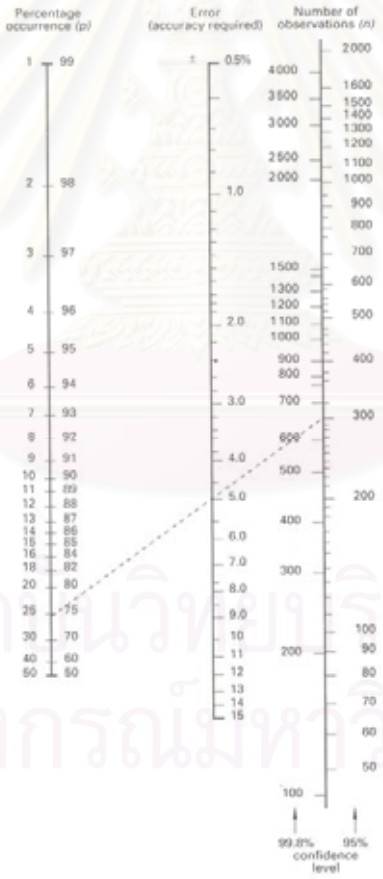


Figure 2.11: Nomogram for Determining Number of Observations

Source: Introduction to Work Study [23]

4) Prepare observation schedule.

5) Observe and record worker activities.

6) Determine the estimated proportion of time spent on each specified activity.

For more understanding of this work sampling method, an example of determining employee time allocation with work sampling is described.

Example1: The manager of one company estimates his employees are idle 25% of the time. He would like to take a work sample that is accurate within 3% and wants to get 95.45% confidence in the results.

Solution: Determine a number of observations from following equation:

$$n = \frac{z^2\, p(1-p)}{h^2}$$

where n = required sample size

Z = 2 for 95.45% confidence level

p = estimated of idle proportion = 25% = 0.25

h = acceptable error of 3% = 0.03

Thus

$$n = \frac{(2)^2\, 0.25\, (1-0.25)}{(0.03)^2}$$

$$= 833 \text{ observations}$$

Then the manager wants to be sure that his employees have adequate time to provide prompt and helpful service. He believes that the service for clients deteriorates rapidly when employees are busy more than 75% of the time. So, he does not want his employees to be occupied with client service activities more than 75% of the time.

Solution: Define “work” and then execute observations.

No. of Observations	Activity
485	On the phone or meeting with a client
126	Idle
62	Personal time
23	Discussion with supervisor
137	Filing, meeting, and computer data entry
833	

The analyst concludes that from 833 observations, 188 observations (126 idle and 62 personal time) are not work related. Since 188/833 = 22.6% is less than the manager target to ensure a high service level. Therefore, he should find a way to reduce workloads, reassignment of responsibilities, or hiring additional manpower.

Example2: Calculating standard time from work sampling.

Information	Activity	Data for One Day
Total time expended by operator (working time and idle time)	Computer payroll system	480 minutes
No. of parts produced	Inspection department	420 pieces
% Working time	Work sampling	85%
% Idle time	Work sampling	15%
Average performance index	Work sampling	110%
Total allowances	Compnay time-study manual	15%

$$\text{Standard time per piece} = \frac{\left(\begin{array}{c}\text{Total time}\\ \text{in minutes}\end{array}\right) \text{x} \left(\begin{array}{c}\text{Working time}\\ \text{proportion}\end{array}\right) \text{x} \left(\begin{array}{c}\text{Performance}\\ \text{index}\end{array}\right)}{\text{Total number of pieces produced}} \text{ x } \frac{1}{\text{1-Alllowances}}$$

$$= \left(\frac{480 \text{ x } 0.85 \text{ x } 1.10}{420}\right) \text{ x } \left(\frac{1}{1 - 0.15}\right)$$

$$= 1.26 \text{ minutes}$$

Work sampling provides several advantages. First, it is less expensive comparing with time study technique since one analyst can simultaneously observe several workers and no timing device is required. Second, unlike predetermined time standards method, it is not necessary for highly skill or well trained analyst. Next, work sampling uses sudden observations over a long period and does not proceed interferingly, so it is unlikely to affect the study's results. Fourth, the temporarily

delay of the study results in a little effect. In contrast, there are some drawbacks as well. First, this technique does not appropriate with work that has short cycle time. Also, because it is less intrusive, it tends to be less accurate. Third, if the analyst does not follow random routes of observation, it could yield biased or incorrect results. Finally, this method does not breakdown elements of work as complete as time study method which will be discussed in next.

(iv) Time Study: Time study was introduced by Frederick Taylor in 1881 and is still the most widely used method of work measurement especially for short and repetitive works. Generally time study is made with a stopwatch, a study board, or time study forms, either by direct observation or from a videotape analysis. Taking a time study requires a regular form consisting of element codes, descriptions, rating, and element durations. These data could be recorded in the plain paper, however, it is more convenient to use a standard form to ensure that each study is of the same consistent format, that all relevant data are recorded, and that the completed studies is more reliable.

Table 2.3: Example of Time Study Sheet

Time study top sheet

Department:	Study No.: Sheet No.: of
Operation: MS No.:	Time off: Time on: Elapsed time:
Plant/Machine: No.:	Operative: Clock No.:
Tools and gauges:	Studied by: Date:
Product/Part: No.: DWG No.: Material: Quality:	Checked:

Note: Sketch the workplace layout/set-up/part on the reverse, or on a separate sheet and attach.

Element description	R	WR	ST	BT	Element description	R	WR	ST	BT

Note: R = Rating. WR = Watch reading. ST = Subtracted time. BT = Basic time.

Source: Operation Management [37]

There are 8 steps of procedure to establish time standard using time study technique.

1) Define the work to be studied. Record all information available about the work, the operative, and the surrounding conditions which are possible to affect the study.

2) Breakdown the work into elements that still can be timed and recorded.

3) Decide the samples needed to be measured.

To determine the sample size or a number of readings that must be made for each element in order to give the desired confidence level of 95.45% and with accuracy of ±5% error margin, the following equation below is used.

$$n = \left(\frac{40 \sqrt{n' \sum x^2 - (\sum x)^2}}{\sum x} \right)^2$$

where n = required sample size

n' = number of readings taken in the preliminary study

x = value of readings

Other than statistical method, a conventional guide for determining a number of cycles to be timed is also used by some researchers and some companies (see table 2.4).

Table 2.4: Number of Recommended Cycles for Time Study

Minutes per cycle	To 0.10	To 0.25	To 0.50	To 0.75	To 1.0	To 2.0	To 5.0	To 10.0	To 20.0	To 40.0	Over 40
Number of cycles recommended	200	100	60	40	30	20	15	10	8	5	3

Source: Introduction to Work Study [23]

4) Time and record the work. At the same time, rate the worker's performance.

There are 2 main methods of timing with stop-watch: cumulative timing and flyback timing. For cumulative timing, the watch starts at the beginning of the study and then runs continuously throughout the study until the whole study is completed. The individual element times are obtained by successive subtractions after the study is completed. For flyback timing, each element is timed separately. The hands of the stopwatch are returned to zero at the end of each element and are allowed to start immediately.

5) Compute the average actual observed time. The average observed time is the times for each work element measured, and can be calculated as the following equation.

$$\text{Average observed time} = \frac{\sum x_i}{n}$$

$\sum x_i$ = sum of the times recorded to perform each element

n = number of observations

6) Determine performance rating and then calculate for normal time of each element.

Normal time is the observed time adjusted for worker performance to make it usable for all workers. It is computed by multiplying the observed time by a performance rating. That is,

Normal time = (Average observed time) x (Performance rating factor)

Rating is the assessment of worker's rate of working relative to the analyst's concept of the rate corresponding to standard pace. When assessing performance, the analyst must compare the observed

performance with the concept of normal. Obviously, performance rating could be the source of conflict between labor and management. Although no one has been able to suggest a way around this matter, sufficient training of analysts can result in a high degree of consistency in ratings. Also, in order to avoid any bias, a second analyst may be called in to together do performance rating.

A normal rating is 1.0. A performance rating of 0.9 indicates a speed that is 90% of normal, where as a rating of 1.10 indicates a speed that is slightly faster than normal or than average. For example, if a worker performs a task in 5 minutes and the analyst rates his performance as 20% higher than normal or than average. The normal time would be 5x1.2 = 6 minutes.

7) Add the normal times for each element to develop a total normal time for the work.

8) Compute the standard time.

Standard time is derived by adding to normal time allowances for personal needs (such as washroom and coffee breaks), unavoidable work delays (such as equipment adjustment, machine breakdown, and lack of materials), and worker fatigue (physical or mental). Allowances can be based on either job time or time worked (e.g. a workday). If the allowances are based on the job time, the standard time is

$$\text{Standard time} = \text{Normal time} \left(1 + \text{Allowance Factor} \right)$$

If the allowances are based on a percentage of the time worked, the appropriated standard time formula is

$$\text{Standard time} = \frac{\text{Total normal time}}{1 - \text{Allowance factor}}$$

In practice, allowances may be based on the judgment of analyst or negotiation between labor and management. Nonetheless, personal allowances are often in the range of 4% to 7% of total time depending on the distance to the restroom or to the canteen whereas delay allowances and fatigue allowances are based on actual studies of the delay that occurs and the knowledge of human energy expenditure respectively. Table 2.5 below shows typical allowances in percentage for various classes of work.

Table 2.5: Typical Allowance Percentages for Working Conditions

	Percent		Percent
A. Constant allowances:		4. Bad light:	
1. Personal allowance	5	a. Slightly below recommended	0
2. Basic fatigue allowances	4	b. Well below	2
B. Variable allowances:		c. Very inadequate	5
1. Standing allowance	2	5. Atmospheric conditions (heat and humidity)—variable	0–10
2. Abnormal position allowance:		6. Close attention:	
a. Slightly awkward	0	a. Fairly fine work	0
b. Awkward (bending)	2	b. Fine or exacting	2
c. Very awkward (lying, stretching)	7	c. Very fine or very exacting	5
3. Use of force or muscular energy (lifting, pulling, or pushing):		7. Noise level:	
Weight lifted (in pounds):		a. Continuous	0
5	0	b. Intermittent—loud	2
10	1	c. Intermittent—very loud	5
15	2	d. High-pitched—loud	5
20	3	8. Mental strain:	
25	4	a. Fairly complex process	1
30	5	b. Complex or wide span of attention	4
35	7	c. Very complex	8
40	9	9. Monotony:	
45	11	a. Low	0
50	13	b. Medium	1
60	17	c. High	4
70	22	10. Tediousness:	
		a. Rather tedious	0
		b. Tedious	2
		c. Very tedious	5

Source: Operation Management [37]

Although time study provides accuracy of setting standard time, there are some limitations of this technique as well. First, to do time study, it requires well trained and skillful analyst. Second, the standard time can not be set up until the actual works are performed. Also, this method disrupts the normal work routine, and workers may resent it in many cases.

For more understanding of this time study method, an example of computing standard time by this method is described.

Example1: One company promotes its management development seminar by mailing thousands of individually composed and typed letters to various firms. A time study has been conducted on the task of preparing letters for mailing. On the basis of the following observations, the company wants to develop a time standard for this task. The personal, delay, and fatigue allowance factor is 15%.

	Observations (in Minutes)					
Job Element	**1**	**2**	**3**	**4**	**5**	**Performance Rating**
A) Compose and type letter	8	10	9	21*	11	120%
B) Type envelope address	2	3	2	1	3	105%
C) Stuff, stamp, seal and sort envelopes	2	1	5*	2	1	110%

Solution:

1) Delete unusual observations which are those with an asterisk (*).

2) Compute the average time for each work element.

$$\text{Average time for A} = \frac{8 + 10 + 9 + 11}{4} = 9.5 \text{ min.}$$

$$\text{Average time for B} = \frac{2 + 3 + 2 + 1 + 3}{5} = 2.2 \text{ min.}$$

$$\text{Average time for C} = \frac{2 + 1 + 2 + 1}{4} = 1.5 \text{ min.}$$

3) Compute normal time for each work element.

Normal time = (Average observed time) x (Performance Rating)

Normal time for A = 9.5 x 1.2 = 11.4 min.

Normal time for B = 2.2 x 1.05 = 2.31 min.

Normal time for C = 1.5 x 1.10 = 1.65 min.

4) Compute the total normal time by adding the normal times of each element.

Total normal time = 11.40 + 2.31 + 1.65 = 15.36 min.

5) Compute standard time for the work.

$$\text{Standard time} = \frac{\text{Total normal time}}{1 - \text{Allowance factor}}$$

$$= \frac{15.36}{1 - 0.15} = 18.07 \text{ min.}$$

2.3.3 Weighted Mean

The arithmetic mean is the most frequently used measure of central location. However, in some cases there is a reason to weight data values differently such as when there are several observations of the same value. Weighted mean is computed by:

$$\text{Weighted Mean } (\bar{x}_w) \quad \frac{\sum w_i x_i}{\sum w_i}$$

where w_i = weight of ith data value

x_i = ith data value

2.4 Literature Review

Every company has to deal with complexity of both external and internal factors especially the surrounding of intense and competitive market environment that can weaken the company efficiency and growth opportunity. In order to be able to compete with competitors, improve competitive advantage, and strengthen survival ability; the development of information system is required. The information system has been recognized for creating and sustaining competitive advantage of a company [16]. It enhances the company's ability to meet objectives and goals. According to their study, Donald Falconer and Alan Hodgett [11] found that most of large Australian companies recognize for the value and importance of the information system and are undertaking the information system strategic planning.

Information system began to evolve in late 1960s [24]. Beynon-Davies P. [31] defined information system as "a system involved in the gathering, processing, distribution and use of information and as such support human activity systems".

Information system has been developed with the assist of different computer programs, such as Visual Basic or Delphi, and use Microsoft Access or SQL to support the database. Its benefits have been studied by a great number of researchers to help find solutions in regards to their subjects as described below:

Many researches are found focusing on developing information system to improve sales efficiency in many kinds of industry [21,34,35]. The newly developed information system is used to solve the problem of error in customer data collection, to reduce the time in managing data of purchase contract, to eliminate the problem of outdated and duplication of customer information, or to improve the current unsystematic database system. The orderly organized, updated, and adequate data as a result of the information system development reveals several advantages such as the improvement of sales decision making, the increase of officers' performances, the high potential in customer services, the reduction of delay delivery, and more recent and efficient report to management.

The implementation of information system also plays an important role in improving purchasing efficiency and scheduling delivery time [7,39] . To solve problems of unable to schedule product delivery time, wrong material orders, long lead time in finding relevant information, and insufficient data in supporting material and supplier selection, which are caused by the lack of systematic data provided, the information system is developed to orderly collect and organize all necessary data to help automate the flow and provide all recent and efficient business information needed to be considered.

The information system was also developed to help collecting and managing essential data in production used for estimating manufacturing cost in Jewelry industry [2]. As a consequence, benefits of systematic data collection and accurate cost analysis enhance the effectiveness of pricing strategy, cost control, and management decision and control.

Technical related aspect such as quality of performance test is also researched to improve its efficiency by implementing information system [41]. The existed lengthy report system was replaced by the information system development. The implementation helped achieve in real time result analysis, more standard report with less reporting procedures, faster response to problems, and defect reduction. Maintenance evaluation system of subway is also another technical related aspect that

information system is studied to improve its efficiency [40]. The tunnel structure and track rail normally work under heavy and severe operation, therefore, it is necessary to develop appropriate and efficient information system for managing maintenance information.

Within the university is where the information system is developed as well. With the similar main objectives of helping processing data recording, performing user inquiries and generating report, the information system was designed and developed its structure for a university press [22]. In addition, the newly developed information system also resulted in organized data collection system, reduction of press material shortage, and reduction of excessive quantity of supplied newspapers relatively compared with student demands.

The information system is also developed for rental business such as car rental. Due to the rapidly increasing desire for information system allowing Europe wide exchange and administration of information, distributed information system is studied to deal with complexity of involved enormous qualitative and quantitative data [3]. Furthermore, the information system is also integrated with Radio Frequency Identify (RFID) based on web services to create the information platform which data can through and exchange by internet, reduce business integration barriers, and help accelerate its deployment. The study by Kuo-Shien Huang and Shun-Ming Tang [19] on bike rental business indicates that the implementation of this technique not only provides new business model for the company but also creates the company profit opportunity. That is, it extends the bike rental services since the data can be interchanged among rental locations. In addition, the company can receive report quickly since the system provides real time information with the use of common information system and database which can economize on customers data input or creation.

Several researches also study in developing the information system for managing order process. First, David M. Dilts [10] introduced the just-in-time logistic information system (JIT-LIS) model to deal with the change in JIT environment where revolution in the information system is required. The example of Seat Company for automotive industry who follows this model is described. With the JIT-LIS model, the company is able to dramatically reduce inventory amount, achieve just-in-time deliver seats to automotive assembly plant, and increase the international

competitiveness of the entire industry. Another related research belongs to Linda Hendry [18]. The objective of this research is to develop a decision support system (DSS) named Customer Orders Planning Program for managing customer enquiries for make-to-order sector of British industry. The program presents information that user can easily understand and consider as many customer orders as required. This research indicates that the output of DSS assists in capacity planning, provide realistic delivery date, and control overall shop workload. This also enhances users' ability to not only negotiate with customer for feasible delivery date but also analyze whether special actions are required in order to achieve promised delivery date.

In summary, an information system is widely used in both manufacturing business and non-manufacturing business. The main contribution of information system is to collect all required data into a system where those data will be systematically organized, easily accessed, updated, and logically processed for further utilization and interpretation to eventually provide effective and efficient output or information for a user.

CHAPTER III

BACKGROUND OF THE CASE STUDY COMPANY

This chapter describes information of ABC Company. First, basic information and the company organization are provided. Then in order to have more understanding of the company business, available products, production process, inventory, business and sales characteristic are described. However, this chapter focuses on the company business, production process, and inventory which are necessary for further analysis of problem that the company currently encounters describing in the next chapter.

3.1 Introduction to ABC Company

ABC Company was established in March 1990 with a headquarter located in Samutprakarn province and a distribution branch located in Rayong province. The company manufactures, sales, and rents high quality steel scaffolding and accessories used in the construction industry throughout Thailand and neighboring countries. With the transferred of advanced equipment and production technology from scaffolding manufacture in Japan, ABC is the first and only scaffolding company in Thailand that received the Certificate of Standard from the Thai Industrial Standard Institute (TISI)'s.

3.2 ABC Company Organization

The company divides responsibilities into 3 departments; marketing department, production department, and general management department (see figure 3.1).

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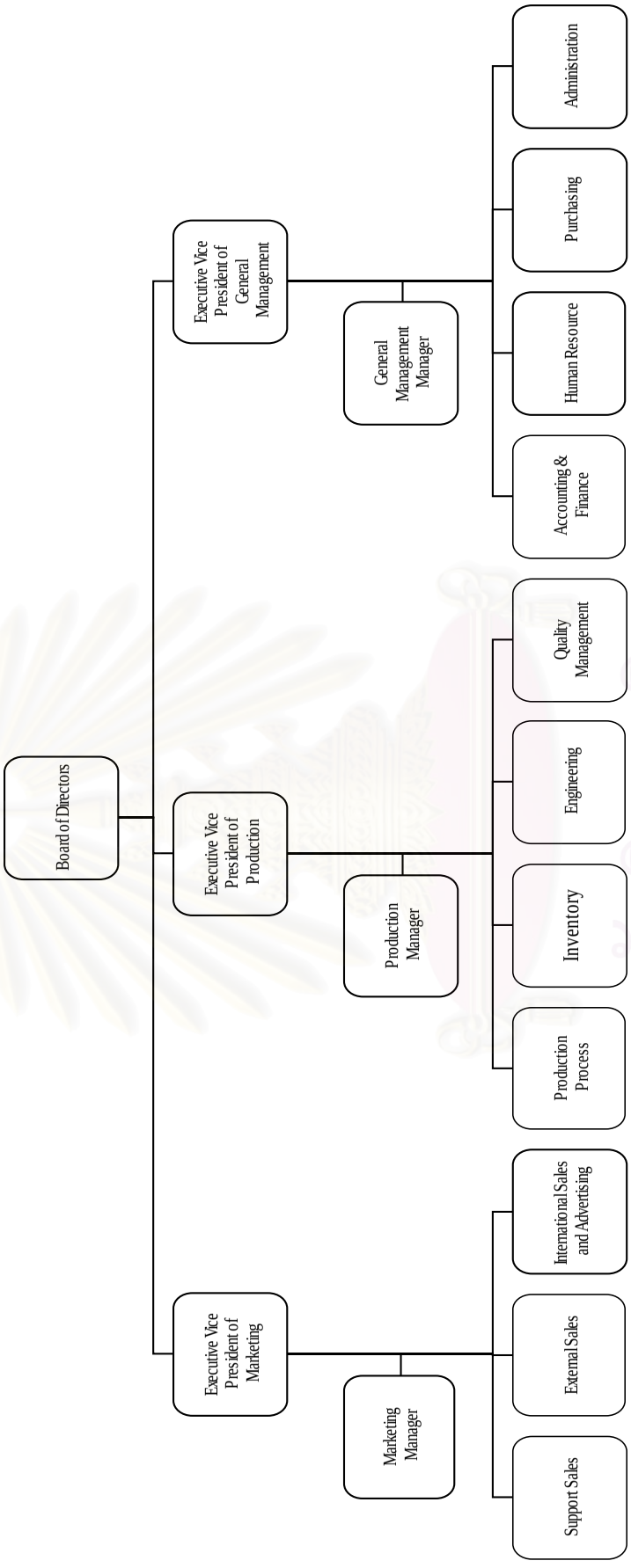

Figure 3.1: ABC Company Organization Structure

3.2.1 Marketing Department

Responsibilities of marketing department includes every activities related to marketing both locally and internationally, customers, and competitors such as pricing strategy, product delivery commitment, market research, competitor information benchmarking, customer feedback improvement, customer service, new product advertising, and product promotion. This department is divided into 3 sections.

I) Support sales section: this section's main responsibilities are to receive order from local customers, and then collaborate with production process section to confirm and commit the deliverable date and quantity of products to customers.

II) External sales section: this section's main responsibilities are to visit local customers to provide company information and collect customers' information and requisitions for further improvement.

III) International sales and advertising section: Although this section's duties cover all responsibilities of support sales section and those of external sales section, this section supports only customers in neighboring countries. Also, this section is responsible for supporting and providing the first 2 sections with advertising and promotion material.

3.2.2 Production Department

Production process, inventory system, product engineering, and quality management are the main duties of this department.

I) Production Process section: this section is responsible for both scheduling production plan and producing products (either by manufacturing or repairing) as soon as possible to finally meet the committed timeline of deliverable date and quantity.

II) Inventory section: this section duties cover confirming the amount of products in every inventory system and reporting to marketing department every morning.

III) Engineering section: this section is responsible for the research, design, and development of the new product.

IV) Quality Management section: this section assures that the quality of products delivered to customers meet the standard and customer expectation. In

addition, internal quality system of the company is also included in this section's responsibilities.

3.2.3 General Management Department

Responsibilities of general management department cover all works which are related to accounting & finance, human resource, purchasing, and administration.

I) Accounting & Finance section: this section is responsible for all activities related with money and accounts; for instance, cost control, billing, payment, loans, etc.

II) Human Resource section: this section involves with recruitment, salary structure, training system, etc.

III) Purchasing section: this section involves with purchasing product component and materials to be used in both office site and production site.

IV) Administration section: this section deals with other miscellaneous responsibilities such as company regulation, documentation.

3.3 Number of Employees

The total employees of 324 are divided into

Head Office: 97 persons

Factory:

Supervisor 21 persons

Staff 406 persons

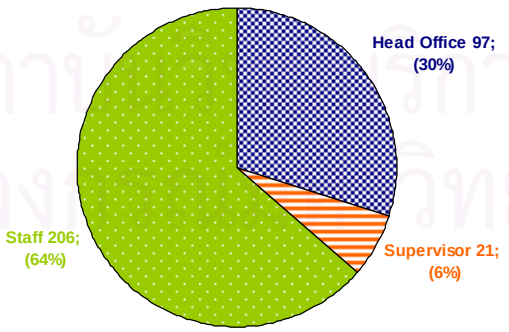

Figure 3.2: Number of Employees

3.4 Product

ABC products can be divided into 4 main groups; scaffoldings, metal form, other accessories, and safety product group.

3.4.1 Scaffolding Group

Scaffoldings are the main products that result in high revenues for the company. They consist of various products such as

- vertical and horizontal frame
- round pipe and square pipe
- steel stairs
- cross brace
- walking panel
- arm lock
- fixed clamp and swivel clamp

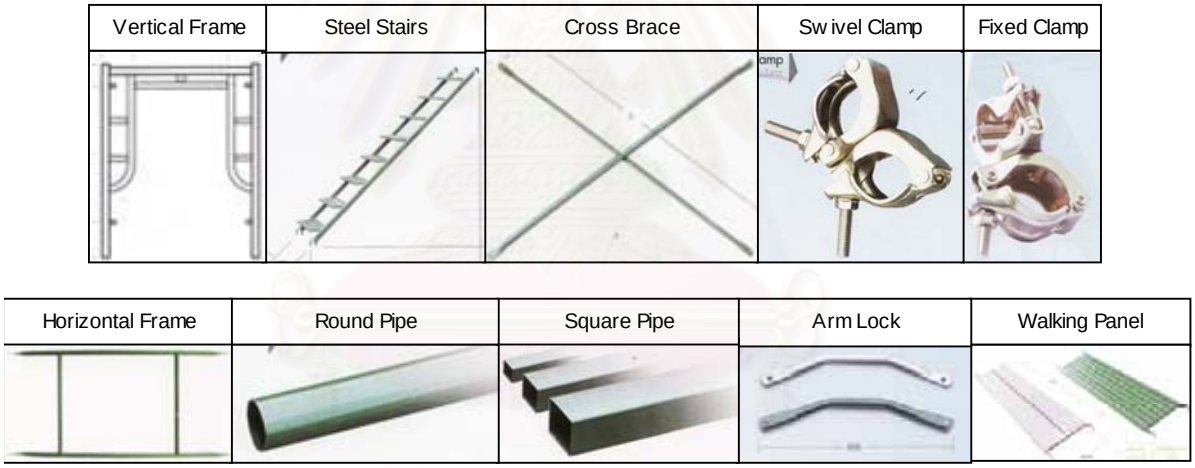

Figure 3.3: Example of Products included in Scaffolding Group

3.4.2 Metal Form Group

This group is the second main products of ABC Company. The products are:

- metal form
- angle corner form
- inside and outside corner form
- U-clip

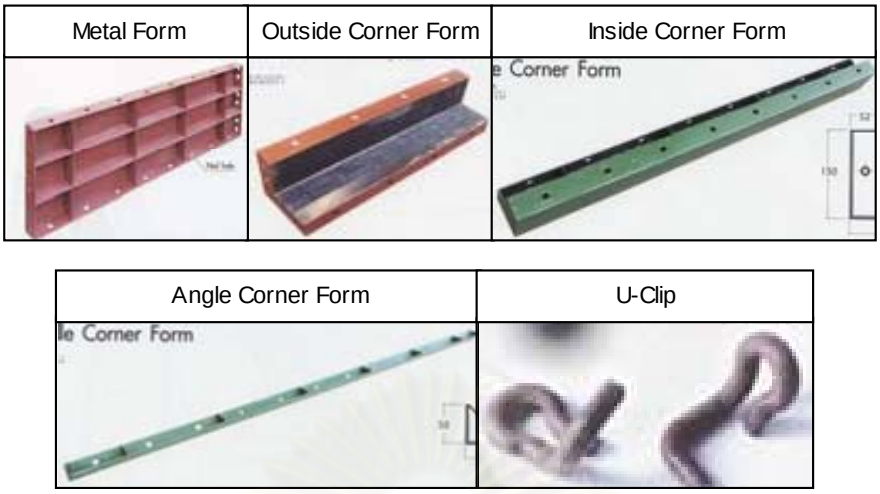

Figure 3.4: Example of Products included in Metal Form Group

3.4.3 Other Accessories Group

This product group is mainly assembled with other products in scaffolding group or metal form group. Many kinds of accessories are available:

- square support
- column clamp
- table form
- temporary fence

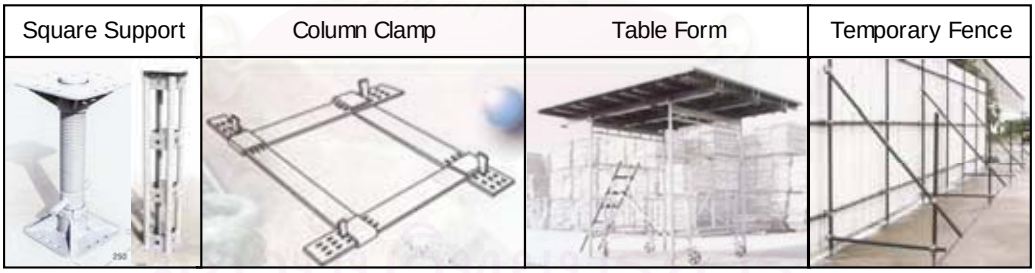

Figure 3.5: Example of Products included in Accessories Group

3.4.4 Safety Group

The main purpose of this safety group is to both prevent workers or other things falling down from the construction site and prevent pedestrians or other people at lower level get injured from those falls as well. The examples of product in this group are as follows:

- Raschel safety net
- protector sheet

- mesh sheet

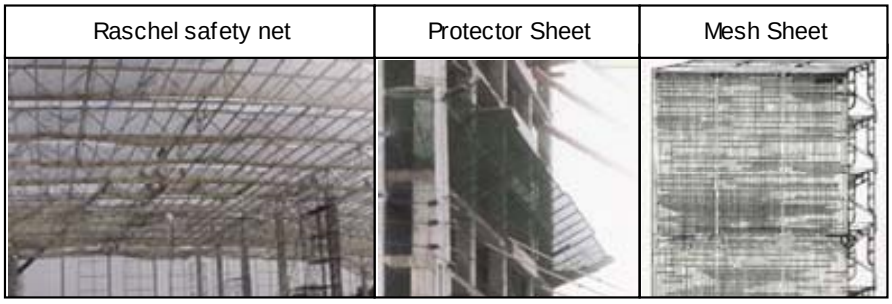

Figure 3.6: Example of Products included in Safety Group

3.5 Business and Sales Characteristic

The business model of ABC Company is quite complicated. The majority of the products are to be rented – at approximately 80% of the time. The remaining 20% is where customers decide to purchase. This has especially resulted in the complexity of production process and inventory system which will be described next in section 3.6 and 3.7 respectively.

Currently ABC divides customers into 7 groups based on the project type that products are used.

1. event: those customers who rent or purchase products for short period activities.
2. decoration: those customers who rent or purchase products for decorating or renovating purposed activities.
3. gas station
4. discount store or convenient store
5. factory
6. condominium: this type of customers also includes those who rent or purchase product for building and school as well.
7. tall building: this type of customers relates with very long project period construction such as tall buildings and express way.

The orders by month of year 2006-2008 are illustrated as in figure 3.7. It shows an increasing trend of customer orders.

Total Order (Units)	January	February	March	April	May	June	July	August	September	October	November	December	Total
Year 2006	563,652	762,595	842,788	363,459	521,566	596,530	698,594	732,409	701,220	713,298	849,380	708,503	8,053,994
Year 2007	1,017,150	882,745	761,341	420,441	705,566	719,119	745,601	796,093	641,759	959,736	964,185	927,962	9,541,698
Year 2008	1,115,804	908,050	1,156,302	784,378	977,254	-	-	-	-	-	-	-	4,941,788

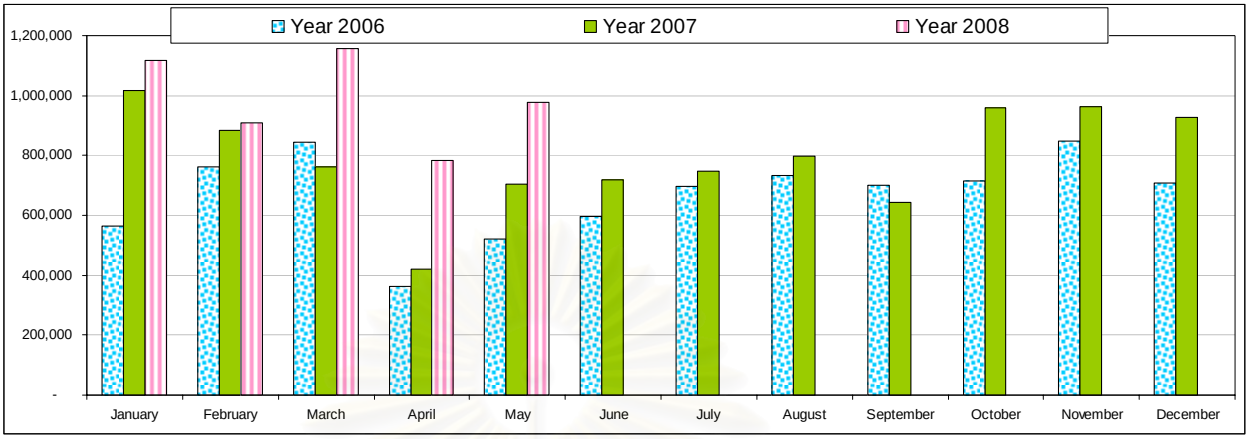

Figure 3.7: Total Order by Monthly of Year 2006 – 2008

3.6 Production Process

Even though, ABC Company aims to have the scaffoldings and accessories by repairing returned goods from customers which costs less, the company continuously manufactures the products in order to meet the customers' rising demand as well. Therefore, the production process can be divided into 2 sectors – repairing products returned from renting customers (repairing process) and manufacturing of new products (manufacturing process).

Repairing process starts with sanding the returned products from customer to clean up the rust or any residue left on surface. Repairing step which includes polishing, bending, welding, and grinding is the next step before the products go to the final step of painting. Unlike the repairing process, manufacturing process starts with cutting the purchased components into the required dimension and shape, then they will be assembled and welded into the product type that customers order, and finally go through painting booth as the final step.

The process flows of repairing process and manufacturing process are depicted in figure 3.8 and figure 3.9 respectively.

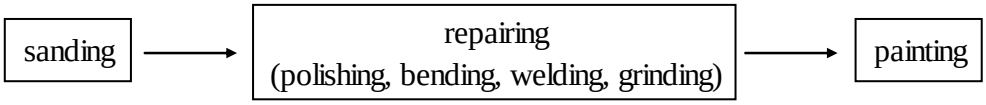

Figure 3.8: Repairing Process Flow

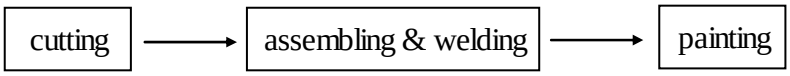

Figure 3.9: Manufacturing Process Flow

3.7 Inventory

Inventory of ABC Company can be quite complicated. Since the main business of ABC is rental scaffolding and accessories, there are 2 more inventories; waiting-for-repair items and at-customer-location products, in the system besides of finished products and work-in-process. The 4 categories of product in inventory can be summarized as below:

1. finished products: in-storage items which are complete and ready to be delivered to customers
2. work-in-process: unfinished items which are in either production process or repair process
3. waiting-for-repair items: in-storage items which are queuing to be repaired
4. at-customer-location products: renting items which are located at customers' site

3.8 Conclusion

From the background of ABC Company, it can be noticed that there are more details and more complicated information related to the 3 main sections of business model, production process, and inventory comparing with other normal businesses. Unlike normal business, in term of business model, 80% of the ABC products are to be rented and only 20% are to be purchased. In term of production process, it consists of 2 processes: repairing process and manufacturing process. Nonetheless, it is one of the company targets to fulfill customers' demands by having products through maximizing repairing process which costs less. In term of inventory, there are 2 more kinds of inventory comparing to normal business: waiting-for-repair items and at-customer-location products.

The more complexity of ABC's business especially of these 3 sections, the harder the company's business decision making and processing. One of the company processes that is directly involved with these 3 sections' complexities is order receiving process. This process uses many sets of information from business model,

production process, and inventory to process customers' orders and fulfill their demands. Also, its efficiency is one of the factor that directly effects the achievement of company targets: on time delivery, fully capacity utilization, and repairing process maximization.

CHAPTER IV

THE ORDER RECEIVING PROCESS OF THE CASE STUDY COMPANY

This chapter discusses about ABC Company order receiving process and its problems. The business process is firstly discussed to give an overview how the rental business is performed. Then, this chapter describes the current order receiving process to explain the flows and the involvement of each department. Finally, the analysis of this process and the summary of the problems causing from the lack of supporting information system are discussed respectively.

4.1 Overall Business Process

The overall business process of ABC Company is illustrated in figure 4.1.

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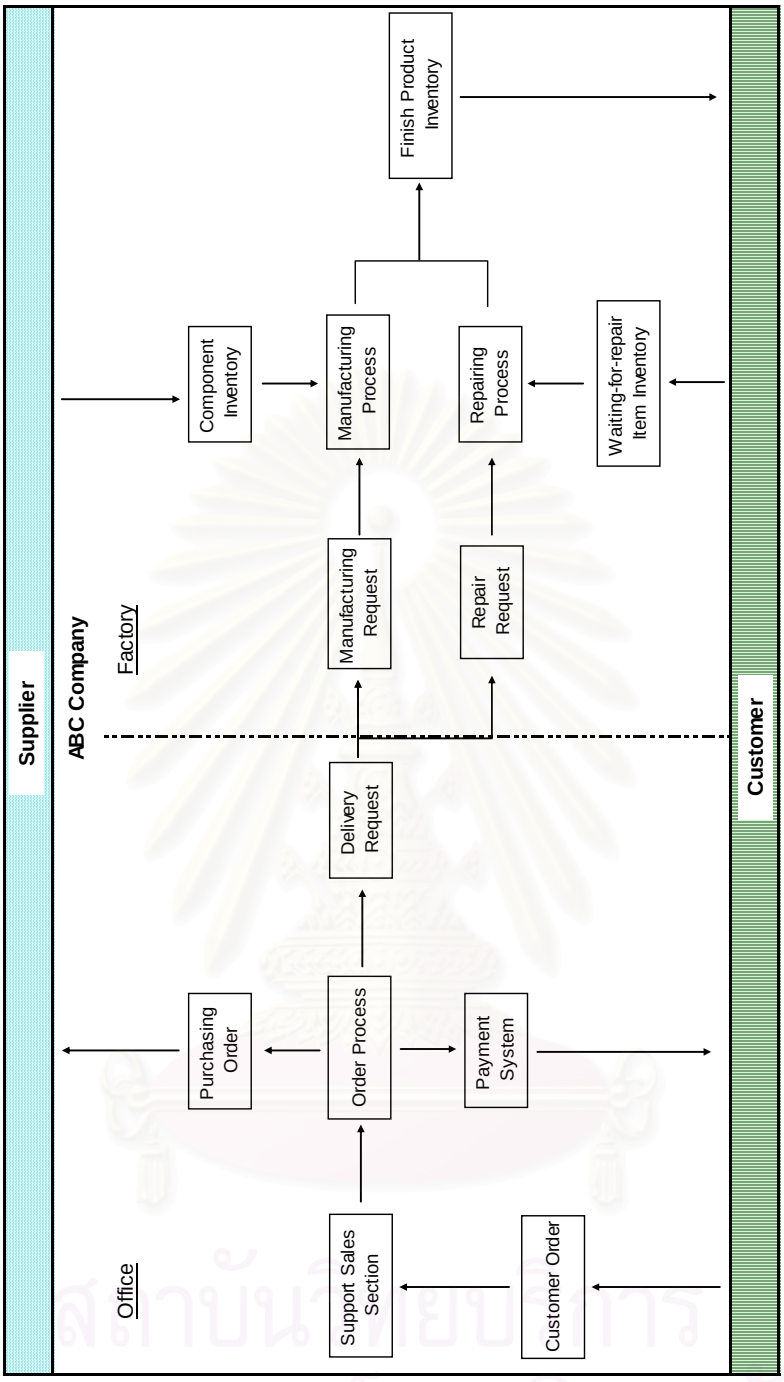


Figure 4.1: Overall Business Process of ABC Company

4.2 Current Order Receiving Process

The current order receiving process involves with 3 departments.

1. Marketing Department: Currently, upon marketing department receives an order from a customer, only 2 categories of inventory are cross-checked manually on paper documents submitted from production department to decide whether the order will be completed, whether the product can be

delivered on time, or whether the required order quantity will be finished. The 2 categories are:

1) finished products (in-storage items which are complete and ready to be delivered to customers): includes daily quantity of finished products ready to be delivered. The record is done on paper document without any systematic clarification of how many have been included in that day's order.

2) waiting-for-repair items (in-storage items which are queuing to be repaired): includes daily items waiting to be repaired. The quantity is recorded on paper document without information of when the products will be scheduled for repair or when they will be completed.

Then, the order is passed to production department and shop floor in order to prepare the products within the timeline given to customer. In other words, the order is forwarded or pushed to the next step of production to either repair or manufacture the products as soon as possible. In addition, if the quantity in finished products and waiting-for-repair items are less than the order quantity, marketing department must inform general management department the purchase detail as well.

2. Production Department: This department submits finished products and waiting-for-repair items inventory data sheets to marketing department everyday. In addition, production department's staffs use their own experiences in determining the possible finished date and quantity to support marketing department in promising product deliverable date and quantity. Also, after receiving repairing detail and manufacturing detail from marketing department, production department schedules both repairing process and manufacturing process to fulfill customer orders within the timeline that marketing department has given to customers.
3. General Management Department: Purchasing section receives purchasing detail from marketing department. Then this section orders components and materials from suppliers in order to support production department scheduling in manufacturing process.

To help understanding ABC's current order receiving process, a flow chart of overall flow is illustrated in figure 4.2.

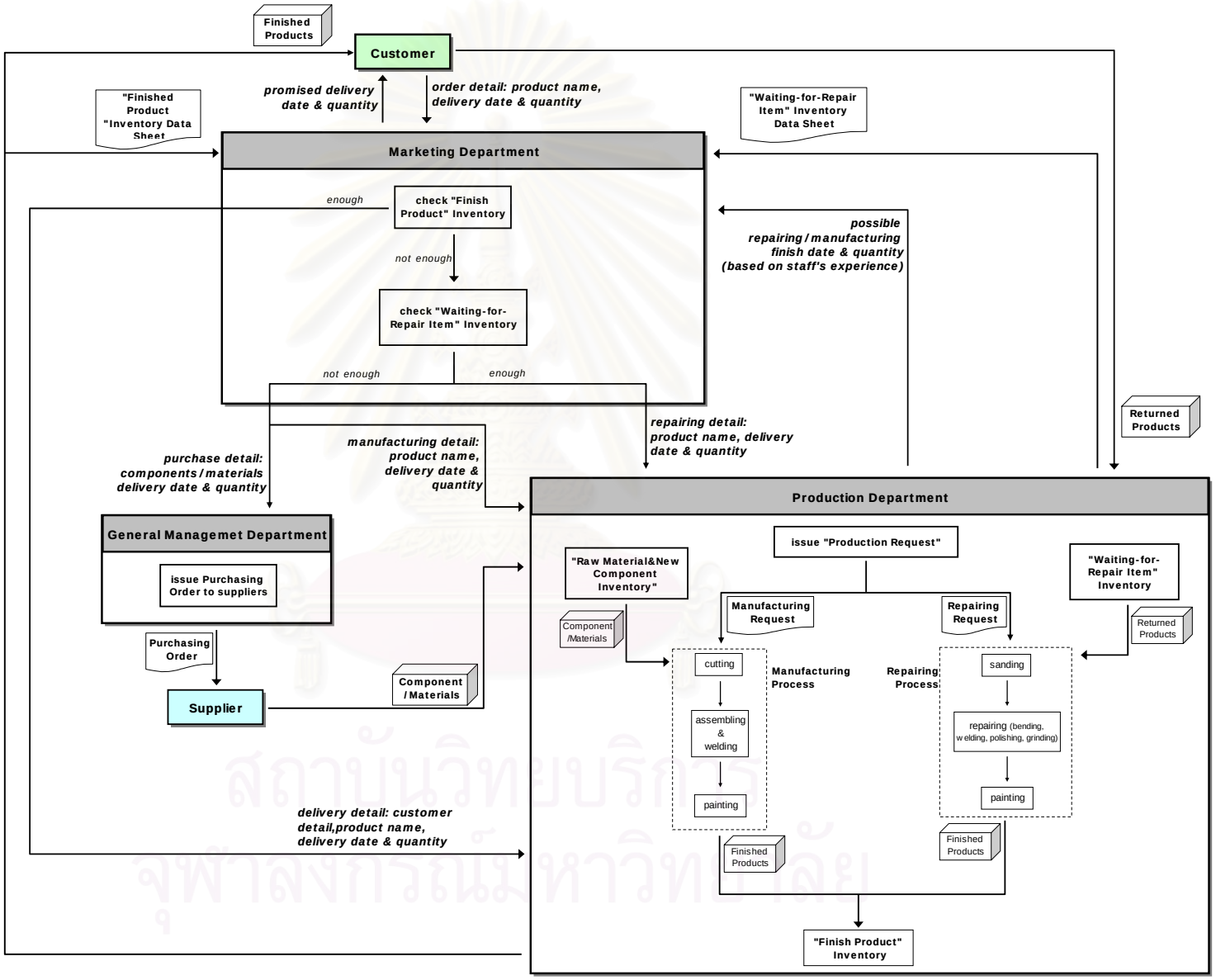


Figure 4.2: Current ABC Company Order Receiving Process Flow

4.3 Problem Analysis of Current Order Receiving Process

To be able to compete in the rental business, ABC aims to achieve 3 main indicators; on time delivery, fully-utilized production capacity (both manufacturing process and repair process), and maximum available product from repairing process. Successful achievement of those indicators requires efficient and adequate information available to be analyzed in order receiving process in order to efficiently respond and fulfill customers demands (see figure 4.3).

