

University of Southern Queensland
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**Production Operation System – Key Performance
Indicator**

A dissertation submitted by

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in fulfillment of the requirements of

Courses ENG4111 and ENG4112 Research Project

towards the degree of

Bachelor of Engineering (Electrical and Electronics)

Submitted: 2nd November 2006

ABSTRACT

This project seeks to increase customers' satisfaction and improve production operation system through customizing analysis tools to monitor various factor e.g. delivery time, production lead time, order lead time, order, sales and inventory.

For the last several years, businesses across the globe have been striving to adjust their processes towards a lean business model. Many companies are set to become a "Lean Enterprise". Lean operations are well-known for leading to all the results which modern enterprises are trying to obtain in today's highly competitive world – shorter lead times, improved quality, reduced cost, increased profit, improved productivity and better customer service.

The methodology used will be to evaluate current sales and operation systems and consider alternate methods to measure production operation system and customers' satisfaction. Discussions and brain-storming will be going on extensively to define and decide the requirements of the systems.

Performance metrics play an important role in guiding and shaping the company by reflecting business factors that are critical to meeting the needs of the market place they serve. In this project, simple measuring systems will be created to measure customers' satisfaction and production operations.

With the development of the measuring systems, the company's performance will be able to be measured accurately and analyzed in a shorter time; solutions and counter-measures can be performed immediately. Ultimately, it will help in increasing customers' satisfaction, reducing production time and controlling work-in-process & inventory.

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ACKNOWLEDGEMENTS

I am most pleased to acknowledge the assistance given to me by a number of people. Mr. Bob Fulcher, my supervisor, has given me his advice and suggestions at the various stages of doing this research project. Ms. Tan Siew Hoon, my superior, has given me great support and guidance in participating in this company's innovation project. Panasonic Electronic Devices, my company, who has provided me with this opportunity to do this research project.

I would also like to thank my family members, especially my husband, Amos, who has been a great help at times when I feel so discouraged juggling between work and studies.

CHUA POH LIAN

University of Southern Queensland
November 2006

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CHAPTER 1

INTRODUCTION

1.1 Outline of the project

For the last several years, businesses across the globe have been striving to adjust their processes towards a lean business model. Many companies are set to become a “Lean Enterprise”. Lean operations are well-known for leading to all the results which modern enterprises are trying to obtain in today’s highly competitive world – shorter lead times, improved quality, reduced cost, increased profit, improved productivity and better customer service. The purpose and scope of this research is detailed in 1.4 Research Objectives.

1.2 Introduction

The lean model originally evolves from the *Toyota Production System*¹ (TPS). It is based on the elimination of any non value-added processes or practices in the product or company. This popular performance improvement method helps companies to redefine entire process stream, link processes more effectively, and drives out waste, resulting in cost savings and more effective processes.

1.2.1 Lean Enterprise Using Information Technology

A lean culture adopts quantitative systems that measure progress in a non-judgmental way. Hence, the strategic use of information technology will help process innovation and performance improvement programs achieve even greater results. Enterprise information systems or enterprise resource planning (ERP) systems are common tools now used to enable the functions that will lead to the creation of a truly lean enterprise. However, systems do not create lean manufacturing environments, they only support the philosophies.

An ERP application is a management tool to support the management and operation of a manufacturing plant. The ability of ERP systems is to be able to handle large amounts of data and complex calculations and to electronically transfer or share with everyone in different and remote locations. It is convenient and transparent.

Before implementing the ERP system, the principles of lean manufacturing must be established for it to be overlaid.

A few examples of lean manufacturing concepts:

- Kanban control: A rule to determine how much to produce and when to stop and change over
- Just-in-time (JIT): A system for producing and delivering the right items at the right time in the right amounts.
- Production smoothing: The creation of the ‘level schedule’ by sequencing orders in a repetitive pattern and smoothing the day-to-day variations in total orders to correspond to longer-term demand.

Any manufacturer who needs to increase productivity, reduce operating costs, improve quality and shorten lead times will consider these lean software applications. That is why there is a surge of ERP vendors.

ERP vendors usually provide advisory and consulting services to help companies with their information strategy, alignment, planning, evaluation and systems implementation. They will understand and communicate with the need to change, identify strategic, operational and tactical issues that hinder achievements and develop sustainable results-generating solutions for them through implementing lean systems.

1.2.2 Performance Measurement System

Performance measurement is one of the ERP systems to measure the performance of the company. Performance metrics play an important role in guiding and shaping the company by reflecting business factors that are critical to meeting the needs of the marketplace they serve. There are a few elements that the selection and maintenance of the metrics depends on: First, the matching of measurements with business strategy. Second, the balancing of product, process and financial measurements. Third, creating metrics that relate and correspond to every level of the organization.

After defining these performance metrics, measurements are prominently displayed in the work areas in the form of boards, charts or graphs. Common display formats are: Inventory levels, Production rate and Customer service.

At different levels of the work place in the company, these measurements are viewed in different formats. Typical formats are shown in the table below:

	Top level; Management	Middle level; Operation/Functional	Ground level; Production/Workshop
Frequency	Monthly	Weekly	Daily
Detail	Summary	Detailed	Focused
Visibility	Distribution	Published	Posted

Table 1.1

Respective in-charges will be responsible for the generation, validity and accuracy of the performance measurements.

The key to any performing measurement system is the ability to monitor and shape behaviour. Linking measurements to the corporate vision provides a company roadmap that everyone can understand and follow. A successful development of performance metrics meets the needs of finance, customers'

requirements, business strategy and, innovation and learning factors, at all levels. Metrics address the questions, “where are we going?”, “how will we change to meet our business need?”, “what are our critical success factors?”, “what is our target performance?”, and “where is performance improvement required?”

If there are no measurements, there will be no improvements; if the measurements are inaccurate, the result or behaviour will be incorrect.

1.3 Towards a Lean Enterprise

Panasonic Electronic Devices Pte Ltd manufactures electronic components, e.g. resistors, capacitors, etc, since 1977. It responds to the expectation from global customers, with the flexible supply capacity of high quality components with competitive cost. Over the past 29 years, there has been an evolution of competing philosophies about how to run manufacturing operations. Like many other companies, Panasonic Electronic Devices constantly keeps a look out and employs effective and useful philosophies in improving management and operation. With this, it formulates an *innovation cycle*² that promotes continuous improvement through enterprise system using information technology (IT).

In-house workshop and training began company-wide understanding of lean principles, generating an awareness of lean concepts and provide employees with the tools they need. Some *lean concepts*³ are:

- 5S & 7 Wastes
- Time Study & Motion Mind
- Line Balancing Analysis
- Just In Time (JIT)
- Total Preventive Maintenance (TPM)

¹See Appendix B

²See Glossary on the explanation of the lean concepts

Quick Model Changeover

- Streamline & Process Analysis
- Toyota Production System
- Material & Information Flowcharts
- Inventory Reduction

Since September 2004, a structure is designed to support the change, to identify and prioritize opportunities for improvement. Value Stream Mapping is used to analyze existing processes and identify improvement. Thus, a *roadmap*⁴ is created for the company's lean journey.

1.3.1 Key Performance Indicators

In the 'Production Monitoring System' as shown in the roadmap, key performance indicators are performance metrics measured and displayed in graphical formats. They are:

- a) Delivery-on-Time (DOT)
- b) Production Lead Time
- c) Order Lead Time
- d) Planned vs. Actual Production
- e) Sales vs. Capacity
- f) Work-in-process (WIP) & Inventory

More details on the indicators will be covered in the next chapter.

³See Appendix C

1.4 Research Objectives

This research comprised of the following:

- a) Background information relating to production operation performance and customers' satisfaction
- b) Evaluation of current systems in use for measuring the performance of production operation and customers' satisfaction.
- c) Identification of significant problems with current system and consideration of alternate methods to measure production operation systems and customers' satisfaction.
- d) Design of new tools for performance indicators to analyze production systems.
- e) Proposal for improvements to an existing system
- f) Cost benefit analysis of the suggested improvements and new indicators
- g) Data collection for new implementations

The aim of the research is to increase customers' satisfaction and improve production operation system through customizing analysis tools to monitor various performance metrics e.g. delivery time, production lead time, order lead time, order, sales and inventory.

The research methodology is divided into six subparts. Each subpart will define individual metric and present the different types of data required for the measurement of the metric. Data relationships and logic will be shown and explained to determine the formula of the measurement.

Data manipulating tools will be created to generate charts and tables for easy understanding and analysis.

1.5 Conclusions: Chapter 1

This dissertation aims to introduce the modern production operation performance metrics and the methods or formulations to measure the metrics.

The research is expected to result in improved or new data analysis tools to manipulate the abundant of data so as to generate useful charts and graphs for easy data analysis.

A review of the literature for this research will provide the background information of the model production operation system and customer's satisfaction.

Research design and methodology will identify the purpose of the metrics and the different types of data required for the measurement. Appropriate tools may be devised for data manipulation purpose.

The outcome of the research will be used in the analysis of the production operation so as to understand current conditions and promote continuous improvement towards a lean enterprise.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Referring to the research objectives stated in section 1.4, this literature review will provide a comprehensive information of why it is important for today's organization to be lean and how Panasonic Electronic Devices works towards lean operations and manufacturing. An evaluation of performance measurement systems used in Panasonic Electronic Devices will be conducted and significant problems will be identified. New and alternative methods will be proposed and discussed.

2.2 Importance of Lean Operation

For the past several years, businesses across the globe have been striving to adjust their processes towards a lean business model. Lean operations really equate to all the results which modern enterprises are trying to obtain in today's highly competitive world – shorter lead times, improved quality, reduced cost, increased profit, improved productivity and better customer service. But becoming lean is not a short or easy journey. The following four points will give a good explanation of the importance of Lean Operation.

2.2.1 What is Lean? Why Lean?

Lean is about eliminating waste. It may sound simple but is never easy to achieve.

A statesman once said, "I can't define it, but I know it when I see it." This is very true if you see how Olympic athletes make their actions look simple only after so many years of practice, focused on a single goal; the elimination of wasteful motion.

Anyone standing at the counter of a fast food restaurant has witnessed Lean Manufacturing. Demands begin at the cash register where upon entry of order,

an electronic signal is passed to the kitchen and production begins. There you find the flexible cell design where all materials are stored at the point of use in an appropriate sequence. Trained workers assemble each item using standardized work procedures and production flows according to a standard rhythm. Production probably ends when the burger is ready to be served to the customer but customer satisfaction will depend on how fast the server hands the finished goods to the customer. So this is an example of a lean manufacturing.

2.2.2 Elimination of Waste

What is waste? It is defined, as anything customers would not be willing to pay for. So, we need to identify them and get rid of them so as to ensure our customers that they are not paying for waste. During the development of the Toyota Production System, Taiichi Ohno and Dr. Shigeo Shingo identified seven distinct forms of waste:

- a) Inventory. Traditional accountants define inventory as an asset, Lean accountants consider it a liability. Excess inventory ties up cash and creates waste in many forms including storage facilities, tracking, transactions, movement, damage, and physical counting and adjustment records.
- b) Delay. It is understood as the unnecessary wait time that occurs throughout the production process. Unnecessary wait time may be caused by improper scheduling, causing people, tools and materials not to appear in the right place at the right time. Any kinds of delays will affect the delivery of goods.
- c) Motion. Unnecessary human motion – the ergonomics of walking, bending, reaching, twisting, lifting, and handling, requiring two hands instead of one – not only wastes effort, but may also cause health and safety issues. In addition to human motion, this form of waste also includes unnecessary

machine motion, which causes additional maintenance, energy cost, and machine wear and tear, leading to quality problems.

- d) Transportation. Unnecessary movement of materials, supplies and resources is waste. Whenever practical, materials should be received in the appropriate quantities at the point of use.

- e) Overproduction. This waste is produced when production makes more or faster than the customer demands. This is usually caused by improper demand planning, long setup times, large lot sizes or quality rejects. Overproduction leads to consumption of extra resources, people, machines, inventory, storage space, energy and cash tied up in these assets. Producing earlier than necessary creates excess inventory and consumes material and capacity that may be required by higher-priority work.

- f) Over-processing. It is caused by performing unnecessary work due to wrong or poorly maintained tools, improper work instructions and inadequate training. Improperly designed information systems can cause over-processing in the form of unnecessary transactions. When a process is simplified, it requires less data to monitor and control. Effort to capture production data that does not add value is wasted processing and motion. When this information is recorded by hand and entered into a computer, the waste is doubled. The time spent storing, managing, printing, distributing and analyzing unnecessary information only adds to this waste.

- g) Defects. This is the cost of poor quality that may result from faulty product design, insufficient training, lack of standardized work methods and instructions, improper tooling, unnecessary inspection and quality countermeasures, and excess processing caused by repair and rework. Defects waste includes interrupted schedules, missed due dates, uneven production flow, inspection to catch defects, and unnecessary setup and runtime caused by unscheduled repair and rework.

These seven forms of waste serve as a set of guidelines to determine the performance metrics and analyze the performance of the production operation system in this research.

2.2.3 The System Innovation Technology

Since 2002, Panasonic Electronic Devices, triggered by a 10% decrease in profit, had adopted an innovation plan towards a lean manufacturing and operation. With the aim of increasing profit and sales, a thorough study with understanding of customer request and production constraints was being carried out. Production system was being evaluated and improved to ensure it achieved the best productivity and throughput.

The procedures in achieving the action plan:

- a) By using order analysis tool, produce and understand the characteristic of order.
- b) By comparing to production status, understand the gap between demand and production.
- c) Determine the inventory stock point and production orders that satisfy the customer demand and cost performance.
- d) Consider the order quantity, order lead-time and machine changeability, utilize standard lot calculation tool to fix the lot size and standard inventory quantity by part number.
- e) Maximize production performance by using the model simulation; develop the way to make the production plan based on the bottleneck process capacity.

- f) Fix the evaluated parameter and evaluate the result; if it is not sufficient then improve again.

The action plan was presented in Figure 2.1.

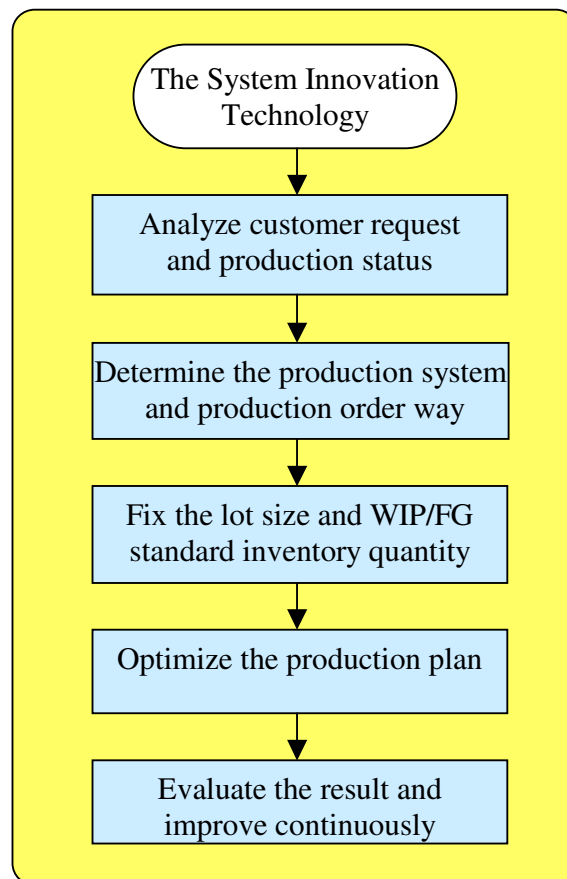


Figure 2.1

2.2.4 Present vs. Future

As business expands, business strategy has evolved from the 'push' method to the 'pull' method, suggested in Figure 2.2, such that a factory should become a manufacturing-cum-sales centre instead of just a manufacturing centre. This means that factory should not concentrate only on the production but also need to understand the sales condition so as to produce according to the market demand.

It used to be factory promoting the product to the customers and attending to them whenever they have enquiries. However, today's customers want to select the product themselves and look for the answer to their enquiries via the web, integrated network or vendor-managed inventory.

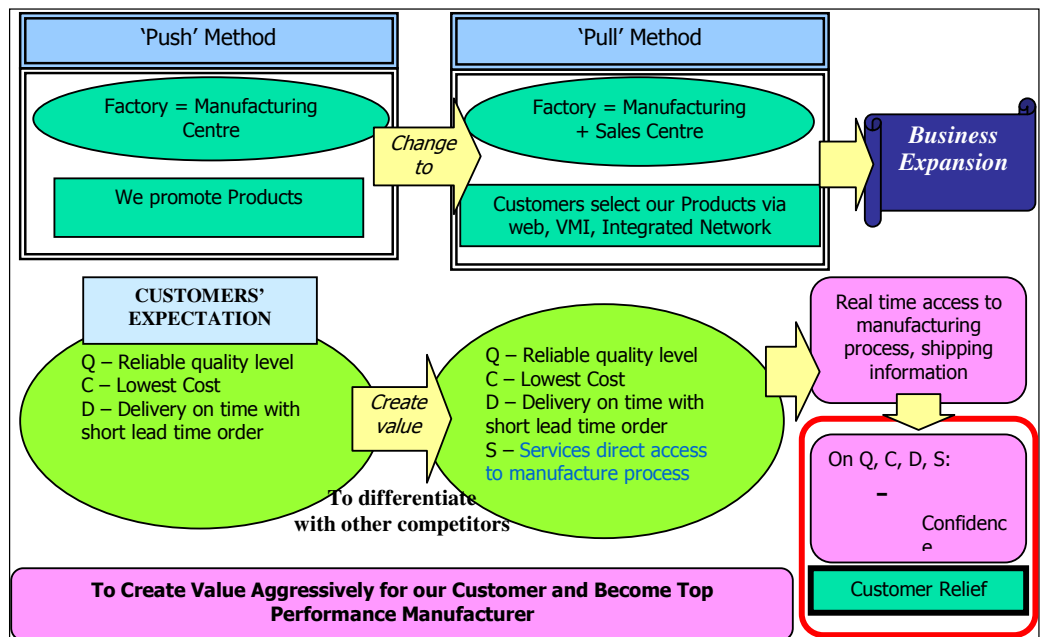


Figure 2.2

There is also a change in customer's expectation, which does not remain only at reliable quality, lowest product cost and delivery-on-time with short lead-time. In order to be different from other companies and stay competitive in the market, it is important to provide customers with a kind of relief and satisfaction. Direct and real-time access to the manufacturing process and information allows customers to understand where their orders have been processed and give them a sense of security and satisfaction.

An example of good customer service is DHL's online tracking system. Customer can track the location of their parcels or shipments through the web by using some assigned reference number.

2.3 Evaluation of Current System

In this section, we will study the then Sales and Operation system, Figure 2.3.