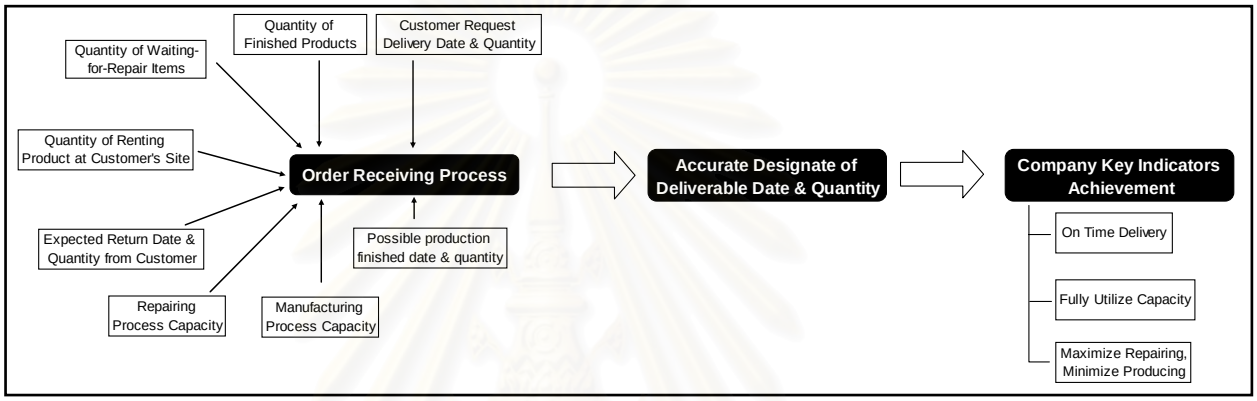


Figure 4.3: Required Information at Order Receiving Process for Key Parameters Achievement

Currently marketing department processes order receiving from customers based on 2 data: quantity of finished products and quantity of waiting-for-repair items to identify product delivery date and quantity. In addition, designated supply date and number of products to be delivered are now based on staffs' experiences, which at times can be inaccurate.

Also, the rental period has never been asked from each customer and recorded; thus the expected actual return date or predicted return date is likely impossible. This has actually made ABC Company relying more on manufacturing new products instead of expecting the returned products, which could have been of less costs.

In addition, the capacity of both production process sectors; repairing process and manufacturing process, is now based on production department staffs' experiences, which make the overall process difficult to manage.

In spite of the fact that more necessary data and information should be provided for marketing department to increase the ability in improving order receiving process by accurately promising the delivery date and quantity to customers,

ABC has never collected and analyzed them before. Those other necessary data and information include

a) other kinds of inventory; goods still at customer location and estimation of product rental period have never been asked from each customer and recorded; thus maximizing finished products through repair process which costs less is difficult to manage.

b) standard processing time; the actual capacity by determining standard time of both production processes (manufacturing process and repairing process) has not yet been studied.

In conclusion, all the above issues have required that marketing department spends a far amount of time in order receiving process to confirm the availability of product for customers. Moreover, despite the facts that various types of products are being produced and that the processes are becoming more sophisticated as the business grows, there is no information system to provide marketing department with required data, constraints, and alternatives for processing customer orders in order to achieve key performance indicators of the business as already described in Figure 4.3.

The lack of data to be analyzed and the lack of information system to support order receiving process of marketing department has subsequently resulted in an inaccurate designated delivery date and number of available products to be delivered, which eventually leads to lateness in delivery and job cancellation. These problems can be considered as one of the important factors that can significantly threaten company competitiveness and its business opportunity. Figure 4.4 shows product delay delivery quantity and the percentage of product that can be delivered on time from January 2006 – May 2008.

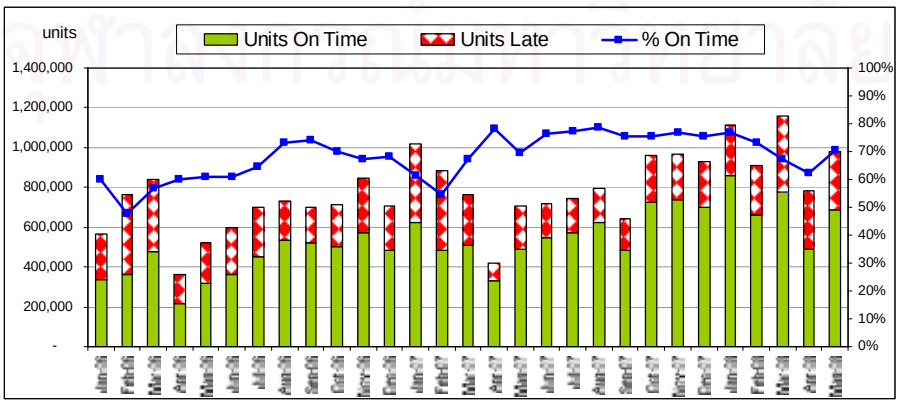


Figure 4.4: Customer Orders Delay Delivery by Month of 2006 – 2008

4.4 Problem Solution

To improve ABC's order receiving process, it is essential to develop an information system, which can support marketing department by providing required data and ensuring that those data, related constraints, and alternatives are integrated and systematically structured to yield more accurate product availability information.

To develop the information system, some required data, which have not yet been developed, have to be firstly studied and recorded. Those data are standard processing time of both production processes (repairing process and manufacturing process). Then, the logical model of the information system such as analysis steps, methodology of production scheduling, or assumptions, are designed. Finally, the newly information system for order receiving process is developed.

CHAPTER V

THE DESIGN AND DEVELOPMENT OF THE INFORMATION SYSTEM DATA

First, this chapter explains the overall development steps of developing the information system. Then this chapter describes more in the design phase and development phase of the data flow and data storage of the information system.

5.1 Overall Development Steps and Methodologies of the Information System for Order Receiving Process

To develop the information system for order receiving process, this thesis divides development steps into 3 phases; design phase, development phase, and evaluation phase as described in figure 5.1.

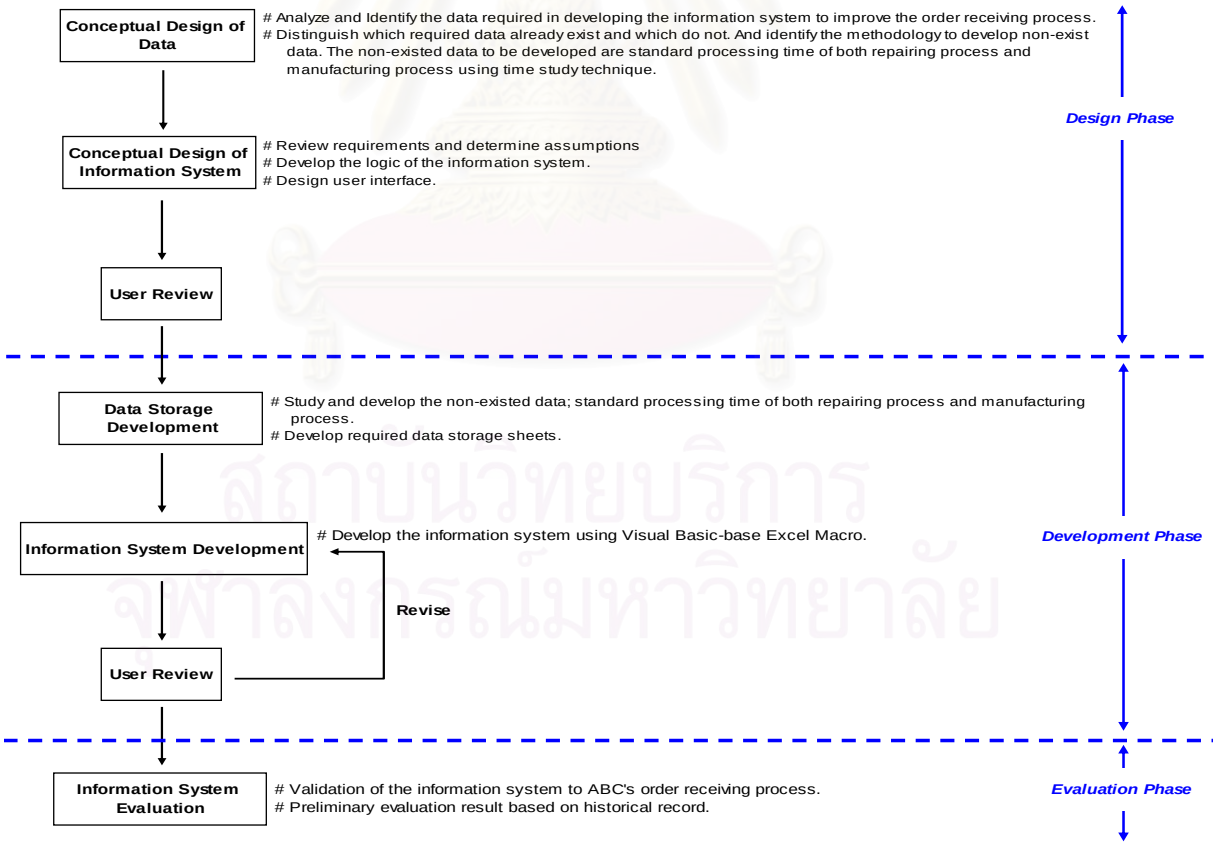


Figure 5.1: The Overall Steps of Information System Development for Order Receiving Process

Design Phase

Design phase consists of 2 steps as below;

1) Data conceptual design: First, data required to be input into the information system for improving current order receiving process are identified. Then, they are distinguished into 2 categories; existed data and non-existed data. Existed data are the data that can be founded in ABC's records or database whereas non-existed data are the data that ABC has never studied and developed before. Finally, methodology for developing the non-existed data is determined.

In this thesis, the non-existed data which are studied and developed are standard processing time of both production process sectors (repairing process and manufacturing process) using time study technique.

2) Information system conceptual design: This step concerns with developing the information system's logical model which operates the data, requirements, and other inputs under the determined assumptions.

3) User review: The designed data and the designed information system have been proved by ABC before they are developed.

Development Phase

Development phase consists of 3 steps; data storage development, information system development, and user review.

1) Data storage development: The first step is to study and develop the non-existed data; standard processing time of both process sectors using time study techniques. Then, all data required for the information system are collected in data storage sheet using Microsoft Excel.

2) Information system development: The information system for ABC's order receiving process is running on Visual Basic-based Excel Macro.

3) User review: Again, to confirm that the newly developed information system meets the objectives and that the users can operate, ABC has proved the information system before it is evaluated.

Evaluation Phase

The newly developed information system is evaluated for its validation to ABC's order receiving process by top managements and marketing department based on its purpose and objective of improving this process by providing adequate information to be able to designate more accurate product available-to-promise date to

customers. The preliminary evaluation result based on historical data is also described to shows the improving trend of on time delivery.

5.2 The Design of the Information System Data for Order Receiving Process

5.2.1 Calendar: Calendar is the data storage that keeps ABC's working day. It consists of:

1) date in one year (starts from 1st of January to 31st of December)
2) day in each week (starts from Monday to Friday)
3) normal weekly holiday(s)
4) company special holiday(s)

5.2.2 Repairing product list: This data storage keeps the information of all products that are included in the thesis' scope and can be repaired in ABC's repairing process. This thesis covers 49 products of ABC's and all of them are in this list. Repairing product list consists of:

1) product code of all 49 products covered in the thesis
2) product name of 49 products covered in the thesis

5.2.3 Manufacturing product list: This data storage keeps the information of products which are included in the thesis' scope and can be manufactured in ABC's manufacturing process. From 49 products covered in the thesis, 6 of them can be manufactured. However, this thesis studies manufacturing of 1 product only. Similar to repairing product list data storage, manufacturing product list consists of:

1) product code of 6 products which can be manufactured
2) product name of 6 products which can be manufactured

5.2.4 Inventory: This data storage is where inventory quantity and booked order quantity of each product are kept. The data are updated and calculated with customer order quantity to determine the product availability channel (through finished product inventory, repairing process, manufacturing process, or outsource). Inventory consists of:

1) product code of all 49 products covered in this thesis
2) product name of all 49 products covered in this thesis
3) quantity of each product in the finished product inventory
4) quantity of each product in the waiting-for-repair items inventory

5) quantity of booked order in case of some units are reserved

6) last updated date

5.2.5 Repairing process capacity: The repairing process is divided into 3 sets of data storage according to repairing process's 3 sub-processes; sanding sub-process data storage, repairing sub-process data storage, and painting sub-process data storage. However, each data storage consists of the same information which are:

1) product code of all 49 products covered in this thesis

2) product name of all 49 products covered in this thesis

3) group code (S for sanding sub-process, R for repairing sub-process, and P for painting sub-process)

4) a number of manpower available and a number of manpower used per 1 team

5) weighted average standard time

5.2.6 Manufacturing process capacity: The manufacturing process capacity is divided into 3 sets of data storage according to manufacturing process's 3 sub-processes; cutting sub-process data storage, assembly & welding sub-process data storage, and painting sub-process data storage. Since the painting sub-process is cross utilization of both repairing process and manufacturing process, the painting sub-process data storage is the same as in repairing process capacity. The data that are kept in the manufacturing process capacity are:

1) product code of all 49 products covered in this thesis

2) product name of all 49 products covered in this thesis

3) standard time of 1 product studied in this thesis

4) a number of manpower available and a number of manpower used per 1 team of 1 product studied in this thesis

5) machines' name a number of machine available and a number of machine used of 1 product studied in this thesis

5.2.7 Customer order: This data storage keeps information about customer order which is the input for processing the order with the information system and also keeps the information about product availability which is the output from the information system. Therefore, the customer order consists of:

Customer order information;

1) order number

2) order date

3) customer detail; name, contact person, contact number, e-mail

4) delivery request date

5) order product code

6) order product name

7) order quantity

8) expected return date

Product availability information;

9) repairing finished date

10) manufacturing finished date

11) estimate delivery date (the latest date of either repairing finished date or manufacturing finished date)

12) delivery quantity through finished product inventory

13) delivery quantity through repairing process

14) delivery quantity through manufacturing process

15) delivery quantity through outsource

5.2.8 Repairing plan: This data storage provides the information about the detail of product, quantity, and order number that is in the sub-process of sanding and repairing in each working hour. Therefore, the repairing plan consists of:

1) sanding sub-processes and repairing sub-process

2) date in one year (starts from 1st of January to 31st of December)

3) each working hour

5.2.9 Repairing schedule: This data storage is where information about work load in the sub-process of sanding and repairing is provided. The repairing schedule consist of

1) sanding sub-processes and repairing sub-process

2) date in one year (starts from 1st of January to 31st of December)

3) each working hour

5.2.10 Manufacturing plan: This data storage provides the information about the detail of product, quantity, and order number that is in the sub-process of cutting and assembly & welding in each working hour. Therefore, the manufacturing plan consists of:

1) cutting sub-processes and assembly and welding sub-process

2) date in one year (starts from 1st of January to 31st of December)

3) each working hour

5.2.11 Manufacturing schedule: This data storage is where information about work load in the sub-process of cutting and assembly and welding is provided. The manufacturing schedule consist of

1) cutting sub-processes and assembly and welding sub-process

2) date in one year (starts from 1st of January to 31st of December)

3) each working hour

5.2.12 Painting sub-process plan: Since the painting sub-process is cross utilization of both repairing process and manufacturing process, the painting sub-process plan data storage individually provides the information about the detail of product, quantity, and order number that is being painted in each working hour. Similar to the previously two data storages, this data storage consists of:

1) date in one year (starts from 1st of January to 31st of December)

2) each working hour

5.2.13 Painting sub-process schedule: This data storage is where information about work load of painting sub-process is provided. The painting sub-process schedule consist of

1) date in one year (starts from 1st of January to 31st of December)

2) each working hour

In order to clearly identify who is responsible for developing each required data and at which level related department can access the data, table 5.1 shows source and authorization of data required in the information system.

Table 5.1: Required Data Development Responsibility and Authorization

Required Data for the Information System	Source of Data		Data Authorization			
	Development Method	Development Responsibility	Top Management	Marketing Department	Production Department	General Management
Calendar	Input working days and holidays	General Management Department	○	○	○	◎
Repairing Product List	Input product name and code that can be repaired	Production Department	○	◎	○	○
Manufacturing Product List	Input product name and code that can be manufactured	Production Department	○	◎	○	○
Inventory	Input quantity of each inventory	Production Department	○	◎	○	○
Repairing Process Capacity	Develop manpower and standard time of repairing process using time study technique	Production Department	○	○	◎	○
Manufacturing Process Capacity	Develop manpower and standard time of manufacturing process using time study technique	Production Department	○	○	◎	○
Customer Order	Input customer order detail	Marketing Department	◎	◎	○	○
Production Plan	***Result from the information system***		○	◎	○	○
Production Schedule			○	◎	○	○

Remark: Authorization Level ◎ ;Can access & input/revise the data ○ ;Can access but can not input/revise the data X ;Can not neither input/revise nor access data

5.3 The Development of the Information System Data for Order Receiving Process

From the designing of data flow and data storage of the information system, now this section explains their developments.

5.3.1 Calendar: Calendar shows all working days in one year round. User must input the first date, the company weekly holiday, and the company special holidays as depicted in figure 5.2.

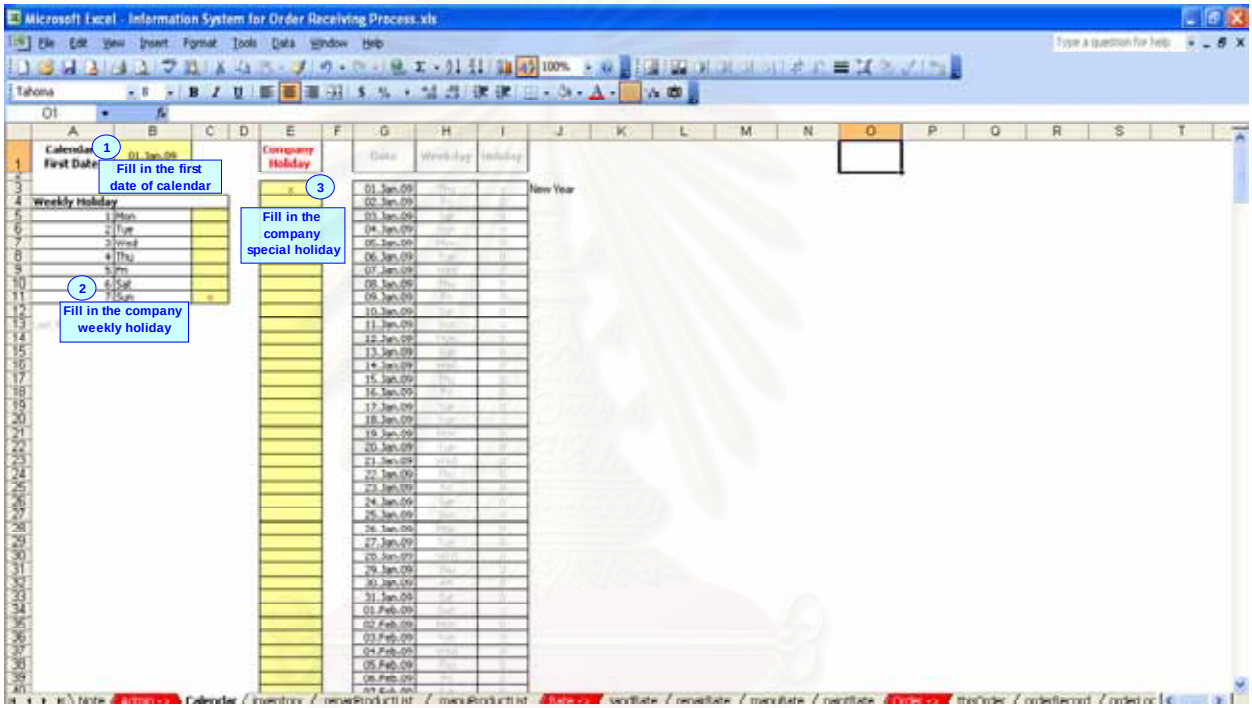


Figure 5.2: Calendar Data Storage

5.3.2 Repairing Product List: User must input each product's code and name that can be repaired. This thesis covers 49 products and all of them are in the repairing product list.

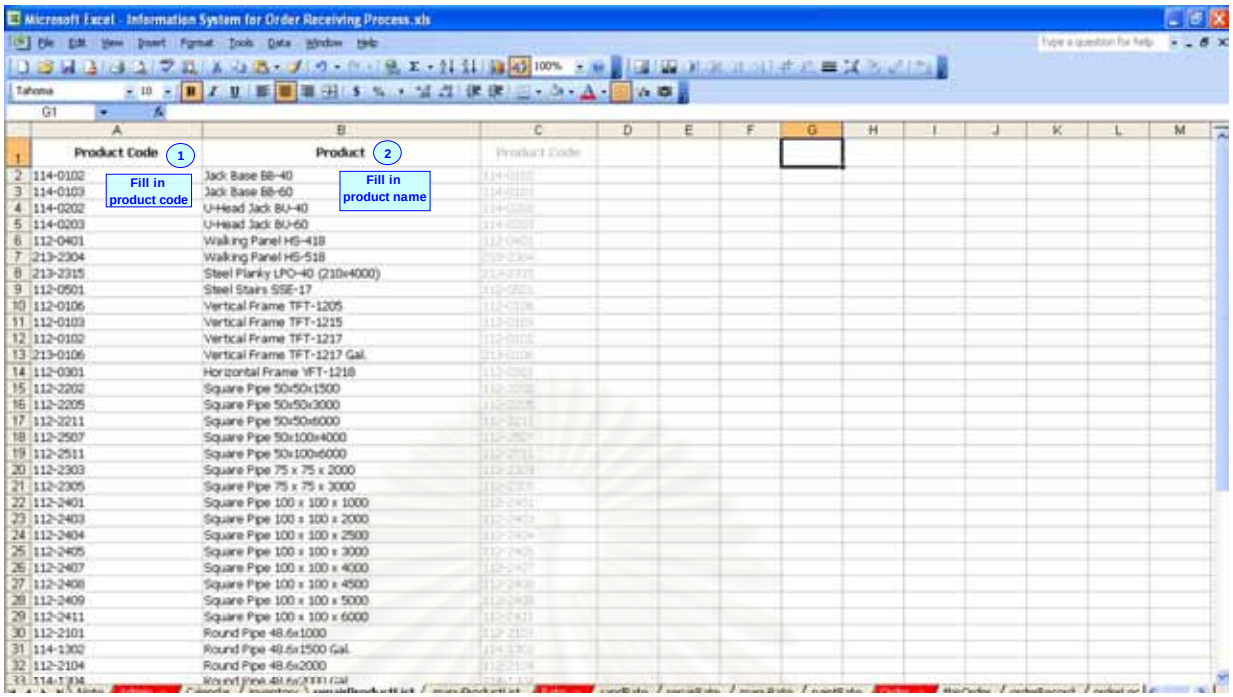


Figure 5.3: Repairing Product List Data Storage

5.3.3 Manufacturing Product List: Like repairing product list, user must input each product' code and name that can be manufactured. From total of 49 products covered in the thesis, 6 of them can be manufactured. However, the thesis studies only manufacturing of walking panel HS418.

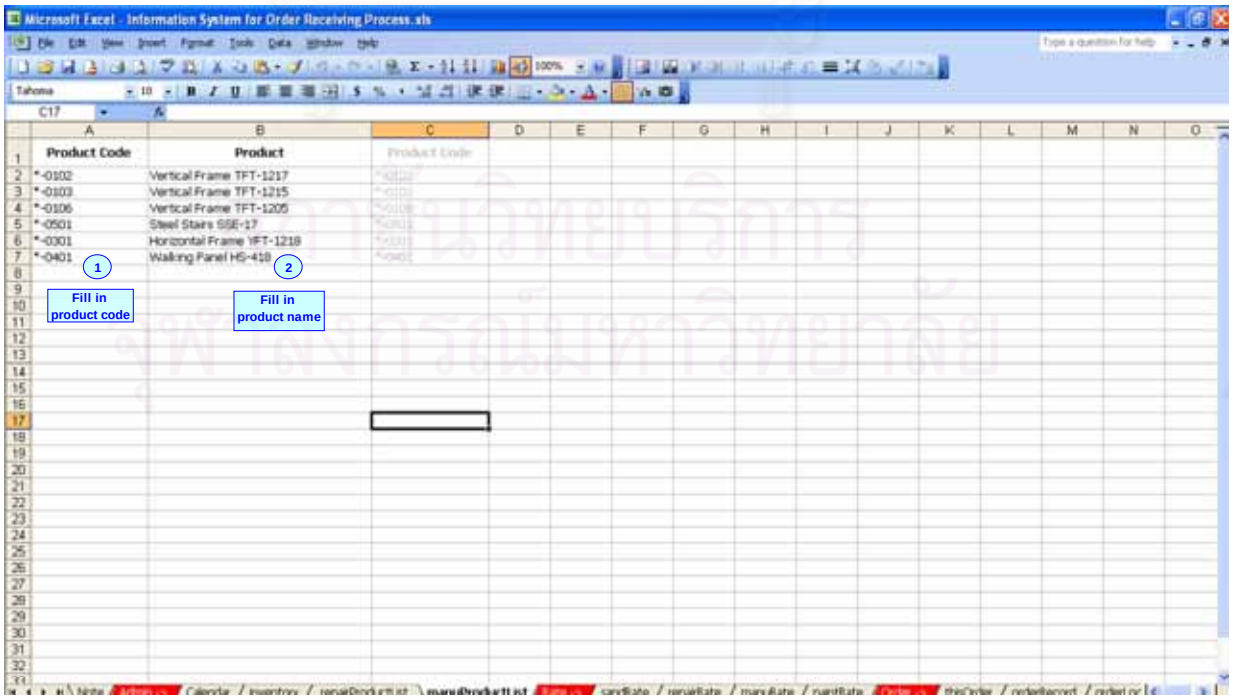


Figure 5.4: Manufacturing Product List Data Storage

5.3.4 Inventory: This storage sheet collects codes and names of all 49 products covered in the thesis. Each product inventory status and each product book order quantity are updated by users. The method for updating is described in the next chapter (section 6.2, chapter 6).

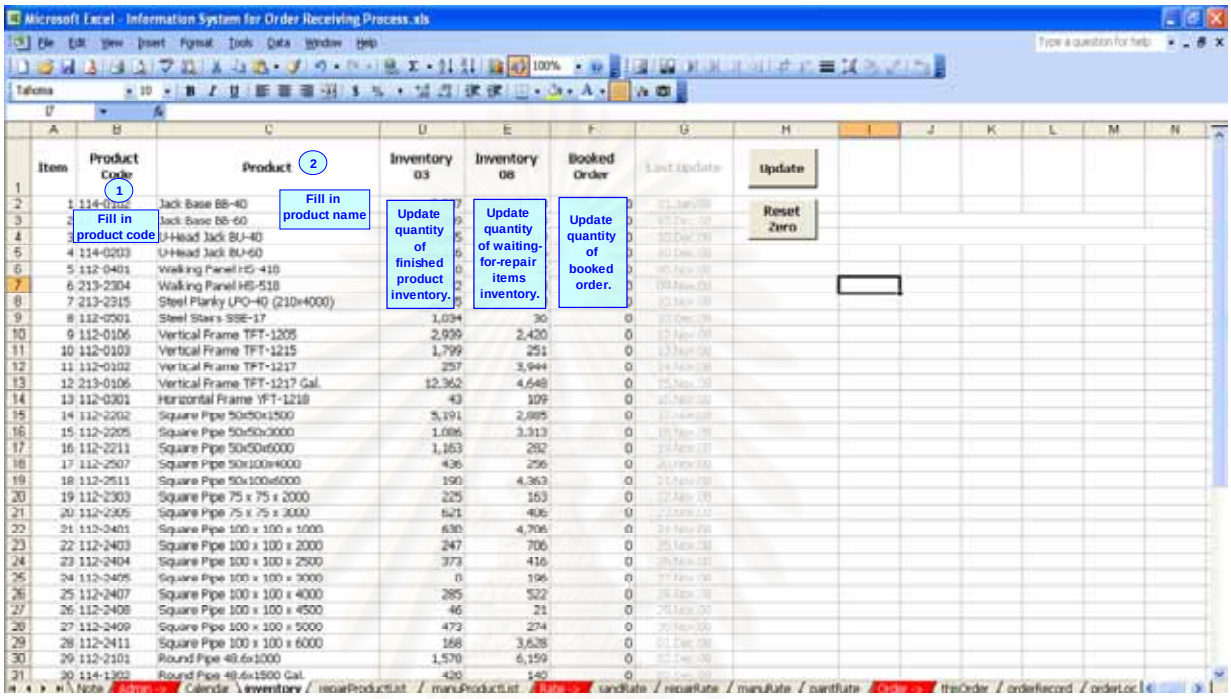


Figure 5.5: Inventory Data Storage

5.3.5 Repairing Process Capacity: Since repairing process capacity is one of the data that ABC have never studied, therefore, the standard time of repairing process is determined using time study technique. From 49 products covered in this thesis, they are divided into 2 main product groups; scaffolding and metal form.

1) Scaffolding Group: Repairing scaffoldings consists of 2 sub-processes; repairing sub-process (polishing, bending, welding, and grinding) and painting sub-process. Some products have these 2 sub-processes separated but some have not.

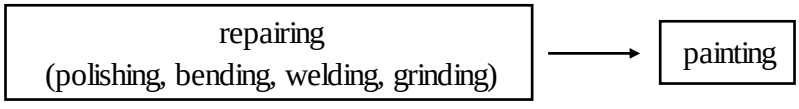


Figure 5.6: Repairing Process Flow of Scaffolding Group

1.1.) Repairing Sub-Process: In this sub-process, scaffoldings are divided into 3 sub-groups (see table 5.2) according to the difference in repairing work elements. In addition, according to ABC's standard, all products except round pipe are divided into 3 levels of difficulty; low difficulty, medium difficulty, and high difficulty depend on the customer return condition. For round pipe, there are only 2 difficulty levels; low difficulty and medium difficulty since the product characteristic and its function is the least severe comparing to others. Overall steps in determining repairing sub-process standard time of scaffolding group are described in figure 5.8.

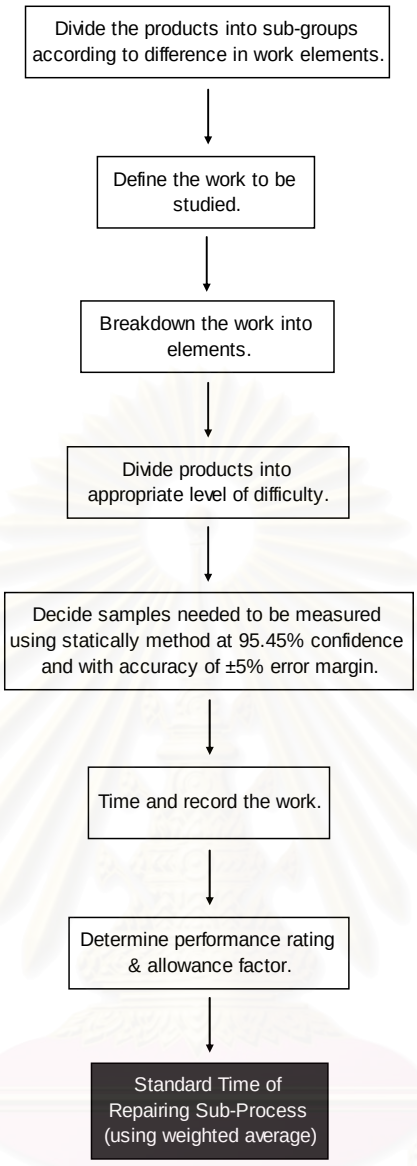


Figure 5.7: Overall Steps in Determining Repairing Sub-Process Standard Time of Scaffolding Group

Each sub-group product and its repairing sub-process work element is described in table 5.2.

Table 5.2: Repairing Sub-Process Work Elements and Manpower of Each Sub-Group of Scaffoldings

Scaffolding Group: Repairing Sub-Process Work Element and Manpower					
Sub-Group	**Product Name**	**Product Code**	**Work Element of 1 Working Team**	**Manpower Used (Head/Working Team)**	**Manpower Available (Total Head)**
R1	Jack Base BB-40	114-0102	1. Put the product on the working station. 2. Confirming the screw. 3. Straighten the product by bending. 4. Polishing the rust and other residue left on the surface. 5. Repair welding. 6. Edge painting. 7. Packing.	3	9
	Jack Base BB-60	114-0103			
	U-Head Jack BU-40	114-0202			
	U-Head Jack BU-60	114-0203			
R2	Walking Panel HS-418	112-0401	1. Put the product on the working table. 2. Confirming the dimension by comparing with standard dimension steel bar. 3. Straighten the product by bending. 4. Polishing the rust and other residue left on the surface. 5. Turnover and repeat element 3 and 4. 6. Repair welding. 7. Grinding. 8. Taking the product down from the working table and put it into the array. 9. For galvanized steel, apply anti-rust paint. 10. Packing	2	26
	Walking Panel HS-518	213-2304			
	Steel Planky LPO-40 (210x4000)	213-2315			
	Steel Stairs SSE-17	112-0501			
	Vertical Frame TFT-1205	112-0106			
	Vertical Frame TFT-1215	112-0103			
	Vertical Frame TFT-1217	112-0102			
	Vertical Frame TFT-1217 Gal.	213-0106			
	Horizontal Frame YFT-1218	112-0301			
R3	Square Pipe 50x50x1500	112-2202	1. Putting the product on the working platform. 2. Straighten the product by bending. 3. Polishing the rust and other residue left on the surface. 4. Repair welding. 5. Pipe modification (if necessary) 6. Painting (for square pipe only). 7. Packing.	3	16
	Square Pipe 50x50x3000	112-2205			
	Square Pipe 50x50x6000	112-2211			
	Square Pipe 50x100x4000	112-2507			
	Square Pipe 50x100x6000	112-2511			
	Square Pipe 75 x 75 x 2000	112-2303			
	Square Pipe 75 x 75 x 3000	112-2305			
	Square Pipe 100 x 100 x 1000	112-2401			
	Square Pipe 100 x 100 x 2000	112-2403			
	Square Pipe 100 x 100 x 2500	112-2404			
	Square Pipe 100 x 100 x 3000	112-2405			
	Square Pipe 100 x 100 x 4000	112-2407			
	Square Pipe 100 x 100 x 4500	112-2408			
	Square Pipe 100 x 100 x 5000	112-2409			
	Square Pipe 100 x 100 x 6000	112-2411			
	Round Pipe 48.6x1000	112-2101			
	Round Pipe 48.6x1500 Gal.	114-1302			
	Round Pipe 48.6x2000	112-2104			
	Round Pipe 48.6x2000 Gal.	114-1304			
	Round Pipe 48.6x3000	112-2106			
	Round Pipe 48.6x4000	112-2108			
	Round Pipe 48.6x4500	112-2109			
	Round Pipe 48.6x5000	112-2110			
	Round Pipe 48.6x6000	112-2112			

1.2) Painting Sub-Process: In this sub-process, work elements of each product are the same. Overall steps in determining painting sub-process standard time of scaffolding group are described in figure 5.8. Products needed to go through this sub-process and the work elements are described in table 5.3.

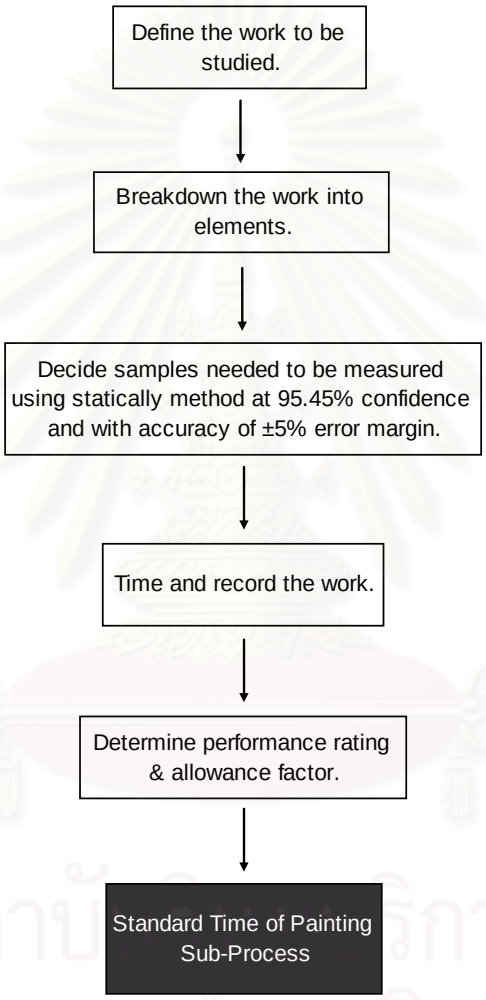


Figure 5.8: Overall Steps in Determining Painting Sub-Process Standard Time of Scaffolding Group

Table 5.3: Painting Sub-Process Work Elements and Manpower of Scaffoldings

Scaffolding Group: Painting Sub-Process Work Element and Manpower					
Group	**Product Name**	**Product Code**	**Work Element per 1 Working Team**	**Manpower Used (Head/Working Team)**	**Manpower Available (Total Head)**
P1	Walking Panel HS-418	112-0401	1. Put the product on painting bath. 2. Pour down the paint. 3. Taking the product down from the bath. 4. Packing	3	9
	Steel Stairs SSE-17	112-0501			
	Vertical Frame TFT-1205	112-0106			
	Vertical Frame TFT-1215	112-0103			
	Vertical Frame TFT-1217	112-0102			
	Horizontal Frame YFT-1218	112-0301			
	Round Pipe 48.6x1000	112-2101			
	Round Pipe 48.6x2000	112-2104			
	Round Pipe 48.6x3000	112-2106			
	Round Pipe 48.6x4000	112-2108			
	Round Pipe 48.6x4500	112-2109			
	Round Pipe 48.6x5000	112-2110			
	Round Pipe 48.6x6000	112-2112			

Finally, each scaffolding' sub-group standard time of repairing process is illustrated in figure 5.9 – figure 5.12.

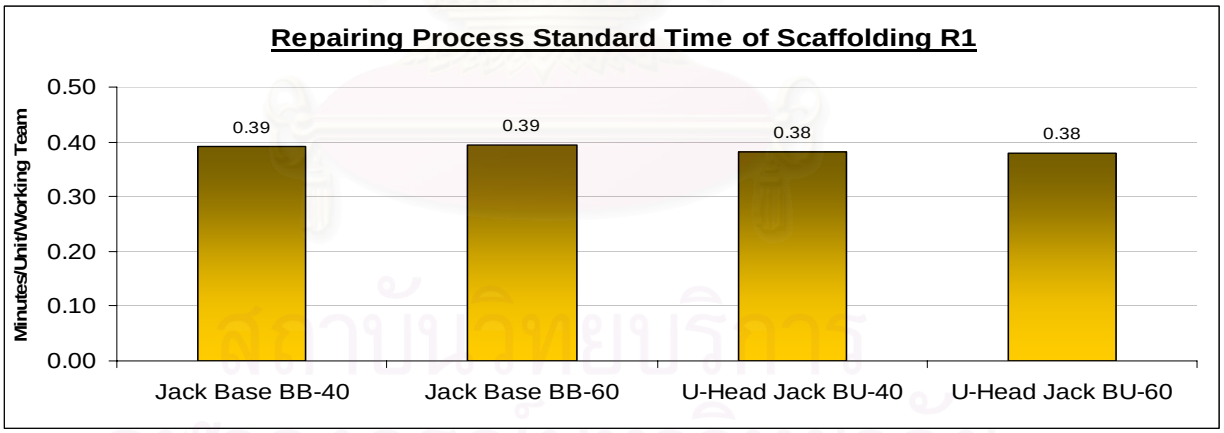


Figure 5.9: Repairing Process Standard Time of Scaffolding R1

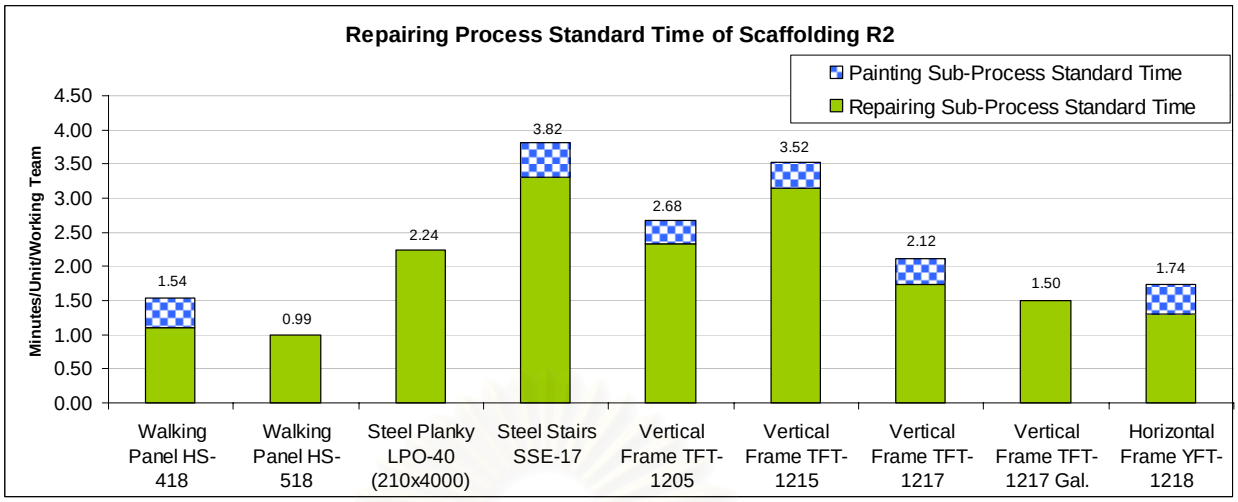


Figure 5.10: Repairing Process Standard Time of Scaffolding R2

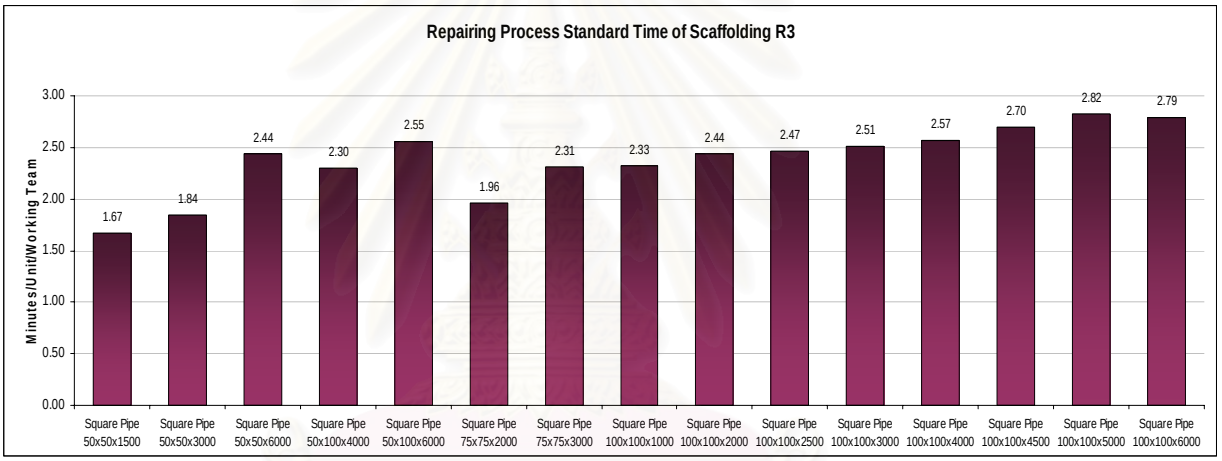


Figure 5.11: Repairing Process Standard Time of Scaffolding R3

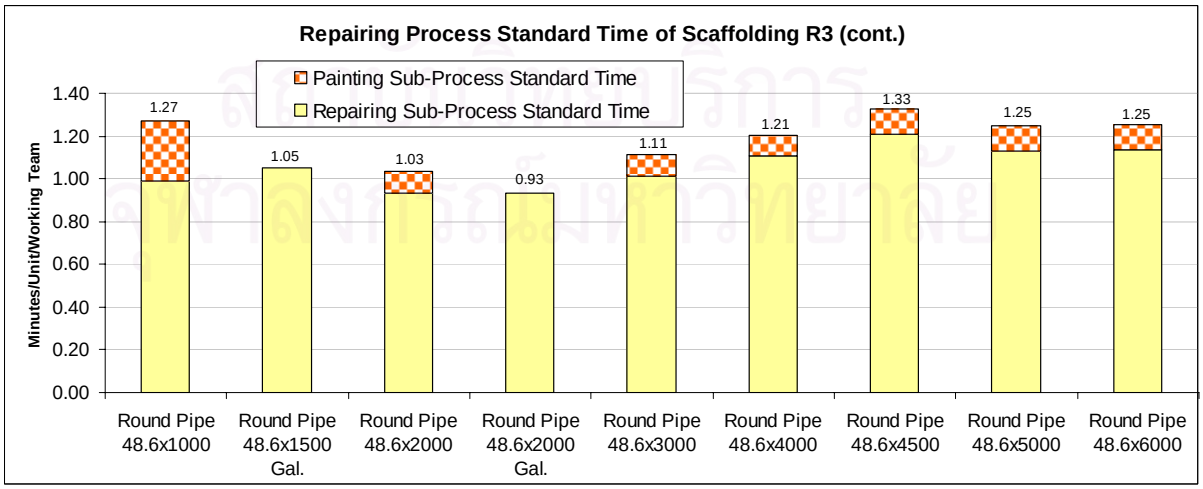


Figure 5.12: Repairing Process Standard Time of Scaffolding R3 (cont.)