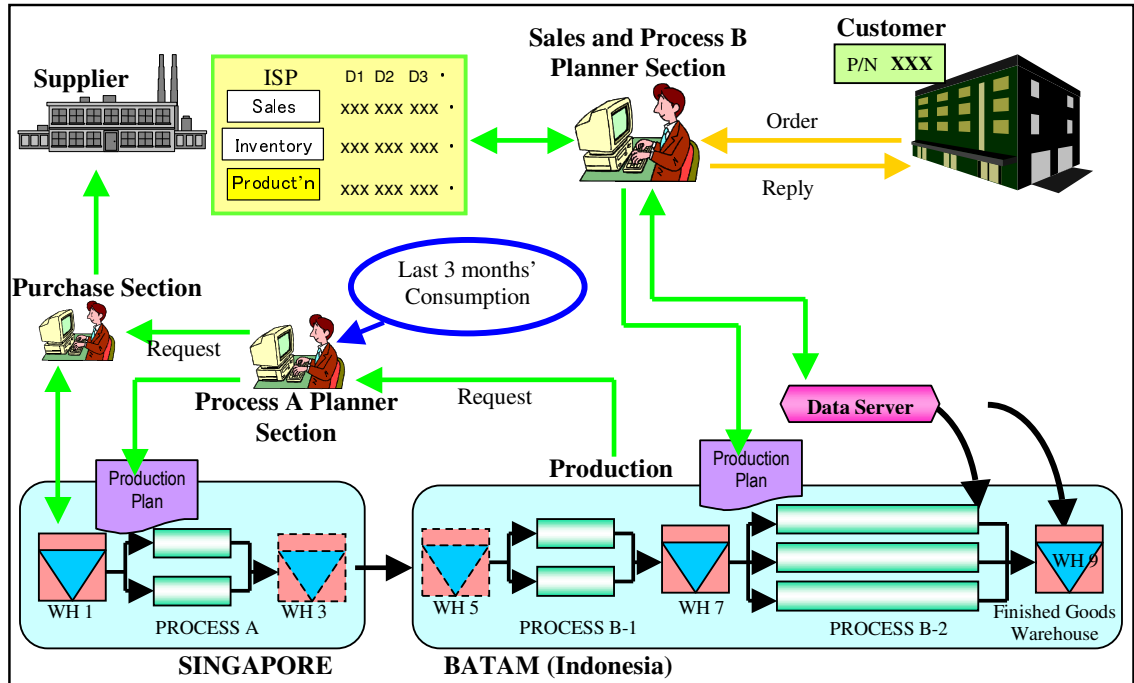


Figure 2.3

In this system, it consists of the Sales section, Planner section, Purchasing section, Supplier and the Production section. Due to the twin operations, Process A and Process B, in Singapore and Batam respectively, there will be two planners and two production in-charges.

Taking for example when a customer called to enquire an order:

2.3.1 Order Request and Order Reply

The Sales Representative will check the data server to see if there is stock in Warehouse 9. If there is stock in the warehouse, he will reply to the customer that the order can be delivered as per request. If there is no available stock in the warehouse, he will check with another planner or production in-charge if there is any in-process stock in the production line. After receiving information from them, he can then reply to the customer the estimated delivery date. Some

negotiations will go on if the customer cannot wait for a later delivery date. Because customer is always right, we will always accept urgent orders by disrupting the existing production.

2.3.2 Order Confirm

Once the order is confirmed, the Sales Representative will issue a production plan to the production in-charge in Batam (Indonesia). The Process B production in-charge will prepare for the production. If there is a lack of material for production at Warehouse 5, he will request material from the Process A planner to send to Batam. Process A planner will either arrange for shipment of material to send to Batam or plan for Process A production. If there is not enough material for Process A production, he will request material from the Purchaser who will get it from the Supplier. On normal days, he will purchase the type and quantity of material base on the past three months' consumption.

2.3.3 Order Ready

After the production for the order has been completed, the product will be stocked into Warehouse 9 where the production lead-time stops. Once the product reaches Warehouse 9, the shipping in-charge will arrange for the product to be sent to the customer as soon as possible. Most of the time, the customer will receive their goods as per their request.

2.4 Identification of Significant Problems

After evaluating the current system, some problems are being identified. These problems are mainly root causes for late delivery and poor customers' satisfaction.

2.4.1 Delay Response of Delivery

Customers are annoyed to be kept waiting for delivery date enquiry. The Sales Representative is not able to give an immediate reply to the customers because he has to ask a few more persons in order to know the answer. Sometimes, he also has to wait for their replies.

This problem lies with the 'data server' that does not contain the whole production's datum. The current data server only contains data for the last process and Warehouse 9. The Sales Representative is only able to check if there is extra stock in the warehouse and depends on other sections' members to help check in-process stock, hence the delay in replying to the customer on the delivery date.

2.4.2 No Safety Stock Inventory

Having goods delivered on time is not enough to satisfy customers' expectation. Because of the constant-changing market, there is an increase trend of urgent product request. When customers place urgent request, which is called 'short lean-time' order, we must make sure that we have the products for them because we value them and we want to provide a better customer service than our competitors. If we cannot fulfill short lead-time orders, we will lose our customers gradually. Hence, we have to keep a certain amount and type of products in the warehouse.

2.4.3 Lack of Material for Production

In this current system, there are cases whereby there is not enough material to run production at both production locations. There is always a breakdown in communications between the production and planning section. Or perhaps nobody dares to bear the responsibility if materials were bought but no order coming in to use them. Very often, materials are purchased or prepared upon requests from respective sections. This tends to delay the whole process of making the product, which is called the production lead-time.

The problem lies in no sharing of Inventory, Sales and Production data.

2.4.4 No Linking of Inventory, Sales and Production data

Individual section is operating according to its function and procedures. There is no common understanding among them. The purchaser only purchases the material when there is request from the planner. The planner only plans when there is an order request from the Sales Representative. The production will run production when the planner issues the planning sheet. Every section acts upon a request which is time consuming and unproductive. Unnecessary waiting time is a kind of waste that must be eliminated.

2.4.5 No Key Performance Indicator

There is no performance measurement system in the then Sales and Operation System. Measurement system is important to gauge the progress and determine how well or how bad the company is doing. Without this kind of measurement system, we would not be able to know what problems we are facing and how to improve on the problems. However, measurement systems may be different at different sections and places; every measuring system is unique.

After evaluating the then Sales and Operation System and identifying the embedded problems, Figure 2.4, we formed a project team and planned a schedule to rectify the problems and improve the Sales and Operation System. The improvements will be detailed in the next section.

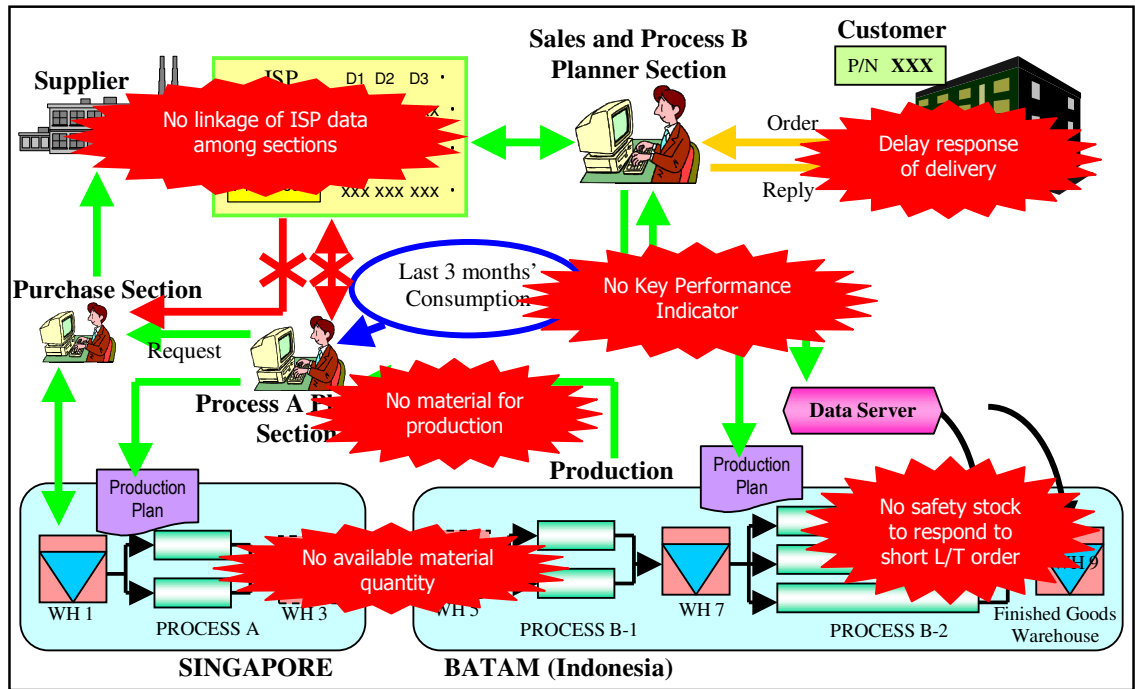


Figure 2.4

2.5 Considerations of System Improvement

First thing first, in order to response to customers quickly, we need to expand our data server to all the processes so that we can access to all warehouses located at both locations.

2.5.1 Expansion of Data Server

In order to improve on the system that is the software side, some improvements have to be done on the hardware side first.

The hardware side basically consists of:

- a) The machines that are used for the production
- b) The machine number structure
- c) The process number structure
- d) The material part number structure
- e) The product part number structure
- f) The customer database and number structure
- g) The warehouses
- h) The computers required for bar-code scanning
- i) The transfer sheet printing tool (for issuing of planning sheets)

After getting ready the physical hardware side, team members from the Information Security Department (ISD) will help to set up two data server, Data Server A and Data Server B, in our company's intranet for data sharing purpose. With assigned IP address, authorized members will be able to log into the database to look for information. ISD member will create a window interface for users to input information to the server or search for data entry.

A new job flow is devised in individual sections for correct data entry purpose. Starting from the planner, where planning sheet is issued. The production upon receiving the planning sheet will 'draw' materials from the warehouse, which is

called 'stock-out'. The materials are then send to the first process. At every process, operators must scan the information before starting the production. Information details include the material number, the quantity, the machine used, the end-product part number and the customer number.

At every warehouse where materials or products are being kept, information must also be keyed into the system, which is called 'stock-in'. When the end product is being stock-out to be delivered to customer, the system will be able to remove the available quantity from the system. The system will also have many records of how long, starting from the first process, it takes to complete the production or at every process.

The data servers are ready for use after much testing and improvements, which took about a year. One of the most important factors is the security and accuracy of the data.

2.5.2 Inventory, Sales and Production (ISP) Data Sharing

After setting up the data servers, the next thing to do is to share the Inventory, Sales and Production data among the Purchasing section, Planner section and Production section. With the sharing of this data, respective team players will have a better understanding on the actual condition of the market situation and be able to make advance necessary planning to countermeasure and get ready for future situation.