2) Metal Form Group: Repairing metal forms consists of 2 sub-processes (see figure 5.13); sanding sub-process and repairing sub-process (polishing, bending, welding, and grinding). Also, similar with scaffoldings, 3 levels of difficulty are divided. Overall steps in determining repairing process standard time of metal form group are described in figure 5.14.

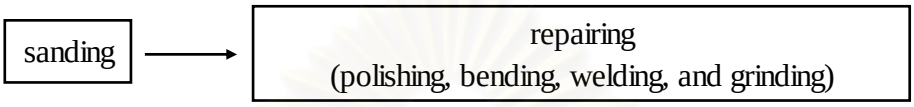


Figure 5.13: Repairing Process Flow of Metal Form Group

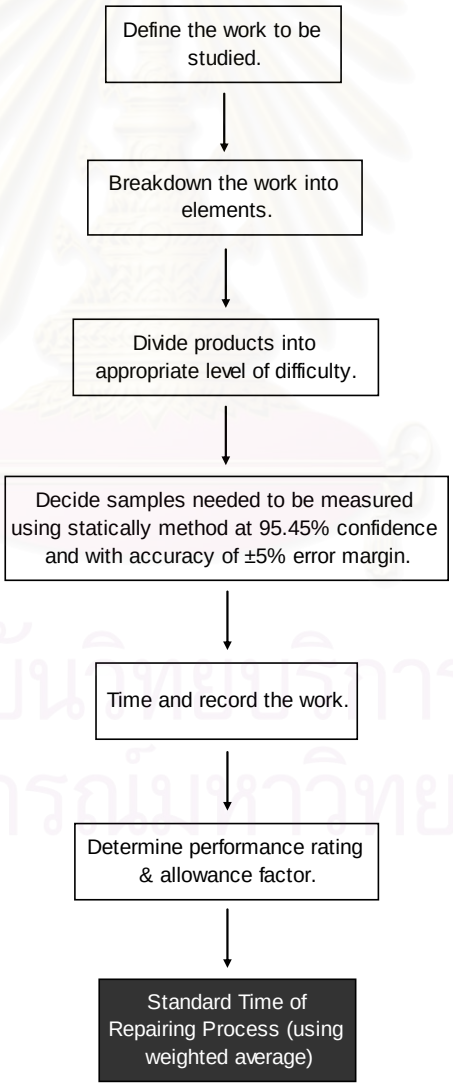


Figure 5.14: Overall Steps in Determining Repairing Process Standard Time of Metal Form Group

Work elements and manpower of each sub-process of metal form repairing process are described in table 5.4 and table 5.5. Repairing process standard time of metal form is illustrated in figure 5.15.

Table 5.4: Sanding Sub-Process Work Elements and Manpower of Metal Forms

Metal Form Group: Sanding Sub-Process Work Element					
Group	**Product Name**	**Product Code**	**Work Element**	**Manpower Used (Head/Team)**	**Manpower Available (Total Head)**
S1	Metal Form 200x1200	114-5304	1. Put the product on sanding machine conveyer. 2. Product automatically goes through sanding sub-process. 3. Taking the product down from sanding machine conveyer.	3	3
	Metal Form 300x1200	114-5504			
	Metal Form 400x1200	114-5704			
	Metal Form 500x1200	114-5904			
	Metal Form 600x1200	114-6104			
	Metal Form 800x1200	114-6204			
	Metal Form 200x1500	114-5305			
	Metal Form 400x1500	114-5705			
	Metal Form 450x1500	114-5805			
	Metal Form 500x1500	114-5905			
	Metal Form 600x1500	114-6105			
	Metal Form 800x1500	114-6205			

Table 5.5: Repairing Sub-Process Work Elements and Manpower of Metal Forms

Metal Form Group: Repairing Sub-Process Work Element and Manpower					
Sub-Group	**Product Name**	**Product Code**	**Work Element**	**Manpower Used (Head/Team)**	**Manpower Available (Total Head)**
R4	Metal Form 200x1200	114-5304	1. Put the product on the working table. 2. Polishing the rust and other residue left on the surface. 3. Straighten the product by bending. 4. Taking the product down from the working table and put it into the array. 5. Grinding all 4 sides. 6. Paint marking all 4 sides. 7. Packing	2	28
	Metal Form 300x1200	114-5504			
	Metal Form 400x1200	114-5704			
	Metal Form 500x1200	114-5904			
	Metal Form 600x1200	114-6104			
	Metal Form 800x1200	114-6204			
	Metal Form 200x1500	114-5305			
	Metal Form 400x1500	114-5705			
	Metal Form 450x1500	114-5805			
	Metal Form 500x1500	114-5905			
	Metal Form 600x1500	114-6105			
	Metal Form 800x1500	114-6205			

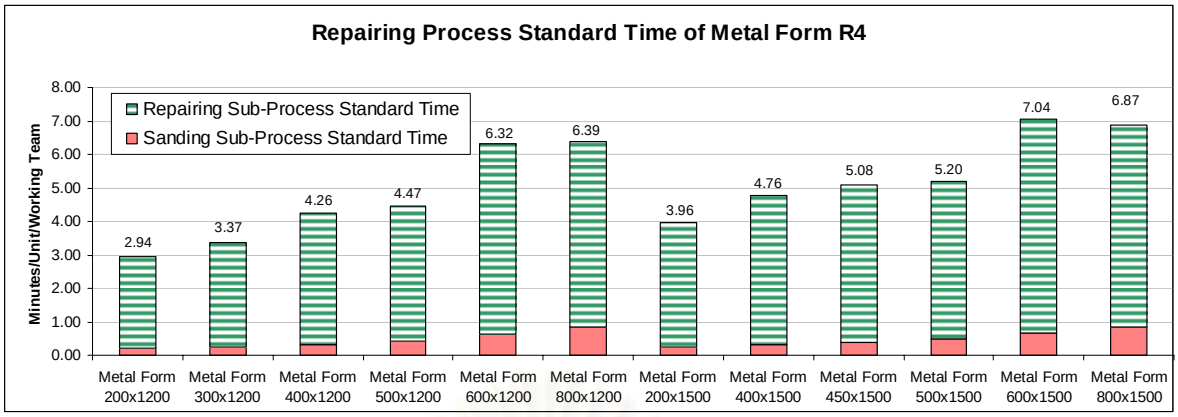


Figure 5.15: Repairing Process Standard Time of Metal Form Product

Finally, the data storages of every sub-processes of repairing process; sanding sub-process, repairing sub-process, and painting sub-process, are developed as in figure 5.16, figure 5.17 and figure 5.18. For any product which is not in any sub-process, the standard time shall be recorded as zero.

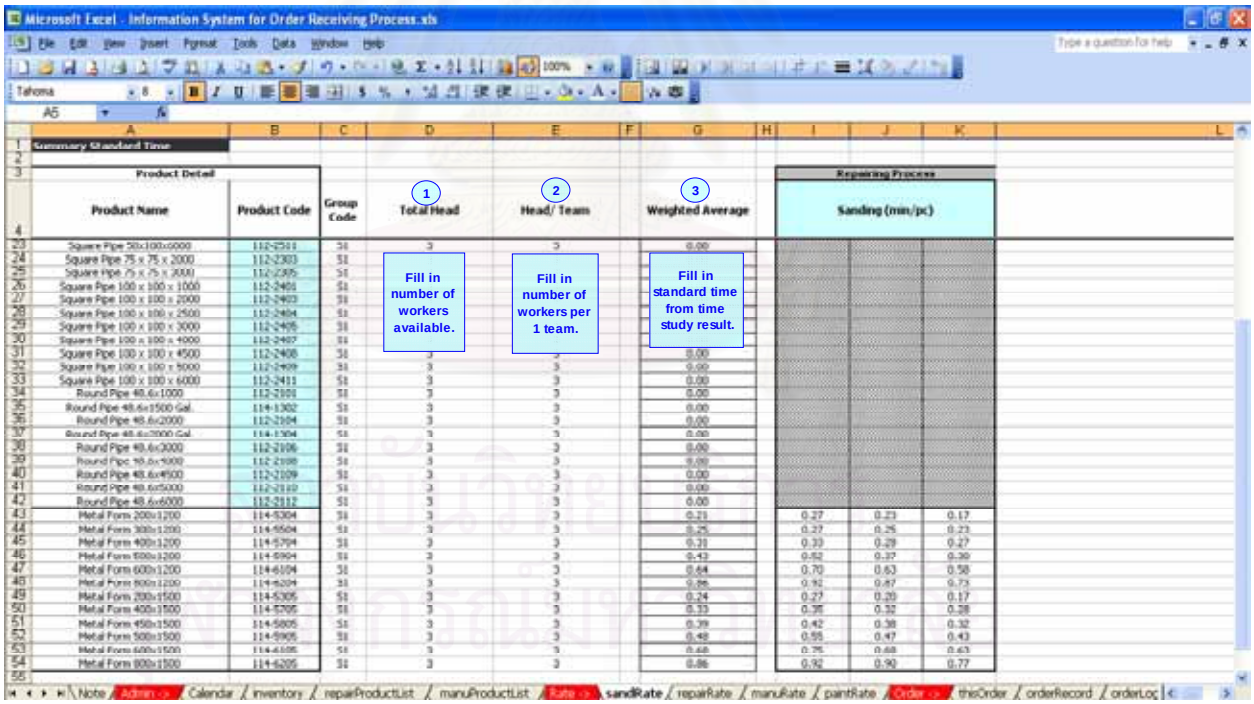


Figure 5.16: Sanding Sub-Process Standard Time and Manpower Data Storage

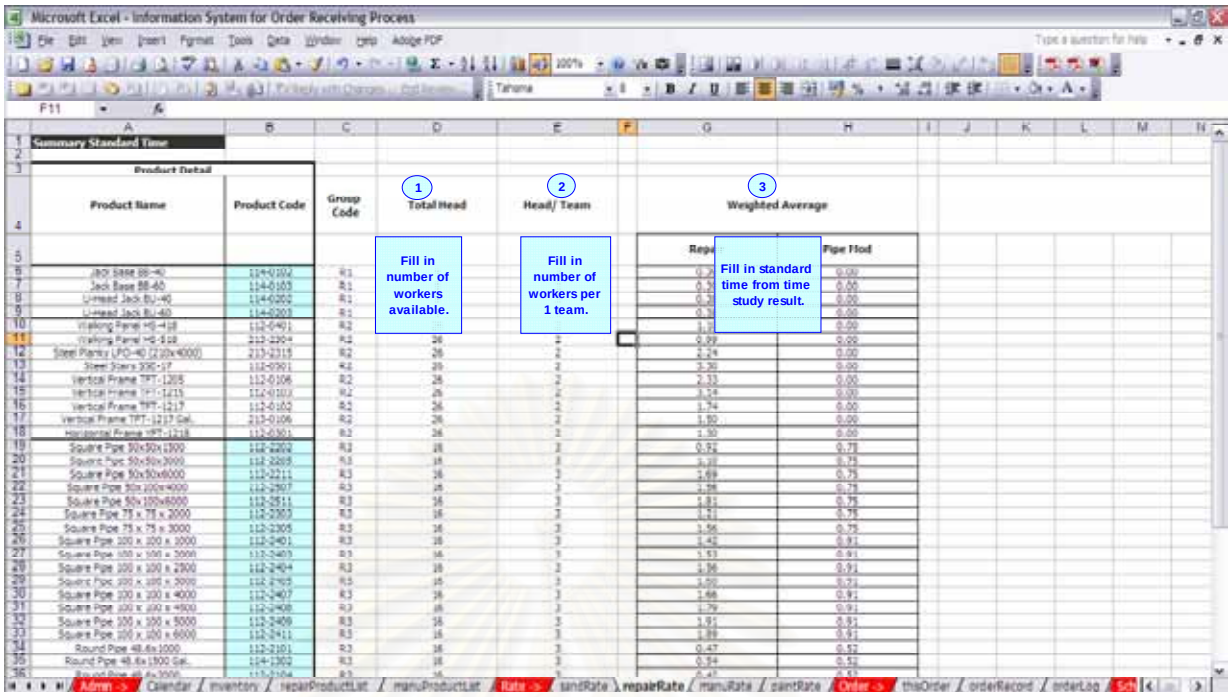


Figure 5.17: Repairing Sub-Process Standard Time and Manpower Data Storage

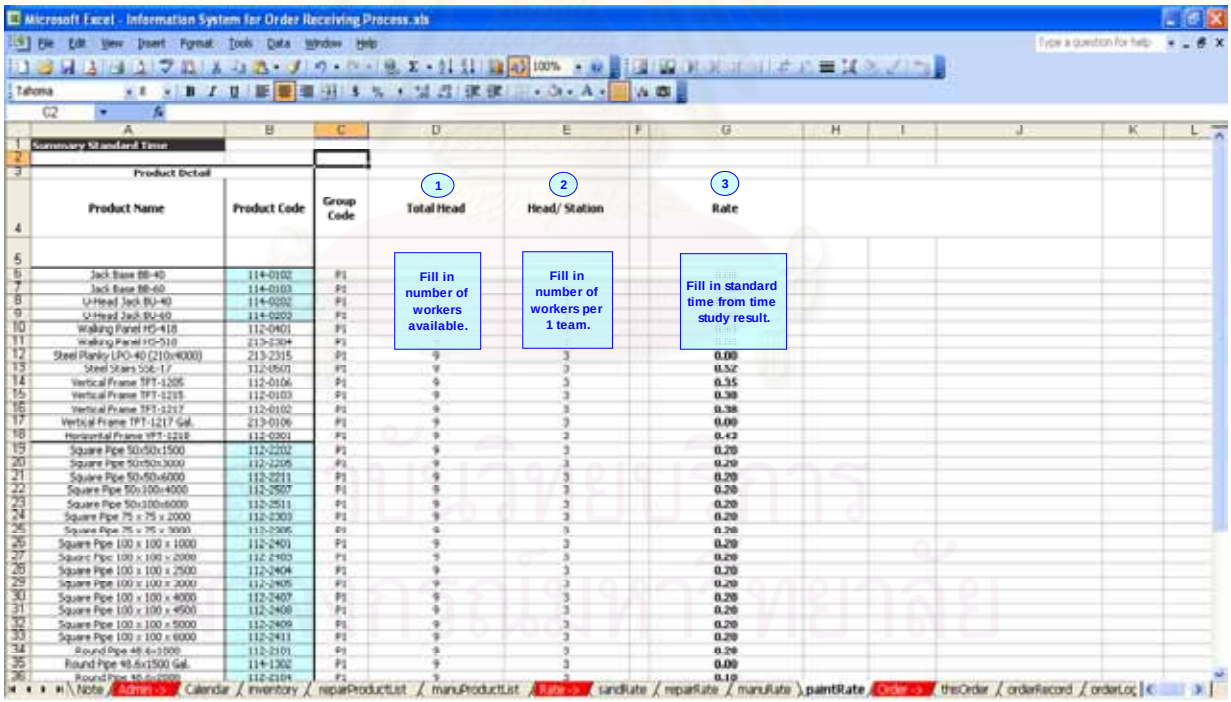


Figure 5.18: Painting Sub-Process Standard Time and Manpower Data Storage

5.3.6 Manufacturing Process Capacity: Manufacturing process capacity is another data that ABC has never studied, therefore, the standard time of manufacturing process is determined using time study technique. From the total of 6

products that can be manufactured, only 1 product is studied; walking panel HS418. Manufacturing process consists of 3 sub-processes as figure 5.19.

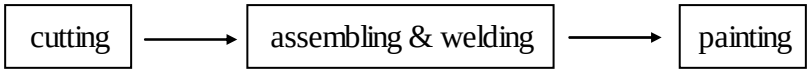


Figure 5.19: Manufacturing Process Flow

Painting sub-process is common with repairing process. Therefore, step in determining its standard time and its result is the same with repairing process's and is not described in this section again.

Steps in determining manufacturing process's cutting, assembly and welding sub-process standard time is explained in figure 5.20. Then cutting sub-process's and assembly and welding sub-process's work elements and manpower are described in table 5.5 and table 5.6 respectively. And finally, manufacturing process standard time of each product is illustrated in figure 5.21.

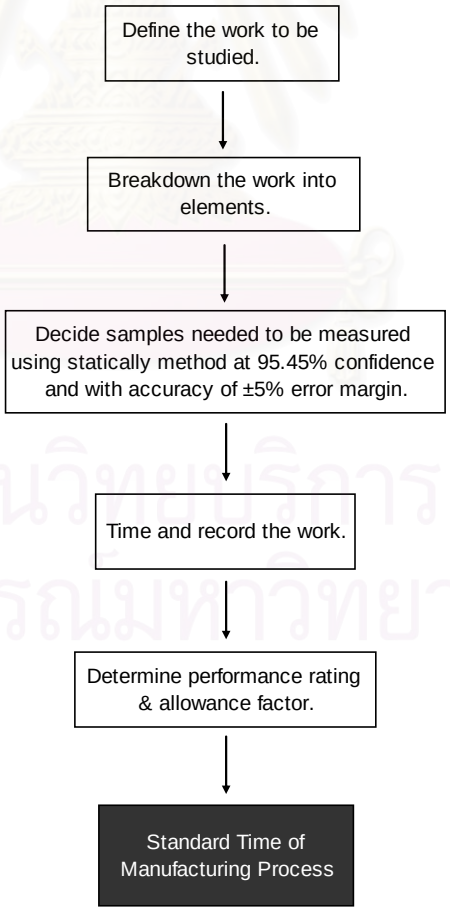


Figure 5.20: Overall Steps in Determining Cutting, Assembling and Welding Sub-Process Standard Time

Table 5.5: Cutting Sub-Process Work Elements and Machine

Manufacturing Process; Cutting Sub-Process Work Elements				
Product Name	**Product Code**	**Work Element**	**Machine Used**	**Machine Avaiable**
Walking Panel HS-418	112-0401	C1. Cut square pipe no.1. C2. Fiber cut square pipe no.2. C3. Bend square pipe no.1. C4. Fiber cut round pipe.	E F C F	C = 2 machines E = 1 machine F = 1 machine

Table 5.6: Assembly and Welding Sub-Process Work Elements and Machine

Manufacturing Process; Assembly&Welding Sub-Process Work Elements				
Product Name	**Product Code**	**Work Element**	**Manpower Used (Head/Team)**	**Manpower Available (Total Head)**
Walking Panel HS-418	112-0401	A&W1. Weld hook. A&W2. Assy panel. A&W3. Weld panel. A&W4. Weld Zn plate.	5	10

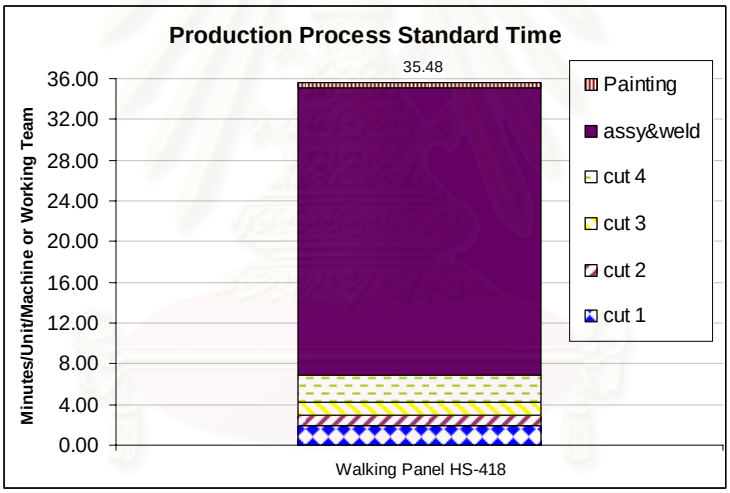


Figure 5.21: Manufacturing Process Standard Time

Similar to repairing process capacity data storage, the standard time of products which are not in manufacturing process's scope shall be recorded as zero. The cutting sub-process's and assembly and welding sub-process's standard time, manpower detail, and machine detail are in the data storage as depicted in figure 5.22 (painting sub-process is common with repairing process as in figure 5.18).

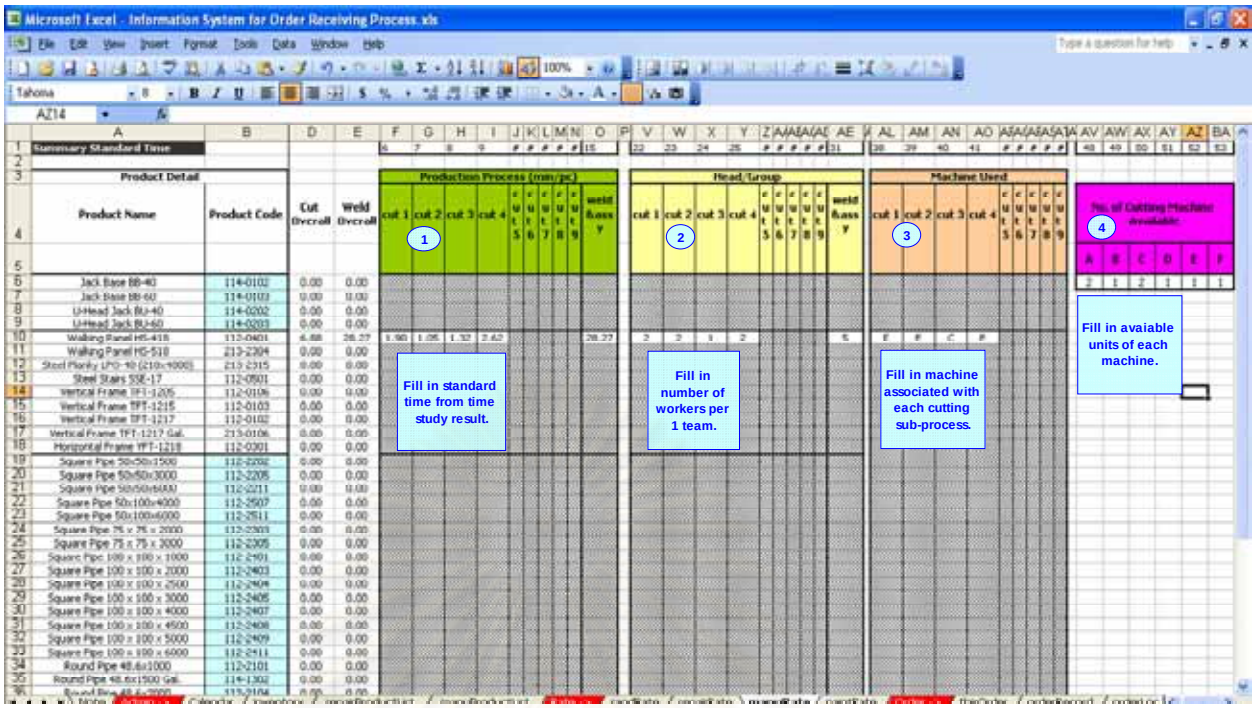


Figure 5.22: Cutting Sub-Process and Assembly and Welding Sub-Process Standard Time and Manpower/Machine Data Storage

5.3.7 Customer Order: As mentioned in the previous section that customer order consists of 2 main data sections; customer order information and product availability information. Customer order information is where user must input the information whereas product availability information is the result provided by the logic of the information system. To input customer order, the steps are described in the next chapter (section 6.2, chapter 6).

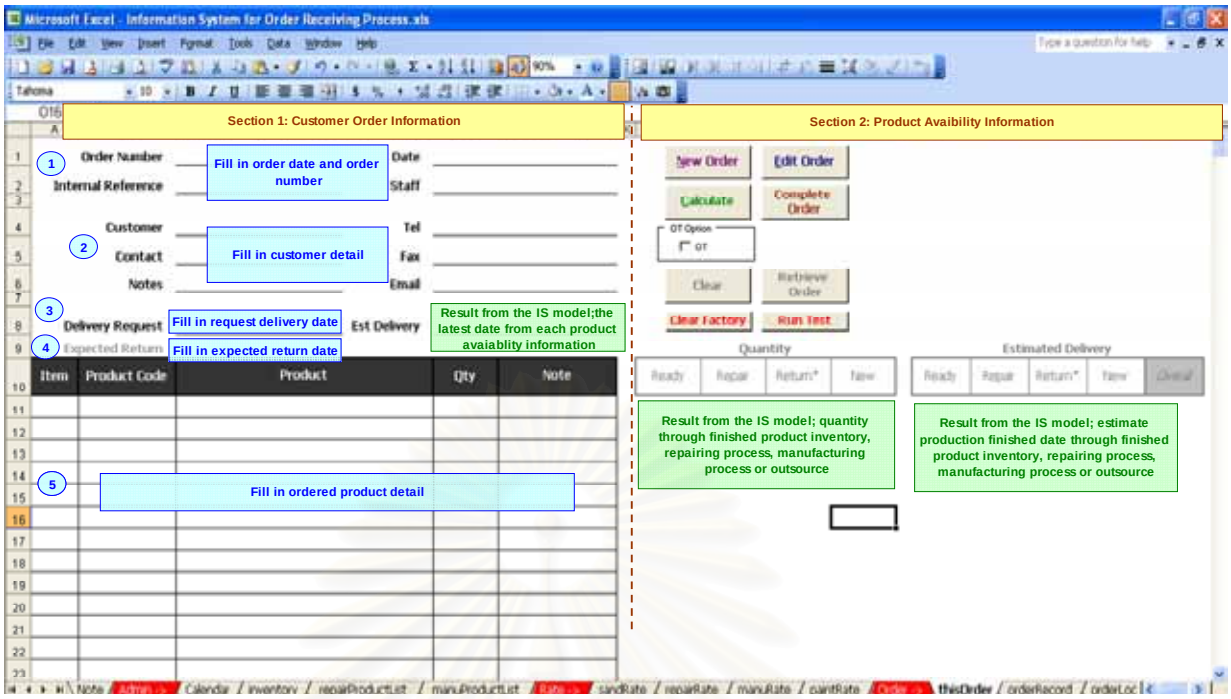


Figure 5.23: Customer Order Data Storage

5.3.8 Repairing Plan: The information in repairing plan data storage is the result from the information system's logic. It provides the user with the sanding sub-process and repairing sub-process schedule detail by hour.

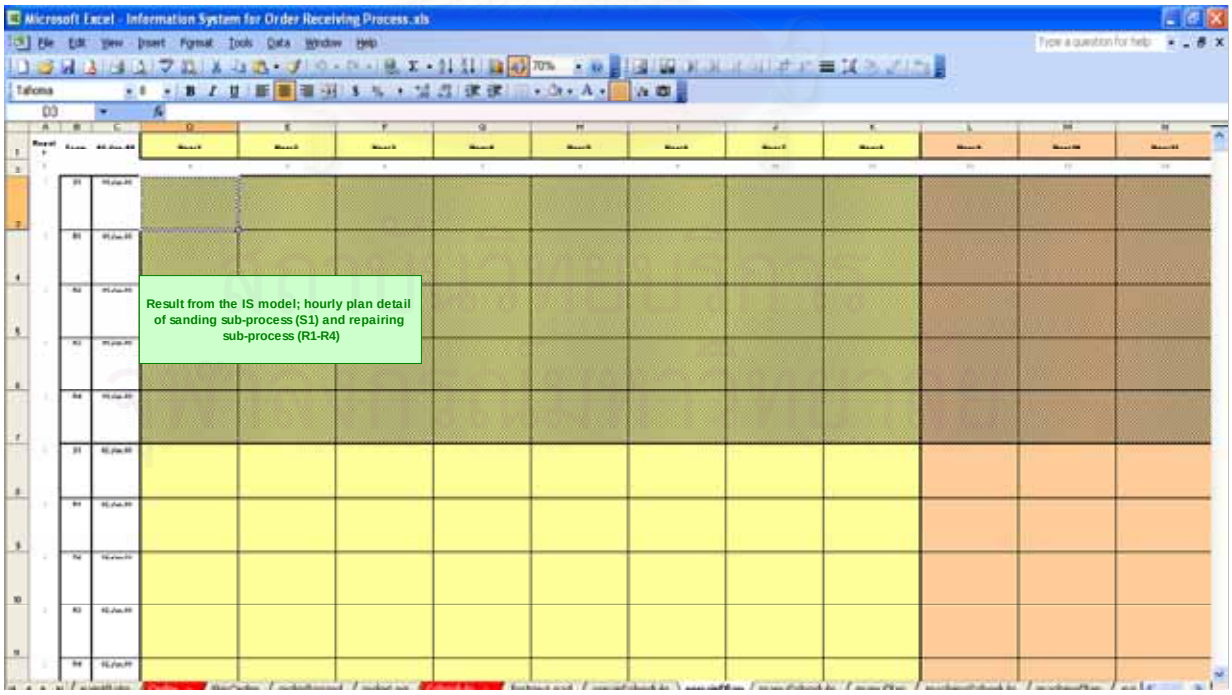


Figure 5.24: Repairing Plan (Sanding Sub-Process and Repairing Sub-Process) Data Storage

5.3.9 Repair Schedule: The information in repair schedule is % work load resulting from the information system's logic. It provides the user with % work load of sanding sub-process (S1) and repairing sub-process (R1-R4) by hour.

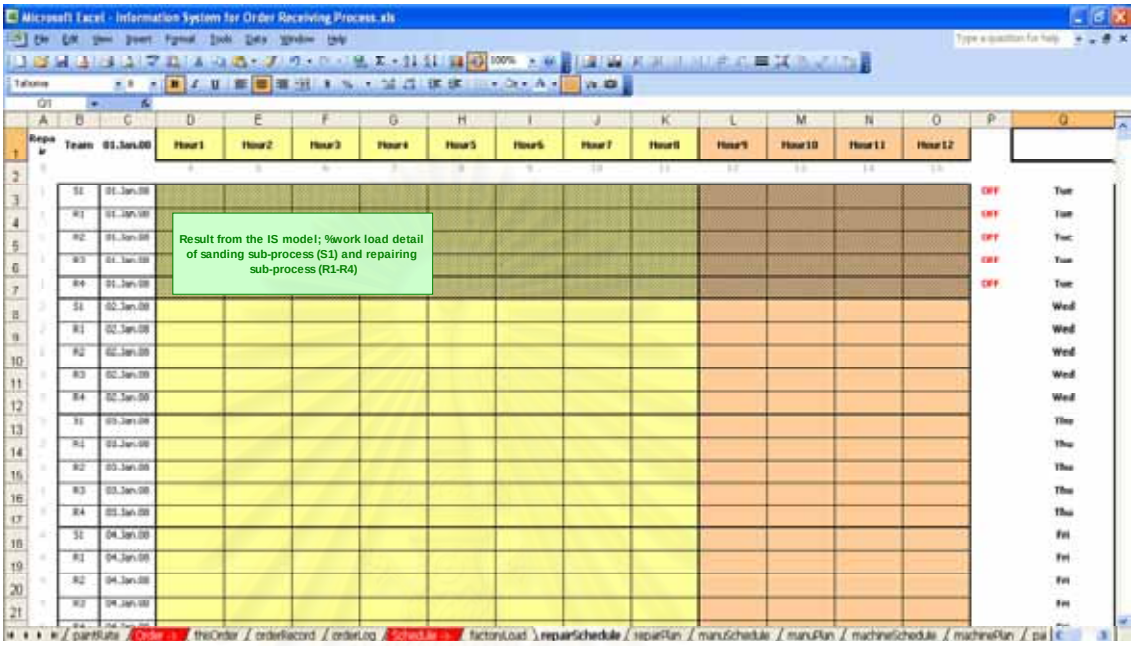


Figure 5.25: Repairing Schedule (Sanding Sub-Process and Repairing Sub-Process) Data Storage

5.3.10 Manufacturing Plan: Similar to repair plan, the information in manufacturing plan data storage is also the result from the information system's logic. It provides the user with the cutting sub-process and assembly and welding sub-process schedule detail by hour.

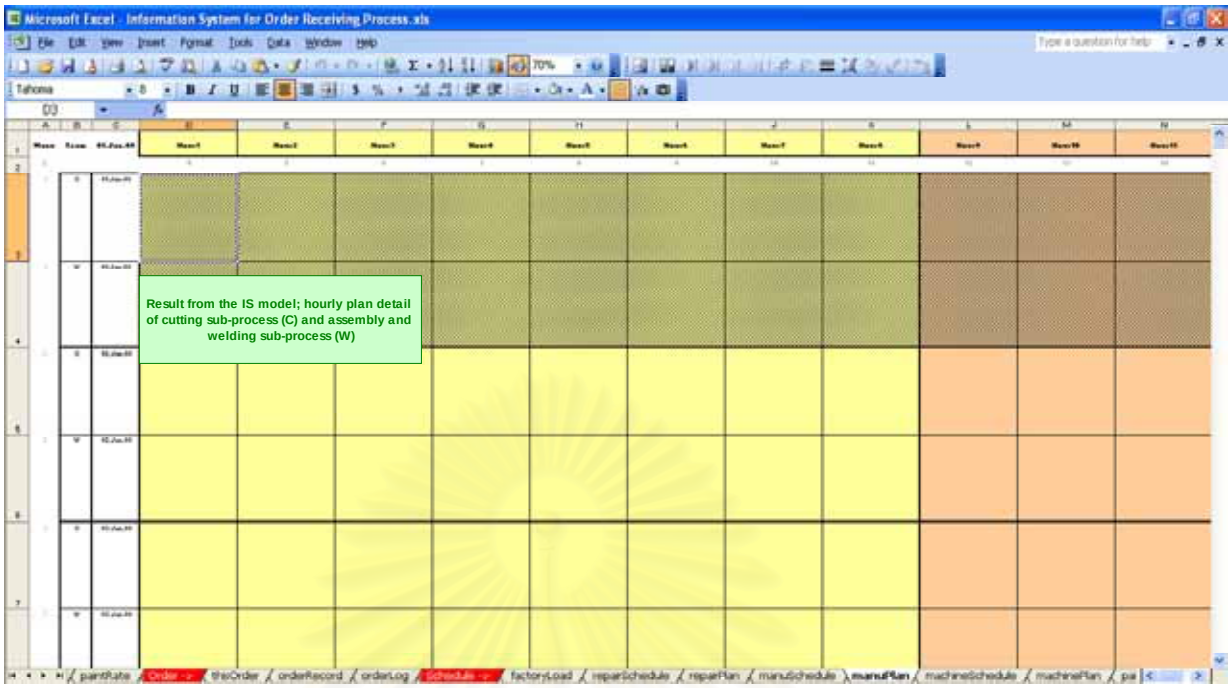


Figure 5.26: Manufacturing Plan (Cutting Sub-Process and Assembly and Welding Sub-Process) Data Storage

5.3.11 Manufacturing Schedule: Similar to repair schedule, the information in manufacturing schedule is % work load resulting from the information system's logic. It provides the user with % work load of cutting sub-process (C) and assembly and welding sub-process (W) by hour.

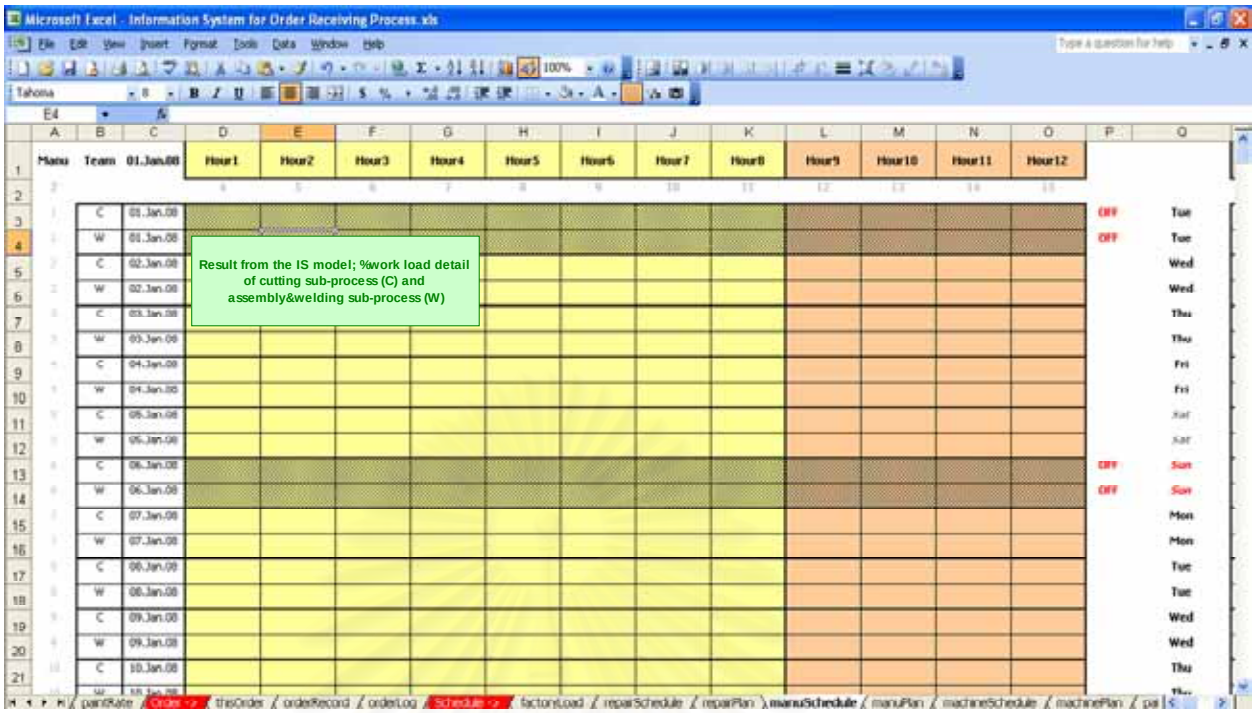


Figure 5.27: Manufacturing Schedule (Cutting Sub-Process and Assembly and Welding Sub-Process) Data Storage

5.3.12 Painting Sub-Process Plan: Since painting sub-process is cross utilization of repairing process and manufacturing process, therefore, its data storage is individually depicted. Like repairing plan and manufacturing plan, the information in painting plan data storage is also the result from the information system's logic. It provides the user with the painting sub-process schedule detail by hour.

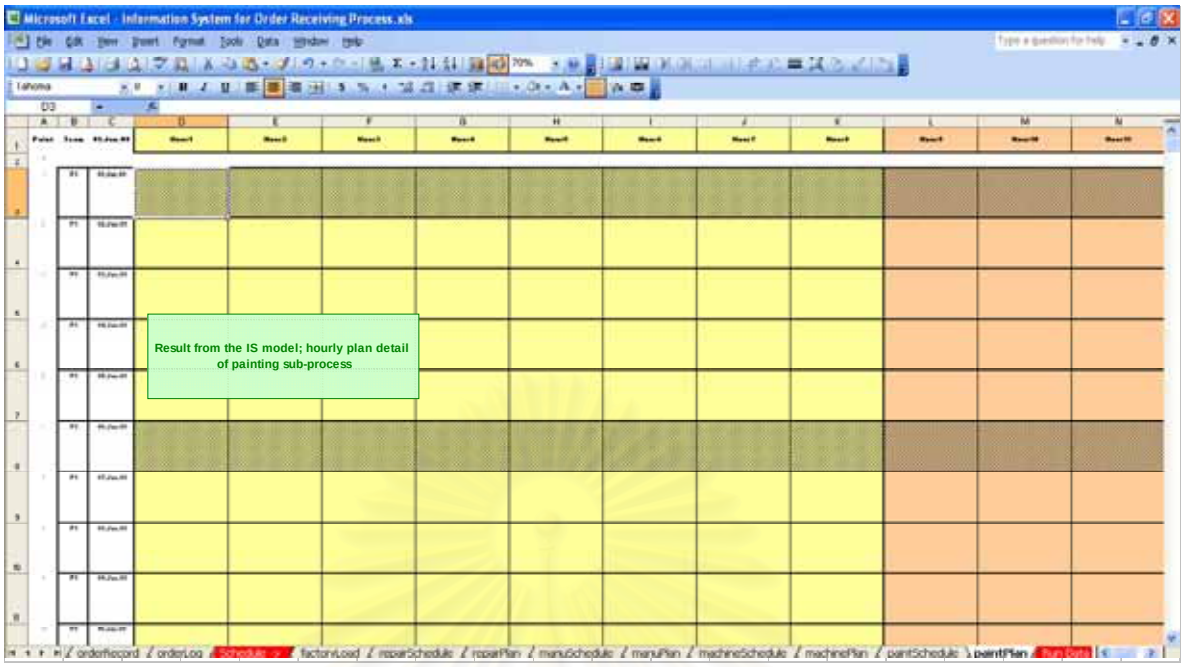


Figure 5.28: Painting Sub-Process Plan Data Storage

5.3.13 Painting Sub-Process Schedule: Similar to repair schedule and manufacturing schedule, the information in painting sub-process schedule is % work load by hour resulting from the information system's logic.

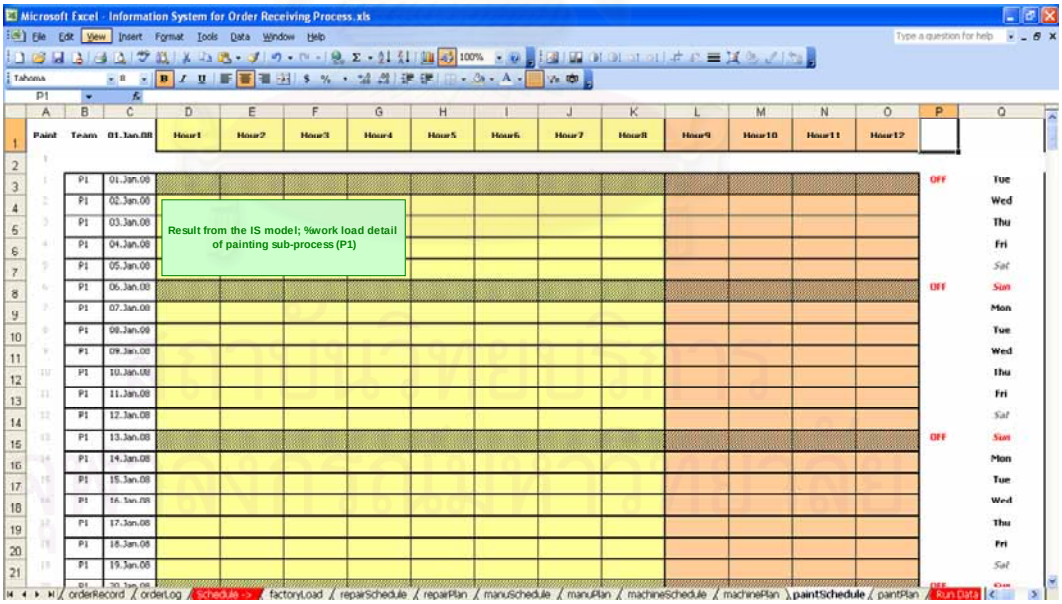


Figure 5.29: Painting Sub-Process Schedule Data Storage

After all data are designed and developed, next chapter explains the design phase and the development phase of the information system for ABC's order receiving process.