The Sales Representative will generate the latest data in the server and the other sections' members will be able to retrieve them from the server with their authorized identification.

2.5.3 Material Order System

Old system employs the 'Push' method in purchasing the material because they use the past records or consumptions quantity as guidelines. Towards a lean enterprise, we need to adopt the 'Pull' method that is to purchase only when needed, but, and will not result time waste. Taking future ISP data and making necessary analysis can do this.

The material order system will be able to calculate the quantity and type of material needed for the next one month. The purchaser will use this material order system.

2.5.4 Key Performance Indicator System

After implementing the necessary improvements, we need to evaluate the new implementations to achieve better results and promote continuous improvements. Measuring system is required to capture the result for evaluation and tells when it must take corrective action. As mentioned earlier, every measurement system is unique. The design of the systems must be decided by the Sales and Operation team members as no one will know best what sort of measurement systems are needed.

In the production and operation field, one of the key factors to measure is 'delivery-on-time' indicator that measures how satisfied the customers are. There are also some other factors to consider e.g. the production lead-time, the sales versus capacity condition, etc, which will be covered in the next section.

2.6 Key Performance Indicators

After some discussions with the team members, some measuring indicators have been decided upon. Some are existing indicators that need to be improved whereas some are new measuring indicators that have to be devised. These measuring indicators are required mainly for monthly reports, market understanding and problem catching purposes.

2.6.1 Delivery-on-Time

Delivery-On-Time measures the percentage of orders that are delivered to the customers on time and is categorized under two groups, i.e. DOT by request or DOT by reply. The former calculates based on the date the customer expects to receive the goods and the latter calculates based on the date the company commits to deliver the goods to the customer.

This is an important metric because it is a gauge for customers' satisfaction. The higher the DOT, the greater the customers' satisfaction. In a competitive world like today, prompt delivery is very important for a smooth function. Any delay may result in heavy penalties, e.g. monetary compensation and bad reputation. The three main causes for late deliveries are usually due to production, logistic and order lead time.

2.6.2 Production Lead-Time

Production lead time is the time taken for the product to undergo the first process to the last process in a production line. Usually all products have a fixed production lead time which helps to forecast the possible delivery date when customers enquire. For example, Product A takes 4 days, Product B takes 6 days, etc.

Long production time may be due to:

- Old and faulty machines which require frequent repair job during production
- Long changeover time when changing model or changing lot
- Slow handling time by operators, shortage of manpower or lack of material
- Poor production planning

Production, due to any of the above, may take as long as 30 days to complete and thus affects the DOT metric.

2.6.3 Order Lead-Time

Order lead time counts the days starting from the day the order is being confirmed to the day the order is being sent to the customer.

For example, there is an order for Product A (five days production lead time) which is confirmed today and the request date to deliver the goods is tomorrow, in the case whereby there is no safety stock in the warehouse, it will be considered a delay due to order lead time. This is because by the time Product A is being produced and delivered, it would be five days after the order is being confirmed which is four days late based on the request date to deliver. Order lead time may be presented in terms of the number of orders or number of product quantity. Short order lead time is a cause for poor DOT.

2.6.4 Plan versus Actual Production

This metric shows how much daily production has been achieved and those productions which are unable to be carried out as plan.

Production planning is done everyday by the planner for the next day based on the number of machines available and their capacity to produce. However, there are chances that production might not be able to be carried out smoothly as per planned due to 'unforeseen circumstances'. Machine may break down, operators

may be on sick leave, unexpected incidents may happen, hence actual production differs from the planned production.

If there is a frequent dis-match between the planned and actual, then more in-depth studies must be made to understand why it happens.

2.6.5 Sales versus Capacity

‘Sales’ means orders from the customers and ‘capacity’ means machine’s ability to run production.

One of the reasons to compare these two factors is to give an accurate delivery reply to the customers. Machine capacities for different processes in a production line are different. Hence, in order to determine the delivery time of the order, the guideline is to base on the process that has the lowest capacity, i.e. the process that takes the longest time to complete.

The second reason is to compare the total production condition against the market demand. If the market is beaming with huge orders in the next few months, then there may be a consideration to either increase machine capacity or machine quantity to prepare for the huge order.

2.6.6 Work-In-Process & Inventory

WIP metric shows the quantity of products that is still in the production line waiting to be processed whereas inventory metric shows the stock available in the warehouse. These two metrics are important in today's production guideline because they are related to producing a lean function. Inventory should be kept at a safety level so that if there is a big order or short lead-time, delivery is still possible. This safety level is such that it tallies with the actual demand. Conventional systems used to make their machine capacity as one of the performance indicator, the higher the better. Hence producing too many unwanted goods that nobody knows if anyone wants, thus incurring a big amount of frozen asset.

2.7 Conclusions: Chapter 2

The literature review has given the background information of modern production operation system and customer satisfaction. Through the evaluation of the system, problems have been identified and new improvements and ideas are being proposed and implemented. The next chapter will detail the methodology of creating the various key performance indicators tools and the improvements on existing methods. Step-by-step procedures in using the tools will be shown and discussed.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The methodology employed is to review and destroy the current job flow and to make a logically job flow and eliminate waste from the job. In order to develop the measuring systems successfully, the following areas are covered:

- a) Study and analyse the business needs in measureable goals
- b) Review of the current system
- c) Conceptual design of the operation of the new system
- d) Equipment requirements
- e) Financial analysis of the costs and benefits including budget
- f) Forms a project team including programmers, users, and support personnels

In all systems developement, data modelling is required to structure or oragnise the large quantities of raw data. This process helps to categorise the data, group them and show the relationship between them.

For different performance metrics, different data fields are reuqired, different data structures are designed to describe the flow and the relationship of the data. Existing systems have been revised and proposed with new operation flows to enhance their features. **However, due to confidentiality reason, the source code and product part structures and details cannot be included in this dissertation.** Only some extractions will be used for explanation.

3.2 Delivery-on-Time (DOT)

As explained in section 2.6.1, DOT is a measurement of customers' satisfaction by determining orders that are being delivered to the customer on time. For those that are not being able to deliver on time, they are caused by 3 possible reasons, mainly:

- a) Production Delay
- b) Short Order Lead-Time
- c) Logistic Delay

For example, out of 100 orders, 65 orders reached the customers on time (based on the date requested by customers). DOT = 65%.

Out of the 35 orders that did not reach the customers on time based on request date,

- 20 orders could not be delivered on time even based on reply date;
- 10 orders were (less than 5 days lead-time) requested by customers urgently;
- 5 orders were delivered on time based on reply date.

This means that 20% was due to Production Delay, 10% was due to Short lead-time and 5% was due to Logistic Delay.

With the concept given, the next step is to select the data field required for the function followed by creating the data structure for the tool to work on.

3.2.1 Data Structure

For Delivery-On-time (DOT) measurement, the following data fields are required:

- a) Item Group
- b) Item Type
- c) Part Number
- d) Customer Code
- e) Quantity
- f) Order Lead-time

- g) Order Invoice Number
- h) Request Date
- i) Acceptance Date
- j) Warehouse In Date
- k) Reply Date

As DOT is calculated based on Request Date and Reply Date, two data tables are required. With some selections using *Tool A Interface*¹, these data tables can be downloaded from the Data Server A in text-file format saved as the file name ‘XNPSS771SIREQ010806_310806’ and ‘XNPSS771SIRLY010806_310806’, Figure 3.1. With a common understanding, the filename always indicates whether it is by request date or by reply date, and the period of data included. For example, in Figure 3.1, the filename (‘REQ’) suggests it is by request date and (‘010806_310806’) suggests it is for the period of August 2006.

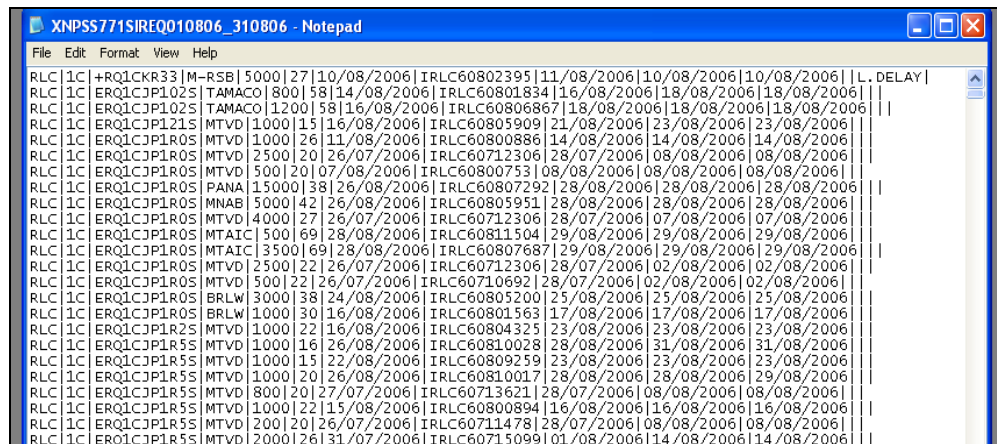


Figure 3.1

Likewise in Figure 3.2, the filename suggests it is by reply date for the period of August 2006.

¹See Glossary on Tool A Interface

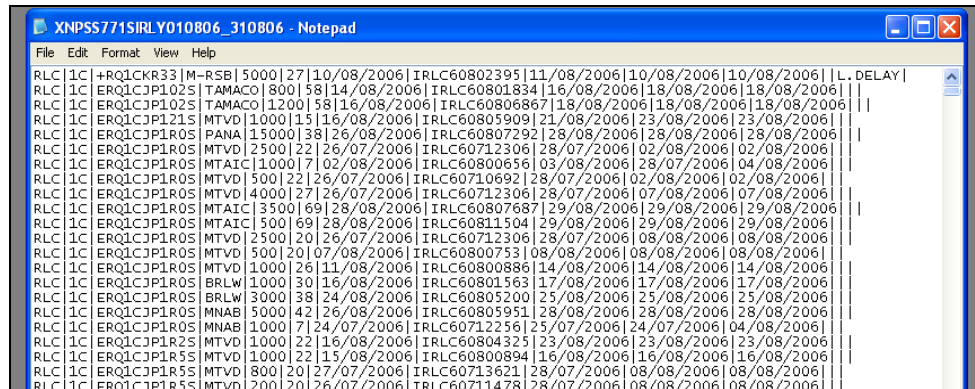


Figure 3.2

This text-file data will then be transferred to the tables in the Microsoft Access Database using the functions created. Always download the text-file DOT data from the server before using the Microsoft Access Database.