CHAPTER VI

THE DESIGN, DEVELOPMENT, AND EVALUATION OF THE INFORMATION SYSTEM

This chapter starts with the design of the logical model of the information system. Then, the development of the information system is explained. Finally, this chapter describes the information system evaluation results.

6.1 The Design of the Information System for ABC's Order Receiving Process

After all required data are designed and developed, they are brought into the newly developed information system. First, this section shows the logical model and the assumptions of overall information system. Then, the logical model and the assumptions of repairing process, manufacturing process, and painting sub-process are separately described.

6.1.1 Overall Information System Logical Model and Assumptions

The logical model of the information system is in figure 6.1. The logical model of

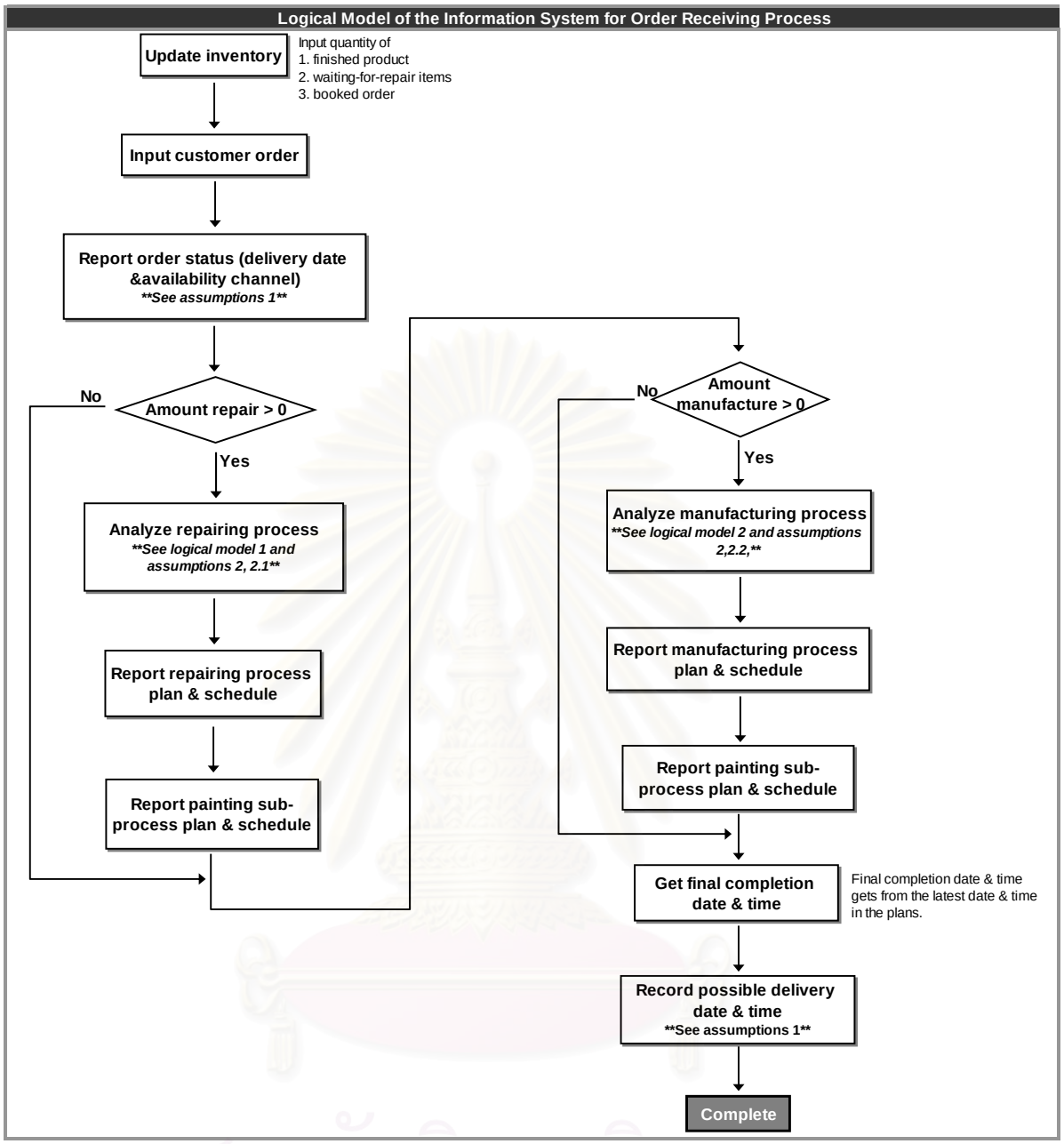


Figure 6.1: The Overall Logical Model of the Information System for Order Receiving Process

Assumption1: Report Order Status & Estimated Delivery Date & Quantity

1. Report order status: after deducting booked order quantity from finished product inventory and waiting-for-repair items inventory,

   Give Customer order quantity = A Units
   Finished product inventory = B Units
   Waiting-for-repair items inventory = C Units

   Then 1. If A < B, then deliver product "A" units through finished product inventory.
   2. If B < A < C, then deliver product "B" units through finished product inventory and "A-B" units through repairing process.
   3. If B+C < A, then deliver product "B" units through finished product inventory, "C"units through repairing process, and "A-(B+C)" units through manufacturing process or outsource.

2. The estimated of possible delivery date is from the final date and time of production plan. Time required for preparing and loading product on vehicles and the vehicles available time is not included.

6.1.2 Production Process Assumptions and Logical Models

Production processes of ABC consist of repairing process and manufacturing process. Before going to each production process's (repairing process's and manufacturing process's) logical model and assumptions, the assumptions covering both production processes are firstly described to help understand their logical models' rational (see assumption 2).

Assumption2: Production Process Assumptions

1. Scheduling method is First In First Out (FIFO).
2. From the repairing process flow and manufacturing process flow (see figure 3.8 and 3.9), in order to allow the following sub-process have input to work on, the production plan is divided into 1 hour period and the output is divided into 1 hour batch size.
3. There is no set up time between each 1 hour period.
4. The 1 hour period is a time segment of 1 hour within a day. When end of day is reached, the next hour period goes to the next working day.
5. Within 1 order, the production works on 1 product until the output quantity equals to the order quantity then goes to the next product.
6. All products in the current order must be completed before going to the next order.
7. All the work elements in current sub-process must be completed before the following sub-process can start.
8. The following sub-process begins on the next available hour.
9. The number of being produced units in the current sub-process can not exceed the total units produced from all previous sub-processes.
10. Load of production process (%) in each hour period identified in the schedule sheet is calculated from

$$\text{Hourly load of production process (\%)} = \frac{\text{Allocated (minutes)} \times \text{number of workers used}}{\text{60 minutes} \times \text{Available Workers}}$$

6.1.2.1 Repairing Process Logical Model and Assumptions

Logical model of repairing process is divided into 3 sections of analysis steps according to its 3 sub-processes; sanding, repairing, and painting sub-process analysis steps. First, the assumptions of repairing process are described (see assumption 2.1) then its logical model (logical model 1) is depicted in figure 6.2.

Assumption2.1: Repairing Process Assumptions

1. For repairing process, each sub-group only works on their responsible tasks. There is no cross-utilization between each sub-group.
2. Time used in repairing each order quantity is calculated from

   For sanding and repairing sub-process;

$$\text{Required time (minutes)} = \frac{\text{To be repaired quantity (units)} \times \text{Weighted average standard time (minutes/unit/working team)}}{\text{Number of teams available}}$$

   For painting sub-process;

$$\text{Required time (minutes)} = \frac{\text{To be repaired quantity (units)} \times \text{Standard time (minutes/unit/working team)}}{\text{Number of teams available}}$$

3. Unocuppied time is the unoccupied minutes within 1 hour period.
4. Allocated time is minumum of either unoccupied time or required time; min(unoccupied,required).

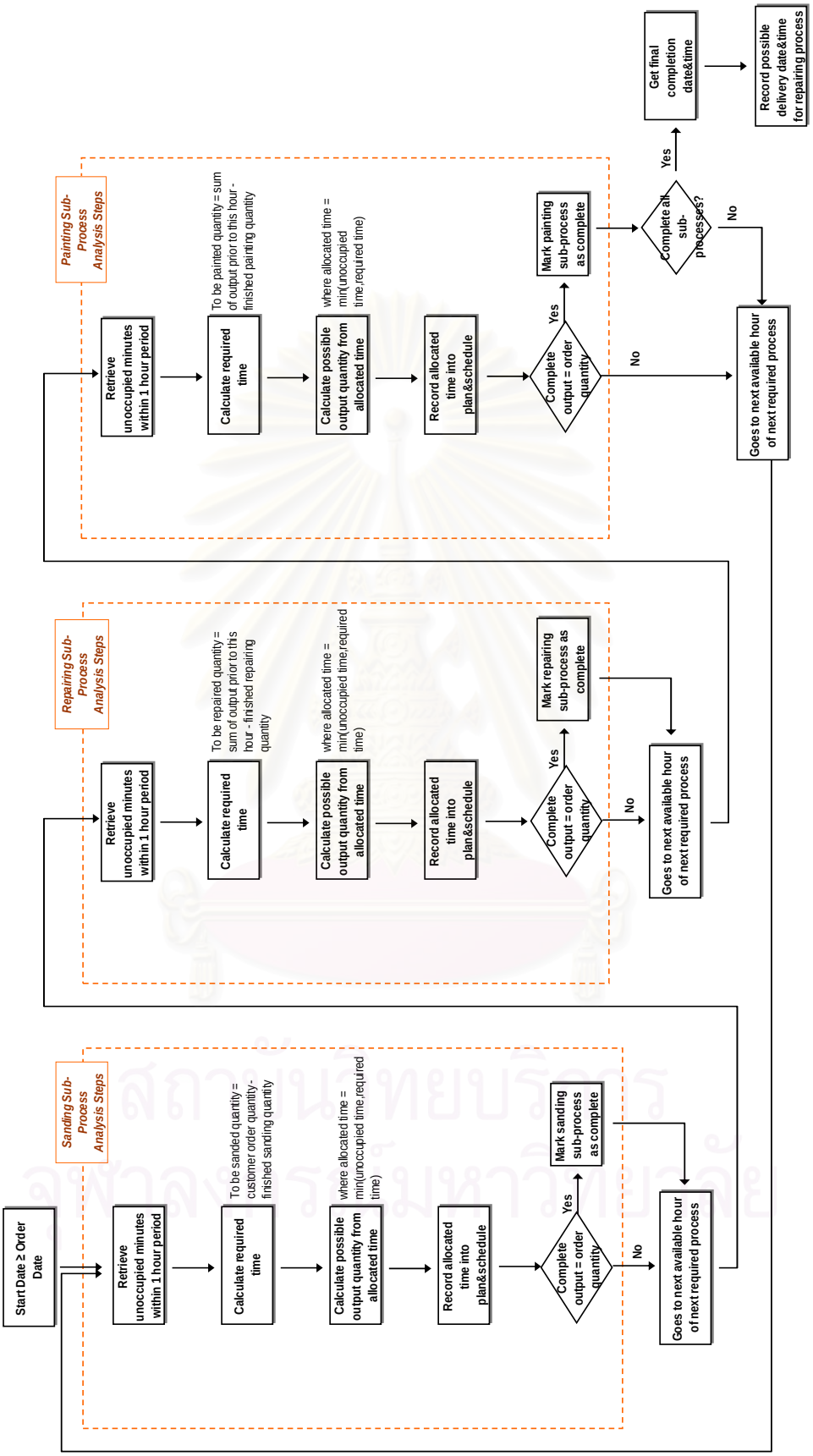


Figure 6.2: The Logical Model 1; Logical Model of Repairing Process

To help understanding the logical model, the examples of repairing metal form 600x1200 and TFT 1205 are explained.

Example: Repairing metal form 600x1200 and TFT 1205 on 20 March, 2009

Product:	Order Quantity	Sanding Weighted Av. Std. Time	Repair Weighted Av. Std. Time	Paint
1. Metal form 600 x 1200	100	0.64	5.68	0
No. of team available		1	14	0
2. TFT1205	100	0	2.33	0.35
No. of team available		0	13	3

Result:

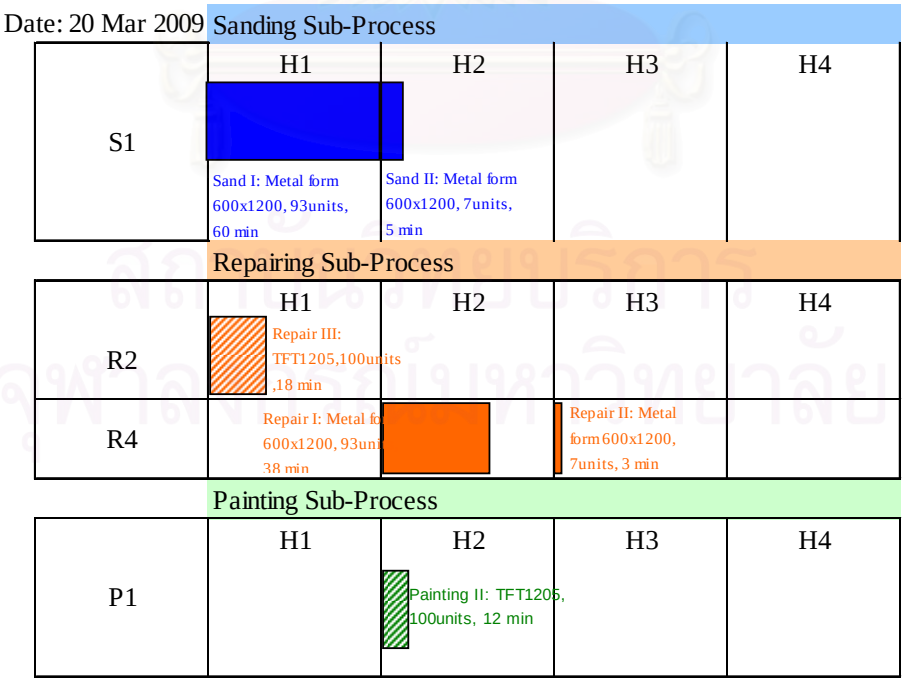
1) Calculation Detail

Metal form 600 x 1200

Sand I:	1. retrieve unoccupied minutes within 1 hour period	60 minutes
	2. calculate required time = (order q'ty x std. time)/no. of teams avail.	64 minutes
	3. calculate possible output = allocated time x no. of teams avail./ std. time	93 units
	allocated time = min(unoccupied time,required time) =	*60 minutes*
	4. record allocated time into plan	60 minutes
	5. complete sub-process?	No (output q'ty ≠ order q'ty)
	6. go to the next available hour	
Repairing I:	1. retrieve unoccupied minutes within 1 hour period	60 minutes
	2. calculate required time = (sum of prior output x std. time)/no. of teams avail.	38 minutes
	3. calculate possible output = allocated time x no. of teams avail./ std. time	93 units
	allocated time = min(unoccupied time,required time) =	*38 minutes*
	4. record allocated time into plan	38 minutes
	5. complete sub-process?	No (output q'ty ≠ order q'ty)
	6. go to the next available hour	
Painting I:	1. retrieve unoccupied minutes within 1 hour period	60 minutes
	2. calculate required time = (sum of prior output x std. time)/no. of teams avail.	0 minutes
	3. mark this sub-process complete	
	4. complete all sub-processes	No (not all sub-process mark complete)
Sand II:	1. retrieve unoccupied minutes within 1 hour period	60 minutes
	2. calculate required time = (order q'ty-finished quantity)xstd. time/no. of teams avail.	5 minutes
	3. calculate possible output = allocated time x no. of teams avail./ std. time	7 units
	allocated time = min(unoccupied time,required time) =	*5 minutes*
	4. record allocated time into plan	5 minutes
	5. complete sub-process?	Yes (output q'ty = order q'ty)
	6. mark this sub-process complete	
	7. go to the next available hour	
Repairing II:	1. retrieve unoccupied minutes within 1 hour period	60 minutes
	2. calculate required time = (sum of prior output x std. time)/no. of teams avail.	3 minutes
	3. calculate possible output = allocated time x no. of teams avail./ std. time	7 units
	allocated time = min(unoccupied time,required time) =	*3 minutes*
	4. record allocated time into plan	3 minutes
	5. complete sub-process?	Yes (output q'ty = order q'ty)
	6. mark this sub-process complete	
	7. complete all sub-processes	Yes (All sub-process mark complete)
	8. get final completion date & time	20 Mar 2009, H3

	TFT1205	
Sand III:	1. retrieve unoccupied minutes within 1 hour period	55 minutes
	2. calculate required time = (order q'ty x std. time)/no. of teams avail.	0 minutes
	3. mark this sub-process complete	
	4. go to the next available hour	
Repairing III:	1. retrieve unoccupied minutes within 1 hour period	60 minutes
	2. calculate required time = (sum of prior output x std. time)/no. of teams avail.	18 minutes
	3. calculate possible output = allocated time x no. of teams avail./ std. time	100 units
	allocated time = min(unoccupied time,required time) =	*18 minutes*
	4. record allocated time into plan	18 minutes
	5. complete sub-process?	Yes (output q'ty =order q'ty)
	6. mark this sub-process complete	
	7. go to the next available hour	
Painting II:	1. retrieve unoccupied minutes within 1 hour period	60 minutes
	2. calculate required time = (sum of prior output x std. time)/no. of teams avail.	12 minutes
	3. calculate possible output = allocated time x no. of teams avail./ std. time	100 units
	allocated time = min(unoccupied time,required time) =	*12 minutes*
	4. record allocated time into plan	12 minutes
	5. complete sub-process?	Yes (output q'ty =order q'ty)
	6. complete all sub-processes	Yes (All sub-process mark complete)
	7. get final completion date & time	20 Mar 2009, H2

2) Summary Plan



3) Summary Result

The order on 20 March, 2009 to repair metal form 600x1200, 100 units and TFT 1205, 100 units is finish on the third hour and the second hour of the same day, 20 March 2009, respectively.

6.1.2.2 Manufacturing Process Logical Model and Assumptions

Similar to repairing process, logical model of manufacturing process is divided into 3 sections of analysis steps according to manufacturing process's sub-process; cutting, assembly & welding, and painting sub-process analysis steps. First, the manufacturing process's assumptions are described (see assumption 2.2) then its logical model (logical model 2) is depicted in figure 6.3.

Assumption2.2: Manufacturing Process Assumptions

1. Time used in manufacturing each order quantity is calculated from

   For cutting sub-process;

   Required time (minutes) = To be manufactured quantity (units) X Standard time (minutes/unit/machine or working team)

   For assembly and welding sub-process and painting sub-process;

   $$\text{Required time (minutes)} = \frac{\text{To be manufactured quantity (units)} \times \text{Standard time (minutes/unit/working team)}}{\text{Number of teams available}}$$

2. Unoccupied time is the unoccupied minutes within 1 hour period.
3. For assembly and welding sub-process and painting sub-process, allocated time is minimum of either unoccupied time or required time; min(unoccupied,required).
4. For cutting sub-process, since the lowest output of all cutting work elements is the input to next sub-process and since some work elements share the same machine, therefore, in order to allocate the output for all cutting work elements, the unoccupied time is divided into 30 minutes. Therefore, allocated time in cutting sub-process is min[(min(unoccupied,30)),required]; where 30 minutes is per 1 machine or 1 working team.

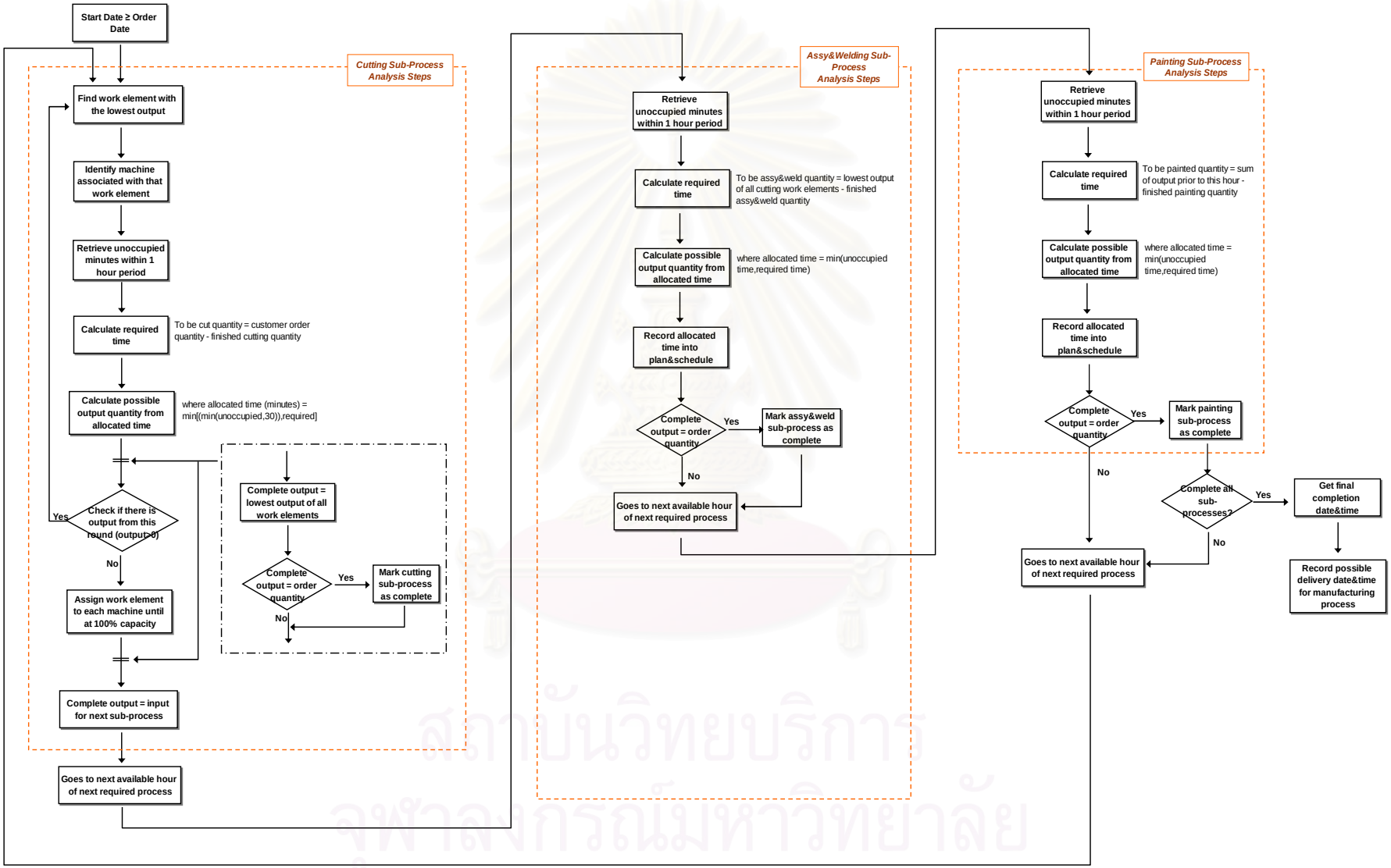


Figure 6.3: The Logical Model 2; Logical Model of Manufacturing Process

To help understanding the logical model, the example of manufacturing HS418 is described.

Example: Manufacturing HS418, 20 units on 20 March, 2009

		Standard Time (min/unit/machine or team)					
Product:	Order Quantity	C1	C2	C3	C4	AW1	Paint
1.HS-418	20	1.90	1.05	1.32	2.62	28.27	0.43
Machine Associated		E	F	C	F		
No. of machine/team avaiable		1	1	2		2	3

Result:

1) Calculation Detail

Cutting Sub-Process I

i:	1. find work element with the lowest output	C1	
	2. Iidentify machine associated with that work element	E	
	3. retrieve unoccupied minutes	60	minutes
	4. calculate required time = (order q'ty x std. time)	38	minutes
	5. calculate possible output = allocated time / std. time	15	units
	allocated time = min[(min(unoccupied,30)),required] =	*30*	*minutes*
	6. complete output = lowest output of all work elements	0	units
	7. complete output = order quantity?	No	
	8. check if output > 0 from this round	Yes	
ii:	9. find work element with the lowest output	C2	
	10. Iidentify machine associated with that work element	F	
	11. retrieve unoccupied minutes	60	minutes
	12. calculate required time = (order q'ty x std. time)	21	minutes
	13. calculate possible output = allocated time / std. time	20	units
	allocated time = min[(min(unoccupied,30)),required] =	*21*	*minutes*
	14. complete output = lowest output of all work elements	0	units
	15. complete output = order quantity?	No	
	16. check if output > 0 from this round	Yes	
iii:	17. find work element with the lowest output	C3	
	18. Iidentify machine associated with that work element	C	
	19. retrieve unoccupied minutes	120	minutes
	20. calculate required time = (order q'ty x std. time)	26	minutes
	21. calculate possible output = allocated time / std. time	20	units 19.997468
	allocated time = min[(min(unoccupied,30)),required] =	*26*	*minutes*
	22. complete output = lowest output of all work elements	0	units
	23. complete output = order quantity?	No	
	24. check if output > 0 from this round	Yes	
iv:	25. find work element with the lowest output	C4	
	26. Iidentify machine associated with that work element	F	
	27. retrieve unoccupied minutes	39	minutes
	28. calculate required time = (order q'ty x std. time)	52	minutes
	29. calculate possible output = allocated time / std. time	11	units
	allocated time = min[(min(unoccupied,30)),required] =	*30*	*minutes*
	30. complete output = lowest output of all work elements	11	units
	31. complete output = order quantity?	No	
	32. check if output > 0 from this round	Yes	
v:	33. find work element with the lowest output	C4	
	34. Iidentify machine associated with that work element	F	
	35. retrieve unoccupied minutes	9	minutes
	36. calculate required time = (order q'ty - finished units) x std. time	23.55	minutes
	37. calculate possible output = allocated time / std. time	3	units
	allocated time = min[(min(unoccupied,30)),required] =	*9*	*minutes*
	38. complete output = lowest output of all work elements	14	units
	39. complete output = order quantity	No	
	40. check if output > 0 from this round	Yes	
vi:	41. find work element with the lowest output	C4	
	42. Iidentify machine associated with that work element	F	
	43. retrieve unoccupied minutes	0	minutes
	44. calculate required time = (order q'ty - finished units) x std. time	0	minutes
	45. calculate possible output = allocated time / std. time	0	units
	allocated time = min[(min(unoccupied,30)),required] =	*0*	*minutes*
	46. complete output = lowest output of all work elements	14	units
	47. complete output = order quantity	No	
	48. check if output > 0 from this round	No	

vii:	49. assign work element to each m/c untill 100% capacity		E	F	C
		time used	30	60	26
		time avail.	60	60	120
	50. find work element associated with available capacity of m/c		C1		
	51. Iidentify machine associated with that work element		E		
	52. retrieve unoccupied minutes		30	minutes	
	53. calculate required time = (order q'ty - finished units) x std. time		10	minutes	
	54. calculate possible output = allocated time / std. time		5	units	
	allocated time = min[(min(unoccupied,30)),required] =		*10*	*minutes*	
	55. complete output = lowest output of all work elements		14	units	
	56. complete output = order quantity		No		
	57. assign work element to each m/c untill 100% capacity		E	F	C
		time used	60	60	26
		time avail.	60	60	120
	58. complete output = lowest output of all work elements		14	units	
	59. go to the next avaiable hour				

Assemble&Welding Sub-Process I

1. retrieve unoccupied minutes within 1 hour period	60	minutes
2. calculate required time = (prior output x std. time)/no. of teams avail.	198	minutes
3. calculate possible output = allocated time x no. of teams avail./ std. time	4	units
allocated time = min(unoccupied time,required time) =	*60*	*minutes*
4. record allocated time into plan	60	minutes
5. complete sub-process?	No	(output q'ty ≠ order q'ty)
6. go to the next available hour		

Painting I:

1. retrieve unoccupied minutes within 1 hour period	60	minutes
2. calculate required time = (prior output x std. time)/no. of teams avail.	1	minutes
3. calculate possible output = allocated time x no. of teams avail./ std. time	4	units
allocated time = min(unoccupied time,required time) =	*1*	*minutes*
4. record allocated time into plan	1	minutes
5. complete sub-process?	No	(output q'ty ≠ order q'ty)
6. go to the next available hour		

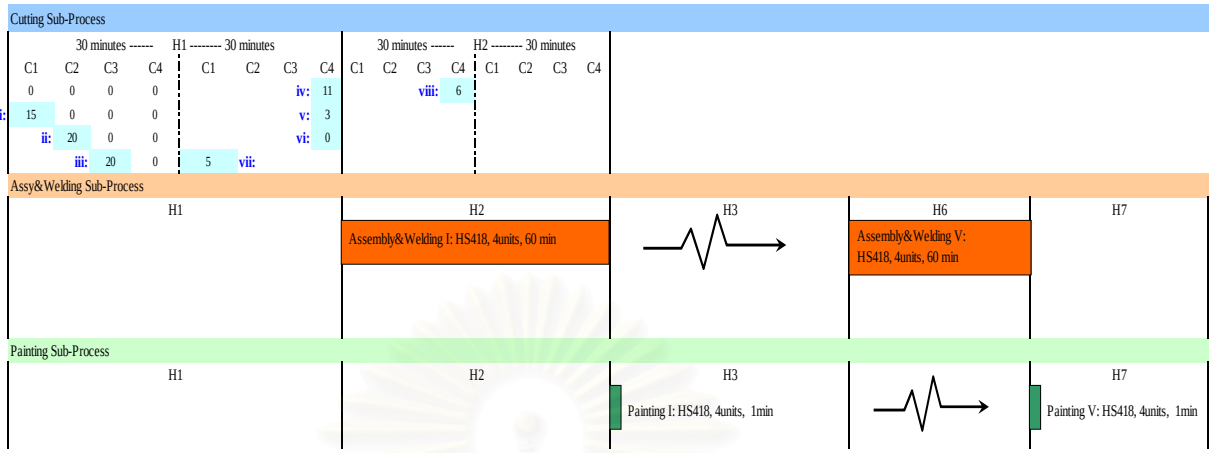
Cutting Sub-Process II

viii: 1. find work element with the lowest output	C4	
2. Iidentify machine associated with that work element	F	
3. retrieve unoccupied minutes	60	minutes
4. calculate required time = (order q'ty - finished units) x std. time	16	minutes
5. calculate possible output = allocated time / std. time	6	units
allocated time = min[(min(unoccupied,30)),required] =	*16*	*minutes*
6. complete output = lowest output of all work elements	6	units
7. complete output = order quantity?	Yes	
8. Mark this sub-process complete		
9. check if output > 0 from this round	Yes	
10. complete output = lowest output of all work elements	6	units
11. go to the next avaiable hour		

Go on to repairing sub-process and painting sub-process, and continue on the calculation until the output quantity = order quantity

2) Summary Plan

20 March 2009



3) Summary Result

The order on 20 March, 2009 to manufacture HS 418, 20 units is finish on the seventh hour of the same day, 20 March 2009.

6.2 The Development and User Interface of Information System for ABC's Order Receiving Process

The developed data storage, data flow, and the logical model are integrated to develop the information system for ABC's order receiving process using Visual Basic-base Excel Macro. Step by step, this thesis explains, starting from calling the information system as a first step to the delivery date estimation as a final step.

6.2.1 Calling the Information System

Opening the information system gives the start up page as figure 6.4.

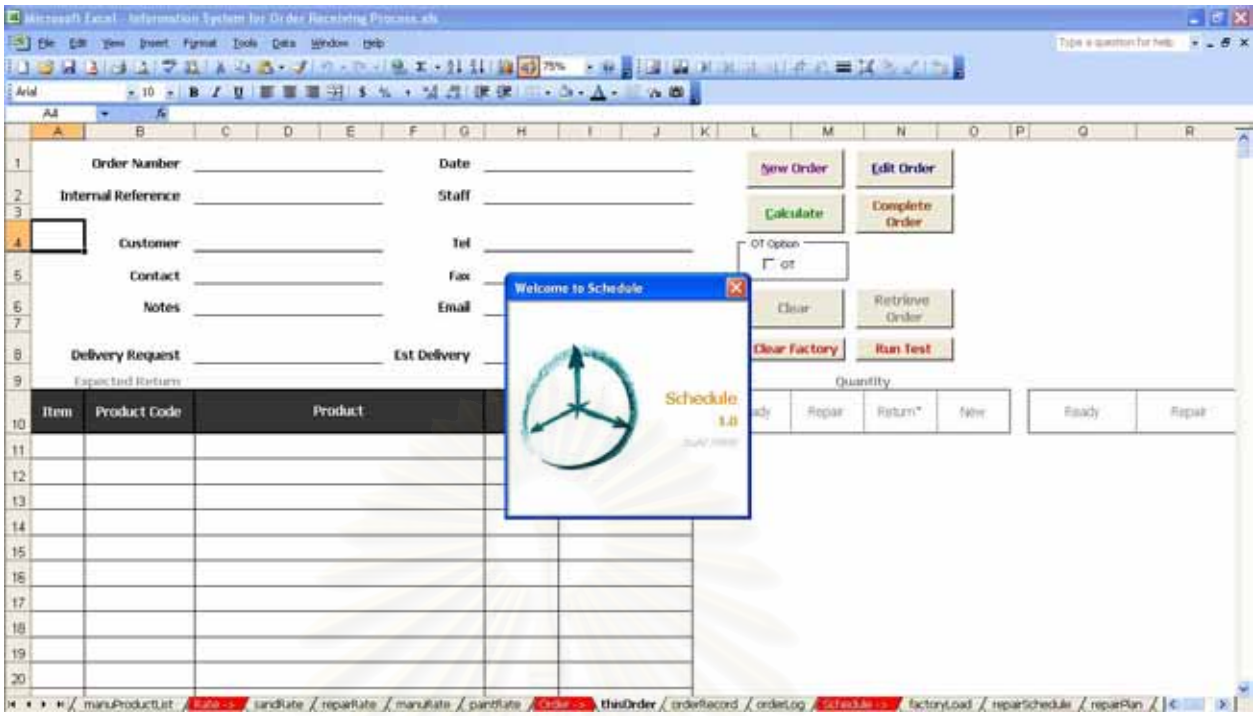


Figure 6.4: The Information System; Start Up Page

6.2.2 Inventory Update

Since the quantity of each inventory is calculated to give the result of product availability channels, it is necessary to update the inventory before running the information system. The steps in inventory update are as follow:

Step1: Go to “inventory” data storage sheet, click on “update” button. The “update inventory” window appears as in figure 6.5.

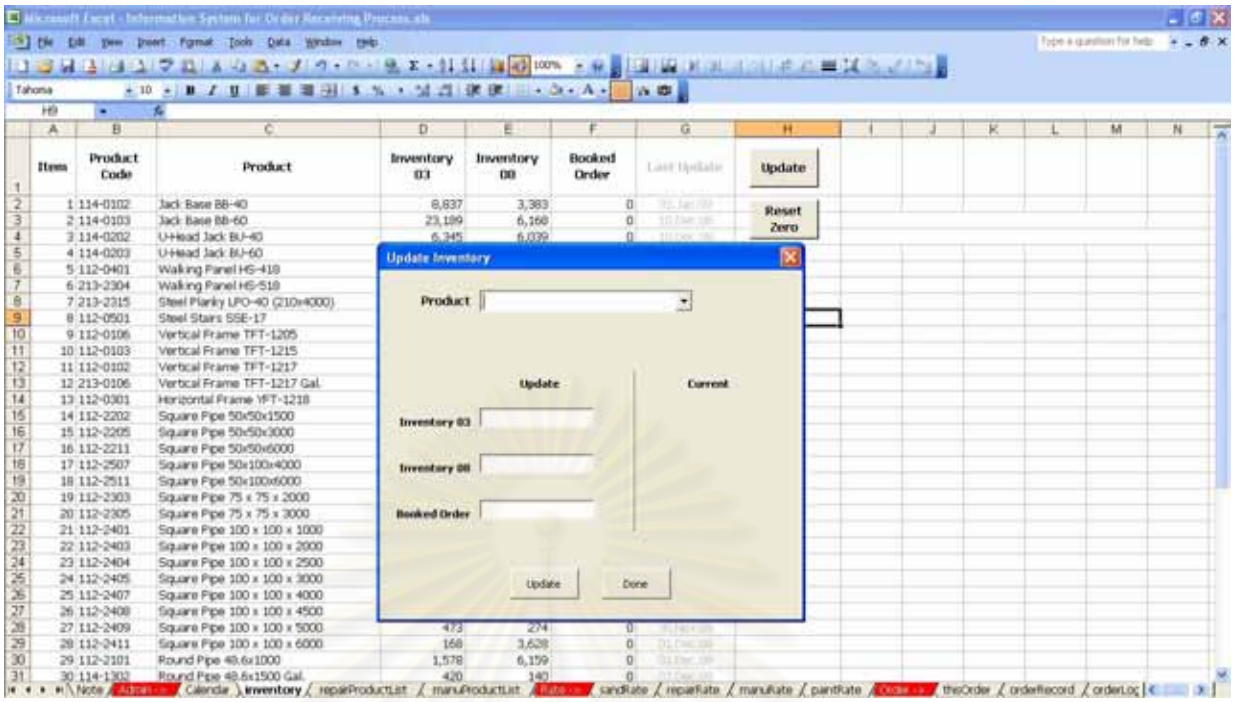


Figure 6.5: The Information System; Inventory Update Data Storage Sheet

Step2: Select the product to be updated, fill in each inventory quantity and book order quantity, and click on “update” button.

To help understand the developed information system, the example of Metal Form 600x1200, TFT1205, and HS418 described in the design of information system (see section 6.1, chapter 6) is also used in this section.

Product	Inventory Status (Units)			Customer Order (Units)
	Finished Product Inventory	Waiting-for-Repair Items	Booked Order	
Metal Form 600x1200	20	100	0	120
TFT1205	20	100	0	120
HS418	0	0	0	20

The inventory update of Metal Form 600x1200 as an example is depicted in figure 6.6.

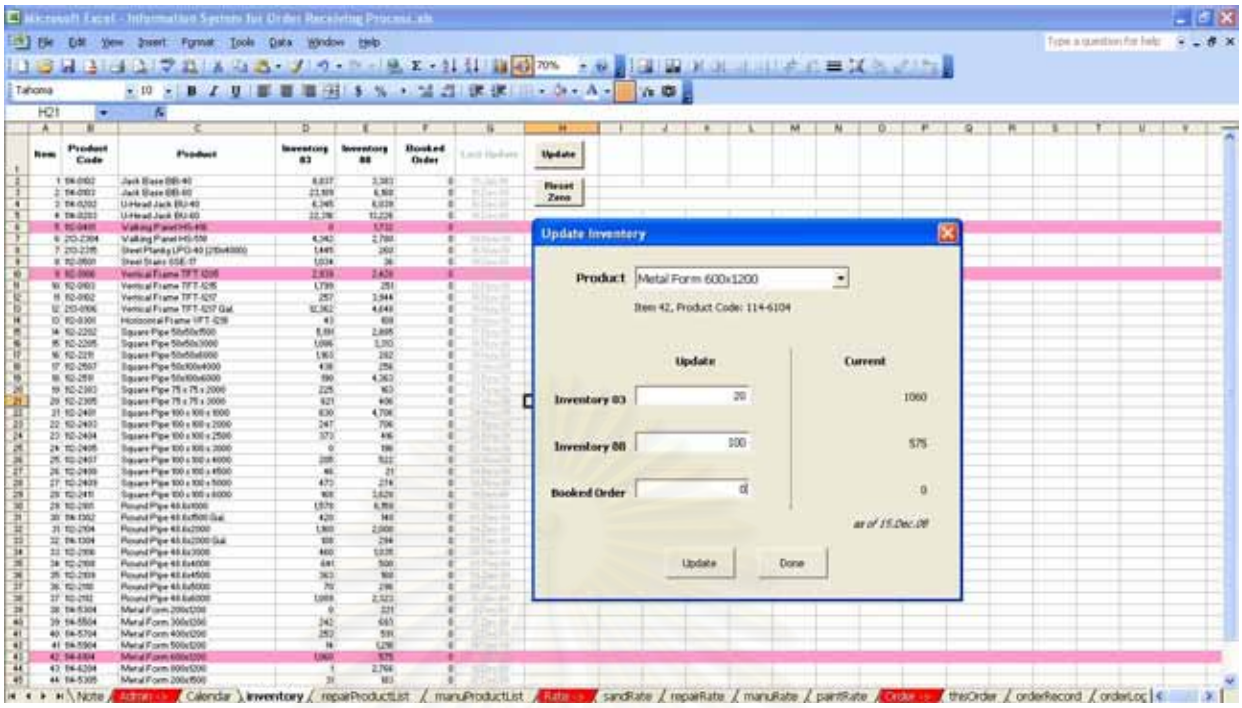


Figure 6.6: The Information System; Updating Inventory Data

Step 3: After updating all products data, click on “done” button to finish this section. The latest updated date is recorded and shown in the page as well. Example of updated Metal Form 600x1200, TFT1205, and HS418 inventory results are in figure 6.7.

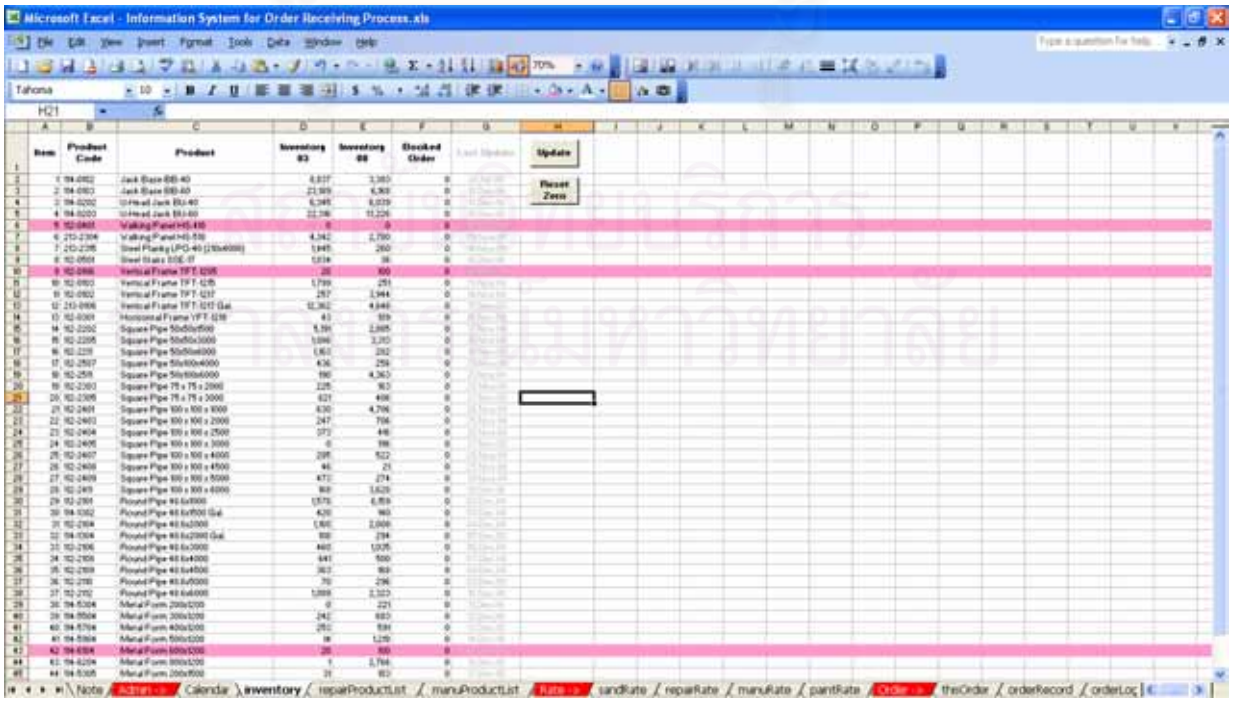


Figure 6.7: The Information System; Updated Inventory Result

6.2.3 Customer Order Information Input

In this step, users input the company internal reference information and customer order information. The steps of customer order information input are as follows:

Step1: Go to “this order” data storage sheet (see figure 6.8).