3.2.2 User Interface

Microsoft Access Database serves as a user interface to transfer datum into the tables, manipulate the large volume of raw data and conveniently present the results in graphical or table format. Visual Basic Application is used to program the tool.

First, there is a main menu as shown in Figure 3.3:

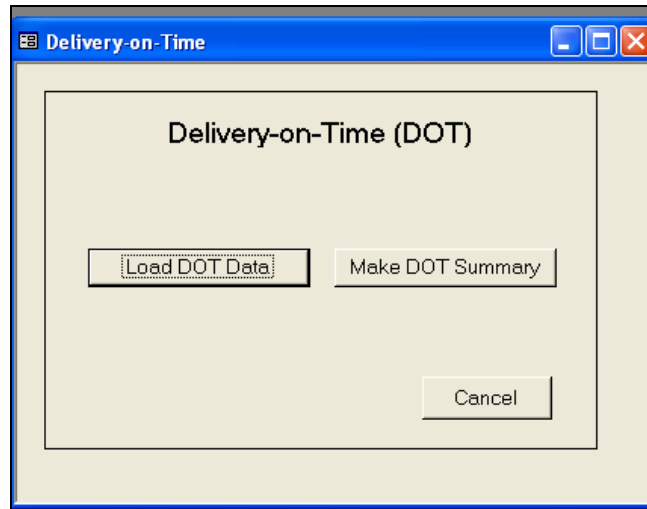


Figure 3.3

When the 'Load DOT Data' button is pushed, input the year and month of the data which is required as shown in Figure 3.4:

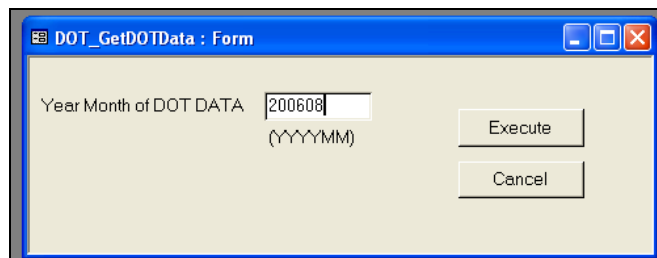


Figure 3.4

For example, to transfer the year 2006 August data into the Microsoft Access Database, input '200608' and push 'Execute' button. Click 'Yes' to confirm execution of reading by request date data, Figure 3.5.

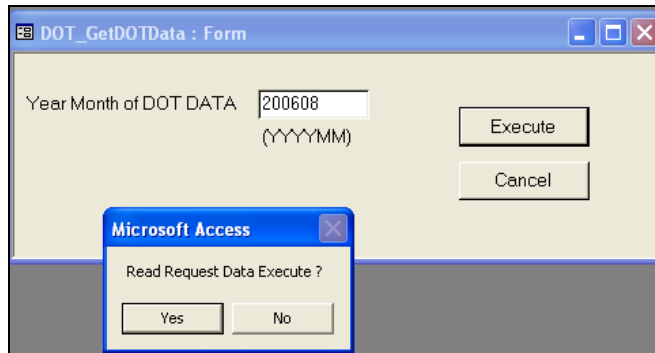


Figure 3.5

A window will be opened to allow user to select the required period's text file data, Figure 3.6. Click 'Open' to start transferring.

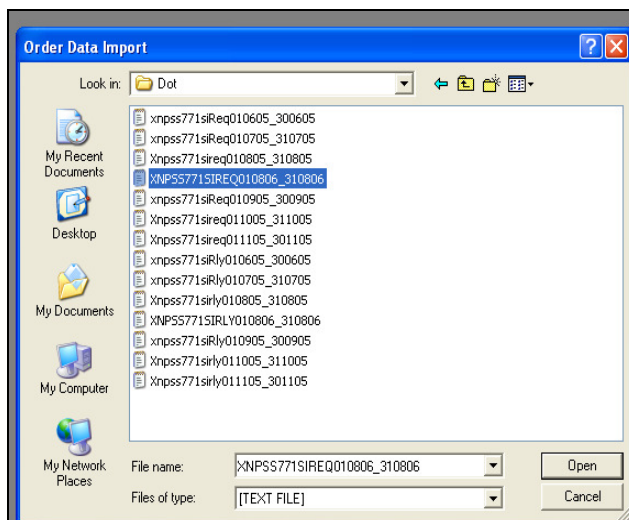


Figure 3.6

Data from the text file will be copied and inputted cell-by-cell into the table. After transferring the data by request, repeat the steps for transferring of the data by reply date, Figure 3.7 and Figure 3.8.

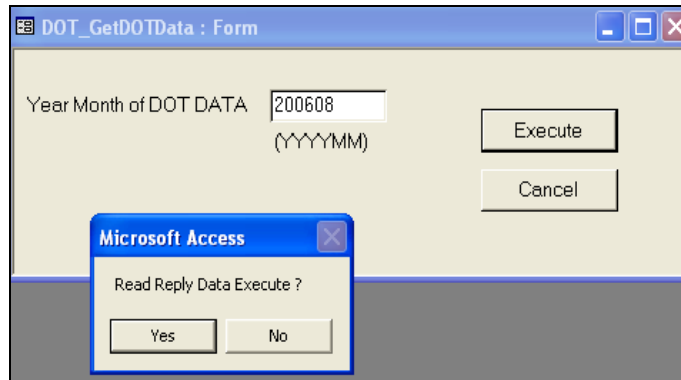


Figure 3.7

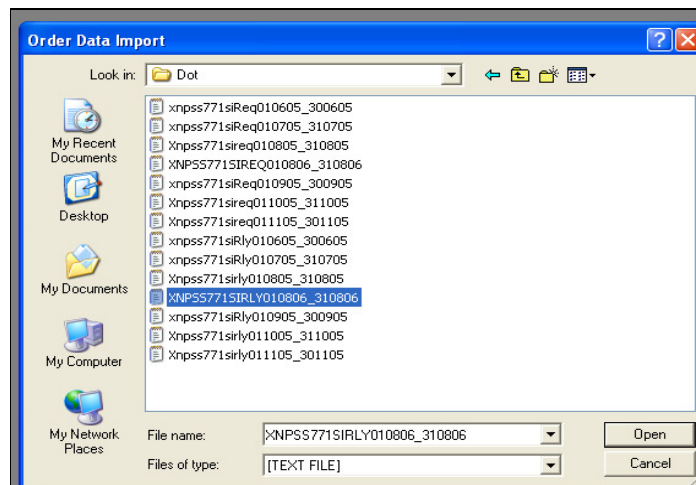


Figure 3.8

When the transferring of data has been completed as shown in Figure 3.9, click 'OK' and 'Cancel' to exit to the Main Menu.

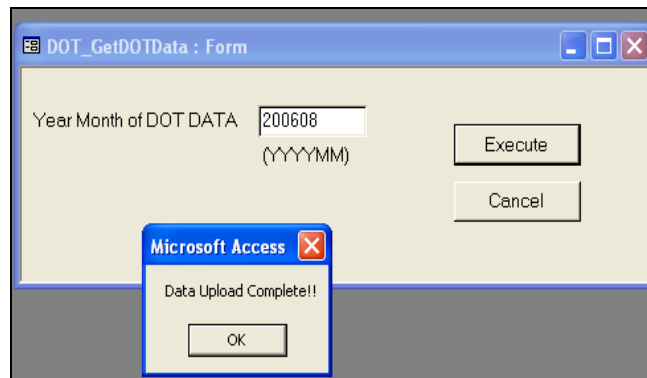


Figure 3.9

From the ‘Objects’ under the ‘Tables’, check for the two tables have been created as shown in Figure 3.10.

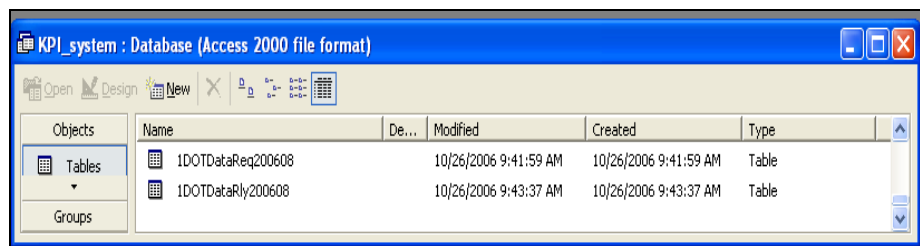


Figure 3.10

The names of the new tables are created based on ‘REQ’ or ‘RLY’ and the inputted ‘YYYYMM’ as confirmed during the previous process.

For data calculation, on the Main Menu, click ‘Make DOT Summary’ button. A window as shown in Figure 3.11 will be opened.

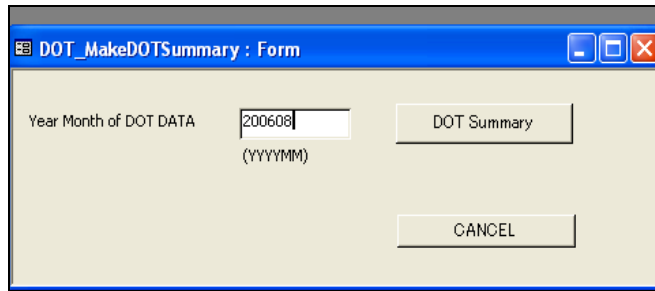


Figure 3.11

Likewise, input the year and date of the data to be calculated e.g. '200608'. Based on the input year and date, the program will use the particular table saved in the database for calculation.

Click 'DOT Summary' and 'Yes' to confirm data calculation, Figure 3.12.

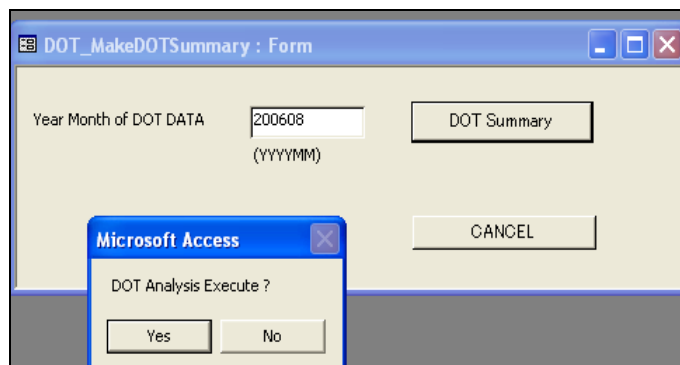


Figure 3.12

The results will be generated in table format as shown in Figure 3.13.

1DOTDetailSummary

Group	ITEM	CONTENTS	CNT	QTY	CNT_Ratio	QTY_Ratio
REQUEST	2S	TTL	5915	32628489	100.0%	100.0%
REQUEST	2S	OK	3901	19644700	66.0%	60.2%
REQUEST	2S	SL/T	549	4294589	9.3%	13.2%
REQUEST	2S	LDELAY	326	1451600	5.5%	4.4%
REQUEST	2S	PDELAY	1139	7237600	19.3%	22.2%
REQUEST	2S	OTHERS	0	0	0.0%	0.0%
REQUEST	1AN	TTL	72	715500	100.0%	100.0%

DOT NG REPLY : Select Query

GRAND ITEM	ITEM TYPE	PartNO	CUSTOMER	ORDER QTY	ORDER L/T	INVOICE CODE	WH5 AVAILABLE DATE	ACCEP
RLN	2D	+RG2DJ20	M-RSB	8600	42	IRLN60808091	2006/08/24	2006/08
RLN	2D	+RG2DJ20	M-RSB	500	42	IRLN60808336	2006/08/24	2006/08
RLN	2D	+RG2DJ22	M-RSB	1100	27	IRLN60804675	2006/08/12	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	1000	18	IRLN60810232	2006/08/24	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	1000	28	IRLN60801792	2006/08/07	2006/08
RLN	2D	ERG2DJ18	MME	14000	20	IRLN60901608	2006/09/05	2007/10

DOT NG REQUEST : Select Query

GRAND ITEM	ITEM TYPE	PartNO	CUSTOMER	ORDER QTY	ORDER L/T	INVOICE CODE	WH5 AVAILABLE DATE	ACCEP
RLN	2D	+RG2DJ15	M-RSB	2000	15	IRLN60812956	2006/08/30	2006/08
RLN	2D	+RG2DJ20	M-RSB	8600	42	IRLN60808091	2006/08/24	2006/08
RLN	2D	+RG2DJ20	M-RSB	500	42	IRLN60808336	2006/08/24	2006/08
RLN	2D	+RG2DJ22	M-RSB	1100	27	IRLN60804675	2006/08/12	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	1000	28	IRLN60801792	2006/08/07	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	1000	18	IRLN60810232	2006/08/24	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	3000	7	IRLN60813422	2006/08/30	2006/08
RLN	2D	ERG2DJ18	MME	14000	20	IRLN60901608	2006/09/05	2007/10
RLN	2D	ERG2DJ18	MME	2000	14	IRLN60803986	2006/08/10	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	1000	14	IRLN60809717	2006/08/23	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	12000	6	IRLN60809716	2006/08/23	2006/08
RLN	2D	ERG2DJ18	HKCM/MUF	5000	14	IRLN60804248	2006/08/10	2006/08

Record: 9 of 1163

Figure 3.13

3.2.3 Result Generation

3 tables are generated.

a) Overall DOT summary table, Figure 3.14.

Group	CONTENTS	CNT	CNT_Ratio
REQUEST	TTL	5915	100.0%
REQUEST	OK	3901	66.0%
REQUEST	S.L/T	549	9.3%
REQUEST	L.DELAY	326	5.5%
REQUEST	P.DELAY	1139	19.3%
REQUEST	OTHERS	0	0.0%
REQUEST	TTL	72	100.0%
REQUEST	OK	50	69.4%
REQUEST	S.L/T	10	13.9%
REQUEST	L.DELAY	1	1.4%
REQUEST	P.DELAY	11	15.3%
REQUEST	OTHERS	0	0.0%
REQUEST	TTL	51	100.0%
REQUEST	OK	35	68.6%
REQUEST	S.L/T	1	2.0%
REQUEST	L.DELAY	2	3.9%
REQUEST	P.DELAY	13	25.5%
REQUEST	OTHERS	0	0.0%
REPLY	TTL	6023	100.0%
REPLY	OK	4652	77.2%
REPLY	S.L/T	158	2.6%
REPLY	L.DELAY	299	5.0%
REPLY	P.DELAY	914	15.2%
REPLY	OTHERS	0	0.0%
REPLY	TTL	86	100.0%
REPLY	OK	78	90.7%
REPLY	S.L/T	2	2.3%
REPLY	L.DELAY	1	1.2%
REPLY	P.DELAY	5	5.8%
REPLY	OTHERS	0	0.0%
REPLY	TTL	50	100.0%
REPLY	OK	39	78.0%
REPLY	S.L/T	0	0.0%
REPLY	L.DELAY	2	4.0%
REPLY	P.DELAY	9	18.0%
REPLY	OTHERS	0	0.0%
*		0	0.0%

Record: 7 of 36

Figure 3.14

- ‘TTL’ means total number of records.
- ‘OK’ means number of records that are delivered before or on the day of request date i.e. ‘Acceptance Date’ < OR = ‘Request Date’.
- ‘S L/T’ means short lead-time i.e. the order lead-time (‘Order L/T’) is less than 5 days.
- ‘L. Delay’ means logistic delay i.e. usually due to shipping delay.
- ‘P. Delay’ means production delay i.e. the product reaches the warehouse (‘WH5 Available Date’) later than the ‘Reply Date’.

- ‘Others’ may be due to causes other than the above, which is very seldom.

Figure 3.15 and Figure 3.16 shows the data of the above explanation.

ORDER	ORDER L/T	WHS AVAILABLE DATE	ACCEPTANCE DATE	REQUEST DATE	REPLY DATE	L/T STATUS	OUT STATUS
3000	-2	2007/10/26	2007/10/26	2006/08/21	2006/09/15	S.L/T	P.DELAY
1000	-5	2007/10/26	2007/10/26	2006/08/28	2006/09/19	S.L/T	P.DELAY
7000	27	2007/10/26	2007/10/26	2006/08/31	2006/08/31		P.DELAY
1000	10	2007/10/26	2007/10/26	2006/08/28	2006/09/08		P.DELAY
4000	-1	2007/10/26	2007/10/26	2006/08/31	2006/09/22	S.L/T	P.DELAY
2000	4	2007/10/26	2007/10/26	2006/08/22	2006/09/08	S.L/T	P.DELAY
4000	-5	2007/10/26	2007/10/26	2006/08/28	2006/09/19	S.L/T	P.DELAY
16000	-5	2007/10/26	2007/10/26	2006/08/24	2006/09/12	S.L/T	P.DELAY
2000	0	2007/10/26	2007/10/26	2006/08/17	2006/09/08	S.L/T	P.DELAY
2000	4	2007/10/26	2007/10/26	2006/08/22	2006/08/25	S.L/T	P.DELAY
2000	0	2007/10/26	2007/10/26	2006/08/17	2006/09/08	S.L/T	P.DELAY
10000	15	2007/10/26	2007/10/26	2006/08/25	2006/09/08		P.DELAY
7000	25	2007/10/26	2007/10/26	2006/08/30	2006/08/30		P.DELAY
4000	20	2007/10/26	2007/10/26	2006/08/25	2006/09/15		P.DELAY
20000	13	2007/10/26	2007/10/26	2006/08/18	2006/09/15		P.DELAY

Figure 3.15

ORDER QTY	ORDER L/T	WHS AVAILABLE DATE	ACCEPTANCE DATE	REQUEST DATE	REPLY DATE	L/T STATUS	OUT STATUS
2000	42	2006/08/26	2006/08/28	2006/08/28	2006/08/28		
2200	42	2006/08/26	2006/08/28	2006/08/28	2006/08/28		
30000	0	2006/08/24	2006/08/25	2006/08/22	2006/08/25	S.L/T	
3500	40	2006/08/28	2006/08/30	2006/08/24	2006/08/24		P.DELAY
40000	1	2006/08/24	2006/08/25	2006/08/23	2006/08/25	S.L/T	
2000	31	2006/08/24	2006/08/25	2006/08/24	2006/08/24		L.DELAY
15700	38	2006/08/26	2006/08/28	2006/08/28	2006/08/28		
33400	-10	2006/08/24	2006/08/25	2006/08/08	2006/08/22	S.L/T	P.DELAY
6000	57	2006/08/24	2006/09/01	2006/08/25	2006/08/25		L.DELAY
9000	26	2006/08/29	2006/08/31	2006/08/25	2006/08/25		P.DELAY
1000	14	2006/08/24	2006/08/25	2006/08/08	2006/08/18		P.DELAY
2000	1	2006/08/24	2006/08/25	2006/07/26	2006/08/18	S.L/T	P.DELAY
1000	18	2006/08/24	2006/08/25	2006/08/16	2006/08/18		P.DELAY
10000	14	2006/08/24	2006/08/25	2006/08/16	2006/08/25		
8000	14	2006/08/24	2006/08/25	2006/08/16	2006/08/25		
13000	14	2006/08/24	2006/08/25	2006/08/16	2006/08/25		
5000	14	2006/08/24	2006/08/25	2006/08/16	2006/08/25		
2000	26	2006/08/28	2007/10/26	2006/08/25	2006/08/25		P.DELAY
2000	6	2006/08/24	2006/08/29	2006/08/03	2006/08/18		P.DELAY
2000	36	2006/08/24	2006/08/25	2006/08/24	2006/08/24		L.DELAY
1000	25	2006/08/24	2006/08/25	2006/08/16	2006/08/28		
2000	26	2006/08/24	2006/08/25	2006/08/16	2006/08/23		P.DELAY

Figure 3.16

- b) DOT ‘Not Good’ condition by request date, Figure 3.17
- c) DOT ‘Not Good’ condition by reply date, Figure 3.18

These tables simply filter out all not good records that are due to ‘Production Delay’.