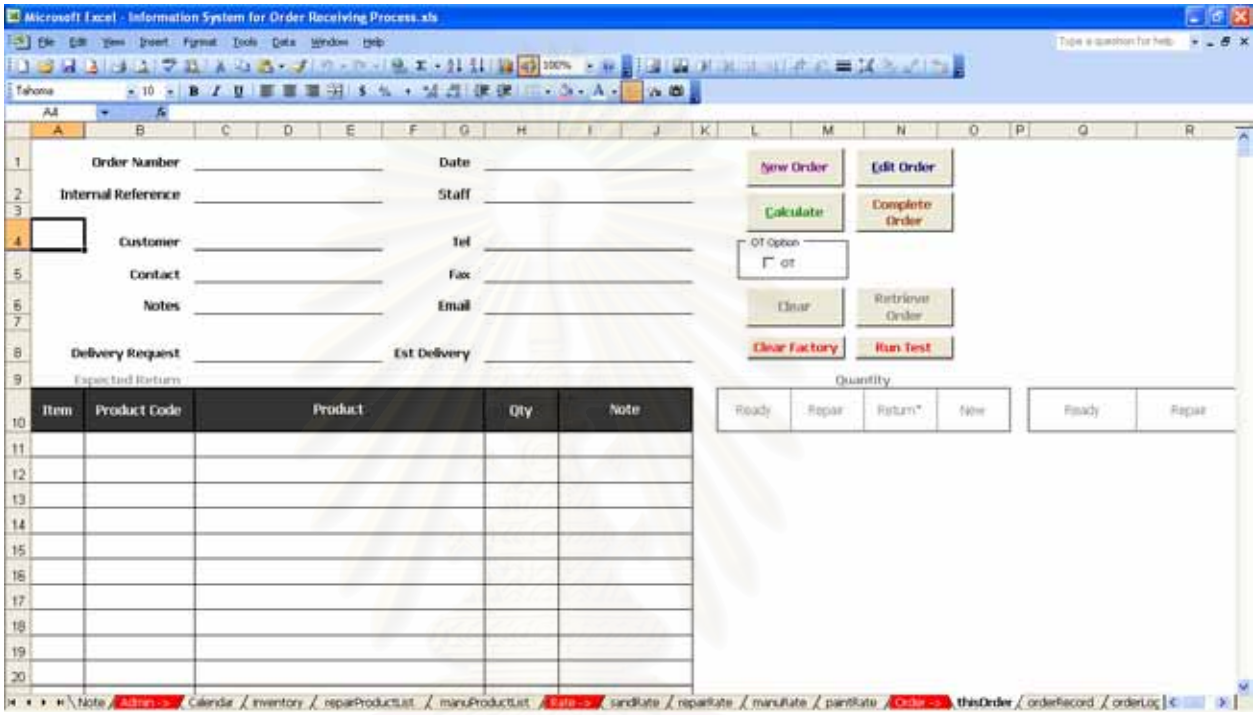


Figure 6.8: The Information System: This Order Data Storage Sheet

Step2: Click “new order” button to input the company internal reference information, customer detail, customer request product delivery date, and estimated product return date.

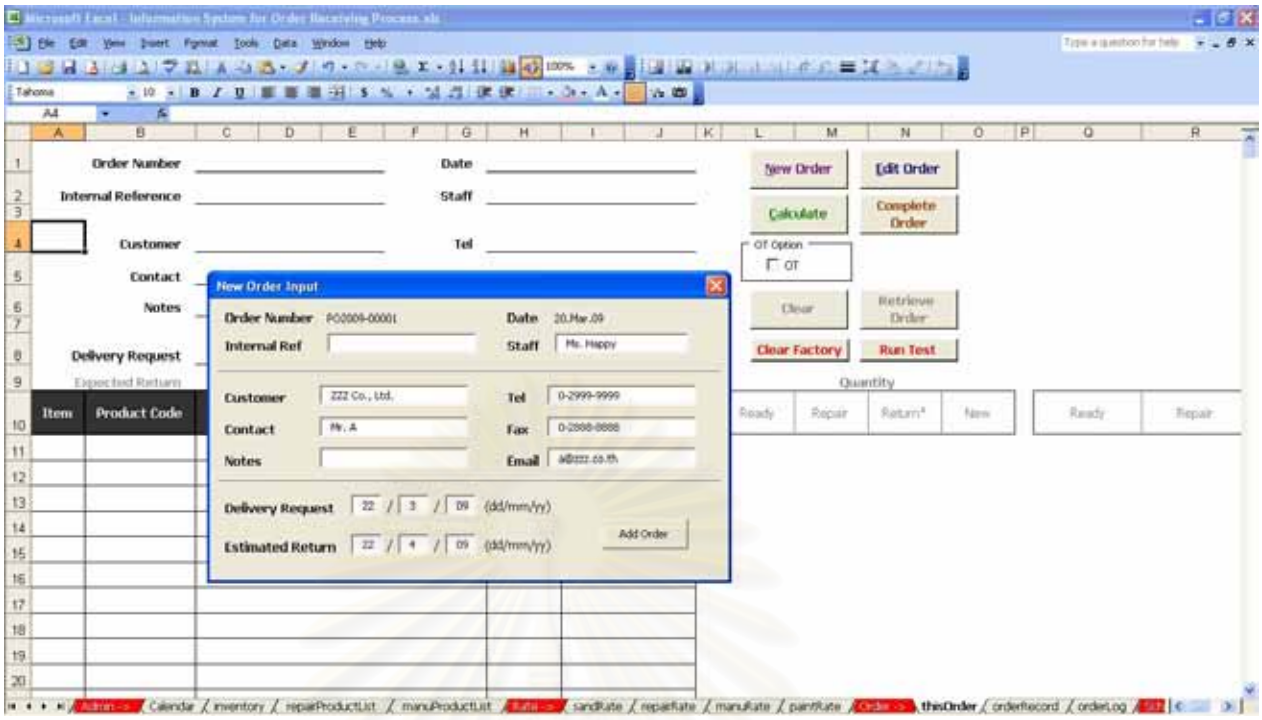


Figure 6.9: The Information System: Internal Reference and Customer Detail Input

Step3: After all required information in step 2 are completely filled, click “add order” button, and then “order edit” window shows up. Users input each order product and its order quantity by clicking “add item” box. If customers inform estimated return date of each product, mark “estimated return by item”, and fill in the informed date. After finish all information are input, click “done” button to finish customer order information input step. The examples of order input are in figure 6.9 and 6.10.

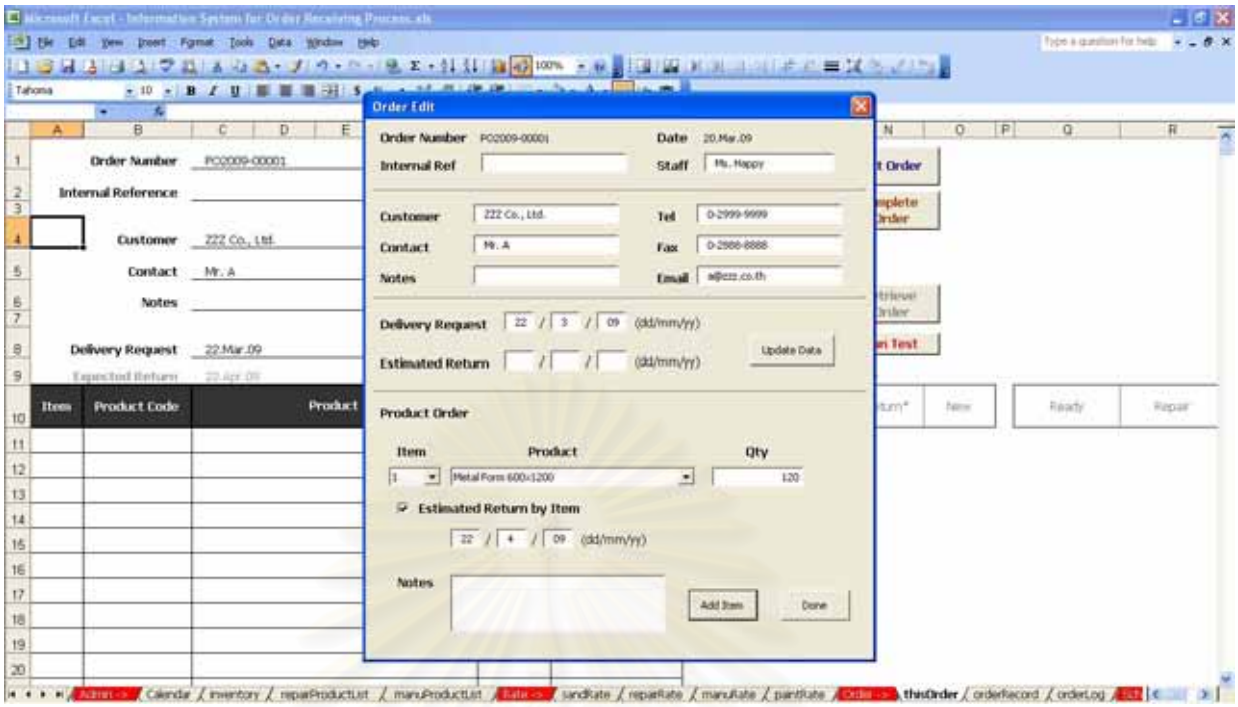


Figure 6.10: The Information System: Order Product Input

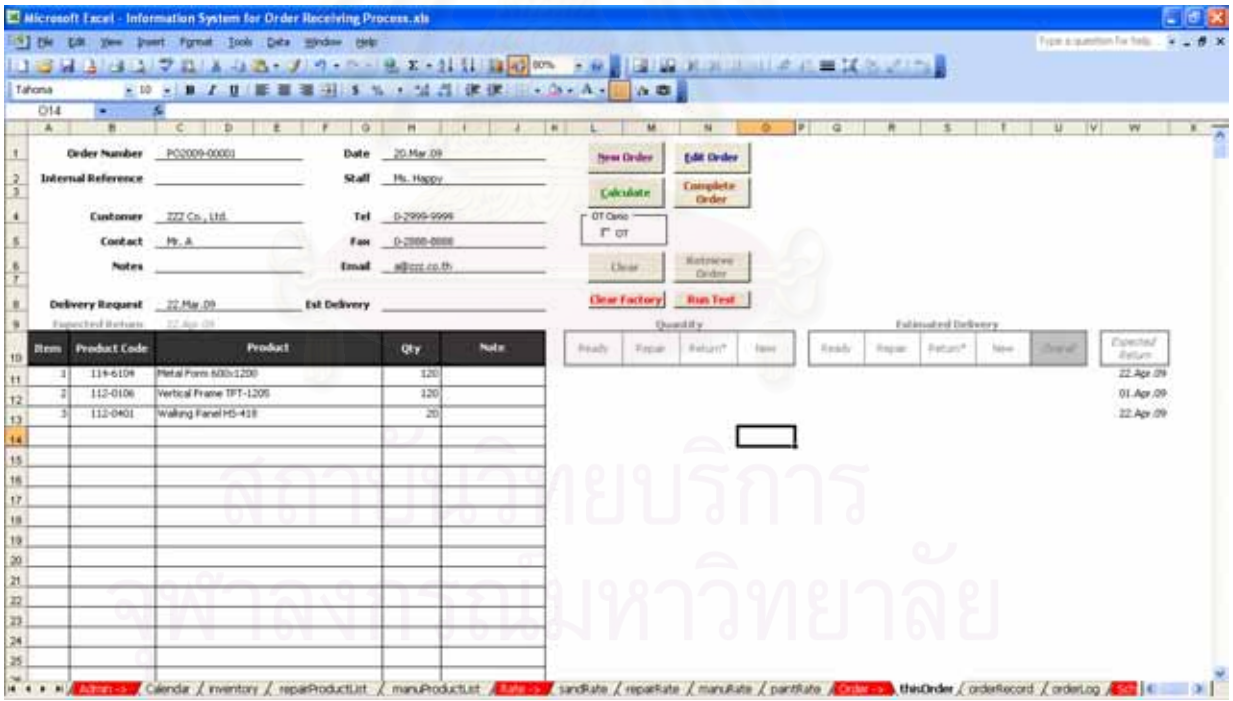


Figure 6.11: The Information System: Customer Order Information Input Result

6.2.4 Estimate Delivery Date and Product Availability Channels

This step is a continuous step from previous step (Customer Order Information Input). After finish customer order information input step, click “calculate” button.

Then the information system calculates for the estimate product delivery date and availability channels as described in the information system logical model.

From the example of Metal Form 600x1200, TFT1205, and HS418, the results are depicted in figure 6.12.

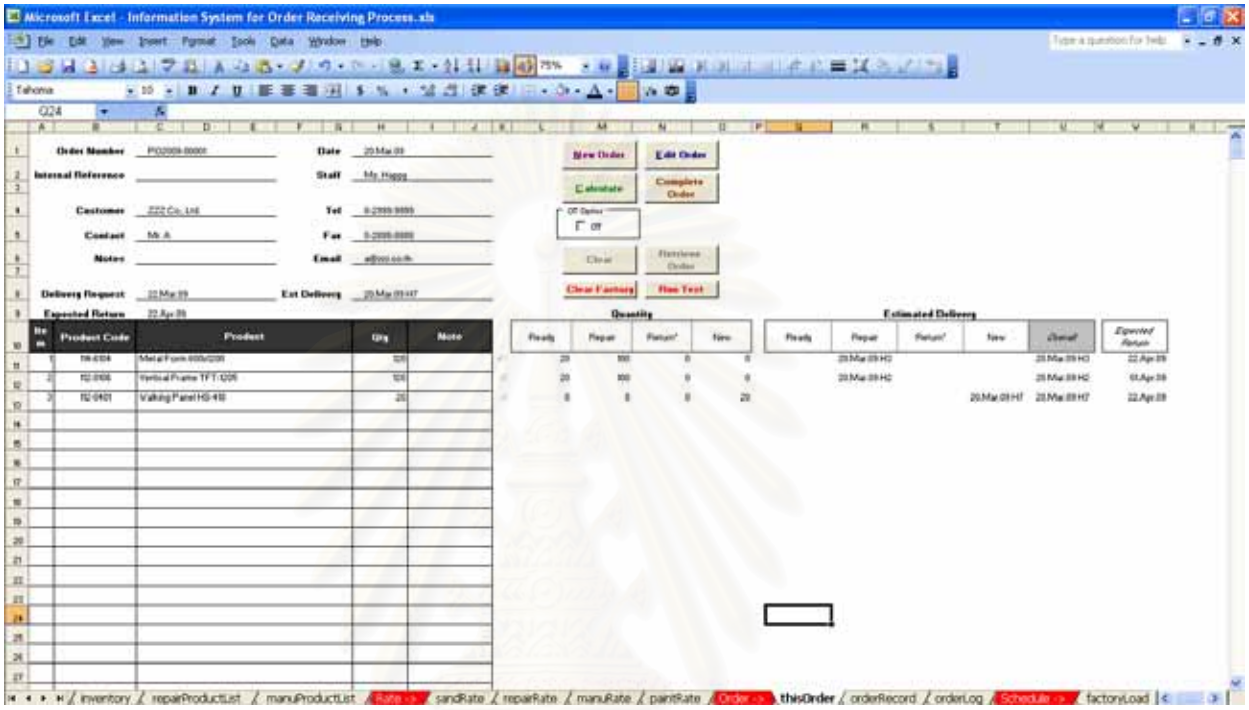


Figure 6.12: The Information System: Estimate Product Delivery Date and Product Availability Channel Result

From figure 6.12, the 20 units from total order of 120 units of Metal Form 600x1200 and TFT1205 are delivered through the finished product inventory whereas the remains are to be repaired. The result of repairing metal form 600x1200, 100 units and TFT 1205, 100 units is finish on the third hour and the second hour of the same day of order date which is the same result with the example given in repairing logical model section (see section 6.1, chapter 6). For HS418, since there is none left in the inventory, the total 20 units order are from the manufacturing process. Finally, the estimate delivery date which will be promised to customer is received from the latest date of getting each product.

Users can see this order's production schedules which are repairing process plan, manufacturing process plan, and painting sub-process plant in the "repair plan" data storage sheet (see figure 6.13), "manufacture plan" data storage sheet (see figure

6.14), and “paint plan” data storage (see figure 6.15) respectively. The schedules are given with the format as depicted in the figures.

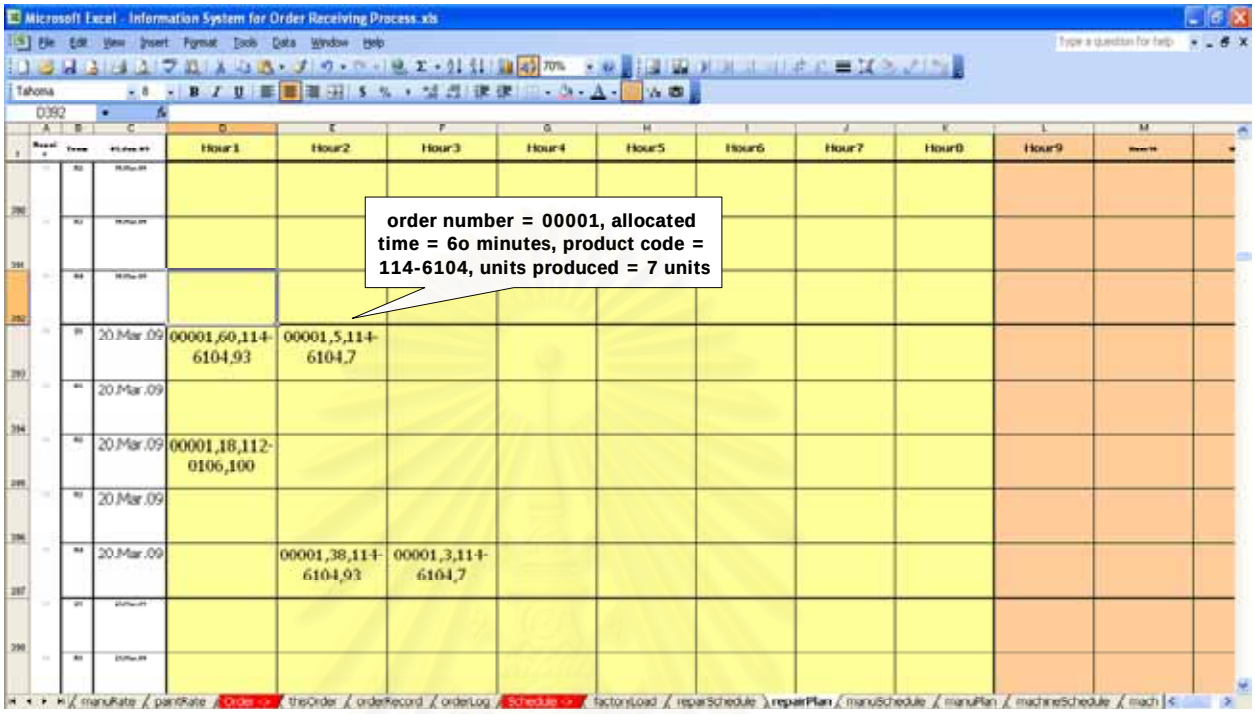


Figure 6.13: The Information System: Repairing Process Plan Result

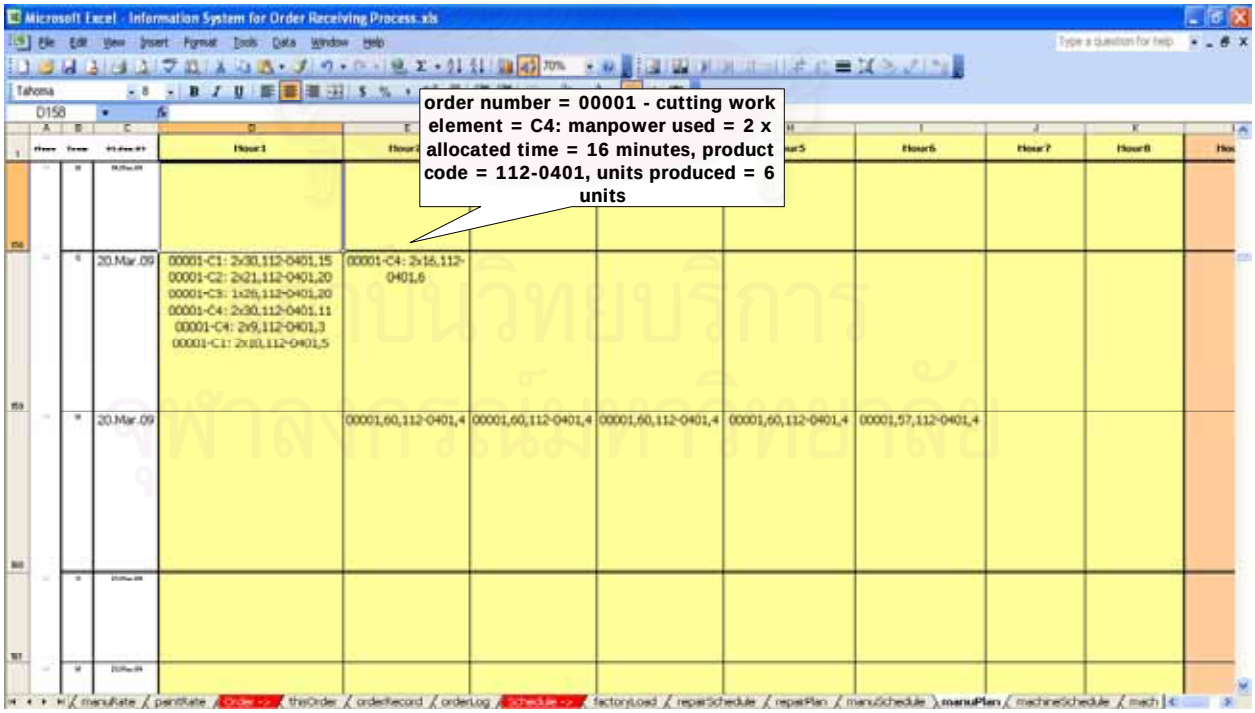


Figure 6.14: The Information System: Manufacturing Process Plan Result

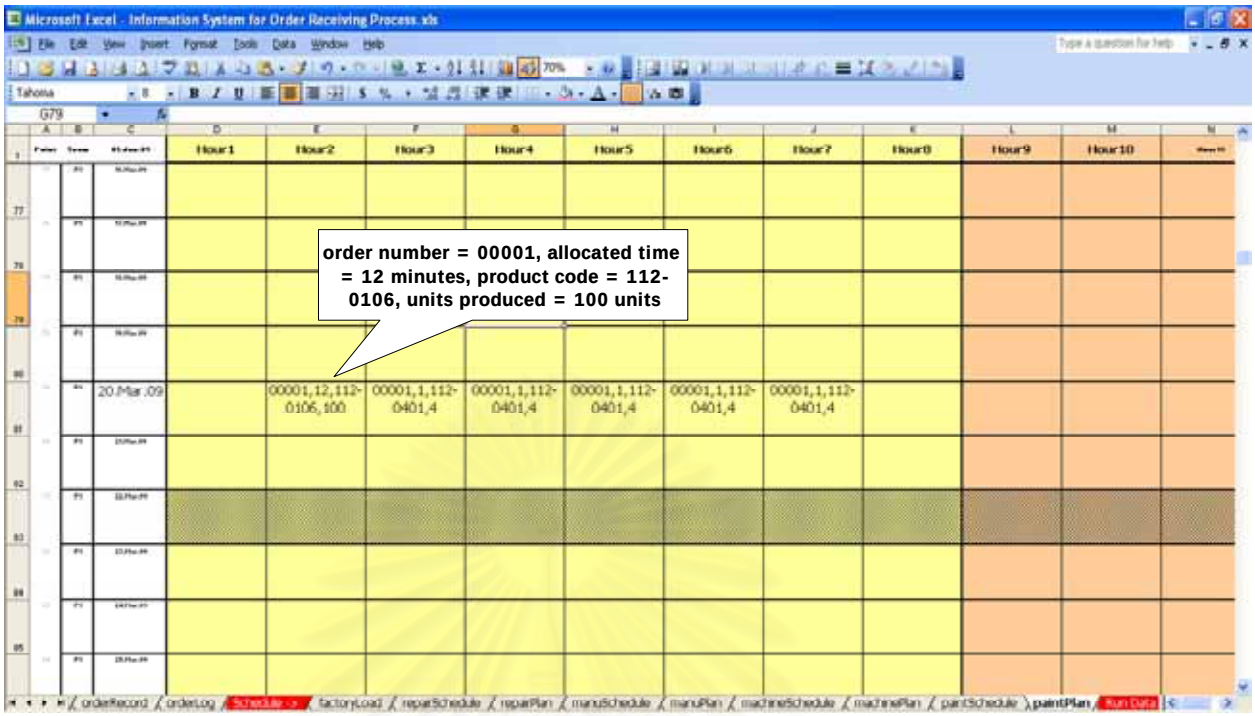


Figure 6.15: The Information System: Painting Sub-Process Plan Result

Upon the current order is finish, click “complete order” to start the next order process.

6.2.5 Editing the Order Information

To edit the order, click “edit order” button, and then the “order edit” appears as in figure 6.16. After editing order information is finished, click “done” button.

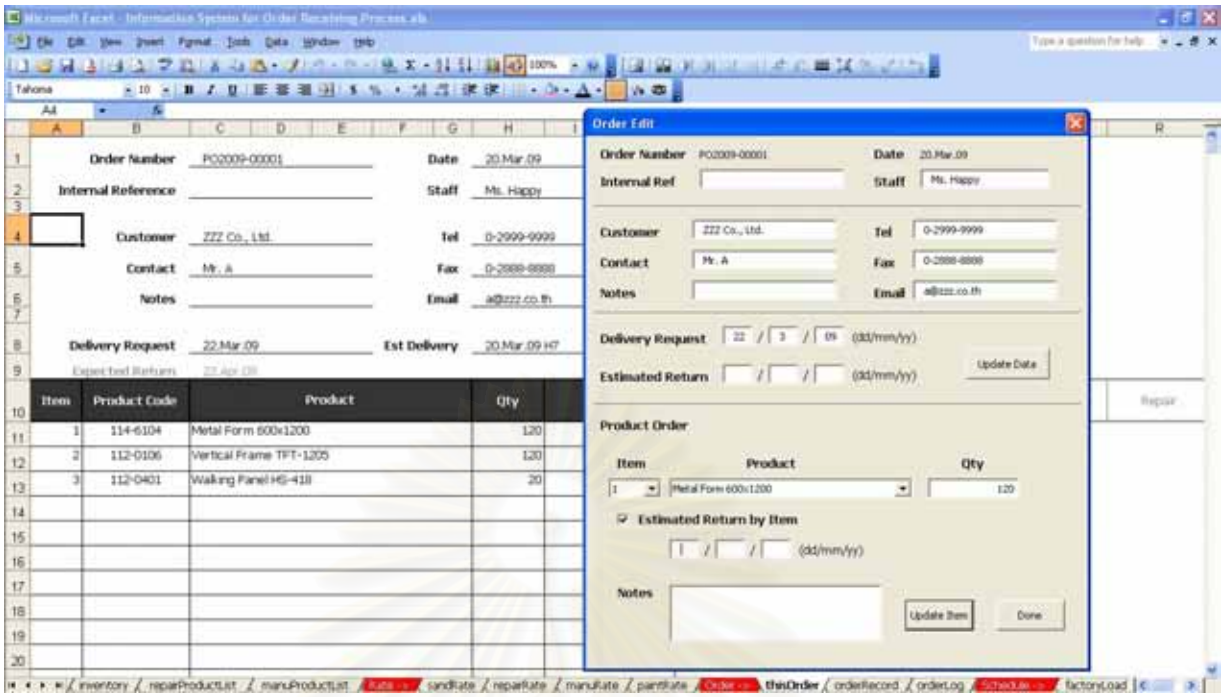


Figure 6.16: The Information System: Editing Order Information

6.2.6 Retrieving the Past Order

To retrieve the past order, the steps are as follows:

Step 1: Go to “this order” data storage sheet (see figure 6.8).

Step 2: Click “retrieve order” button and the “import past order” window appears as in figure 6.17. Select the order needed to be retrieved, click “OK” button, then the “retrieve order complete” window shows up as in figure 6.18.

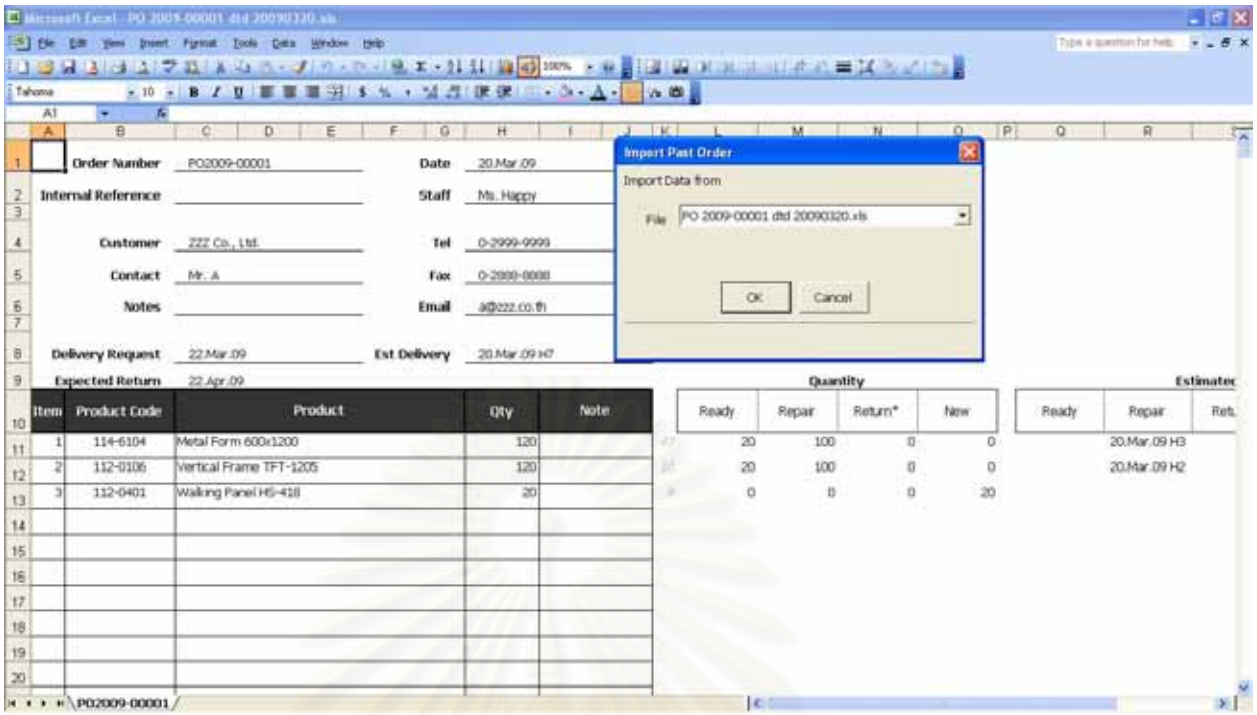


Figure 6.17: The Information System: Import the Past Order Selection

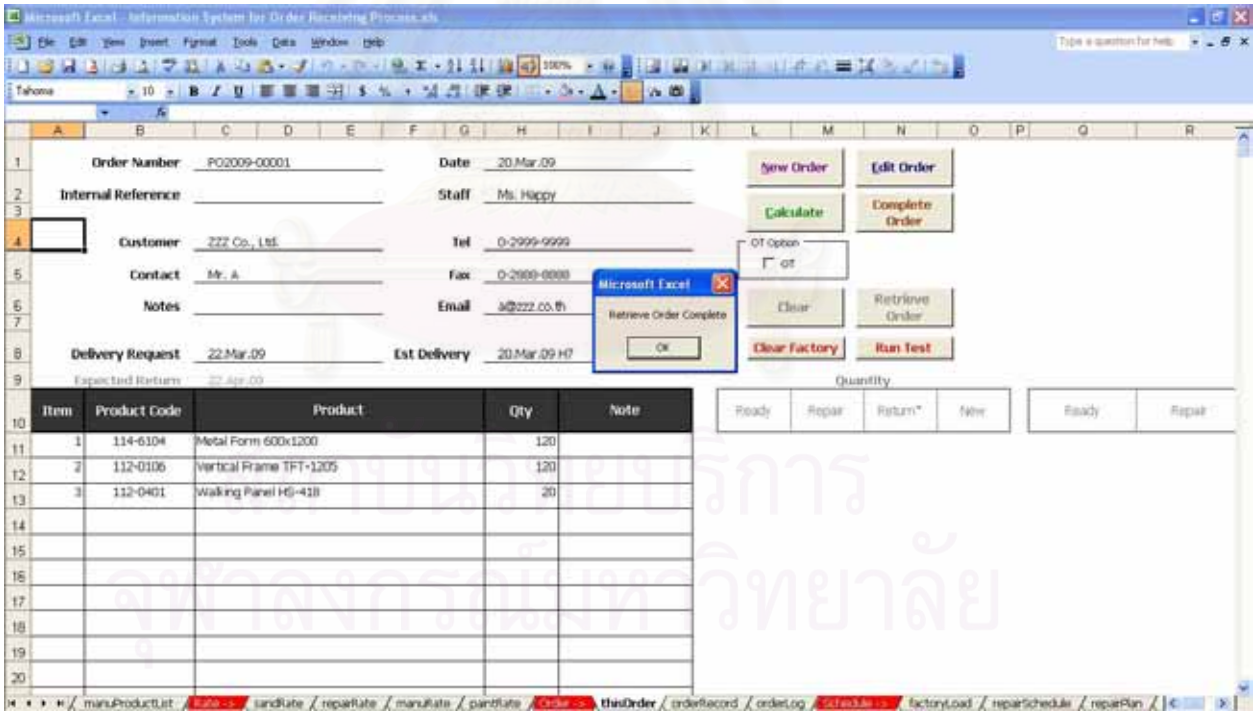


Figure 6.18: The Information System: Import the Past Order Finish

Step 3: If users would like to edit the retrieved order, click “edit order” button and follow the steps described in section 6.2.5.

6.2.7 Outsource Notification

In case of outsource is required as explained in assumption 1 of the information system logic (section 6.1, chapter6), “outsource required” is display after calculation is finished. Figures 6.19 shows an example of customer order TFT1205, 100 units when both finished product inventory and waiting-for-repair items are empty and outsource is required.

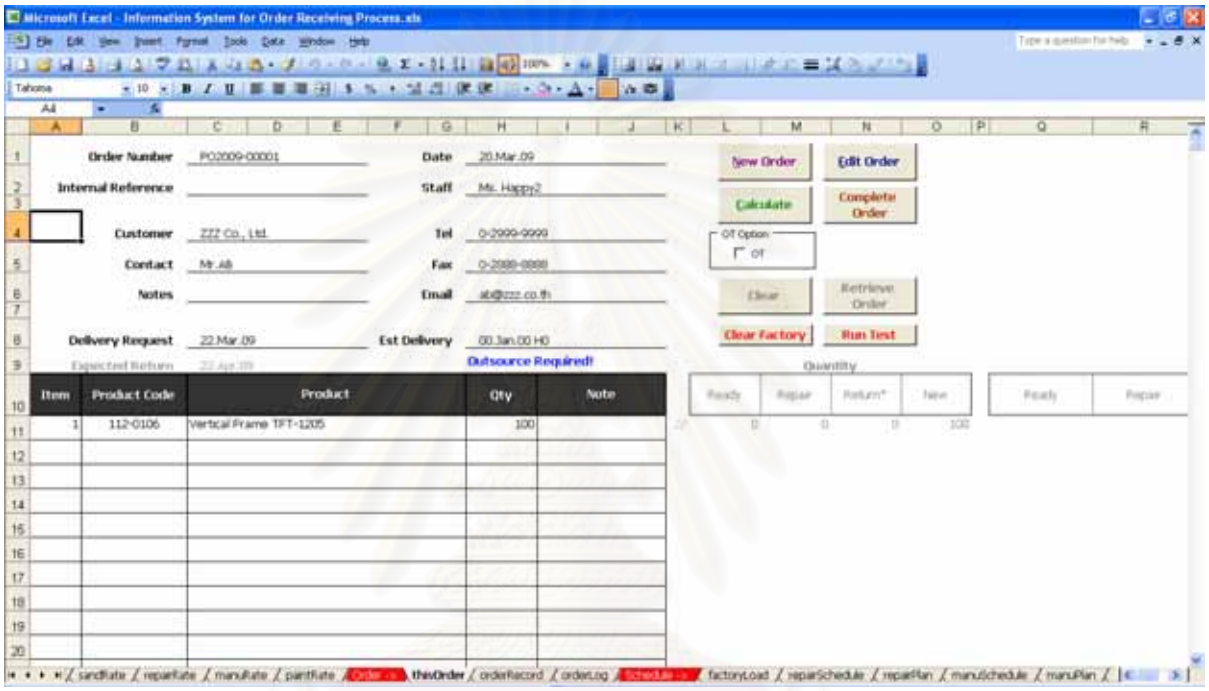


Figure 6.19: The Information System: Estimate Product Delivery Date and Product Availability Channel Result - Outsource Notification

The newly developed information system for ABC’s order receiving process consists of adequate required information in order to support marketing department in proactively negotiating and promising more accurate product deliverable date and quantity. Numbers of products available through each channel and production detail of both production process sectors are also provided. In addition, expected returned date from customers which has never been asked for customers is recorded for future analysis of ABC Company.

After the information system has been developed, it is evaluated for its validation to ABC’s order receiving process by top management and marketing department staffs based on its purpose and objective of improving this process by providing adequate information to be able to designate more accurate product

available-to-promise date and proactively negotiate with customers. Moreover, the preliminary evaluation result based on historical data is also described to shows the improving trend of on time delivery.

6.3 The Validation of the Information System to ABC Company

Currently marketing department process customers order based on 2 data of inventory in paper sheet; quantity of finished products and quantity of waiting-for-repair items. With the production capacity information determined by production staff's experience, then, marketing department promise product available-to-promise date based on their experience which at times can be inaccurate.

In order to improve ABC's order receiving process by providing adequate information for marketing department to process customer orders, the information system is developed with sufficient required data to be logically calculated to support marketing department in designating more accurate product available-to-promise date to customers. In stead of paper sheet, the inventory is recorded in the information system which can be more easily to process. The standard time of both production process sectors; repairing process and manufacturing process, is studied and developed at 95.45% confidence and accuracy of 5% error margin. In addition, the expected return date from customer is also recorded for further analysis by ABC of expecting the returned products which costs less than relying more on manufacturing.

The newly developed information system's validation to order receiving process of ABC's is assessed by top managements and marketing department. According to them, the newly developed information system is accepted and considered as a prototype consisting of sufficient required data and accepted logical model for order receiving process which will be further exploited to cover all products available in ABC. Moreover, it is also accepted for its contributions to the company's ability in achieving the 3 key indicators of on time delivery, fully utilize capacity, and maximum repairing process by several ways. First, in stead of pushing the orders to production department to finish products within timeline given to customers where the historical delay delivery record indicates that several orders can not be finished on time, the information system can support marketing department with the adequate information in order to designate more accurate available-to-promise date and proactively negotiate with customers. As a consequence, it can improve late delivery

which could lead to customer dissatisfaction or, more importantly, losing customers trusts which are big threats to the company.

Second, the established standard time of both production process sectors is utilized as a standard working time of ABC's which not only helps top managements in analyzing actual productivity and standard productivity for further improvement but also in monitoring and evaluating operation workers performance by top management themselves instead of totally being informed and based on production department staff.

The detail and % load of production plan provided in the newly developed information system also helps further improvement of production capacity allocation in the future. In addition, it also helps both top managements and production department in monitoring the production results, early detecting for late delivery possibility, adjusting the production schedule, or informing to marketing department to renegotiate with customers prior to the lateness in delivery or job cancellation occurs.

Finally, currently ABC has never asked for product rental period from each customer and recorded; thus the expected actual return date is likely impossible. Therefore, the estimated return date to be recorded in the newly developed information system is useful and supportive to top managements' decisions in terms of maximizing product through repairing process which costs less.

6.4 Preliminary Evaluation of the Information System

The preliminary evaluation of the newly developed information system is also conducted based on historical data to show the improving trend of on time delivery. However, this evaluation result doest not entirely indicate the efficiency of the information system due to some limitations and conditions of inputting evaluating data which can be different from the real situation at that time. Those limitations and conditions are:

1. There is no unfinished product left in the process prior to the start evaluation date.
2. The order is run by first-in first-out according to its order date. There is no interrupt of urgent order.
3. The production works on 100% capacity.

4. If there is not enough quantity in finished product inventory, the left order quantity is either repaired or manufactured.
5. Lead time used in preparing delivery vehicle is minimum value; 1 day.

The preliminary evaluation result is based on 2 indicators; reduction of units late and %error in available-to-promise date. Unit late is calculated from number of products which actual delivery date is after promised date. Whereas, % error in available-to-promise date is calculated from number of orders which its actual delivery date is after promised date. The preliminary evaluation result is the comparison between the result of ABC's current order receiving process and the result of the newly developed information system (see table 6.1)

Table 6.1: The Preliminary Evaluation Result of the Information System

Source of Product Availability Information	Total Order Quantity (units)	Total Number of Orders	Units Late	% Units Late	No. of Error Available-to-Promise Date Orders	% Error Available-to-Promise Date	Average No. of Delay Days
Current ABC's System	53541	498	16077	30	109	22	8
Newly Developed Information System			13288	25	99	20	6

The result indicates that under the limitations and conditions of the preliminary evaluation, the newly developed information system results in an improving trend of on time delivery by the reduction of 2,789 units late or 5% and 10 numbers of error available-to-promised date orders or 2%. In addition, average numbers of delay days also improve from 8 days to 6 days. To be criticized, around 57% of units late and 64% of error available-to-promise date from the developed information system are in the range of 1 -2 delay days late whereas around 38% of units late and 52% of error available-to-promise date from current ABC's system are within that range. With the information supported by ABC Company, the 2,789 units save from job cancellation due to late delivery can be converted to approximately 250,000 baht – 420,000 baht.

From this improving trend of on time delivery, the fully implemented of the newly developed information system is believed to result in more reduction in unit late and % error available-to-promise date since the limitations and conditions are

synchronized with the real situation; for example, the production plan that has to be shifted due to machine breakdown, or there is an interrupt of urgent order which has to be fulfill first.

CHAPTER VII

CONCLUSION AND RECOMMENDATION

The company studied in this thesis, ABC Company, is the scaffolding and accessories manufacturer in Thailand. The business model of ABC is quite complex as the majority of products, approximately 80% are to be rented whereas the remaining 20% is where customer decide to purchase. As a consequence, it has resulted in the complexity of production process and inventory. To be able to compete in the rental business and go beyond competitors, ABC aims to achieve on time delivery, fully-utilized production capacity (both repairing process and manufacturing process), and maximum available products through repairing process. Successful achievement of those 3 indicators requires adequate information to be analyzed in order receiving process which is the responsibility of marketing department. In spite of the facts that various type of products are being produced, the processes are becoming more sophisticated as business grows, and more necessary data and information should be provided, still there is no information system support marketing department in order receiving process which leads to lateness in delivery and job cancellation problems due to ineffective and inefficient of designated product deliverable date and quantity to customers.

The purpose of this thesis is to develop the information system to improve ABC Company's order receiving process by providing sufficient data in order to reduce lateness in delivery due to ineffective and inefficient designated product available-to-promise date. Currently designated product available-to-promise date and quantity is based on 2 paper sheets of inventory and marketing staff's experience which at times can be inaccurate. In addition, production process capacity of both repairing process and manufacturing process is based on human experience. Also, the expected returned date has never been asked from customer which makes the overall decision in production process more difficult. Therefore, the information system is developed to improve ABC's order receiving process.

7.1 The Information System Development Methodology

In this thesis, the development methodology and steps of the information system for order receiving process are summarized as follows:

1. Study current order receiving process. Analyze which information customers require from marketing department once they orders and which information marketing department must have to response their orders.
2. Examine the problems and the causes of problems. Identify the developed information system's objective and scope to improve current order receiving process.
3. Analyze and collect required data in order receiving process to be input in the information system. Identify which required data is already existed and which one is necessary to be studied and developed. Then, identify which department is responsible for each data collection. Also, analyze which information should be provided as the output from the information system.
4. Study both production process sectors and develop both process sectors' standard time using time study technique.
5. Design the logical model of the information system under the determined assumptions to generate the required output. Then, develop the information system using Visual Basic-based Excel Macro.
6. Evaluate the information system's validation by ABC's top management and marketing department. Also, perform preliminary evaluation based on historical data.