G	M	F	C	ORDER QTY	ORDER LT	IN	WH5 AVAILABLE DATE	ACCEPTANCE DATE	REQUEST DATE	REPLY DATE	LT STATUS	OUT STATUS
R	2	I	-	2000	15	IF	2006/08/30	2006/08/31	2006/08/25	2006/09/08		P. DELAY
R	2	I	-	8600	42	IF	2006/08/24	2006/08/25	2006/08/15	2006/08/15		P. DELAY
R	2	I	-	500	42	IF	2006/08/24	2006/08/25	2006/08/15	2006/08/15		P. DELAY
R	2	I	-	1100	27	IF	2006/08/12	2006/08/14	2006/08/10	2006/08/10		P. DELAY
R	2	I	E	1000	28	IF	2006/08/07	2006/08/08	2006/08/02	2006/08/02		P. DELAY
R	2	I	E	1000	18	IF	2006/08/24	2006/08/25	2006/08/16	2006/08/18		P. DELAY
R	2	I	E	3000	7	IF	2006/08/30	2006/08/31	2006/08/17	2006/08/31		P. DELAY
R	2	I	E	14000	20	IF	2006/09/05	2007/10/26	2006/08/28	2006/08/30		P. DELAY
R	2	I	E	2000	14	IF	2006/08/10	2006/08/11	2006/08/01	2006/08/08		P. DELAY
R	2	I	E	1000	14	IF	2006/08/23	2006/08/24	2006/08/16	2006/08/25		P. DELAY
R	2	I	E	12000	6	IF	2006/08/23	2006/08/24	2006/08/08	2006/08/25		P. DELAY
R	2	I	E	5000	14	IF	2006/08/10	2006/08/11	2006/08/02	2006/08/11		P. DELAY
R	2	I	E	2000	14	IF	2006/08/28	2006/08/29	2006/08/16	2006/08/25		P. DELAY
R	2	I	E	2000	10	IF	2006/08/21	2006/08/22	2006/08/08	2006/08/18		P. DELAY
R	2	I	E	10000	14	IF	2006/08/24	2006/08/25	2006/08/16	2006/08/25		P. DELAY
R	2	I	E	2000	10	IF	2006/08/21	2006/08/22	2006/08/08	2006/08/18		P. DELAY
R	2	I	E	8000	14	IF	2006/08/24	2006/08/25	2006/08/16	2006/08/25		P. DELAY

Figure 3.17

G	M	F	C	ORDER QTY	ORDER LT	IN	WH5 AVAILABLE DATE	ACCEPTANCE DATE	REQUEST DATE	REPLY DATE	LT STATUS	OUT STATUS
R	2	I	-	8600	42	IF	2006/08/24	2006/08/25	2006/08/15	2006/08/15		P. DELAY
R	2	I	-	500	42	IF	2006/08/24	2006/08/25	2006/08/15	2006/08/15		P. DELAY
R	2	I	-	1100	27	IF	2006/08/12	2006/08/14	2006/08/10	2006/08/10		P. DELAY
R	2	I	E	1000	18	IF	2006/08/24	2006/08/25	2006/08/16	2006/08/18		P. DELAY
R	2	I	E	1000	28	IF	2006/08/07	2006/08/08	2006/08/02	2006/08/02		P. DELAY
R	2	I	E	14000	20	IF	2006/09/05	2007/10/26	2006/08/28	2006/08/30		P. DELAY
R	2	I	E	2000	7	IF	2006/08/10	2006/08/11	2006/07/25	2006/08/08		P. DELAY
R	2	I	E	2000	14	IF	2006/08/10	2006/08/11	2006/08/01	2006/08/08		P. DELAY
R	2	I	E	2000	10	IF	2006/08/21	2006/08/22	2006/08/08	2006/08/18		P. DELAY
R	2	I	E	2000	10	IF	2006/08/21	2006/08/22	2006/08/08	2006/08/18		P. DELAY
R	2	I	E	8000	28	IF	2006/08/10	2006/08/11	2006/08/02	2006/08/02		P. DELAY
R	2	I	E	1000	18	IF	2006/08/21	2006/08/22	2006/08/16	2006/08/18		P. DELAY
R	2	I	E	7000	21	IF	2006/08/10	2006/08/11	2006/08/02	2006/08/02		P. DELAY
R	2	I	E	2000	14	IF	2006/08/28	2006/08/29	2006/08/16	2006/08/25		P. DELAY
R	2	I	E	5000	50	IF	2006/08/05	2006/08/07	2006/08/04	2006/08/04		P. DELAY
R	2	I	E	12000	47	IF	2006/08/05	2006/08/07	2006/08/01	2006/08/01		P. DELAY
R	2	I	E	9000	50	IF	2006/08/10	2006/08/11	2006/08/04	2006/08/04		P. DELAY

Figure 3.18

3.3 Production Lead-Time

It counts from the day the order is confirmed to the day when the product reaches the warehouse.

When an order is confirmed, the planner will send a planning sheet to the production. The production will then draw material from the warehouse to start production at the first process. The production stops at the point where the finished product is stocked into the warehouse.

At the issuing of the planning sheet, the system will record the start date of the production. When material is drawn out for production, the system also captures this

date. At the end of every process, the operator has to bar-code scanned the item of which the process number, machine number, quantity, operation shift, etc is registered into the system.

Hence the system is always active and real-time.

For this particular product group, the overall production lead-time is 5 working days. This estimation aids in the replying of customer regarding delivery date.

3.3.1 Data Structure

For production lead-time calculation, the following data fields are required:

- a) Lot Number
- b) Part Number
- c) Item Group
- d) Machine Number
- e) Process Number
- f) Production Start Date
- g) Process End Date
- h) Issue Quantity
- i) Good Quantity
- j) Operation Shift
- k) Item Type

Two data tables, in text file format, containing production data and warehouse data are automatically generated in the server. The filename starts with 'Moltime' and 'MOpostat' for production data and warehouse data respectively, Figure 3.19 and Figure 3.20.

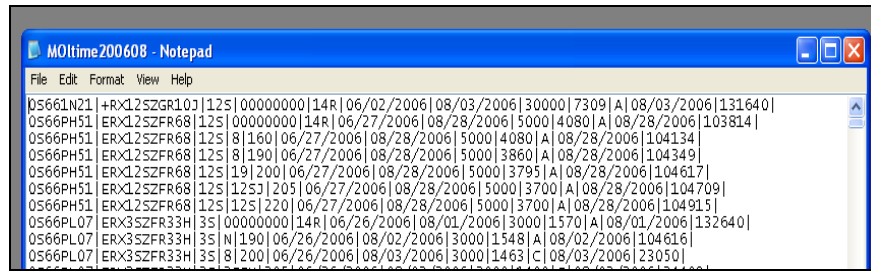


Figure 3.19

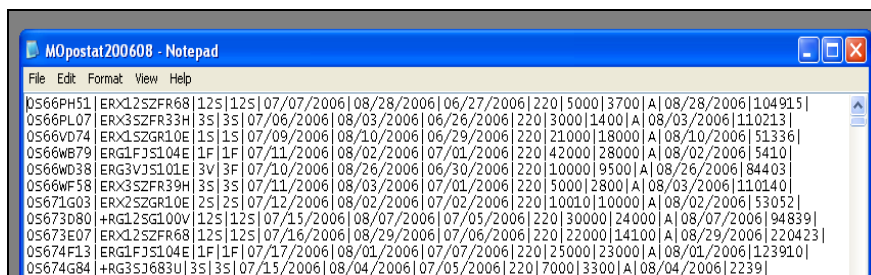


Figure 3.20

These text-file data will then be transferred to the tables in the Microsoft Access Database using the functions created.

3.3.2 User Interface

Microsoft Access Database serves as a user interface to download text file data from the Data Server to the computer, transfer the data into the tables, manipulate the large volume of raw data and conveniently present the results in graphical or table format. Visual Basic Application is used to program the tool. First, there is a main menu as shown in Figure 3.21:

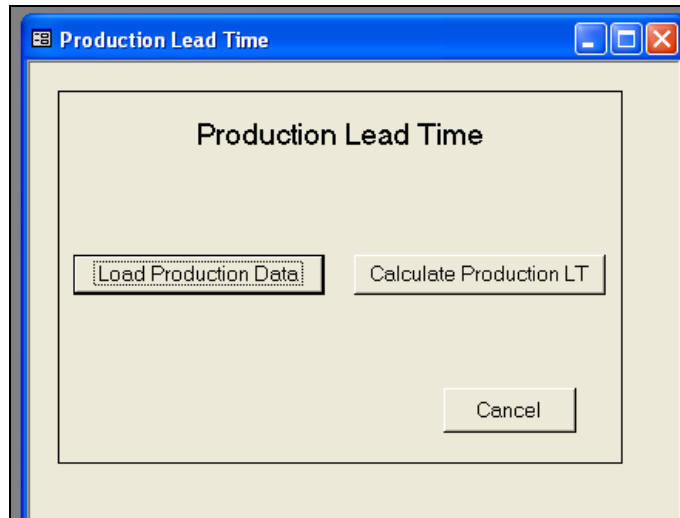


Figure 3.21

Click 'Load Production Data' to select the data (Production OR Warehouse) to be downloaded from the Data Server as shown in Figure 3.22.