After the information system for ABC's order receiving process is developed and evaluated, the evaluation result of both validation and preliminary evaluation results are summarized.

7.2 Result of Study

The newly developed information system is accepted and conformed to ABC's top managements' and marketing department's requirements since it consists of sufficient data and logical model which are required for ABC's order receiving process improvement in terms of marketing department can designate more accurate available-to-promise date and proactively negotiate to customers. Its preliminary evaluation result under some limitations and conditions of inputting the historical data also indicates the improving trend of on time delivery by the reduction of % units late, % error available-to-promise date, and numbers of delay days and yet it is believed to

improve more once the information system is fully implemented. In addition, according to the top managements, this accepted newly developed information system will also be used as a prototype for all other available products in ABC for further improvement of those products' order receiving process as well.

Moreover, the newly developed information system is also accepted by ABC's top managements for its contributions for other aspects' improvement as well. First, the developed standard time can enhance the ability of top management in evaluating and analyzing the actual productivity comparing with standard productivity for further improvement. It also enhances the ability to detect the possibility of late delivery and be able to prevent such a problem before it occurs since the hourly detail of production plan is provided. Finally, the expected returned date from customer recorded in the information system can support top managements' decisions in order to maximizing products available through repairing process.

7.3 Future Implementation Plan

Since the developed information system will be implemented in ABC in the future, this section describes the implementation plan and the information system interface with other system in the company.

7.3.1 Information System Implementation Plan

Although the developed information system in this thesis does not cover all products available in ABC, input of the remain products and development of their standard time using time study technique are all necessary for implementation the developed information system. Figure 7.1 explains the implementation steps for implementing the information system for order receiving process developed in this thesis.

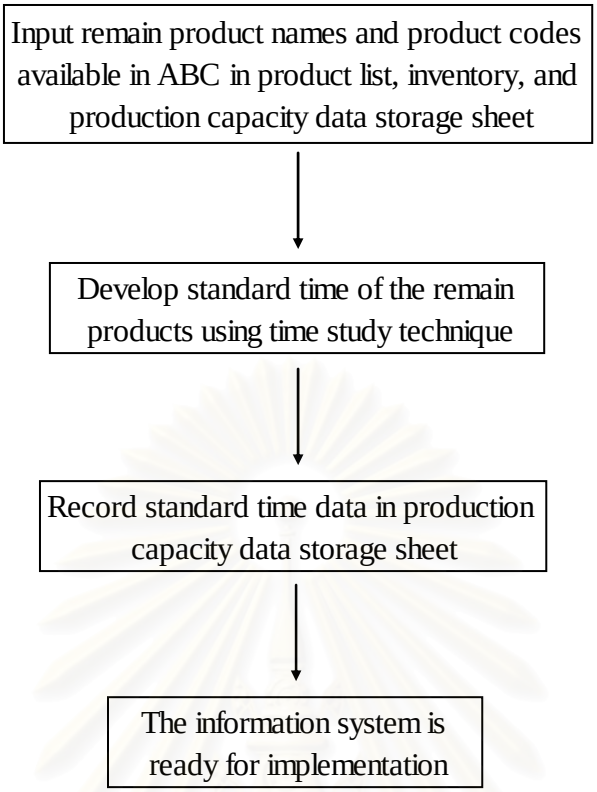


Figure 7.1: Implementation Steps of the Information System

7.3.2 Information System Interface with Other ABC's System

In the near future, ABC's will implement Enterprise Resource Planning (ERP) which is now under developing the system. To help understanding the boundary of the developed information system and its interface with ERP system, the data flow diagram is depicted in figure 7.2.

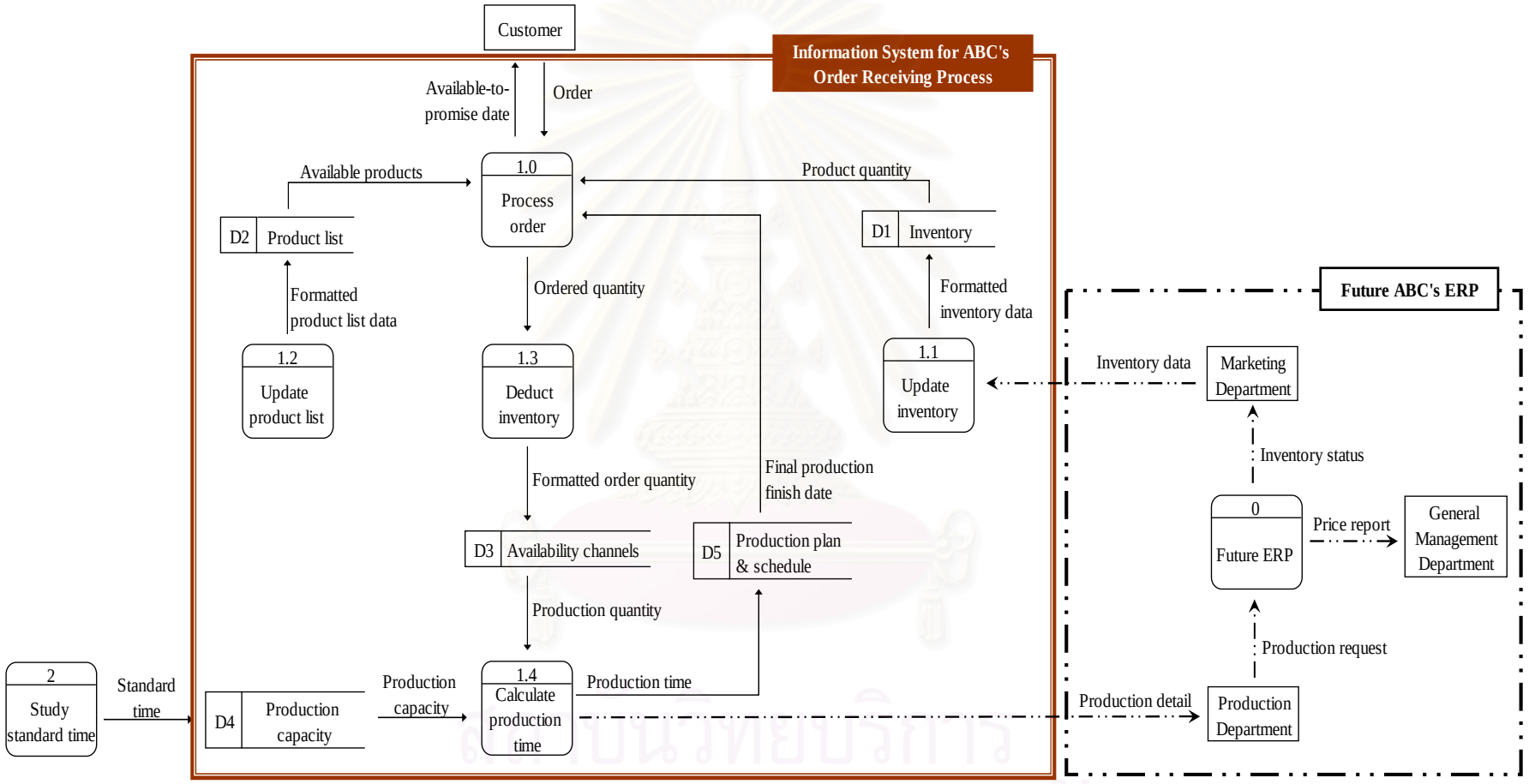


Figure 7.2: The Interface of the Information System for Order Receiving Process

7.4 Recommendation

7.4.1 Information System Synchronization with Actual Production

The newly developed information system aims to improve order receiving process by providing marketing department with more accurate product available-to-promise date. At the same time, it also provides the department with the production plan of both process sectors (repairing process and manufacturing process). The information system can be continuously run with the normal user interface steps (as explained in section 6.2, chapter 6) if the production plan provided in the information system is synchronized with actual production result. However, if the actual production result is different from the plan in the information system, the adjustment of the production plan is necessary for maintaining the estimate available-to-promise date accuracy. With the agreement with ABC's top managements, the author propose to adjust the production plan in the information system to be synchronized with the actual production result when end of day is reached.

7.4.2 Returned Product Receiving Improvement

Currently upon production department receives returned products from customers, the products are transferred to waiting-for-repair items inventory where they are waiting to be repaired. To assign staff as a repair difficulty level evaluator who is able to see the production plan would be helpful for early repair time assessment and possibility of finished repair date reconsideration.

7.4.3 Authenticity of Product Delivery Recorded Data Improvement

- Improvement Objective: To generate more accurate recorded data for further analysis of late delivery by both ABC or future researcher.
- Current Status: Order date, requested date, and delivery date are incorrectly recorded. With the same order number, requested date or delivery date are found to be early than order date. According to ABC Company, the order date will be automatically run with the current system whereas the other 2 dates are input by marketing department; therefore, this problem could be occurred by human error.
- Improvement Suggestion: To prevent error data input, the automatically alert in the system should be utilized. The information system developed in the thesis involves with the 2 dates of order date and requested date. For preventive action of the error, it will remind users when such error happens by

the emphasized red date's characters. However, ABC can further improve this problem with the system that prohibits further process if the error data of any date are found.

7.4.4 Authenticity of Return Characteristic Recorded Data Improvement

- Improvement Objective: To help in future research of product return characteristic.
- Current Status: Many of data were found incorrectly recorded. Those data are
  1) return quantity: With the same order number, return quantity is higher than ordered or rental quantity. The possible reason for this matter, given by ABC Company, is that if customer does not return all rental products together at one time, the return quantity that is left from the first return time will be recorded into another order number.
  2) return date: Return date in some records is early than delivery date which is impossible. Moreover, in some cases, those two dates are the same date, which are also unlikely to be happening, without any remark such as order cancellation.
- Improvement Suggestion: The authenticity of these 2 data can be improved with the implementation of new procedure of data recording or with the automatically alert in the data recording system that ABC is currently using. The new procedure should suggest in the way that the final information receive from the record tell the future researcher of rental customer, project used, product delivery date, delivery quantity, return date, and return quantity per 1 order.

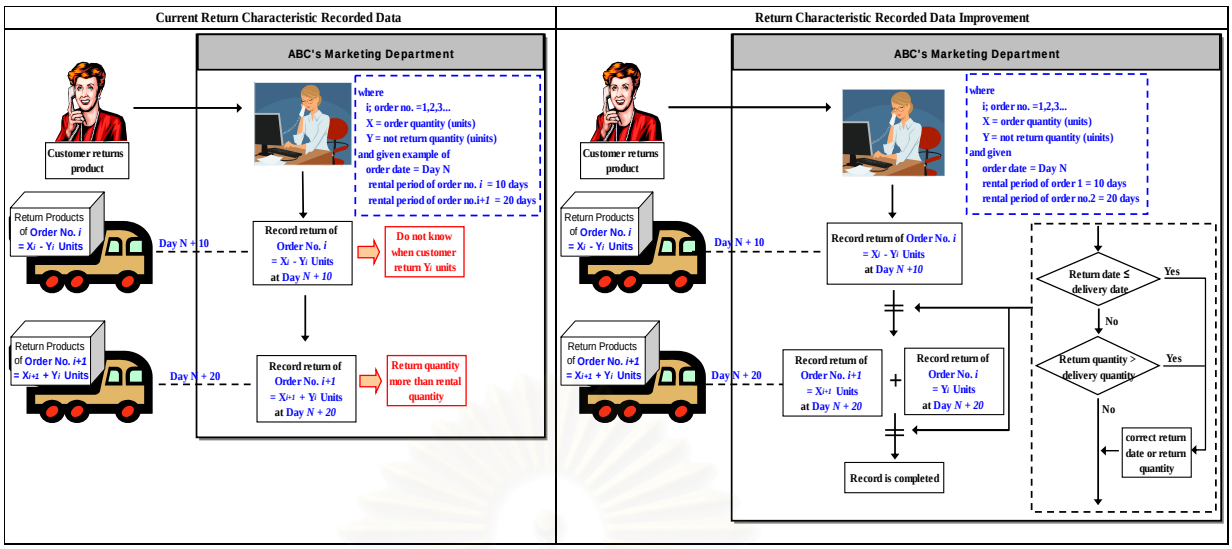


Figure 7.3: Proposed Return Characteristic Recorded Data Improvement Flow

7.4.5 Separation of On Time Indicators

Currently the customer requested date and promised date of product delivery is recorded in the same date as product available-to-promised date. According to ABC, there are cases that customers request for delivery date which the company knows that this order can not be delivered on time. Therefore, to support future analysis of % on time delivery, the 2 indicators of % on time to customer requested date and % on time to company promised date separated should be useful for the company to analyzed whether the lateness in delivery comes from factors in the company such as the delay of production or not.

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APPENDICES

Appendix A: Time Study Result

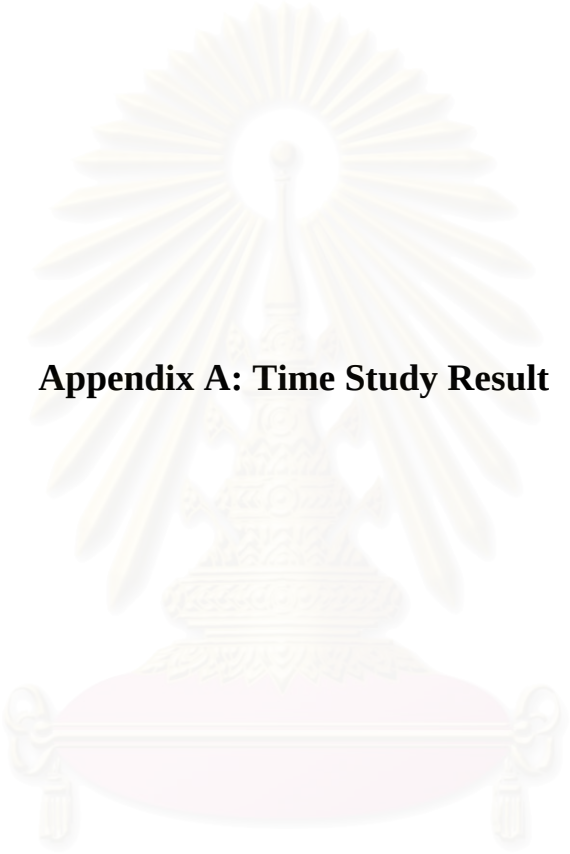

Table A1: Allowance Factor of Repairing Process

Allowance Percentage: Repairing Process

Allowance	Sanding Sub-Process	Repairing Sub-Process			Painting Sub-Process
		Scaffolding R1 and R2 Sub-Group	Scaffolding R3 Sub-Group	Scaffolding R4 Sub-Group	
Personal Allowance	1	3	3	4	4
Fatigue Allowance	0	5	3	5	2
Noise	0	2	1	2	1
Use of Force	0	2	1	2	0
Machine Breakdown/Maintenance	2	0	0	0	0
Total (%)	**3**	**12**	**8**	**13**	**7**

Table A2: Allowance Factor of Manufacturing Process

Allowance Percentage: Repairing Process

Allowance	Cutting Sub-Process	Assembly&Welding Sub-Proces	Painting Sub-Process
Personal Allowance	3	3	4
Fatigue Allowance	2	4	2
Noise	1	1	1
Use of Force	1	1	0
Machine Breakdown/Maintenance	7	4	0
Total (%)	**14**	**13**	**7**

Table A3: Repairing Process: Repairing Sub-Process Time Study Result: BB40

Repairing Process: Repairing Sub-Process Time Study Result: BB40

Repairing Sub-Process of BB40	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	24	73	0.32	0.39
Medium Difficulty	6	18	0.47	
High Difficulty	3	9	0.85	
Total Study Units	33			

Low Difficulty

	WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team											
no.	min	sec	total sec		total sec			Rating	total sec		total sec	minute
1	0	15	15		16.66666667	24	23.36	1	16.6667	0.12	18.93939	0.32
2	0	15	15									
3	0	14	14									
4	0	17	17									
5	0	19	19									
6	0	16	16									
7	0	18	18									
8	0	20	20									
9	0	15	15									
10	0	17	17									
11	0	17	17									
12	0	16	16									
13	0	18	18									
14	0	23	23									
15	0	16	16									
16	0	14	14									
17	0	17	17									
18	0	15	15									
19	0	17	17									
20	0	18	18									
21	0	16	16									
22	0	14	14									
23	0	16	16									
24	0	17	17									

Medium Difficulty

	WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team											
no.	min	sec	total sec		total sec			Rating	total sec		total sec	minute
1	0	24	24		25	6	5.97	1	25	0.12	28.40909	0.47
2	0	24	24									
3	0	27	27									
4	0	23	23									
5	0	27	27									
6	0	25	25									

High Difficulty

	WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team											
no.	min	sec	total sec		total sec			Rating	total sec		total sec	minute
1	0	47	47		44.666667	3	2.32	1	44.6667	0.12	50.75758	0.85
2	0	43	43									
3	0	44	44									

Table A4: Repairing Process: Repairing Sub-Process Time Study Result: BB60

Repairing Process: Repairing Sub-Process Time Study Result: BB60

Repairing Sub-Process of BB60	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	16	73	0.32	0.39
Medium Difficulty	4	18	0.47	
High Difficulty	2	9	0.87	
Total Study Units	22			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	16	16	16.8125	16	15.01	1	16.8125	0.12	19.10511	0.32
2	0	19	19								
3	0	17	17								
4	0	14	14								
5	0	18	18								
6	0	17	17								
7	0	20	20								
8	0	16	16								
9	0	14	14								
10	0	18	18								
11	0	16	16								
12	0	18	18								
13	0	16	16								
14	0	15	15								
15	0	17	17								
16	0	18	18								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	27	27	25	4	3.84	1	25	0.12	28.40909	0.47
2	0	25	25								
3	0	24	24								
4	0	24	24								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	45	45	46	2	0.76	1	46	0.12	52.272727	0.87
2	0	47	47								

Table A5: Repairing Process: Repairing Sub-Process Time Study Result: BU40

Repairing Process: Repairing Sub-Process Time Study Result: BU40

Repairing Sub-Process of BU40	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	40	80	0.33	0.38
Medium Difficulty	8	16	0.50	
High Difficulty	2	4	0.88	
Total Study Units	50			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	21	21	17.225	40	39.498	1	17.225	0.12	19.57386	0.33
2	0	16	16								
3	0	13	13								
4	0	17	17								
5	0	16	16								
6	0	13	13								
7	0	19	19								
8	0	22	22								
9	0	15	15								
10	0	19	19								
11	0	14	14								
12	0	12	12								
13	0	17	17								
14	0	16	16								
15	0	13	13								
16	0	16	16								
17	0	16	16								
18	0	20	20								
19	0	18	18								
20	0	13	13								
21	0	18	18								
22	0	17	17								
23	0	17	17								
24	0	17	17								
25	0	18	18								
26	0	20	20								
27	0	16	16								
28	0	15	15								
29	0	17	17								
30	0	17	17								
31	0	22	22								
32	0	18	18								
33	0	23	23								
34	0	17	17								
35	0	19	19								
36	0	20	20								
37	0	19	19								
38	0	14	14								
39	0	22	22								
40	0	17	17								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	26	26	26.25	8	7.98	1	26.25	0.12	29.82955	0.50
2	0	25	25								
3	0	30	30								
4	0	25	25								
5	0	25	25								
6	0	27	27								
7	0	24	24								
8	0	28	28								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	45	45	46.5	2	1.66	1	46.5	0.12	52.84091	0.88
2	0	48	48								

Table A6: Repairing Process: Repairing Sub-Process Time Study Result: BU60

Repairing Process: Repairing Sub-Process Time Study Result: BU60

Repairing Sub-Process of BU60	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	44	81	0.33	0.38
Medium Difficulty	8	15	0.50	
High Difficulty	2	4	0.92	
Total Study Units	54			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	23	23	17.6363636	44	43.04	1	17.6364	0.12	20.04132	0.33
2	0	14	14								
3	0	14	14								
4	0	18	18								
5	0	24	24								
6	0	20	20								
7	0	13	13								
8	0	19	19								
9	0	13	13								
10	0	22	22								
11	0	18	18								
12	0	15	15								
13	0	21	21								
14	0	19	19								
15	0	19	19								
16	0	13	13								
17	0	18	18								
18	0	17	17								
19	0	20	20								
20	0	14	14								
21	0	16	16								
22	0	13	13								
23	0	14	14								
24	0	20	20								
25	0	19	19								
26	0	14	14								
27	0	20	20								
28	0	22	22								
29	0	18	18								
30	0	14	14								
31	0	17	17								
32	0	19	19								
33	0	21	21								
34	0	16	16								
35	0	18	18								
36	0	15	15								
37	0	20	20								
38	0	18	18								
39	0	20	20								
40	0	18	18								
41	0	17	17								
42	0	20	20								
43	0	16	16								
44	0	17	17								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	25	25	26.25	8	6.82	1	26.25	0.12	29.82955	0.50
2	0	30	30								
3	0	25	25								
4	0	25	25								
5	0	28	28								
6	0	26	26								
7	0	25	25								
8	0	26	26								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	48	48	48.5	2	0.17	1	48.5	0.12	55.113636	0.92
2	0	49	49								

Table A7: Repairing Process: Repairing Sub-Process Time Study Result: HS418

Repairing Process: Repairing Sub-Process Time Study Result: HS418

Repairing Sub-Process of HS418	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	5	25	0.62	1.10
Medium Difficulty	11	55	1.10	
High Difficulty	4	20	1.72	
Total Study Units	20			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	31	31	32.6	5	3.97	1	32.6	0.12	37.045455	0.62
2	0	34	34								
3	0	31	31								
4	0	32	32								
5	0	35	35								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	60	60	58.2727273	11	10.97	1	58.2727	0.12	66.219008	1.10
2	1	4	64								
3	1	1	61								
4	0	52	52								
5	0	63	63								
6	0	58	58								
7	0	51	51								
8	0	58	58								
9	1	6	66								
10	0	55	55								
11	0	53	53								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	27	87	91	4	3.38	1	91	0.12	103.40909	1.72
2	1	38	98								
3	1	29	89								
4	1	30	90								

Table A8: Repairing Process: Repairing Sub-Process Time Study Result: HS518

Repairing Process: Repairing Sub-Process Time Study Result: HS518

Repairing Sub-Process of HS518	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	12	40	0.57	0.99
Medium Difficulty	14	47	1.10	
High Difficulty	4	13	1.9	
Total Study Units	30			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	27	27	29.8333333	12	11.64	1	29.8333	0.12	33.90152	0.57
2	0	26	26								
3	0	36	36								
4	0	28	28								
5	0	29	29								
6	0	32	32								
7	0	31	31								
8	0	29	29								
9	0	32	32								
10	0	30	30								
11	0	29	29								
12	0	29	29								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	9	69	58	14	13.45	1	58	0.12	65.909091	1.10
2	1	2	62								
3	0	53	53								
4	1	3	63								
5	0	51	51								
6	0	49	49								
7	1	1	61								
8	0	56	56								
9	1	0	60								
10	0	54	54								
11	0	53	53								
12	1	0	60								
13	1	2	62								
14	0	59	59								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	46	106	100.25	4	3.77	1	100.25	0.12	113.9205	1.90
2	1	33	93								
3	1	43	103								
4	1	39	99								

Table A9: Repairing Process: Repairing Sub-Process Time Study Result: LPO40

Repairing Process: Repairing Sub-Process Time Study Result: LPO40

Repairing Sub-Process of LPO40	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	9	27	1.20	2.24
Medium Difficulty	20	61	2.37	
High Difficulty	4	12	3.97	
Total Study Units	33			

Low Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	10	70	63.11111111	9	8.34	1	63.1111	0.12	71.717172	1.20
2	0	58	58								
3	1	9	69								
4	1	5	65								
5	1	7	67								
6	0	59	59								
7	0	58	58								
8	1	3	63								
9	0	59	59								

Medium Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	16	136	125.3	20	20	1	125.3	0.12	142.38636	2.37
2	1	51	111								
3	2	13	133								
4	1	39	99								
5	2	3	123								
6	2	8	128								
7	2	10	130								
8	2	18	138								
9	1	52	112								
10	1	58	118								
11	2	1	121								
12	1	53	113								
13	2	9	129								
14	2	23	143								
15	2	40	160								
16	2	2	122								
17	2	24	144								
18	1	57	117								
19	2	0	120								
20	1	49	109								

High Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	33	213	209.75	4	3.44	1	209.75	0.12	238.3523	3.97
2	3	29	209								
3	3	42	222								
4	3	15	195								

Table A10: Repairing Process: Repairing Sub-Process Time Study Result: SSE17

Repairing Process: Repairing Sub-Process Time Study Result: SSE17

Repairing Sub-Process of SSE17	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	12	32	1.97	3.30
Medium Difficulty	14	37	3.22	
High Difficulty	12	32	4.73	
Total Study Units	38			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	44	104	104.25	12	11.27	1	104.25	0.12	118.4659	1.97
2	1	41	101								
3	1	50	110								
4	1	53	113								
5	1	32	92								
6	1	34	94								
7	2	3	123								
8	1	39	99								
9	1	44	104								
10	1	43	103								
11	1	53	113								
12	1	35	95								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	57	177	170.142857	14	12.77	1	170.143	0.12	193.3442	3.22
2	2	17	137								
3	2	57	177								
4	3	2	182								
5	2	57	177								
6	3	21	201								
7	2	28	148								
8	3	2	182								
9	2	49	169								
10	2	55	175								
11	2	36	156								
12	2	44	164								
13	2	47	167								
14	2	50	170								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	20	260	250	12	2.64	1	250	0.12	284.0909	4.73
2	4	30	270								
3	4	3	243								
4	3	53	233								
5	4	16	256								
6	4	10	250								
7	4	21	261								
8	4	8	248								
9	3	59	239								
10	4	7	247								
11	4	13	253								
12	4	0	240								

Table A11: Repairing Process: Repairing Sub-Process Time Study Result: TFT1205

Repairing Process: Repairing Sub-Process Time Study Result: TFT1205

Repairing Sub-Process of TFT1205	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	9	43	1.77	2.33
Medium Difficulty	8	38	2.33	
High Difficulty	4	19	3.58	
Total Study Units	21			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	23	83	93.6666667	9	8.63	1	93.6667	0.12	106.4394	1.77
2	1	33	93								
3	1	41	101								
4	1	43	103								
5	1	35	95								
6	1	30	90								
7	1	40	100								
8	1	35	95								
9	1	23	83								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	2	122	122.875	8	6.34	1	122.875	0.12	139.6307	2.33
2	2	17	137								
3	2	14	134								
4	2	1	121								
5	1	59	119								
6	1	53	113								
7	1	59	119								
8	1	58	118								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	21	201	189	4	3.25	1	189	0.12	214.773	3.58
2	3	2	182								
3	3	13	193								
4	3	0	180								

Table A12: Repairing Process: Repairing Sub-Process Time Study Result: TFT1215

Repairing Process: Repairing Sub-Process Time Study Result: TFT1215

Repairing Sub-Process of TFT1215	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	17	1.85	3.14
Medium Difficulty	16	67	2.97	
High Difficulty	4	17	5.12	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	40	100	97.5	4	3.24	1	97.5	0.12	110.7955	1.85
2	1	30	90								
3	1	39	99								
4	1	41	101								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	16	136	157	16	15	1	157	0.12	178.40909	2.97
2	2	47	167								
3	2	17	137								
4	2	59	179								
5	2	31	151								
6	2	44	164								
7	2	30	150								
8	3	0	180								
9	2	33	153								
10	2	51	171								
11	2	44	164								
12	2	25	145								
13	2	31	151								
14	2	47	167								
15	2	50	170								
16	2	7	127								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	17	257	270.5	4	3.504	1	270.5	0.12	307.3864	5.12
2	4	48	288								
3	4	37	277								
4	4	20	260								

Table A12: Repairing Process: Repairing Sub-Process Time Study Result: TFT1217

Repairing Process: Repairing Sub-Process Time Study Result: TFT1217

Repairing Sub-Process of TFT1217	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	18	35	0.90	1.74
Medium Difficulty	19	37	1.92	
High Difficulty	15	29	2.52	
Total Study Units	52			

Low Difficulty

WR Time Time/1piece/team				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	46	46	47.3888889	18	17.9	1	47.3889	0.12	53.85101	0.90
2	0	51	51								
3	0	38	38								
4	0	42	42								
5	0	47	47								
6	0	51	51								
7	0	49	49								
8	0	48	48								
9	0	51	51								
10	0	47	47								
11	0	53	53								
12	0	49	49								
13	0	43	43								
14	1	0	60								
15	0	44	44								
16	0	50	50								
17	0	43	43								
18	0	41	41								

Medium Difficulty

WR Time Time/1piece/team				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	55	115	101.578947	19	18.04	1	101.579	0.12	115.4306	1.92
2	1	49	109								
3	1	50	110								
4	1	47	107								
5	1	31	91								
6	1	43	103								
7	1	38	98								
8	1	44	104								
9	1	34	94								
10	1	51	111								
11	1	52	112								
12	1	23	83								
13	1	51	111								
14	1	38	98								
15	1	54	114								
16	1	16	76								
17	1	27	87								
18	1	46	106								
19	1	41	101								

High Difficulty

WR Time Time/1piece/team				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	8	128	132.866667	15	13.29	1	132.867	0.12	150.98485	2.52
2	2	5	125								
3	2	4	124								
4	2	16	136								
5	2	4	124								
6	2	23	143								
7	2	7	127								
8	2	27	147								
9	1	52	112								
10	2	17	137								
11	2	10	130								
12	2	4	124								
13	2	12	132								
14	2	19	139								
15	2	45	165								

Table A13: Repairing Process: Repairing Sub-Process Time Study Result: TFT1217Galvanized

Repairing Process: Repairing Sub-Process Time Study Result: TFT1217Galvanized

Repairing Sub-Process of TFT1217G	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	52	51	0.95	1.50
Medium Difficulty	37	37	1.80	
High Difficulty	12	12	2.92	
Total Study Units	101			

Low Difficulty

no.	WR Time Time/1piece/team min	sec	converted	total sec	Average WR Time total sec	n'	n	Normal Time Rating	Normal Time total sec	Allowance Factor	Standard Time total sec	Standard Time minute
1	0	55	0.91667	55	55.4615385	52	51.63	0.9	49.9154	0.12	56.722028	0.95
2	1	0	1	60								
3	0	53	0.88333	53								
4	0	51	0.85	51								
5	0	42	0.7	42								
6	0	50	0.83333	50								
7	0	59	0.98333	59								
8	0	47	0.78333	47								
9	1	1	1.01667	61								
10	0	53	0.88333	53								
11	0	49	0.81667	49								
12	0	47	0.78333	47								
13	0	55	0.91667	55								
14	0	55	0.91667	55								
15	1	0	1	60								
16	0	48	0.8	48								
17	0	39	0.65	39								
18	0	49	0.81667	49								
19	0	48	0.8	48								
20	0	50	0.83333	50								
21	0	57	0.95	57								
22	0	55	0.91667	55								
23	0	42	0.7	42								
24	1	3	1.05	63								
25	0	49	0.81667	49								
26	1	2	1.03333	62								
27	0	46	0.76667	46								
28	1	4	1.06667	64								
29	0	40	0.66667	40								
30	0	43	0.71667	43								
31	1	3	1.05	63								
32	0	56	0.93333	56								
33	0	40	0.66667	40								
34	0	44	0.73333	44								
35	0	40	0.66667	40								
36	1	5	1.08333	65								
37	1	0	1	60								
38	0	53	0.88333	53								
39	0	46	0.76667	46								
40	1	1	1.01667	61								
41	0	56	0.93333	56								
42	1	11	1.18333	71								
43	1	12	1.2	72								
44	1	7	1.11667	67								
45	0	51	0.85	51								
46	1	10	1.16667	70								
47	1	7	1.11667	67								
48	1	18	1.3	78								
49	1	1	1.01667	61								
50	1	16	1.26667	76								
51	0	59	0.98333	59								
52	1	16	1.26667	76								

Medium Difficulty

no.	WR Time Time/1piece/team min	sec	total sec	Average WR Time total sec	n'	n	Normal Time Rating	Normal Time total sec	Allowance Factor	Standard Time total sec	Standard Time minute
1	1	51	111	105.513514	37	34.07	0.9	94.9622	0.12	107.9115	1.80
2	2	11	131								
3	2	12	132								
4	1	41	101								
5	1	23	83								
6	1	20	80								
7	1	40	100								
8	1	23	83								
9	1	24	84								
10	1	38	98								
11	1	57	117								
12	2	1	121								
13	1	58	118								
14	1	26	86								
15	1	37	97								
16	1	39	99								
17	2	6	126								
18	1	55	115								
19	1	50	110								
20	1	28	88								
21	1	26	86								
22	1	45	105								
23	1	43	103								
24	1	42	102								
25	1	52	112								
26	1	50	110								
27	1	30	90								
28	2	6	126								
29	2	5	125								
30	1	46	106								
31	1	31	91								
32	1	44	104								
33	1	50	110								
34	1	25	85								
35	2	13	133								
36	2	4	124								
37	1	52	112								

High Difficulty

no.	WR Time Time/1piece/team min	sec	total sec	Average WR Time total sec	n'	n	Normal Time Rating	Normal Time total sec	Allowance Factor	Standard Time total sec	Standard Time minute
1	2	35	155	171.333333	12	11.35	0.9	154.2	0.12	175.22727	2.92
2	2	51	171								
3	2	31	151								
4	2	44	164								
5	2	51	171								
6	2	45	165								
7	3	0	180								
8	3	17	197								
9	2	53	173								
10	3	5	185								
11	2	32	152								
12	3	12	192								

Table A14: Repairing Process: Repairing Sub-Process Time Study Result: YFT1218

Repairing Process: Repairing Sub-Process Time Study Result: YFT1218

Repairing Sub-Process of YFT1218	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	24	43	0.58	1.30
Medium Difficulty	16	29	1.35	
High Difficulty	16	29	2.33	
Total Study Units	56			

Low Difficulty

WR Time (Time/1piece/team)				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	31	31	30.8333333	24	22.53	1	30.8333	0.12	35.03788	0.58
2	0	31	31								
3	0	29	29								
4	0	21	21								
5	0	33	33								
6	0	38	38								
7	0	31	31								
8	0	28	28								
9	0	31	31								
10	0	29	29								
11	0	30	30								
12	0	29	29								
13	0	30	30								
14	0	28	28								
15	0	36	36								
16	0	33	33								
17	0	28	28								
18	0	31	31								
19	0	28	28								
20	0	33	33								
21	0	40	40								
22	0	32	32								
23	0	31	31								
24	0	29	29								

Medium Difficulty

WR Time (Time/1piece/team)				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	4	64	71.3125	16	14.78	1	71.3125	0.12	81.036932	1.35
2	1	13	73								
3	1	11	71								
4	1	19	79								
5	0	59	59								
6	1	17	77								
7	1	21	81								
8	1	7	67								
9	1	7	67								
10	1	18	78								
11	1	15	75								
12	1	20	80								
13	0	58	58								
14	1	13	73								
15	1	9	69								
16	1	10	70								

High Difficulty

WR Time (Time/1piece/team)				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	0	120	123.25	16	15.71	1	123.25	0.12	140.05682	2.33
2	1	58	118								
3	2	2	122								
4	1	40	100								
5	2	10	130								
6	2	21	141								
7	2	5	125								
8	2	1	121								
9	2	7	127								
10	1	52	112								
11	2	30	150								
12	1	59	119								
13	2	15	135								
14	1	55	115								
15	2	11	131								
16	1	46	106								

Table A15: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 50x50x1500

Repairing Process: Repairing Sub-Process Time Study Result: SQ50x50x1500

Repairing Sub-Process of SQ50x50x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	22	0.53	0.92
Medium Difficulty	10	56	0.77	
High Difficulty	4	22	1.7	
Total Study Units	18			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	28	28	29.5	4	2.3	1	29.5	0.08	32.06522	0.53
2	0	29	29								
3	0	31	31								
4	0	30	30								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	39	39	42.3	10	9.67	1	42.3	0.08	45.978261	0.77
2	0	44	44								
3	0	40	40								
4	0	45	45								
5	0	38	38								
6	0	49	49								
7	0	42	42								
8	0	45	45								
9	0	39	39								
10	0	42	42								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	31	91	94	4	3.8	1	94	0.08	102.1739	1.70
2	1	41	101								
3	1	29	89								
4	1	35	95								

Table A16: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 50x50x3000

Repairing Process: Repairing Sub-Process Time Study Result: SQ50x50x3000

Repairing Sub-Process of SQ50x50x3000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	22	0.73	1.10
Medium Difficulty	10	56	0.95	
High Difficulty	4	22	1.83	
Total Study Units	18			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	41	41	40.5	4	3.17	1	40.5	0.08	44.02174	0.73
2	0	38	38								
3	0	43	43								
4	0	40	40								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	58	58	52.2	10	9.61	1	52.2	0.08	56.73913	0.95
2	0	52	52								
3	0	49	49								
4	0	51	51								
5	0	52	52								
6	1	0	60								
7	0	47	47								
8	0	55	55								
9	0	48	48								
10	0	50	50								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	39	99	101.25	4	3.31	1	101.25	0.08	110.05435	1.83
2	1	49	109								
3	1	37	97								
4	1	40	100								

Table A17: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 50x50x6000

Repairing Process: Repairing Sub-Process Time Study Result: SQ50x50x6000

Repairing Sub-Process of SQ50x50x6000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	10	29	1.03	1.69
Medium Difficulty	20	57	1.88	
High Difficulty	5	14	2.25	
Total Study Units	35			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	0	60	56.6	10	9.51	1	56.6	0.08	61.52174	1.03
2	0	54	54								
3	0	55	55								
4	0	59	59								
5	1	4	64								
6	0	51	51								
7	0	49	49								
8	0	57	57								
9	1	1	61								
10	0	56	56								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	50	110	103.55	20	19.99	1	103.55	0.08	112.5543	1.88
2	1	41	101								
3	1	30	90								
4	1	20	80								
5	1	42	102								
6	1	40	100								
7	1	22	82								
8	1	51	111								
9	1	27	87								
10	1	52	112								
11	1	41	101								
12	1	49	109								
13	1	49	109								
14	1	51	111								
15	1	45	105								
16	1	52	112								
17	2	1	121								
18	1	55	115								
19	1	33	93								
20	2	0	120								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	4	124	124.2	5	4.54	1	124.2	0.08	135	2.25
2	1	52	112								
3	2	11	131								
4	2	5	125								
5	2	9	129								

Table A18: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 50x100x4000

Repairing Process: Repairing Sub-Process Time Study Result: SQ50x100x4000

Repairing Sub-Process of SQ50x100x4000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	16	22	0.65	1.56
Medium Difficulty	40	56	1.73	
High Difficulty	16	22	2.02	
Total Study Units	72			

Low Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	39	39	35.6875	16	12.52	1	35.6875	0.08	38.79076	0.65
2	0	36	36								
3	0	40	40								
4	0	38	38								
5	0	34	34								
6	0	35	35								
7	0	29	29								
8	0	37	37								
9	0	39	39								
10	0	32	32								
11	0	31	31								
12	0	35	35								
13	0	37	37								
14	0	40	40								
15	0	33	33								
16	0	36	36								

High Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	0	120	111.375	16	15.33	1	111.375	0.08	121.0598	2.02
2	1	29	89								
3	2	3	123								
4	1	55	115								
5	1	59	119								
6	2	0	120								
7	1	41	101								
8	1	49	109								
9	1	52	112								
10	1	44	104								
11	1	48	108								
12	1	57	117								
13	1	59	119								
14	1	44	104								
15	2	10	130								
16	1	32	92								

Medium Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	44	104	95.3	40	38	1	95.3	0.08	103.587	1.73
2	0	40	40								
3	1	32	92								
4	1	29	89								
5	1	31	91								
6	1	33	93								
7	1	33	93								
8	1	55	115								
9	1	37	97								
10	1	50	110								
11	1	41	101								
12	1	28	88								
13	2	0	120								
14	1	39	99								
15	1	28	88								
16	1	35	95								
17	1	44	104								
18	1	20	80								
19	1	33	93								
20	1	28	88								
21	1	40	100								
22	1	37	97								
23	1	29	89								
24	1	33	93								
25	0	48	48								
26	1	40	100								
27	1	24	84								
28	1	36	96								
29	1	38	98								
30	2	0	120								
31	1	41	101								
32	1	39	99								
33	1	44	104								
34	1	51	111								
35	1	48	108								
36	1	33	93								
37	1	39	99								
38	1	33	93								
39	1	42	102								
40	1	37	97								

Table A19: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 50x100x6000

Repairing Process: Repairing Sub-Process Time Study Result: SQ50x100x6000

Repairing Sub-Process of SQ50x100x6000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	22	0.70	1.81
Medium Difficulty	10	56	2.03	
High Difficulty	4	22	2.35	
Total Study Units	18			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	40	40	38.75	4	3.93	1	38.75	0.08	42.11957	0.70
2	0	36	36								
3	0	41	41								
4	0	38	38								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	0	120	112.2	10	9.6	1	112.2	0.08	121.9565	2.03
2	1	39	99								
3	2	9	129								
4	1	50	110								
5	1	39	99								
6	1	57	117								
7	1	49	109								
8	1	51	111								
9	1	51	111								
10	1	57	117								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	9	129	129.75	4	4.01	1	129.75	0.08	141.0326	2.35
2	2	18	138								
3	2	12	132								
4	2	0	120								

Table A20: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 75x75x2000

Repairing Process: Repairing Sub-Process Time Study Result: SQ75x75x2000

Repairing Sub-Process of SQ75x75x2000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	22	0.53	1.21
Medium Difficulty	10	56	1.32	
High Difficulty	4	22	1.63	
Total Study Units	18			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	28	28	29	4	2.85	1	29	0.08	31.52174	0.53
2	0	29	29								
3	0	28	28								
4	0	31	31								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	10	70	73.1	10	9.73	1	73.1	0.08	79.45652	1.32
2	1	20	80								
3	1	13	73								
4	1	17	77								
5	1	10	70								
6	1	18	78								
7	1	15	75								
8	1	12	72								
9	0	59	59								
10	1	17	77								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	37	97	90.25	4	3.87	1	90.25	0.08	98.097826	1.63
2	1	31	91								
3	1	28	88								
4	1	25	85								

Table A21: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 75x75x3000

Repairing Process: Repairing Sub-Process Time Study Result: SQ75x75x3000

Repairing Sub-Process of SQ75x75x3000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	5	20	0.58	1.56
Medium Difficulty	15	60	1.75	
High Difficulty	5	20	1.98	
Total Study Units	25			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	31	31	31.8	5	4.68	1	31.8	0.08	34.56522	0.58
2	0	31	31								
3	0	35	35								
4	0	32	32								
5	0	30	30								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	37	97	96.3333333	15	13.16	1	96.3333	0.08	104.7101	1.75
2	1	40	100								
3	1	29	89								
4	1	33	93								
5	1	51	111								
6	1	38	98								
7	1	29	89								
8	1	32	92								
9	1	51	111								
10	1	29	89								
11	1	40	100								
12	1	30	90								
13	1	50	110								
14	1	36	96								
15	1	20	80								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	50	110	109.4	5	5.01	1	109.4	0.08	118.913	1.98
2	1	48	108								
3	1	41	101								
4	1	48	108								
5	2	0	120								

Table A22: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x1000

Repairing Process: Repairing Sub-Process Time Study Result: SQ10x100x1000

Repairing Sub-Process of SQ100x100x1000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	22	0.85	1.42
Medium Difficulty	10	56	1.28	
High Difficulty	4	22	2.33	
Total Study Units	18			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	47	47	46.75	4	4.53	1	46.75	0.08	50.81522	0.85
2	0	50	50								
3	0	47	47								
4	0	43	43								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	9	69	70.8	10	6.5	1	70.8	0.08	76.95652	1.28
2	1	10	70								
3	1	0	60								
4	1	11	71								
5	1	13	73								
6	1	13	73								
7	1	18	78								
8	1	9	69								
9	1	10	70								
10	1	15	75								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	1	121	128.5	4	2.45	1	128.5	0.08	139.67391	2.33
2	2	12	132								
3	2	7	127								
4	2	14	134								

Table A23: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x2000

Repairing Process: Repairing Sub-Process Time Study Result: SQ100x100x200

Repairing Sub-Process of SQ100x100x2000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	6	33	1.17	1.53
Medium Difficulty	9	50	1.52	
High Difficulty	3	17	2.32	
Total Study Units	18			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	5	65	64.3333333	6	4.6	1	64.3333	0.08	69.92754	1.17
2	1	2	62								
3	1	3	63								
4	1	8	68								
5	0	59	59								
6	1	9	69								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	27	87	83.66666667	9	8.99	1	83.6667	0.08	90.942029	1.52
2	1	24	84								
3	1	19	79								
4	1	27	87								
5	1	29	89								
6	1	21	81								
7	1	18	78								
8	1	13	73								
9	1	35	95								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	13	133	128.333333	3	2.68	1	128.333	0.08	139.4928	2.32
2	2	11	131								
3	2	1	121								

Table A24: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x2500

Repairing Process: Repairing Sub-Process Time Study Result: SQ100x100x2500

Repairing Sub-Process of SQ100x100x2500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	7	35	1.18	1.56
Medium Difficulty	10	50	1.65	
High Difficulty	3	15	2.13	
Total Study Units	20			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	10	70	65.2857143	7	6.83	1	65.2857	0.08	70.96273	1.18
2	1	4	64								
3	1	2	62								
4	1	13	73								
5	1	5	65								
6	1	3	63								
7	1	0	60								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	17	77	90.9	10	8.73	1	90.9	0.08	98.80435	1.65
2	1	33	93								
3	1	23	83								
4	1	29	89								
5	1	41	101								
6	1	31	91								
7	1	32	92								
8	1	40	100								
9	1	31	91								
10	1	32	92								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	57	117	117.666667	3	2.8	1	117.667	0.08	127.8986	2.13
2	2	4	124								
3	1	52	112								

Table A25: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x3000

Repairing Process: Repairing Sub-Process Time Study Result: SQ100x100x3000

Repairing Sub-Process of SQ100x100x3000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	7	35	1.22	1.60
Medium Difficulty	10	50	1.65	
High Difficulty	3	15	2.32	
Total Study Units	20			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	0	60	67.5714286	7	6.39	1	67.5714	0.08	73.4472	1.22
2	1	9	69								
3	1	13	73								
4	1	11	71								
5	1	7	67								
6	1	10	70								
7	1	3	63								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	45	105	90.9	10	9.27	1	90.9	0.08	98.80435	1.65
2	1	28	88								
3	1	27	87								
4	1	19	79								
5	1	40	100								
6	1	27	87								
7	1	29	89								
8	1	29	89								
9	1	34	94								
10	1	31	91								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	2	122	128.333333	3	2.74	1	128.333	0.08	139.4928	2.32
2	2	15	135								
3	2	8	128								

Table A26: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x4000

Repairing Process: Repairing Sub-Process Time Study Result: SQ100x100x4000

Repairing Sub-Process of SQ100x100x4000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	8	33	1.22	1.66
Medium Difficulty	12	50	1.75	
High Difficulty	4	17	2.27	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	11	71	67.25	8	7.76	1	67.25	0.08	73.09783	1.22
2	1	7	67								
3	1	4	64								
4	1	12	72								
5	1	15	75								
6	1	2	62								
7	1	6	66								
8	1	1	61								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	38	98	96.6666667	12	7.66	1	96.6667	0.08	105.0725	1.75
2	1	28	88								
3	1	43	103								
4	1	41	101								
5	1	50	110								
6	1	37	97								
7	1	30	90								
8	1	29	89								
9	1	31	91								
10	1	44	104								
11	1	38	98								
12	1	31	91								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	5	125	125.25	4	3.59	1	125.25	0.08	136.1413	2.27
2	2	15	135								
3	2	0	120								
4	2	1	121								

Table A27: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x4500

Repairing Process: Repairing Sub-Process Time Study Result: SQ100x100x4500

Repairing Sub-Process of SQ100x100x4500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	14	35	1.30	1.79
Medium Difficulty	20	50	1.97	
High Difficulty	6	15	2.35	
Total Study Units	40			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	14	74	71.5714286	14	6.99	1	71.5714	0.08	77.79503	1.30
2	1	9	69								
3	1	10	70								
4	1	7	67								
5	1	21	81								
6	1	3	63								
7	1	18	78								
8	1	12	72								
9	1	17	77								
10	1	9	69								
11	1	11	71								
12	1	11	71								
13	1	6	66								
14	1	14	74								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	51	111	108.55	20	17.62	1	108.55	0.08	117.989	1.97
2	1	48	108								
3	1	44	104								
4	1	39	99								
5	1	52	112								
6	1	40	100								
7	1	41	101								
8	1	38	98								
9	2	12	132								
10	1	39	99								
11	1	50	110								
12	1	54	114								
13	2	23	143								
14	1	41	101								
15	1	38	98								
16	1	45	105								
17	1	50	110								
18	1	58	118								
19	1	39	99								
20	1	49	109								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	21	141	129.666667	6	5.92	1	129.667	0.08	140.942	2.35
2	2	3	123								
3	2	12	132								
4	2	18	138								
5	2	4	124								
6	2	0	120								

Table A28: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x5000

Repairing Process: Repairing Sub-Process Time Study Result: SQ100x100x5000

Repairing Sub-Process of SQ100x100x5000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	7	20	1.32	1.91
Medium Difficulty	21	60	1.83	
High Difficulty	7	20	2.75	
Total Study Units	35			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	21	81	73	7	6.78	1	73	0.08	79.34783	1.32
2	1	9	69								
3	1	10	70								
4	1	17	77								
5	1	6	66								
6	1	13	73								
7	1	15	75								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	48	108	100.952381	21	19.61	1	100.952	0.08	109.7308	1.83
2	1	55	115								
3	1	41	101								
4	1	43	103								
5	1	57	117								
6	1	46	106								
7	1	29	89								
8	1	33	93								
9	2	0	120								
10	1	21	81								
11	1	38	98								
12	1	41	101								
13	1	49	109								
14	1	52	112								
15	1	38	98								
16	1	31	91								
17	1	51	111								
18	1	47	107								
19	1	29	89								
20	1	20	80								
21	1	31	91								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	44	164	151.714286	7	6.89	1	151.714	0.08	164.9068	2.75
2	2	21	141								
3	2	34	154								
4	2	31	151								
5	2	14	134								
6	2	38	158								
7	2	40	160								

Table A29: Repairing Process: Repairing Sub-Process Time Study Result: Square Pipe 100x100x6000

Repairing Process: Repairing Sub-Process Time Study Result: SQ100x100x6000

Repairing Sub-Process of SQ100x100x6000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	14	1.25	1.89
Medium Difficulty	12	43	1.78	
High Difficulty	12	43	2.20	
Total Study Units	28			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	7	67	62.75	4	3.73	1.1	69.025	0.08	75.02717	1.25
2	1	4	64								
3	1	1	61								
4	0	59	59								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	41	101	98.1666667	12	11.15	1	98.1667	0.08	106.7029	1.78
2	1	33	93								
3	1	34	94								
4	1	40	100								
5	1	45	105								
6	1	39	99								
7	1	41	101								
8	1	35	95								
9	2	0	120								
10	1	32	92								
11	1	28	88								
12	1	30	90								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	2	122	121.666667	12	10.98	1	121.667	0.08	132.2464	2.20
2	2	0	120								
3	1	45	105								
4	2	11	131								
5	2	1	121								
6	2	17	137								
7	2	1	121								
8	2	0	120								
9	2	9	129								
10	2	11	131								
11	2	3	123								
12	1	40	100								

Table A30: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x1000

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x1000

Repairing Sub-Process of RO 48.6x1000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	20	83	0.42	0.47
Medium Difficulty	4	17	0.75	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	25	25	26.05	20	19.92	0.9	23.445	0.08	25.4837	0.42
2	0	27	27								
3	0	30	30								
4	0	29	29								
5	0	25	25								
6	0	22	22								
7	0	24	24								
8	0	23	23								
9	0	21	21								
10	0	30	30								
11	0	27	27								
12	0	31	31								
13	0	25	25								
14	0	27	27								
15	0	27	27								
16	0	26	26								
17	0	30	30								
18	0	25	25								
19	0	21	21								
20	0	26	26								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	43	43	46	4	3.4	0.9	41.4	0.08	45	0.75
2	0	46	46								
3	0	46	46								
4	0	49	49								

Table A31: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x1500Galvanized

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x1500Gal.

Repairing Sub-Process of RO 48.6x1500 G.	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	20	83	0.48	0.54
Medium Difficulty	4	17	0.80	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	24	24	26.7	20	17.3	1	26.7	0.08	29.02174	0.48
2	0	29	29								
3	0	31	31								
4	0	26	26								
5	0	31	31								
6	0	26	26								
7	0	21	21								
8	0	30	30								
9	0	27	27								
10	0	25	25								
11	0	25	25								
12	0	31	31								
13	0	26	26								
14	0	26	26								
15	0	30	30								
16	0	25	25								
17	0	23	23								
18	0	27	27								
19	0	27	27								
20	0	24	24								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	43	43	44	4	3.72	1	44	0.08	47.82609	0.80
2	0	46	46								
3	0	46	46								
4	0	41	41								

Table A32: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x2000

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x2000

Repairing Sub-Process of RO 48.6x2000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	16	80	0.33	0.42
Medium Difficulty	4	20	0.75	
Total Study Units	20			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	17	17	15.3125	16	12.55	1.2	18.375	0.08	19.97283	0.33
2	0	15	15								
3	0	16	16								
4	0	14	14								
5	0	15	15								
6	0	14	14								
7	0	17	17								
8	0	15	15								
9	0	14	14								
10	0	16	16								
11	0	17	17								
12	0	16	16								
13	0	15	15								
14	0	15	15								
15	0	12	12								
16	0	17	17								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	37	37	34.5	4	3.02	1.2	41.4	0.08	45	0.75
2	0	34	34								
3	0	33	33								
4	0	34	34								

Table A33: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x2000G

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x2000Gal.

Repairing Sub-Process of RO 48.6x2000G	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	20	83	0.33	0.42
Medium Difficulty	4	17	0.83	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	14	14	15.35	20	17.84	1.2	18.42	0.08	20.0217	0.33
2	0	17	17								
3	0	17	17								
4	0	16	16								
5	0	18	18								
6	0	14	14								
7	0	15	15								
8	0	17	17								
9	0	18	18								
10	0	16	16								
11	0	14	14								
12	0	13	13								
13	0	15	15								
14	0	18	18								
15	0	15	15								
16	0	14	14								
17	0	15	15								
18	0	13	13								
19	0	14	14								
20	0	14	14								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	38	38	38	4	3.88	1.2	45.6	0.08	49.56522	0.83
2	0	35	35								
3	0	40	40								
4	0	39	39								

Table A34: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x3000

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x3000

Repairing Sub-Process of RO 48.6x3000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	20	80	0.40	0.50
Medium Difficulty	5	20	0.88	
Total Study Units	25			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	24	24	22.2	20	17.08	1	22.2	0.08	24.13043	0.40
2	0	19	19								
3	0	21	21								
4	0	20	20								
5	0	24	24								
6	0	21	21								
7	0	27	27								
8	0	19	19								
9	0	22	22								
10	0	25	25								
11	0	23	23								
12	0	24	24								
13	0	20	20								
14	0	25	25								
15	0	21	21								
16	0	19	19								
17	0	24	24								
18	0	22	22								
19	0	24	24								
20	0	20	20								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	45	45	48.4	5	3.99	1	48.4	0.08	52.6087	0.88
2	0	50	50								
3	0	47	47								
4	0	48	48								
5	0	52	52								

Table A35: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x4000

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x4000

Repairing Sub-Process of RO 48.6x4000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	18	75	0.47	0.59
Medium Difficulty	6	25	0.95	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	24	24	26.1111111	18	17.7	1	26.1111	0.08	28.38164	0.47
2	0	26	26								
3	0	25	25								
4	0	28	28								
5	0	21	21								
6	0	24	24								
7	0	31	31								
8	0	27	27								
9	0	24	24								
10	0	30	30								
11	0	21	21								
12	0	27	27								
13	0	30	30								
14	0	28	28								
15	0	25	25								
16	0	26	26								
17	0	25	25								
18	0	28	28								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	52	52	52.3333333	6	5.58	1	52.3333	0.08	56.88406	0.95
2	0	56	56								
3	0	50	50								
4	0	54	54								
5	0	55	55								
6	0	47	47								

Table A36: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x4500

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x4500

Repairing Sub-Process of RO 48.6x4500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	20	77	0.58	0.69
Medium Difficulty	6	23	1.05	
Total Study Units	26			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	29	29	31.8	20	18.29	1	31.8	0.08	34.56522	0.58
2	0	31	31								
3	0	30	30								
4	0	27	27								
5	0	35	35								
6	0	32	32								
7	0	38	38								
8	0	37	37								
9	0	29	29								
10	0	34	34								
11	0	27	27								
12	0	36	36								
13	0	30	30								
14	0	29	29								
15	0	33	33								
16	0	31	31								
17	0	28	28								
18	0	34	34								
19	0	37	37								
20	0	29	29								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	55	55	57.83333333	6	5.97	1	57.8333	0.08	62.86232	1.05
2	1	3	63								
3	0	58	58								
4	0	59	59								
5	1	0	60								
6	0	52	52								

Table A37: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x5000

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x5000

Repairing Sub-Process of RO 48.6x5000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	20	77	0.48	0.61
Medium Difficulty	6	23	1.05	
Total Study Units	26			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	30	30	26.65	20	18.99	1	26.65	0.08	28.96739	0.48
2	0	26	26								
3	0	21	21								
4	0	31	31								
5	0	26	26								
6	0	28	28								
7	0	27	27								
8	0	30	30								
9	0	24	24								
10	0	27	27								
11	0	25	25								
12	0	25	25								
13	0	29	29								
14	0	30	30								
15	0	23	23								
16	0	26	26								
17	0	24	24								
18	0	28	28								
19	0	22	22								
20	0	31	31								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	57	57	58.1666667	6	4.32	1	58.1667	0.08	63.22464	1.05
2	0	54	54								
3	1	0	60								
4	1	2	62								
5	0	55	55								
6	1	1	61								

Table A38: Repairing Process: Repairing Sub-Process Time Study Result: Round Pipe 48.6x6000

Repairing Process: Repairing Sub-Process Time Study Result: RO48.6x6000

Repairing Sub-Process of RO 48.6x6000	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	16	80	0.50	0.62
Medium Difficulty	4	20	1.10	
Total Study Units	20			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	25	25	24.875	16	15.47	1.1	27.3625	0.08	29.74185	0.50
2	0	26	26								
3	0	22	22								
4	0	24	24								
5	0	26	26								
6	0	27	27								
7	0	25	25								
8	0	29	29								
9	0	28	28								
10	0	22	22								
11	0	19	19								
12	0	23	23								
13	0	25	25								
14	0	24	24								
15	0	27	27								
16	0	26	26								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	51	51	55	4	3.438	1.1	60.5	0.08	65.76087	1.10
2	0	55	55								
3	0	56	56								
4	0	58	58								

Table A39: Repairing Process: Repairing Sub-Process Time Study Result: Pipe Modification

Repairing Process: Repairing Sub-Process Time Study Result: Pipe Modification

Work Detail		WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Product Name	Process	Time/1piece/team											
		no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
SQ50x100xlength	Repairing Sub-Process	1	0	39	39	41.2	5	3.92	1	41.2	0.08	44.78261	0.75
	(Pipe Modification)	2	0	45	45								
		3	0	40	40								
		4	0	41	41								
		5	0	41	41								

Work Detail		WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Product Name	Process	Time/1piece/team											
		no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
SQ75x100xlength	Repairing Sub-Process	1	0	44	44	41.5555556	9	4.55	1	41.5556	0.08	45.16908	0.75
	(Pipe Modification)	2	0	41	41								
		3	0	39	39								
		4	0	43	43								
		5	0	45	45								
		6	0	41	41								
		7	0	38	38								
		8	0	40	40								
		9	0	43	43								

Work Detail		WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Product Name	Process	Time/1piece/team											
		no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
SQ100x100xlength	Repairing Sub-Process	1	0	47	47	50	4	4.16	1	50	0.08	54.34783	0.91
	(Pipe Modification)	2	0	54	54								
		3	0	49	49								
		4	0	50	50								

Work Detail		WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Product Name	Process	Time/1piece/team											
		no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
Round Pipe 48.6xength	Repairing Sub-Process	1	0	27	27	28.6666667	6	5.6247	1	28.6667	0.08	31.15942	0.52
	(Pipe Modification)	2	0	29	29								
		3	0	29	29								
		4	0	31	31								
		5	0	26	26								
		6	0	30	30								

Table A40.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 200x1200

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 200x1200

Sanding Sub-Process of Metal Form 200x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	2	20	0.27	0.21
speed 90	4	40	0.23	
speed 100	4	40	0.17	
Total Study Units	10			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	15	15	15.5	2	1.66	1	15.5	0.03	15.97938	0.27
2	0	16	16								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	14	14	13.5	4	2.19	1	13.5	0.03	13.91753	0.23
2	0	13	13								
3	0	14	14								
4	0	13	13								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	9	9	9.75	4	3.16	1	9.75	0.03	10.051546	0.17
2	0	10	10								
3	0	10	10								
4	0	10	10								

Table A40.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 200x1200

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 200x1200

Repairing Sub-Process of Metal Form 200x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	12	35	1.83	2.73
Medium Difficulty	18	53	3.12	
High Difficulty	4	12	3.62	
Total Study Units	34			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	37	97	95.58333333	12	11.63	1	95.5833	0.13	109.8659	1.83
2	1	28	88								
3	1	41	101								
4	1	27	87								
5	1	31	91								
6	1	38	98								
7	1	50	110								
8	1	35	95								
9	1	41	101								
10	1	38	98								
11	1	43	103								
12	1	18	78								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	31	151	162.666667	18	14.32	1	162.667	0.13	186.97318	3.12
2	3	11	191								
3	2	38	158								
4	2	49	169								
5	2	44	164								
6	2	24	144								
7	2	33	153								
8	2	57	177								
9	2	38	158								
10	2	14	134								
11	2	40	160								
12	2	28	148								
13	2	51	171								
14	2	57	177								
15	3	4	184								
16	2	20	140								
17	2	51	171								
18	2	58	178								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	16	196	188.75	4	3.98	1	188.75	0.13	216.954	3.62
2	3	20	200								
3	2	58	178								
4	3	1	181								

Table A41.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 300x1200

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 300x1200

Sanding Sub-Process of Metal Form 300x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	2	29	0.27	0.25
speed 90	2	29	0.25	
speed 100	3	43	0.23	
Total Study Units	7			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	16	16	16	2	0	1	16	0.03	16.49485	0.27
2	0	16	16								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	14	14	14.5	2	1.9	1	14.5	0.03	14.94845	0.25
2	0	15	15								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	14	14	13.3333333	3	2	1	13.3333	0.03	13.7457	0.23
2	0	13	13								
3	0	13	13								

Table A41.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 300x1200

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 300x1200

Repairing Sub-Process of Metal Form 300x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	12	50	2.43	3.13
Medium Difficulty	8	33	3.42	
High Difficulty	4	17	4.62	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	15	135	126.8333333	12	7.71	1	126.833	0.13	145.78544	2.43
2	2	6	126								
3	2	0	120								
4	2	12	132								
5	2	14	134								
6	2	7	127								
7	2	21	141								
8	1	49	109								
9	2	3	123								
10	1	54	114								
11	2	13	133								
12	2	8	128								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	8	188	178.75	8	6.39	1	178.75	0.13	205.4598	3.42
2	2	37	157								
3	2	53	173								
4	3	2	182								
5	3	10	190								
6	2	48	168								
7	3	12	192								
8	3	0	180								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	0	240	241	4	3.65	1	241	0.13	277.01149	4.62
2	3	43	223								
3	4	14	254								
4	4	7	247								

Table A42.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 400x1200

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 400x1200

Sanding Sub-Process of Metal Form 400x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	9	50	0.33	0.31
speed 90	6	33	0.28	
speed 100	3	17	0.27	
Total Study Units	18			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	19	19	19	9	4.92	1	19	0.03	19.58763	0.33
2	0	21	21								
3	0	18	18								
4	0	19	19								
5	0	20	20								
6	0	18	18								
7	0	20	20								
8	0	18	18								
9	0	18	18								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	17	17	16.5	6	5.39	1	16.5	0.03	17.01031	0.28
2	0	18	18								
3	0	15	15								
4	0	16	16								
5	0	16	16								
6	0	17	17								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	15	15	15.6666667	3	1.45	1	15.6667	0.03	16.1512	0.27
2	0	16	16								
3	0	16	16								

Table A42.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 400x1200

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 400x1200

Repairing Sub-Process of Metal Form 400x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	13	2.70	3.95
Medium Difficulty	16	50	3.80	
High Difficulty	12	38	4.57	
Total Study Units	32			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	21	141	141	4	3.74	1	141	0.13	162.069	2.70
2	2	10	130								
3	2	25	145								
4	2	28	148								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	13	193	198.375	16	15.12	1	198.375	0.13	228.0172	3.80
2	3	31	211								
3	3	50	230								
4	3	0	180								
5	3	27	207								
6	2	40	160								
7	3	21	201								
8	3	33	213								
9	3	31	211								
10	3	20	200								
11	2	57	177								
12	3	31	211								
13	3	40	220								
14	2	41	161								
15	3	22	202								
16	3	17	197								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	9	249	238.666667	12	9.91	1	238.667	0.13	274.3295	4.57
2	4	12	252								
3	3	33	213								
4	4	7	247								
5	4	0	240								
6	3	48	228								
7	4	15	255								
8	4	1	241								
9	3	55	235								
10	4	37	277								
11	3	40	220								
12	3	27	207								

Table A43.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 500x1200

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 500x1200

Sanding Sub-Process of Metal Form 500x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	8	50	0.52	0.43
speed 90	4	25	0.37	
speed 100	4	25	0.3	
Total Study Units	16			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	29	29	30	8	4	1	30	0.03	30.92784	0.52
2	0	31	31								
3	0	28	28								
4	0	28	28								
5	0	32	32								
6	0	30	30								
7	0	30	30								
8	0	32	32								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	21	21	21.5	4	2.6	1	21.5	0.03	22.1649	0.37
2	0	23	23								
3	0	21	21								
4	0	21	21								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	16	16	17.25	4	3.7	1	17.25	0.03	17.78351	0.30
2	0	17	17								
3	0	18	18								
4	0	18	18								

Table A43.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 500x1200

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 500x1200

Repairing Sub-Process of Metal Form 500x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	8	18	2.72	4.05
Medium Difficulty	32	73	4.28	
High Difficulty	4	9	4.80	
Total Study Units	44			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	14	134	141.75	8	7.82	1	141.75	0.13	162.931	2.72
2	2	31	151								
3	2	40	160								
4	2	27	147								
5	2	9	129								
6	2	21	141								
7	2	11	131								
8	2	21	141								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	13	253	223.625	32	30	1	223.625	0.13	257.0402	4.28
2	2	4	124								
3	3	51	231								
4	3	44	224								
5	4	8	248								
6	4	0	240								
7	3	25	205								
8	4	11	251								
9	3	50	230								
10	3	52	232								
11	4	6	246								
12	4	12	252								
13	4	3	243								
14	2	49	169								
15	4	5	245								
16	3	57	237								
17	3	51	231								
18	3	49	229								
19	4	4	244								
20	4	0	240								
21	3	51	231								
22	2	24	144								
23	4	9	249								
24	4	3	243								
25	3	30	210								
26	3	17	197								
27	3	21	201								
28	4	7	247								
29	3	37	217								
30	3	28	208								
31	4	3	243								
32	3	12	192								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	57	237	250.5	4	3.55	1	250.5	0.13	287.931	4.80
2	4	28	268								
3	4	3	243								
4	4	14	254								

Table A44.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 600x1200

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 600x1200

Sanding Sub-Process of Metal Form 600x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	12	30	0.70	0.64
speed 90	20	50	0.63	
speed 100	8	20	0.58	
Total Study Units	40			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	40	40	41	12	3.33	1	41	0.03	42.26804	0.70
2	0	44	44								
3	0	40	40								
4	0	40	40								
5	0	39	39								
6	0	45	45								
7	0	40	40								
8	0	40	40								
9	0	41	41								
10	0	41	41								
11	0	43	43								
12	0	39	39								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	36	36	36.9	20	6.57	1	36.9	0.03	38.04124	0.63
2	0	35	35								
3	0	38	38								
4	0	38	38								
5	0	40	40								
6	0	35	35								
7	0	35	35								
8	0	39	39								
9	0	36	36								
10	0	36	36								
11	0	37	37								
12	0	31	31								
13	0	35	35								
14	0	38	38								
15	0	42	42								
16	0	34	34								
17	0	38	38								
18	0	38	38								
19	0	39	39								
20	0	38	38								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	34	34	33.5	8	4.99	1	33.5	0.03	34.53608	0.58
2	0	29	29								
3	0	33	33								
4	0	33	33								
5	0	34	34								
6	0	35	35								
7	0	35	35								
8	0	35	35								

Table A44.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 600x1200

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 600x1200

Repairing Sub-Process of Metal Form 600x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	6	18	3.37	5.68
Medium Difficulty	18	53	5.27	
High Difficulty	10	29	7.82	
Total Study Units	34			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	45	165	176	6	2.91	1	176	0.13	202.2989	3.37
2	3	0	180								
3	3	0	180								
4	3	7	187								
5	2	56	176								
6	2	48	168								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	41	281	275.333333	18	15.5	1	275.333	0.13	316.4751	5.27
2	3	32	212								
3	4	9	249								
4	4	30	270								
5	4	0	240								
6	5	3	303								
7	4	51	291								
8	4	6	246								
9	4	38	278								
10	4	54	294								
11	5	1	301								
12	4	23	263								
13	5	21	321								
14	4	30	270								
15	5	5	305								
16	4	12	252								
17	4	40	280								
18	5	0	300								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	7	0	420	408.1	10	9.13	1	408.1	0.13	469.08046	7.82
2	7	3	423								
3	5	49	349								
4	6	21	381								
5	6	50	410								
6	7	11	431								
7	6	58	418								
8	7	30	450								
9	7	14	434								
10	6	5	365								

Table A45.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 800x1200

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 800x1200

Sanding Sub-Process of Metal Form 800x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	6	50	0.92	0.86
speed 90	3	25	0.87	
speed 100	3	25	0.73	
Total Study Units	12			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	54	54	53.8333333	6	1.55	1	53.8333	0.03	55.49828	0.92
2	0	54	54								
3	0	57	57								
4	0	52	52								
5	0	54	54								
6	0	52	52								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	50	50	50.66666667	3	1.8	1	50.6667	0.03	52.23368	0.87
2	0	53	53								
3	0	49	49								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	41	41	42.6666667	3	1.37	1	42.6667	0.03	43.98625	0.73
2	0	44	44								
3	0	43	43								

Table A45.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 800x1200

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 800x1200

Repairing Sub-Process of Metal Form 800x1200	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	5	14	3.85	5.54
Medium Difficulty	20	57	4.90	
High Difficulty	10	29	7.65	
Total Study Units	35			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	21	201	200.8	5	4.88	1	200.8	0.13	230.8046	3.85
2	3	12	192								
3	3	8	188								
4	3	23	203								
5	3	40	220								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	50	290	255.85	20	19.6	1	255.85	0.13	294.0805	4.90
2	3	27	207								
3	4	3	243								
4	4	16	256								
5	4	51	291								
6	4	42	282								
7	3	29	209								
8	4	14	254								
9	4	5	245								
10	4	24	264								
11	5	0	300								
12	4	19	259								
13	4	32	272								
14	4	41	281								
15	3	10	190								
16	4	15	255								
17	4	31	271								
18	4	15	255								
19	4	21	261								
20	3	52	232								

High Difficulty

WR Time					Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team												
no.	min	sec	converted	total sec	total sec			Rating	total sec		total sec	minute
1	6	39	6.65	399	399.5	10	5.39	1	399.5	0.13	459.1954	7.65
2	7	12	7.2	432								
3	6	51	6.85	411								
4	6	44	6.73333	404								
5	6	57	6.95	417								
6	5	49	5.81667	349								
7	6	9	6.15	369								
8	6	31	6.51667	391								
9	6	48	6.8	408								
10	6	55	6.91667	415								

Table A46.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 200x1500

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 200x1500

Sanding Sub-Process of Metal Form 200x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	12	67	0.27	0.24
speed 90	3	17	0.20	
speed 100	3	17	0.17	
Total Study Units	18			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	15	15	16	12	11.46	1	16	0.03	16.494845	0.27
2	0	14	14								
3	0	18	18								
4	0	18	18								
5	0	16	16								
6	0	14	14								
7	0	18	18								
8	0	16	16								
9	0	16	16								
10	0	16	16								
11	0	15	15								
12	0	16	16								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.6666667	3	2.61	1	11.6667	0.03	12.027491	0.20
2	0	12	12								
3	0	12	12								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	10	10	10	3	0	1	10	0.03	10.309278	0.17
2	0	10	10								
3	0	10	10								

Table A46.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 200x1500

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 200x1500

Repairing Sub-Process of Metal Form 200x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	10	27	2.40	3.72
Medium Difficulty	20	54	4.17	
High Difficulty	7	19	4.35	
Total Study Units	37			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	6	126	125.3	10	9.499	1	125.3	0.13	144.0229885	2.40
2	2	0	120								
3	2	1	121								
4	2	14	134								
5	2	23	143								
6	2	11	131								
7	1	56	116								
8	2	13	133								
9	2	1	121								
10	1	48	108								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	51	231	217.9	20	17.41	1	217.9	0.13	250.45977	4.17
2	3	29	209								
3	4	0	240								
4	3	33	213								
5	3	50	230								
6	3	29	209								
7	3	37	217								
8	4	9	249								
9	3	17	197								
10	4	20	260								
11	3	17	197								
12	3	20	200								
13	3	41	221								
14	3	17	197								
15	2	56	176								
16	3	32	212								
17	3	22	202								
18	3	39	219								
19	4	31	271								
20	3	28	208								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	44	224	226.857143	7	5.89	1	226.857	0.13	260.75534	4.35
2	4	11	251								
3	3	34	214								
4	3	39	219								
5	3	51	231								
6	3	29	209								
7	4	0	240								

Table A47.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 400x1500

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 400x1500

Sanding Sub-Process of Metal Form 400x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	10	50	0.35	0.33
speed 90	7	35	0.32	
speed 100	3	15	0.28	
Total Study Units	20			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	21	21	20.5	10	4	1	20.5	0.03	21.13402	0.35
2	0	19	19								
3	0	22	22								
4	0	21	21								
5	0	21	21								
6	0	20	20								
7	0	19	19								
8	0	22	22								
9	0	20	20								
10	0	20	20								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	19	19	18.8571429	7	6.98	1	18.8571	0.03	19.440353	0.32
2	0	19	19								
3	0	16	16								
4	0	20	20								
5	0	19	19								
6	0	20	20								
7	0	19	19								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	16	16	16.3333333	3	1.33	1	16.3333	0.03	16.83849	0.28
2	0	16	16								
3	0	17	17								

Table A47.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 400x1500

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 400x1500

Repairing Sub-Process of Metal Form 400x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	3	15	2.98	4.43
Medium Difficulty	10	50	4.37	
High Difficulty	7	35	5.15	
Total Study Units	20			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	29	149	155.6666667	3	1.64	1	155.667	0.13	178.9272	2.98
2	2	37	157								
3	2	41	161								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	50	230	228.2	10	5.05	1	228.2	0.13	262.2989	4.37
2	3	48	228								
3	3	57	237								
4	4	1	241								
5	3	51	231								
6	4	8	248								
7	3	52	232								
8	3	22	202								
9	3	40	220								
10	3	33	213								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	5	0	300	268.5714286	7	6.31	1	268.571	0.13	308.7028	5.15
2	4	31	271								
3	4	29	269								
4	3	59	239								
5	4	34	274								
6	4	19	259								
7	4	28	268								

Table A48.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 450x1500

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 450x1500

Sanding Sub-Process of Metal Form 450x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	10	50	0.42	0.39
speed 90	7	35	0.38	
speed 100	3	15	0.32	
Total Study Units	20			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	28	28	24.4	10	6.02	1	24.4	0.03	25.154639	0.42
2	0	25	25								
3	0	24	24								
4	0	24	24								
5	0	25	25								
6	0	23	23								
7	0	24	24								
8	0	22	22								
9	0	24	24								
10	0	25	25								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	24	24	22.1428571	7	5.06	1	22.1429	0.03	22.82769	0.38
2	0	21	21								
3	0	21	21								
4	0	24	24								
5	0	21	21								
6	0	22	22								
7	0	22	22								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	19	19	18.66666667	3	1.02	1	18.6667	0.03	19.24399	0.32
2	0	18	18								
3	0	19	19								

Table A48.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 450x1500

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 450x1500

Repairing Sub-Process of Metal Form 450x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	10	36	3.27	4.69
Medium Difficulty	10	36	4.83	
High Difficulty	8	29	6.30	
Total Study Units	28			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	3	10	190	170.9	10	9.033	1	170.9	0.13	196.4368	3.27
2	2	27	147								
3	3	1	181								
4	2	40	160								
5	2	42	162								
6	2	55	175								
7	3	4	184								
8	3	0	180								
9	2	39	159								
10	2	51	171								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	12	252	251.9	10	5.54	1	251.9	0.13	289.5402	4.83
2	3	57	237								
3	4	3	243								
4	4	43	283								
5	3	59	239								
6	4	18	258								
7	4	22	262								
8	4	0	240								
9	3	57	237								
10	4	28	268								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	5	46	346	328.875	8	5.91	1	328.875	0.13	378.0172	6.30
2	5	41	341								
3	4	41	281								
4	5	28	328								
5	5	18	318								
6	5	37	337								
7	5	36	336								
8	5	44	344								

Table A49.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 500x1500

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 500x1500

Sanding Sub-Process of Metal Form 500x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	7	33	0.55	0.48
speed 90	7	33	0.47	
speed 100	7	33	0.43	
Total Study Units	21			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	35	35	32.14285714	7	6.38	1	32.1429	0.03	33.13697	0.55
2	0	33	33								
3	0	31	31								
4	0	30	30								
5	0	33	33								
6	0	34	34								
7	0	29	29								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	29	29	27.28571429	7	5.96	1	27.2857	0.03	28.129602	0.47
2	0	26	26								
3	0	29	29								
4	0	27	27								
5	0	24	24								
6	0	28	28								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	22	22	25	7	6.58	1	25	0.03	25.7732	0.43
2	0	25	25								
3	0	25	25								
4	0	27	27								
5	0	27	27								
6	0	24	24								
7	0	25	25								

Table A49.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 500x1500

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 500x1500

Repairing Sub-Process of Metal Form 500x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	4	13	3.03	4.72
Medium Difficulty	24	75	4.62	
High Difficulty	4	13	7.02	
Total Study Units	32			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	40	160	158	4	3.11	1	158	0.13	181.6092	3.03
2	2	29	149								
3	2	35	155								
4	2	48	168								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	29	269	241.041667	24	20.55	1	241.042	0.13	277.05939	4.62
2	3	41	221								
3	3	39	219								
4	3	55	235								
5	4	21	261								
6	4	7	247								
7	4	29	269								
8	3	52	232								
9	4	13	253								
10	4	17	257								
11	4	40	280								
12	4	11	251								
13	2	47	167								
14	3	8	188								
15	4	21	261								
16	4	9	249								
17	4	40	280								
18	4	21	261								
19	3	48	228								
20	3	57	237								
21	4	2	242								
22	3	46	226								
23	3	20	200								
24	4	12	252								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	6	31	391	366.5	4	3.47	1	366.5	0.13	421.2644	7.02
2	6	12	372								
3	5	45	345								
4	5	58	358								

Table A50.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 600x1500

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 600x1500

Sanding Sub-Process of Metal Form 600x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	4	20	0.75	0.68
speed 90	10	50	0.68	
speed 100	6	30	0.63	
Total Study Units	20			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	41	41	43.5	4	2.75	1	43.5	0.03	44.84536	0.75
2	0	46	46								
3	0	44	44								
4	0	43	43								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	39	39	39.3	10	8.09	1	39.3	0.03	40.51546	0.68
2	0	33	33								
3	0	43	43								
4	0	39	39								
5	0	38	38								
6	0	42	42								
7	0	39	39								
8	0	39	39								
9	0	43	43								
10	0	38	38								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	37	37	36.5	6	3.1	1	36.5	0.03	37.62887	0.63
2	0	35	35								
3	0	35	35								
4	0	39	39								
5	0	38	38								
6	0	35	35								

Table A50.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 600x1500

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 600x1500

Repairing Sub-Process of Metal Form 600x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	6	15	3.65	6.36
Medium Difficulty	28	68	6.22	
High Difficulty	7	17	9.37	
Total Study Units	41			

Low Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	58	178	190.6666667	6	5.6	1	190.667	0.13	219.157088	3.65
2	3	4	184								
3	3	12	192								
4	3	29	209								
5	3	21	201								
6	3	0	180								

Medium Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	5	18	318	324.428571	28	27.51	1	324.429	0.13	372.9064	6.22
2	6	3	363								
3	4	14	254								
4	5	55	355								
5	5	12	312								
6	5	9	309								
7	4	14	254								
8	5	55	355								
9	6	17	377								
10	4	59	299								
11	5	13	313								
12	6	12	372								
13	5	31	331								
14	4	26	266								
15	5	57	357								
16	6	3	363								
17	6	21	381								
18	4	49	289								
19	6	6	366								
20	4	43	283								
21	5	44	344								
22	6	20	380								
23	4	56	296								
24	4	8	248								
25	6	12	372								
26	4	28	268								
27	5	1	301								
28	5	58	358								

High Difficulty

	WR Time			Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
	Time/1piece/team										
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	8	59	539	488.857143	7	3.67	1	488.857	0.13	561.9048	9.37
2	8	12	492								
3	8	4	484								
4	7	47	467								
5	8	0	480								
6	8	17	497								
7	7	43	463								

Table A51.1: Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 800x1500

Repairing Process: Sanding Sub-Process Time Study Result: Metal Form 800x1500

Sanding Sub-Process of Metal Form 800x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
speeed 80	9	38	0.92	0.86
speed 90	6	25	0.90	
speed 100	9	38	0.77	
Total Study Units	24			

Speed 80

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	55	55	53.77777778	9	3.05	1	53.7778	0.03	55.44101	0.92
2	0	50	50								
3	0	55	55								
4	0	57	57								
5	0	53	53								
6	0	53	53								
7	0	56	56								
8	0	50	50								
9	0	55	55								

Speed 90

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	50	50	52.1666667	6	3.22	1	52.1667	0.03	53.780069	0.90
2	0	49	49								
3	0	51	51								
4	0	53	53								
5	0	55	55								
6	0	55	55								

Speed 100

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	46	46	44.8888889	9	8.37	1	44.8889	0.03	46.277205	0.77
2	0	47	47								
3	0	47	47								
4	0	36	36								
5	0	45	45								
6	0	45	45								
7	0	45	45								
8	0	47	47								
9	0	46	46								

Table A51.2: Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 800x1500

Repairing Process: Repairing Sub-Process Time Study Result: Metal Form 800x1500

Repairing Sub-Process of Metal Form 800x1500	No. of Study Units	% Distribution	Standard Time (minutes)	Weighted Average Standard Time (minutes)
Low Difficulty	12	50	4.80	6.01
Medium Difficulty	9	38	6.23	
High Difficulty	3	13	10.22	
Total Study Units	24			

Low Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	4	24	264	250.333333	12	6.38	1	250.333	0.13	287.7395	4.80
2	3	30	210								
3	4	0	240								
4	4	30	270								
5	4	27	267								
6	4	11	251								
7	3	58	238								
8	4	3	243								
9	4	8	248								
10	3	55	235								
11	4	12	252								
12	4	10	250								

Medium Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	5	27	327	325.1111111	9	7.69	1	325.111	0.13	373.6909	6.23
2	5	12	312								
3	6	2	362								
4	5	51	351								
5	5	47	347								
6	5	19	319								
7	4	48	288								
8	5	13	313								
9	5	7	307								

High Difficulty

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	8	58	538	533.333333	3	2.05	1	533.333	0.13	613.0268	10.22
2	8	28	508								
3	9	14	554								

Manufacturing Process: Cutting Sub-Process Time Study Result: HS418

Cutting 1

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	35	95	97.8	10	1.16	1	97.8	0.14	113.7209	1.90
2	1	38	98								
3	1	37	97								
4	1	38	98								
5	1	43	103								
6	1	39	99								
7	1	35	95								
8	1	38	98								
9	1	41	101								
10	1	34	94								

Cutting 2

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	57	57	54.4	10	5.54	1	54.4	0.14	63.25581	1.05
2	0	50	50								
3	0	51	51								
4	0	52	52								
5	0	55	55								
6	0	54	54								
7	0	58	58								
8	1	0	60								
9	0	56	56								
10	0	51	51								

Cutting 3

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	1	10	70	68.3	10	4.12	1	68.3	0.14	79.4186	1.32
2	1	7	67								
3	1	8	68								
4	1	13	73								
5	1	1	61								
6	1	5	65								
7	1	10	70								
8	1	6	66								
9	1	11	71								
10	1	12	72								

Cutting 4

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	2	11	131	135	10	1.47	1	135	0.14	156.9767	2.62
2	2	18	138								
3	2	12	132								
4	2	10	130								
5	2	9	129								
6	2	15	135								
7	2	19	139								
8	2	17	137								
9	2	22	142								
10	2	17	137								

Table A52.2: Manufacturing Process: Welding Sub-Process Time Study Result: HS418

Manufacturing Process: Welding Sub-Process Time Study Result: HS418

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	24	21	1461	1425	10	0.42	1	1425	0.16	1696.429	28.27
2	23	39	1419								
3	23	42	1422								
4	23	51	1431								
5	24	1	1441								
6	23	42	1422								
7	23	13	1393								
8	24	11	1451								
9	23	0	1380								
10	23	50	1430								

Table A53: Painting Sub-Process Time Study Result: HS418

Painting Sub-Process Time Study Result: HS418

Painting Sub-Process of HS418	Standard Time (minutes)
Painting	0.15
Packing	0.08
Marking	0.2
Total Standard Time (minutes)	0.43

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	8	8	8.428571429	7	5.52	1	8.42857	0.07	9.06298	0.15
2	0	8	8								
3	0	8	8								
4	0	9	9								
5	0	9	9								
6	0	9	9								
7	0	8	8								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	5	5	4.875	8	7.36	1	4.875	0	4.875	0.08
2	0	5	5								
3	0	4	4								
4	0	5	5								
5	0	5	5								
6	0	5	5								
7	0	5	5								
8	0	5	5								

Marking

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.75	4	2.2	1	11.75	0	11.75	0.20
2	0	12	12								
3	0	12	12								
4	0	12	12								

Table A54: Painting Sub-Process Time Study Result: SSE17

Painting Sub-Process Time Study Result: SSE17

Painting Sub-Process of SSE17	Standard Time (minutes)
Painting	0.20
Packing	0.12
Marking	0.2
Total Standard Time (minutes)	0.52

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.25	4	2.37	1	11.25	0.07	12.09677	0.20
2	0	12	12								
3	0	11	11								
4	0	11	11								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	7	7	7	2	0	1	7	0	7	0.12
2	0	7	7								

Marking

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.75	4	2.17	1	11.75	0	11.75	0.20
2	0	12	12								
3	0	12	12								
4	0	12	12								

Table A55: Painting Sub-Process Time Study Result: TFT1205

Painting Sub-Process Time Study Result: TFT1205

Painting Sub-Process of TFT1205	Standard Time (minutes)
Painting	0.07
Packing	0.08
Marking	0.20
Total Standard Time (minutes)	0.35

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	4	4	4	3	0	1	4	0.07	4.301075	0.07
2	0	4	4								
3	0	4	4								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	5	5	5	3	0	1	5	0	5	0.08
2	0	5	5								
3	0	5	5								

Marking

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.75	4	2.17	1	11.75	0	11.75	0.20
2	0	12	12								
3	0	12	12								
4	0	12	12								

Table A56: Painting Sub-Process Time Study Result: TFT1215

Painting Sub-Process Time Study Result: TFT1215

Painting Sub-Process of TFT1215	Standard Time (minutes)
Painting	0.10
Packing	0.08
Marking	0.20
Total Standard Time (minutes)	0.38

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	6	6	5.8	10	7.61	1	5.8	0.07	6.236559	0.10
2	0	6	6								
3	0	5	5								
4	0	6	6								
5	0	6	6								
6	0	5	5								
7	0	6	6								
8	0	6	6								
9	0	6	6								
10	0	6	6								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	5	5	5	3	0	1	5	0	5	0.08
2	0	5	5								
3	0	5	5								

Marking

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.75	4	2.17	1	11.75	0	11.75	0.20
2	0	12	12								
3	0	12	12								
4	0	12	12								

Table A57: Painting Sub-Process Time Study Result: TFT1217

Painting Sub-Process Time Study Result: TFT1217

Painting Sub-Process of TFT1217	Standard Time (minutes)
Painting	0.10
Packing	0.08
Marking	0.20
Total Standard Time (minutes)	0.38

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	6	6	5.8	10	7.61	1	5.8	0.07	6.236559	0.10
2	0	6	6								
3	0	6	6								
4	0	6	6								
5	0	6	6								
6	0	6	6								
7	0	5	5								
8	0	6	6								
9	0	5	5								
10	0	6	6								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	5	5	5	3	0	1	5	0	5	0.08
2	0	5	5								
3	0	5	5								

Marking

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.75	4	2.17	1	11.75	0	11.75	0.20
2	0	12	12								
3	0	12	12								
4	0	12	12								

Table A58: Painting Sub-Process Time Study Result: YFT1218

Painting Sub-Process Time Study Result: YFT1218

Painting Sub-Process of YFT1218	Standard Time (minutes)
Painting	0.13
Packing	0.10
Marking	0.20
Total Standard Time (minutes)	0.43

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	7	7	7	3	0	1	7	0.07	7.526882	0.13
2	0	7	7								
3	0	7	7								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	6	6	5.875	8	5.07	1	5.875	0	5.875	0.10
2	0	6	6								
3	0	5	5								
4	0	6	6								
5	0	6	6								
6	0	6	6								
7	0	6	6								
8	0	6	6								

Marking

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.75	4	2.17	1	11.75	0	11.75	0.20
2	0	12	12								
3	0	12	12								
4	0	12	12								

Table A59: Painting Sub-Process Time Study Result: Round Pipe 48.6x1000

Painting Sub-Process Time Study Result: RO48.6x1000

Painting Sub-Process of RO48.6x1000	Standard Time (minutes)
Painting	0.05
Packing	0.03
Marking	0.20
Total Standard Time (minutes)	0.28

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	3	3	3	3	0	1	3	0.07	3.225806	0.05
2	0	3	3								
3	0	3	3								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	2	2	2	2	0	1	2	0	2	0.03
2	0	2	2								

Marking

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	11	11	11.75	4	2.17	1	11.75	0	11.75	0.20
2	0	12	12								
3	0	12	12								
4	0	12	12								

Table A60: Painting Sub-Process Time Study Result: Round Pipe 48.6x2000

Painting Sub-Process Time Study Result: RO48.6x2000

Painting Sub-Process of RO48.6x2000	Standard Time (minutes)
Painting	0.07
Packing	0.03
Total Standard Time (minutes)	0.10

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	4	4	4	3	0	1	4	0.07	4.301075	0.07
2	0	4	4								
3	0	4	4								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	2	2	2	2	0	1	2	0	2	0.03
2	0	2	2								

Table A56: Painting Sub-Process Time Study Result: Round Pipe 48.6x3000

Painting Sub-Process Time Study Result: RO48.6x3000

Painting Sub-Process of RO48.6x3000	Standard Time (minutes)
Painting	0.07
Packing	0.03
Total Standard Time (minutes)	0.10

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	3	3	3.9	10	9.47	1	3.9	0.07	4.193548	0.07
2	0	4	4								
3	0	4	4								
4	0	4	4								
5	0	4	4								
6	0	4	4								
7	0	4	4								
8	0	4	4								
9	0	4	4								
10	0	4	4								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	2	2	2	2	0	1	2	0	2	0.03
2	0	2	2								

Table A61: Painting Sub-Process Time Study Result: Round Pipe 48.6x4000

Painting Sub-Process Time Study Result: RO48.6x4000

Painting Sub-Process of RO48.6x4000	Standard Time (minutes)
Painting	0.07
Packing	0.03
Total Standard Time (minutes)	0.10

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	4	4	4	3	0	1	4	0.07	4.301075	0.07
2	0	4	4								
3	0	4	4								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	2	2	2	2	0	1	2	0	2	0.03
2	0	2	2								

Table A62: Painting Sub-Process Time Study Result: Round Pipe 48.6x4500

Painting Sub-Process Time Study Result: RO48.6x4500

Painting Sub-Process of RO48.6x4500	Standard Time (minutes)
Painting	0.08
Packing	0.03
Total Standard Time (minutes)	0.12

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	4	4	4.2	15	14.51	1	4.2	0.07	4.516129	0.08
2	0	4	4								
3	0	4	4								
4	0	5	5								
5	0	4	4								
6	0	4	4								
7	0	4	4								
8	0	4	4								
9	0	4	4								
10	0	4	4								
11	0	4	4								
12	0	5	5								
13	0	5	5								
14	0	4	4								
15	0	4	4								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	2	2	2	2	0	1	2	0	2	0.03
2	0	2	2								

Table A63: Painting Sub-Process Time Study Result: Round Pipe 48.6x5000

Painting Sub-Process Time Study Result: RO48.6x5000

Painting Sub-Process of RO48.6x5000	Standard Time (minutes)
Painting	0.08
Packing	0.03
Total Standard Time (minutes)	0.12

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	5	5	4.2	15	14.51	1	4.2	0.07	4.516129	0.08
2	0	5	5								
3	0	4	4								
4	0	4	4								
5	0	4	4								
6	0	4	4								
7	0	4	4								
8	0	4	4								
9	0	4	4								
10	0	4	4								
11	0	4	4								
12	0	4	4								
13	0	5	5								
14	0	4	4								
15	0	4	4								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	2	2	2	2	0	1	2	0	2	0.03
2	0	2	2								

Table A64: Painting Sub-Process Time Study Result: Round Pipe 48.6x6000

Painting Sub-Process Time Study Result: RO48.6x6000

Painting Sub-Process of RO48.6x6000	Standard Time (minutes)
Painting	0.08
Packing	0.03
Total Standard Time (minutes)	0.12

Painting

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	5	5	4.69565217	23	21.7	1	4.69565	0.07	5.049088	0.08
2	0	3	3								
3	0	4	4								
4	0	4	4								
5	0	5	5								
6	0	4	4								
7	0	4	4								
8	0	5	5								
9	0	4	4								
10	0	5	5								
11	0	5	5								
12	0	5	5								
13	0	5	5								
14	0	5	5								
15	0	5	5								
16	0	5	5								
17	0	5	5								
18	0	5	5								
19	0	5	5								
20	0	5	5								
21	0	5	5								
22	0	5	5								
23	0	5	5								

Packing

WR Time				Average WR Time	n'	n	Normal Time		Allowance Factor	Standard Time	Standard Time
Time/1piece/team											
no.	min	sec	total sec	total sec			Rating	total sec		total sec	minute
1	0	2	2	2	2	0	1	2	0	2	0.03
2	0	2	2								

Appendix B: The Information System Preliminary Evaluation Result

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR011772_Y	114-0203	200	15.มี.ค..08	15.มี.ค..08	15.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR011774_Y	112-2403	150	15.มี.ค..08	15.มี.ค..08	15.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR011776_Y	112-0102	150	15.มี.ค..08	15.มี.ค..08	15.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036701	112-0102	100	15.มี.ค..08	17.มี.ค..08	16.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036701	112-0102	100	15.มี.ค..08	17.มี.ค..08	16.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036702	213-2304	200	15.มี.ค..08	16.มี.ค..08	16.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036701	112-2411	50	15.มี.ค..08	17.มี.ค..08	16.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036701	112-2411	50	15.มี.ค..08	17.มี.ค..08	17.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036701	112-0102	200	15.มี.ค..08	17.มี.ค..08	17.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036701	114-0203	100	15.มี.ค..08	17.มี.ค..08	17.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036700	112-0401	12	15.มี.ค..08	17.มี.ค..08	17.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036695	112-2407	10	15.มี.ค..08	17.มี.ค..08	18.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036695	112-2411	10	15.มี.ค..08	17.มี.ค..08	18.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036705	112-0401	30	15.มี.ค..08	16.มี.ค..08	18.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036705	213-2304	320	15.มี.ค..08	16.มี.ค..08	18.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036705	114-0203	132	15.มี.ค..08	16.มี.ค..08	18.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036705	112-0102	280	15.มี.ค..08	16.มี.ค..08	19.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036705	114-0203	100	15.มี.ค..08	16.มี.ค..08	19.มี.ค..08	15.มี.ค..08	16.มี.ค..08
DR036705	112-2106	377	15.มี.ค..08	16.มี.ค..08	19.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036705	112-0401	40	15.มี.ค..08	16.มี.ค..08	20.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036705	112-0501	100	15.มี.ค..08	16.มี.ค..08	20.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036705	112-0501	20	15.มี.ค..08	16.มี.ค..08	21.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036707	213-2304	200	15.มี.ค..08	15.มี.ค..08	23.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036707	112-0401	200	15.มี.ค..08	15.มี.ค..08	26.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR011779_Y	112-2407	20	16.มี.ค..08	16.มี.ค..08	16.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036712	112-0102	50	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR011782_Y	112-0102	52	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR011787_Y	112-0102	300	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR011793_Y	114-5704	100	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036716	213-2304	20	17.มี.ค..08	18.มี.ค..08	18.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036715	112-0401	20	17.มี.ค..08	18.มี.ค..08	18.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036715	213-2304	60	17.มี.ค..08	18.มี.ค..08	18.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036714	112-0102	252	17.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036731	112-0102	60	17.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036731	112-0401	20	17.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036729	213-2304	100	17.มี.ค..08	19.มี.ค..08	19.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036728	213-2304	80	17.มี.ค..08	18.มี.ค..08	20.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036723	114-0202	1200	17.มี.ค..08	18.มี.ค..08	20.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036723	114-5904	50	17.มี.ค..08	18.มี.ค..08	20.มี.ค..08	17.มี.ค..08	18.มี.ค..08
DR036732	213-2304	30	17.มี.ค..08	17.มี.ค..08	24.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR011807_Y	112-0102	300	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR011813_Y	112-0102	40	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR011813_Y	213-2304	5	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR011815_Y	114-0203	300	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR011817_Y	112-0102	48	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR011820_Y	114-0203	300	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR011825_Y	112-0401	48	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036748	112-0401	96	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036748	112-2403	48	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036748	114-0203	96	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036748	112-0102	192	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036747	213-2304	50	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036739	112-0102	190	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036739	213-2304	80	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036739	112-2403	50	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036737	112-0401	30	18.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036744	112-0102	40	18.มี.ค..08	19.มี.ค..08	20.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036744	112-0401	20	18.มี.ค..08	19.มี.ค..08	20.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036741	114-5904	40	18.มี.ค..08	19.มี.ค..08	22.มี.ค..08	18.มี.ค..08	19.มี.ค..08
DR036758	112-2205	200	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036758	112-2409	50	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036767	112-0102	8	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR011826_Y	112-2112	60	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR011828_Y	114-5305	141	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR011831_Y	213-2304	40	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR011832_Y	112-0102	50	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR011833_Y	112-2409	20	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR011834_Y	112-0102	250	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR011836_Y	112-2403	199	19.มี.ค..08	19.มี.ค..08	19.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036762	112-2106	100	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036762	112-2405	98	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036780	112-0102	300	19.มี.ค..08	23.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036780	112-0102	400	19.มี.ค..08	23.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036756	112-2112	200	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036780	112-0102	300	19.มี.ค..08	23.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036774	112-2106	120	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036777	112-0102	80	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036777	112-2112	40	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036757	112-2112	500	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036770	114-0203	100	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036771	112-2112	50	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036771	112-2405	60	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036771	112-2411	15	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036771	114-0203	100	19.มี.ค..08	20.มี.ค..08	20.มี.ค..08	19.มี.ค..08	20.มี.ค..08
DR036783	112-0401	90	19.มี.ค..08	21.มี.ค..08	21.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036783	112-0501	86	19.มี.ค..08	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036783	112-2112	250	19.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036776	112-2112	80	19.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036776	112-2411	100	19.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036774	112-2112	180	19.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036776	112-0401	100	19.มี.ค..08	20.มี.ค..08	22.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036776	112-0401	149	19.มี.ค..08	20.มี.ค..08	24.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036776	213-2304	400	19.มี.ค..08	20.มี.ค..08	24.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011848_Y	112-0401	5	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011848_Y	213-2304	25	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011849_Y	112-0102	30	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011851_Y	213-2304	100	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011852_Y	112-0102	30	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011853_Y	112-0501	18	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011853_Y	213-2304	18	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR011856_Y	112-0401	100	20.มี.ค..08	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036802	112-2411	40	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036790	213-2304	140	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036791	112-0102	40	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036791	112-2411	12	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036784	114-5904	102	20.มี.ค..08	20.มี.ค..08	21.มี.ค..08	20.มี.ค..08	21.มี.ค..08
DR036800	112-0102	100	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036797	112-0401	100	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036797	112-0501	20	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036793	112-2108	160	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036797	112-0102	200	20.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036801	112-2411	39	20.มี.ค..08	22.มี.ค..08	22.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036800	112-0102	100	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036800	112-0401	60	20.มี.ค..08	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036814	112-2409	35	20.มี.ค..08	21.มี.ค..08	23.มี.ค..08	24.มี.ค..08	25.มี.ค..08
DR036806	213-2304	15	20.มี.ค..08	24.มี.ค..08	24.มี.ค..08	21.มี.ค..08	22.มี.ค..08
DR036809	112-2211	240	20.มี.ค..08	24.มี.ค..08	24.มี.ค..08	24.มี.ค..08	25.มี.ค..08
DR036814	112-2411	35	20.มี.ค..08	21.มี.ค..08	24.มี.ค..08	24.มี.ค..08	25.มี.ค..08
DR036811	112-0102	16	20.มี.ค..08	24.มี.ค..08	24.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036811	112-0401	10	20.มี.ค..08	24.มี.ค..08	24.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036798	112-2112	640	20.มี.ค..08	20.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036798	112-2408	46	20.มี.ค..08	20.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036793	112-2108	240	20.มี.ค..08	21.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036798	112-2409	50	20.มี.ค..08	20.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR036793	112-2108	240	20.มี.ค..08	21.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036798	112-2408	50	20.มี.ค..08	20.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036793	112-2108	300	20.มี.ค..08	21.มี.ค..08	26.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR036798	112-2112	400	20.มี.ค..08	20.มี.ค..08	26.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR036798	112-2109	500	20.มี.ค..08	20.มี.ค..08	26.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR036793	112-2108	275	20.มี.ค..08	21.มี.ค..08	27.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR036793	112-2112	160	20.มี.ค..08	21.มี.ค..08	27.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR036798	112-2112	260	20.มี.ค..08	20.มี.ค..08	27.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR036798	112-2112	226	20.มี.ค..08	20.มี.ค..08	27.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR036793	112-2112	220	20.มี.ค..08	21.มี.ค..08	28.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036803	112-2108	40	20.มี.ค..08	21.มี.ค..08	28.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036817	112-2112	40	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR011869_Y	112-2404	14	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR011875_Y	112-2112	200	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR011878_Y	112-2112	120	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR011879_Y	112-0401	2	21.มี.ค..08	21.มี.ค..08	21.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036818	112-2112	48	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036826	112-2112	200	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036828	112-0401	10	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036831	112-0401	20	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036827	112-0401	20	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036827	112-2112	40	21.มี.ค..08	22.มี.ค..08	22.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036829	112-0401	99	21.มี.ค..08	24.มี.ค..08	24.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036829	112-0501	20	21.มี.ค..08	24.มี.ค..08	24.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036831	112-2112	24	21.มี.ค..08	22.มี.ค..08	24.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036829	112-0401	60	21.มี.ค..08	24.มี.ค..08	25.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036829	213-2304	160	21.มี.ค..08	24.มี.ค..08	25.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036824	112-2511	300	21.มี.ค..08	25.มี.ค..08	25.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036816	112-2112	300	21.มี.ค..08	24.มี.ค..08	25.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR036816	112-2112	200	21.มี.ค..08	24.มี.ค..08	27.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR036833	213-2304	10	22.มี.ค..08	22.มี.ค..08	22.มี.ค..08	22.มี.ค..08	23.มี.ค..08
DR036878	114-0202	200	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036882	112-0102	20	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011905_Y	112-0401	15	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011905_Y	112-0501	10	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011909_Y	114-5504	88	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011912_Y	114-0202	100	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011913_Y	112-0102	12	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011913_Y	213-2304	3	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011915_Y	112-0102	300	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011916_Y	112-0102	250	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011918_Y	112-2112	300	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR011919_Y	114-5304	200	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011926_Y	114-5904	23	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR011923_Y	112-0102	100	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036888	112-0102	40	25.มี.ค..08	26.มี.ค..08	26.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036883	114-5504	20	25.มี.ค..08	25.มี.ค..08	26.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036881	112-2407	12	25.มี.ค..08	26.มี.ค..08	26.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR036881	114-0202	64	25.มี.ค..08	26.มี.ค..08	26.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036885	112-0102	200	25.มี.ค..08	26.มี.ค..08	26.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR036884	114-5305	20	25.มี.ค..08	26.มี.ค..08	26.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036894	114-5504	27	25.มี.ค..08	27.มี.ค..08	27.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036894	213-2304	50	25.มี.ค..08	27.มี.ค..08	27.มี.ค..08	25.มี.ค..08	26.มี.ค..08
DR036891	112-2407	100	25.มี.ค..08	27.มี.ค..08	27.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR036893	112-2407	15	25.มี.ค..08	30.มี.ค..08	29.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR036909	213-2304	1	26.มี.ค..08	26.มี.ค..08	26.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR011924_Y	213-2315	60	26.มี.ค..08	26.มี.ค..08	26.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR011936_Y	112-2108	320	26.มี.ค..08	26.มี.ค..08	26.มี.ค..08	01.เม.ย..08	02.เม.ย..08
DR011939_Y	112-2112	240	26.มี.ค..08	26.มี.ค..08	26.มี.ค..08	01.เม.ย..08	02.เม.ย..08
DR036904	213-2304	50	26.มี.ค..08	27.มี.ค..08	27.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR036917	213-2304	60	26.มี.ค..08	27.มี.ค..08	27.มี.ค..08	26.มี.ค..08	27.มี.ค..08
DR036911	112-2511	20	26.มี.ค..08	28.มี.ค..08	29.มี.ค..08	01.เม.ย..08	02.เม.ย..08
DR036911	112-2112	300	26.มี.ค..08	28.มี.ค..08	01.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR011944_Y	213-2304	68	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR011946_Y	213-2304	3	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	28.มี.ค..08

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR011949_Y	112-2112	4	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	01.เม.ย..08	02.เม.ย..08
DR011951_Y	114-0202	1000	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR011953_Y	112-2112	240	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	01.เม.ย..08	02.เม.ย..08
DR011954_Y	112-2112	80	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	01.เม.ย..08	02.เม.ย..08
DR011955_Y	114-1304	140	27.มี.ค..08	27.มี.ค..08	27.มี.ค..08	01.เม.ย..08	02.เม.ย..08
DR036928	213-2304	1	27.มี.ค..08	28.มี.ค..08	28.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR036933	213-2304	150	27.มี.ค..08	28.มี.ค..08	28.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR036938	112-2101	400	27.มี.ค..08	28.มี.ค..08	28.มี.ค..08	02.เม.ย..08	03.เม.ย..08
DR036933	213-2304	50	27.มี.ค..08	28.มี.ค..08	28.มี.ค..08	27.มี.ค..08	28.มี.ค..08
DR036924	112-2409	60	27.มี.ค..08	29.มี.ค..08	29.มี.ค..08	02.เม.ย..08	03.เม.ย..08
DR036928	213-2304	60	27.มี.ค..08	28.มี.ค..08	03.เม.ย..08	27.มี.ค..08	28.มี.ค..08
DR036945	213-2304	20	28.มี.ค..08	29.มี.ค..08	28.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR011958_Y	213-2304	30	28.มี.ค..08	28.มี.ค..08	28.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR011965_Y	213-2304	50	28.มี.ค..08	28.มี.ค..08	28.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR011966_Y	112-2108	220	28.มี.ค..08	28.มี.ค..08	28.มี.ค..08	02.เม.ย..08	03.เม.ย..08
DR036964	112-2112	250	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	02.เม.ย..08	03.เม.ย..08
DR036943	112-2112	50	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	02.เม.ย..08	03.เม.ย..08
DR036953	112-2112	40	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	03.เม.ย..08	04.เม.ย..08
DR036949	112-0501	9	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036965	112-0501	10	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036964	112-2101	320	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	03.เม.ย..08	04.เม.ย..08
DR036948	112-0501	15	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036948	213-2304	10	28.มี.ค..08	29.มี.ค..08	29.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036962	213-2304	40	28.มี.ค..08	28.มี.ค..08	31.มี.ค..08	28.มี.ค..08	29.มี.ค..08
DR036967	213-2304	100	28.มี.ค..08	29.มี.ค..08	02.เม.ย..08	28.มี.ค..08	29.มี.ค..08
DR036969	112-0102	246	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036969	114-0202	200	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036973	114-0202	400	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036991	112-2112	161	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	03.เม.ย..08	04.เม.ย..08
DR011975_Y	112-2112	90	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	03.เม.ย..08	04.เม.ย..08
DR011984_Y	213-2304	110	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR011985_Y	213-2304	90	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR011986_Y	112-0501	40	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR011987_Y	213-2304	3	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR011989_Y	112-0102	220	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036982	213-2304	45	29.มี.ค..08	30.มี.ค..08	30.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036977	112-0102	300	29.มี.ค..08	31.มี.ค..08	31.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036977	112-0102	90	29.มี.ค..08	31.มี.ค..08	31.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036978	213-2304	20	29.มี.ค..08	31.มี.ค..08	31.มี.ค..08	29.มี.ค..08	30.มี.ค..08
DR036985	112-0102	280	29.มี.ค..08	01.เม.ย..08	01.เม.ย..08	29.มี.ค..08	30.มี.ค..08
DR036985	213-2304	50	29.มี.ค..08	01.เม.ย..08	01.เม.ย..08	29.มี.ค..08	30.มี.ค..08
DR036977	112-0102	150	29.มี.ค..08	31.มี.ค..08	04.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR036996	114-5504	480	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR011993_Y	112-0501	8	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR011996_Y	112-0501	2	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR011999_Y	112-0401	5	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR012000_Y	112-2112	320	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	04.เม.ย..08	05.เม.ย..08
DR012001_Y	112-0102	200	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR012005_Y	112-0102	16	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	31.มี.ค..08	01.เม.ย..08
DR037016	112-0102	100	31.มี.ค..08	01.เม.ย..08	01.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR037024	112-0102	130	31.มี.ค..08	01.เม.ย..08	01.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR037024	213-2304	30	31.มี.ค..08	01.เม.ย..08	01.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR037009	112-0102	10	31.มี.ค..08	01.เม.ย..08	01.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR037020	112-0401	40	31.มี.ค..08	01.เม.ย..08	01.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR037020	213-2304	10	31.มี.ค..08	01.เม.ย..08	01.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR037017	112-0102	40	31.มี.ค..08	01.เม.ย..08	01.เม.ย..08	31.มี.ค..08	01.เม.ย..08
DR037002	112-0401	41	01.เม.ย..08	02.เม.ย..08	01.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR037002	112-2112	100	01.เม.ย..08	02.เม.ย..08	01.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR012007_Y	213-2304	100	01.เม.ย..08	01.เม.ย..08	01.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR012010_Y	112-2112	80	01.เม.ย..08	01.เม.ย..08	01.เม.ย..08	04.เม.ย..08	05.เม.ย..08

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR012013_Y	213-2304	100	01.เม.ย..08	01.เม.ย..08	01.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR012085_Y	112-0501	80	01.เม.ย..08	01.เม.ย..08	01.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR037029	112-0401	10	01.เม.ย..08	02.เม.ย..08	02.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR037029	213-2304	55	01.เม.ย..08	02.เม.ย..08	02.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR037029	213-2304	50	01.เม.ย..08	02.เม.ย..08	02.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR037043	213-2304	29	01.เม.ย..08	02.เม.ย..08	02.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR037042	112-2409	30	01.เม.ย..08	02.เม.ย..08	02.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037025	114-0202	400	01.เม.ย..08	02.เม.ย..08	02.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR037041	112-2407	200	01.เม.ย..08	02.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037029	112-0501	109	01.เม.ย..08	02.เม.ย..08	04.เม.ย..08	01.เม.ย..08	02.เม.ย..08
DR012019_Y	112-2409	50	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR012025_Y	213-2304	200	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR012028_Y	213-2304	3	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR012030_Y	114-0202	400	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR012030_Y	213-2304	100	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR012034_Y	213-2304	4	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037061	112-0401	20	02.เม.ย..08	03.เม.ย..08	03.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037061	112-2106	200	02.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037061	112-2112	200	02.เม.ย..08	03.เม.ย..08	03.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037061	213-2304	40	02.เม.ย..08	03.เม.ย..08	03.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037077	213-2304	100	02.เม.ย..08	03.เม.ย..08	03.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037058	112-0401	27	02.เม.ย..08	03.เม.ย..08	04.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037069	213-2304	65	02.เม.ย..08	04.เม.ย..08	04.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037057	213-2304	51	02.เม.ย..08	02.เม.ย..08	04.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037077	213-2304	240	02.เม.ย..08	03.เม.ย..08	04.เม.ย..08	02.เม.ย..08	03.เม.ย..08
DR037082	112-0401	50	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR037083	213-2315	50	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR037088	112-0501	4	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012035_Y	213-2304	20	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012036_Y	213-2304	40	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012038_Y	112-0401	60	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012038_Y	112-0501	10	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012039_Y	112-0401	8	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012039_Y	112-0501	8	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012042_Y	112-2112	160	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR012045_Y	213-2304	180	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR037086	213-2315	14	03.เม.ย..08	04.เม.ย..08	04.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR037084	112-2112	100	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037084	213-2304	50	03.เม.ย..08	03.เม.ย..08	04.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR036779	112-2303	510	03.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037094	112-2112	10	03.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037094	213-2304	30	03.เม.ย..08	04.เม.ย..08	04.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR037095	112-0401	10	03.เม.ย..08	04.เม.ย..08	04.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR037090	112-2112	20	03.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037074	112-2112	40	03.เม.ย..08	05.เม.ย..08	05.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037079	112-2112	7	03.เม.ย..08	09.เม.ย..08	10.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037079	213-2304	35	03.เม.ย..08	09.เม.ย..08	10.เม.ย..08	03.เม.ย..08	04.เม.ย..08
DR012053_Y	112-0501	50	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR012053_Y	213-2304	120	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR012054_Y	213-2304	260	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR012055_Y	112-0501	8	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR012055_Y	213-2304	4	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR012057_Y	112-2409	50	04.เม.ย..08	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037103	112-2106	50	04.เม.ย..08	05.เม.ย..08	05.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037104	112-0401	70	04.เม.ย..08	04.เม.ย..08	05.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037101	213-2304	4	04.เม.ย..08	05.เม.ย..08	05.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037102	112-0401	6	04.เม.ย..08	05.เม.ย..08	05.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037099	112-2108	20	04.เม.ย..08	05.เม.ย..08	05.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037109	213-2304	20	04.เม.ย..08	05.เม.ย..08	05.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037106	112-0401	30	04.เม.ย..08	05.เม.ย..08	05.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037106	112-2108	40	04.เม.ย..08	05.เม.ย..08	05.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037109	213-2304	280	04.เม.ย..08	05.เม.ย..08	09.เม.ย..08	04.เม.ย..08	05.เม.ย..08
DR037097	112-2108	8	04.เม.ย..08	05.เม.ย..08	10.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037109	213-2304	300	04.เม.ย..08	05.เม.ย..08	10.เม.ย..08	04.เม.ย..08	05.เม.ย..08

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR012068_Y	213-2304	8	05.เม.ย..08	05.เม.ย..08	05.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037116	112-0401	100	05.เม.ย..08	07.เม.ย..08	08.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037116	112-0501	100	05.เม.ย..08	07.เม.ย..08	08.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037117	112-0401	21	05.เม.ย..08	06.เม.ย..08	25.เม.ย..08	05.เม.ย..08	06.เม.ย..08
DR037126	112-0401	150	07.เม.ย..08	08.เม.ย..08	07.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR012077_Y	213-2304	15	07.เม.ย..08	07.เม.ย..08	07.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037131	213-2304	100	07.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037132	112-2108	40	07.เม.ย..08	09.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037139	112-0401	18	07.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037138	213-2304	145	07.เม.ย..08	11.เม.ย..08	11.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037148	112-0401	70	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR012081_Y	112-0401	120	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR012081_Y	112-0501	15	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR012081_Y	112-2106	20	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR012090_Y	112-0401	15	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR012091_Y	112-0501	15	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037176	112-0401	8	08.เม.ย..08	09.เม.ย..08	09.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037149	112-0401	20	08.เม.ย..08	09.เม.ย..08	09.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037149	112-0501	20	08.เม.ย..08	09.เม.ย..08	09.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037144	112-2106	6	08.เม.ย..08	08.เม.ย..08	09.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037151	112-2106	10	08.เม.ย..08	08.เม.ย..08	10.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037177	114-5704	230	08.เม.ย..08	09.เม.ย..08	11.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037177	114-5904	180	08.เม.ย..08	09.เม.ย..08	11.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR037145	213-2304	300	08.เม.ย..08	18.เม.ย..08	18.เม.ย..08	08.เม.ย..08	09.เม.ย..08
DR012093_Y	112-0401	80	09.เม.ย..08	09.เม.ย..08	09.เม.ย..08	09.เม.ย..08	10.เม.ย..08
DR012093_Y	112-2108	30	09.เม.ย..08	09.เม.ย..08	09.เม.ย..08	09.เม.ย..08	10.เม.ย..08
DR012094_Y	112-0401	20	09.เม.ย..08	09.เม.ย..08	09.เม.ย..08	09.เม.ย..08	10.เม.ย..08
DR037189	112-0401	100	09.เม.ย..08	10.เม.ย..08	10.เม.ย..08	09.เม.ย..08	10.เม.ย..08
DR037187	213-2304	50	09.เม.ย..08	11.เม.ย..08	11.เม.ย..08	09.เม.ย..08	10.เม.ย..08
DR037188	114-5704	500	09.เม.ย..08	11.เม.ย..08	15.เม.ย..08	09.เม.ย..08	10.เม.ย..08
DR037188	114-5704	240	09.เม.ย..08	11.เม.ย..08	19.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037188	114-5704	200	09.เม.ย..08	11.เม.ย..08	24.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037188	114-5704	60	09.เม.ย..08	11.เม.ย..08	25.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037193	114-5304	320	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037200	112-0301	20	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR012099_Y	112-0401	30	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR012105_Y	112-0301	10	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037192	112-0401	10	10.เม.ย..08	11.เม.ย..08	11.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037191	112-0301	20	10.เม.ย..08	11.เม.ย..08	11.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037202	112-0301	100	10.เม.ย..08	11.เม.ย..08	11.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037194	112-0301	140	10.เม.ย..08	19.เม.ย..08	20.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037194	112-0401	6	10.เม.ย..08	19.เม.ย..08	20.เม.ย..08	10.เม.ย..08	11.เม.ย..08
DR037215	114-5304	60	11.เม.ย..08	11.เม.ย..08	19.เม.ย..08	11.เม.ย..08	12.เม.ย..08
DR037218	112-0401	20	18.เม.ย..08	18.เม.ย..08	18.เม.ย..08	18.เม.ย..08	19.เม.ย..08
DR037227	112-0401	40	18.เม.ย..08	19.เม.ย..08	18.เม.ย..08	18.เม.ย..08	19.เม.ย..08
DR012115_Y	112-2409	36	18.เม.ย..08	18.เม.ย..08	18.เม.ย..08	18.เม.ย..08	19.เม.ย..08
DR037218	112-0401	100	18.เม.ย..08	18.เม.ย..08	19.เม.ย..08	18.เม.ย..08	19.เม.ย..08
DR037228	112-0401	84	18.เม.ย..08	19.เม.ย..08	19.เม.ย..08	18.เม.ย..08	19.เม.ย..08
DR037220	112-0401	10	18.เม.ย..08	19.เม.ย..08	21.เม.ย..08	18.เม.ย..08	19.เม.ย..08
DR012123_Y	112-0401	40	19.เม.ย..08	19.เม.ย..08	19.เม.ย..08	19.เม.ย..08	20.เม.ย..08
DR012129_Y	112-2409	30	19.เม.ย..08	19.เม.ย..08	19.เม.ย..08	19.เม.ย..08	20.เม.ย..08
DR012134_Y	112-0401	5	19.เม.ย..08	19.เม.ย..08	19.เม.ย..08	19.เม.ย..08	20.เม.ย..08
DR037249	112-0401	40	19.เม.ย..08	20.เม.ย..08	20.เม.ย..08	19.เม.ย..08	20.เม.ย..08
DR012154_Y	112-2106	100	20.เม.ย..08	20.เม.ย..08	20.เม.ย..08	21.เม.ย..08	22.เม.ย..08
DR037254	114-5904	100	21.เม.ย..08	21.เม.ย..08	21.เม.ย..08	21.เม.ย..08	22.เม.ย..08
DR037275	112-0401	306	21.เม.ย..08	22.เม.ย..08	25.เม.ย..08	21.เม.ย..08	22.เม.ย..08
DR012156_Y	114-5305	24	22.เม.ย..08	22.เม.ย..08	22.เม.ย..08	22.เม.ย..08	23.เม.ย..08
DR037300	112-2106	200	22.เม.ย..08	23.เม.ย..08	23.เม.ย..08	22.เม.ย..08	23.เม.ย..08
DR012184_Y	114-5904	100	23.เม.ย..08	23.เม.ย..08	23.เม.ย..08	23.เม.ย..08	24.เม.ย..08
DR037340	114-5904	60	23.เม.ย..08	25.เม.ย..08	25.เม.ย..08	23.เม.ย..08	24.เม.ย..08

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR037352	114-5305	168	24.เม.ย..08	25.เม.ย..08	26.เม.ย..08	24.เม.ย..08	25.เม.ย..08
DR037428	112-0102	80	28.เม.ย..08	29.เม.ย..08	29.เม.ย..08	28.เม.ย..08	29.เม.ย..08
DR037415	112-0102	30	28.เม.ย..08	29.เม.ย..08	29.เม.ย..08	28.เม.ย..08	29.เม.ย..08
DR037426	112-0102	140	28.เม.ย..08	29.เม.ย..08	29.เม.ย..08	28.เม.ย..08	29.เม.ย..08
DR037441	114-5305	142	29.เม.ย..08	29.เม.ย..08	29.เม.ย..08	29.เม.ย..08	30.เม.ย..08
DR037478	114-5305	24	30.เม.ย..08	30.เม.ย..08	02.พ.ค..08	30.เม.ย..08	01.พ.ค..08
DR037514	112-0401	50	02.พ.ค..08	02.พ.ค..08	03.พ.ค..08	02.พ.ค..08	03.พ.ค..08
DR037504	112-0102	260	02.พ.ค..08	03.พ.ค..08	03.พ.ค..08	02.พ.ค..08	03.พ.ค..08
DR037507	112-0401	20	02.พ.ค..08	03.พ.ค..08	03.พ.ค..08	02.พ.ค..08	03.พ.ค..08
DR037507	112-0401	60	02.พ.ค..08	03.พ.ค..08	03.พ.ค..08	02.พ.ค..08	03.พ.ค..08
DR037521	112-0102	40	03.พ.ค..08	03.พ.ค..08	03.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR037527	112-0401	80	03.พ.ค..08	04.พ.ค..08	03.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR037527	112-0102	35	03.พ.ค..08	04.พ.ค..08	03.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR012277_Y	112-0102	52	03.พ.ค..08	03.พ.ค..08	03.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR037531	112-0401	50	03.พ.ค..08	05.พ.ค..08	05.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR037532	114-5305	80	03.พ.ค..08	06.พ.ค..08	05.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR037534	112-0102	96	03.พ.ค..08	05.พ.ค..08	05.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR037517	114-5704	140	03.พ.ค..08	06.พ.ค..08	06.พ.ค..08	03.พ.ค..08	04.พ.ค..08
DR037554	112-0401	200	05.พ.ค..08	05.พ.ค..08	05.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR012291_Y	112-0102	6	05.พ.ค..08	05.พ.ค..08	05.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037570	112-0102	80	05.พ.ค..08	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037550	112-0401	240	05.พ.ค..08	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037553	114-5504	51	05.พ.ค..08	05.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037550	112-0401	180	05.พ.ค..08	06.พ.ค..08	08.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037583	112-0401	10	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037580	112-0401	4	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037591	112-0401	40	06.พ.ค..08	07.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR012295_Y	114-5304	6	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR012306_Y	112-0401	1	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037588	112-0401	100	06.พ.ค..08	07.พ.ค..08	07.พ.ค..08	06.พ.ค..08	07.พ.ค..08
DR037588	112-0401	180	06.พ.ค..08	07.พ.ค..08	07.พ.ค..08	07.พ.ค..08	08.พ.ค..08
DR037586	112-0401	25	06.พ.ค..08	07.พ.ค..08	08.พ.ค..08	07.พ.ค..08	08.พ.ค..08
DR012317_Y	114-5305	36	07.พ.ค..08	07.พ.ค..08	07.พ.ค..08	07.พ.ค..08	08.พ.ค..08
DR037616	112-0401	100	07.พ.ค..08	08.พ.ค..08	08.พ.ค..08	07.พ.ค..08	08.พ.ค..08
DR037602	112-0401	12	07.พ.ค..08	08.พ.ค..08	08.พ.ค..08	07.พ.ค..08	08.พ.ค..08
DR037609	112-0401	30	07.พ.ค..08	09.พ.ค..08	09.พ.ค..08	07.พ.ค..08	08.พ.ค..08
DR037617	114-5305	72	07.พ.ค..08	15.พ.ค..08	15.พ.ค..08	07.พ.ค..08	08.พ.ค..08
DR012325_Y	112-2112	80	08.พ.ค..08	08.พ.ค..08	08.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR012330_Y	112-2112	220	08.พ.ค..08	08.พ.ค..08	08.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037639	112-2112	100	08.พ.ค..08	09.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037638	112-0102	100	08.พ.ค..08	09.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037638	112-2112	20	08.พ.ค..08	09.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037634	112-0102	60	08.พ.ค..08	09.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037634	112-0401	20	08.พ.ค..08	09.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037634	112-2112	250	08.พ.ค..08	09.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037653	112-0102	90	08.พ.ค..08	08.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037653	112-0401	48	08.พ.ค..08	08.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037650	112-0102	20	08.พ.ค..08	09.พ.ค..08	09.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037646	112-2110	50	08.พ.ค..08	11.พ.ค..08	11.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037598	112-0401	226	08.พ.ค..08	11.พ.ค..08	11.พ.ค..08	08.พ.ค..08	09.พ.ค..08
DR037647	112-0102	300	08.พ.ค..08	15.พ.ค..08	14.พ.ค..08	09.พ.ค..08	10.พ.ค..08
DR037647	112-0102	150	08.พ.ค..08	15.พ.ค..08	14.พ.ค..08	09.พ.ค..08	10.พ.ค..08
DR037647	112-0401	200	08.พ.ค..08	15.พ.ค..08	14.พ.ค..08	09.พ.ค..08	10.พ.ค..08
DR037649	112-0102	250	08.พ.ค..08	11.พ.ค..08	15.พ.ค..08	09.พ.ค..08	10.พ.ค..08
DR037664	112-0401	180	09.พ.ค..08	10.พ.ค..08	09.พ.ค..08	09.พ.ค..08	10.พ.ค..08
DR037664	112-0401	280	09.พ.ค..08	10.พ.ค..08	09.พ.ค..08	09.พ.ค..08	10.พ.ค..08
DR012347_Y	112-0401	20	09.พ.ค..08	09.พ.ค..08	09.พ.ค..08	09.พ.ค..08	10.พ.ค..08
DR037667	112-0401	200	09.พ.ค..08	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR037670	112-0401	180	09.พ.ค..08	11.พ.ค..08	11.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR037659	112-0401	12	09.พ.ค..08	12.พ.ค..08	12.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR037668	112-0401	9	09.พ.ค..08	13.พ.ค..08	13.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR012365_Y	112-0102	300	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR012366_Y	112-0401	300	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR012367_Y	112-0102	50	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR012367_Y	112-0401	100	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	11.พ.ค..08

Order Number	Item	Order QTY	Order Date	ABC's Promised Date	Actual Delivery Date	Estimate Delivery Date from IS	Estimate Delivery Date from IS+min 1day logistic
DR012370_Y	112-0102	10	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR012373_Y	112-0102	20	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	11.พ.ค..08
DR012374_Y	112-0401	300	10.พ.ค..08	10.พ.ค..08	10.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037689	112-0102	150	10.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037686	112-0102	12	10.พ.ค..08	13.พ.ค..08	14.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037678	112-0401	20	10.พ.ค..08	10.พ.ค..08	15.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037693	112-0102	68	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037693	112-0401	176	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037693	112-0102	100	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037693	112-0401	100	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037693	112-2411	10	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037698	112-0301	192	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037698	112-2411	48	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037696	112-0102	80	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037696	112-0102	80	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037701	112-0102	100	12.พ.ค..08	13.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037701	112-0401	100	12.พ.ค..08	13.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR012377_Y	112-0102	30	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR012377_Y	112-0301	7	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR012382_Y	112-0102	66	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR012382_Y	112-0301	12	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR012389_Y	114-6204	150	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037723	112-0102	20	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037723	112-0301	15	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037716	112-0401	130	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037699	112-0301	100	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037724	114-5904	130	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	12.พ.ค..08	13.พ.ค..08
DR037720	112-0401	30	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037718	112-0102	10	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037718	112-0401	5	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037723	112-0102	20	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037723	112-0401	20	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037723	112-0102	40	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037723	112-0301	25	12.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037703	112-0102	36	12.พ.ค..08	14.พ.ค..08	14.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037703	112-0401	12	12.พ.ค..08	14.พ.ค..08	14.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037731	112-0102	8	12.พ.ค..08	15.พ.ค..08	26.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037731	112-0301	3	12.พ.ค..08	15.พ.ค..08	26.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037752	112-0102	135	13.พ.ค..08	14.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR012391_Y	114-5904	108	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR012393_Y	114-5904	71	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037733	112-2403	599	13.พ.ค..08	14.พ.ค..08	14.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037743	112-0102	20	13.พ.ค..08	14.พ.ค..08	14.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037734	112-0102	8	13.พ.ค..08	14.พ.ค..08	14.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037749	112-0102	66	13.พ.ค..08	14.พ.ค..08	15.พ.ค..08	13.พ.ค..08	14.พ.ค..08
DR037774	114-6204	150	14.พ.ค..08	16.พ.ค..08	17.พ.ค..08	14.พ.ค..08	15.พ.ค..08
DR037774	114-6204	150	14.พ.ค..08	16.พ.ค..08	21.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR037761	114-5904	582	14.พ.ค..08	15.พ.ค..08	22.พ.ค..08	17.พ.ค..08	18.พ.ค..08
DR037773	114-5305	143	14.พ.ค..08	20.พ.ค..08	23.พ.ค..08	17.พ.ค..08	18.พ.ค..08
DR012421_Y	112-0301	50	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR012424_Y	112-0401	24	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR012428_Y	112-0301	72	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR012429_Y	112-0301	20	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR037781	114-5305	36	15.พ.ค..08	16.พ.ค..08	16.พ.ค..08	17.พ.ค..08	18.พ.ค..08
DR037778	112-2405	100	15.พ.ค..08	16.พ.ค..08	16.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR037800	112-0102	290	15.พ.ค..08	16.พ.ค..08	16.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR037798	112-0401	10	15.พ.ค..08	15.พ.ค..08	16.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR037790	112-0401	16	15.พ.ค..08	16.พ.ค..08	16.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR037792	112-0102	300	15.พ.ค..08	19.พ.ค..08	20.พ.ค..08	15.พ.ค..08	16.พ.ค..08
DR037792	112-0102	300	15.พ.ค..08	19.พ.ค..08	22.พ.ค..08	15.พ.ค..08	16.พ.ค..08

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Miss Poranee Phaspinyo was born on 26 April, 1981 in Bangkok, Thailand. She has obtained her Bachelor degree in Material Science from Chulalongkorn University. While she is working for Toyota Motor Thailand, Co., Ltd, she enrolls for Master degree in Engineering Business Management at Regional Center for Manufacturing System Engineering, Chulalongkorn University and University of Warwick.