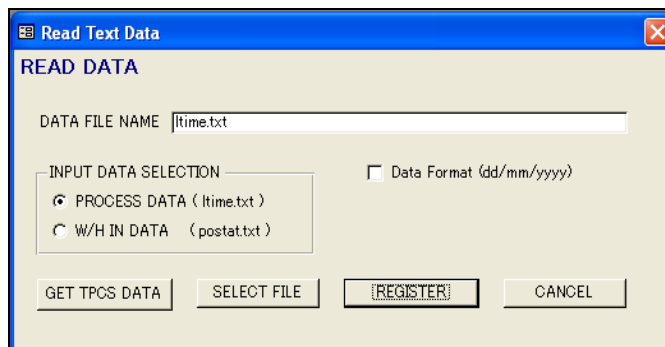


Figure 3.22

Click 'Get TPCS Data' and input the year and month of the data required as shown in Figure 3.23.

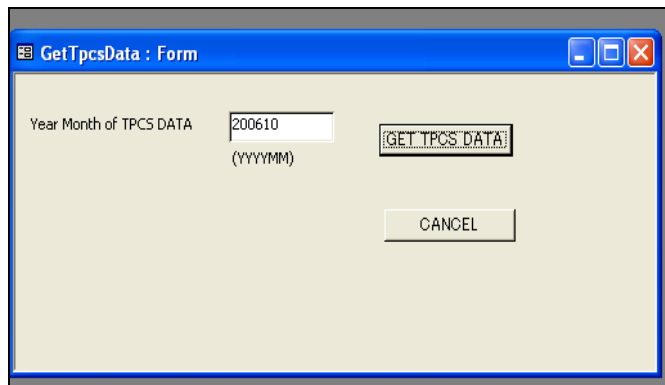


Figure 3.23

For example, key in '200608' to get data for August 2006.

Click 'Get TPCS Data' again and confirm execution by clicking 'Yes', Figure 3.24.

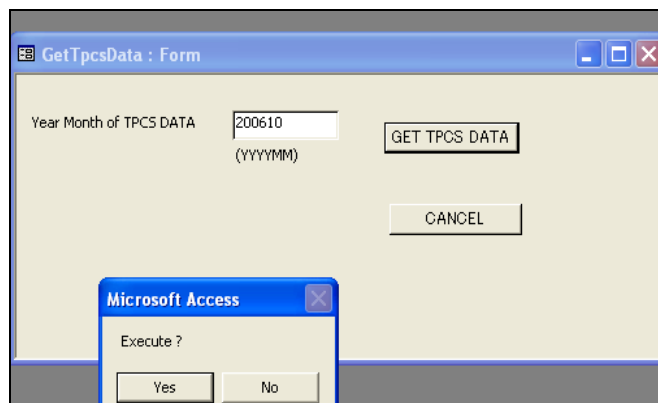


Figure 3.24

The text data is downloaded using the 'File Transfer Protocol', Figure 3.25, and saved in the same directory as the Microsoft Access Database.

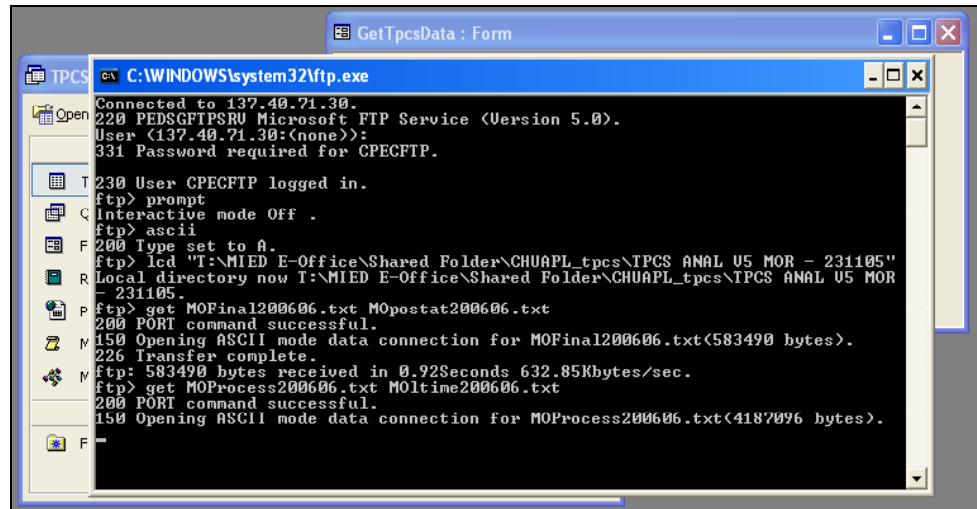


Figure 3.25

After downloading the production data, check 'W/H IN DATA' selection and repeat the steps for downloading of warehouse data, Figure 3.26.

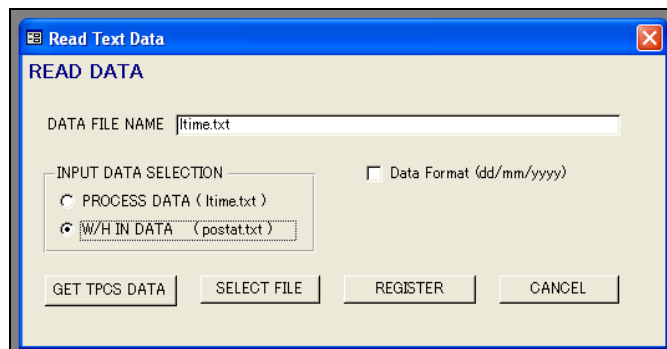


Figure 3.26

When the downloading has been completed, click 'Select File' button and open the data file to be transferred to the database as shown in Figure 3.27.

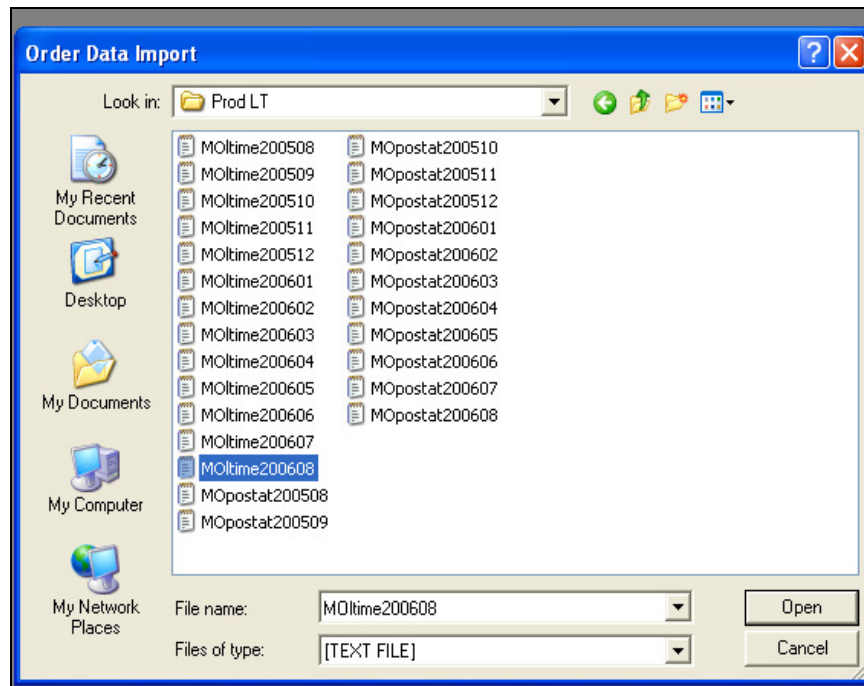


Figure 3.27

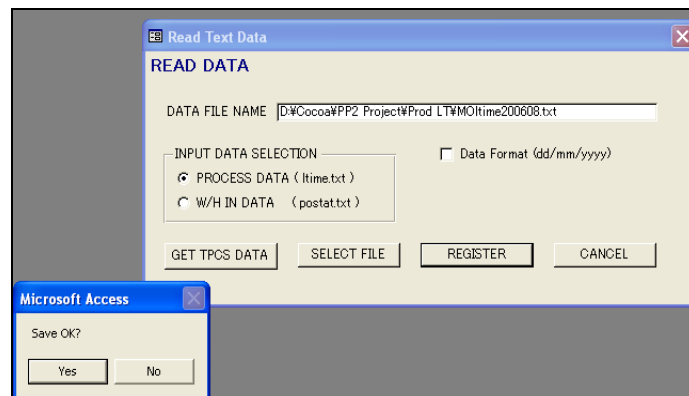


Figure 3.28

After registering the data file as shown in Figure 3.28, click 'Register' to transfer data from the text file to the 'Production Master' table in the database and 'Yes' to confirm execution.

When completed, click 'OK' and repeat the steps to transfer warehouse data to the 'Warehouse Master' in the database, Figure 3.29.

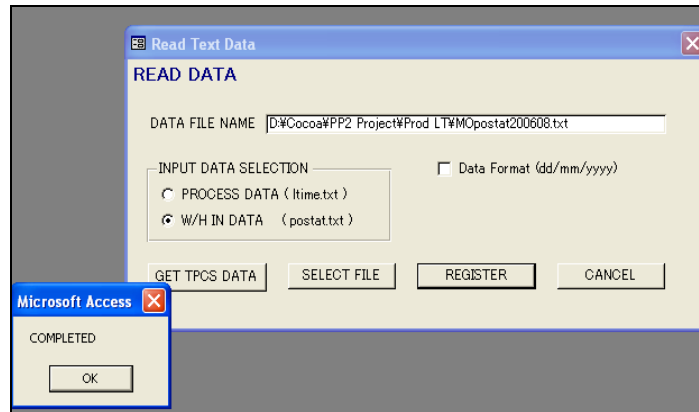


Figure 3.29

Click 'Cancel' to return to the Main Menu.

Click 'Calculate Production LT' to go to the calculation menu, Figure 3.30.

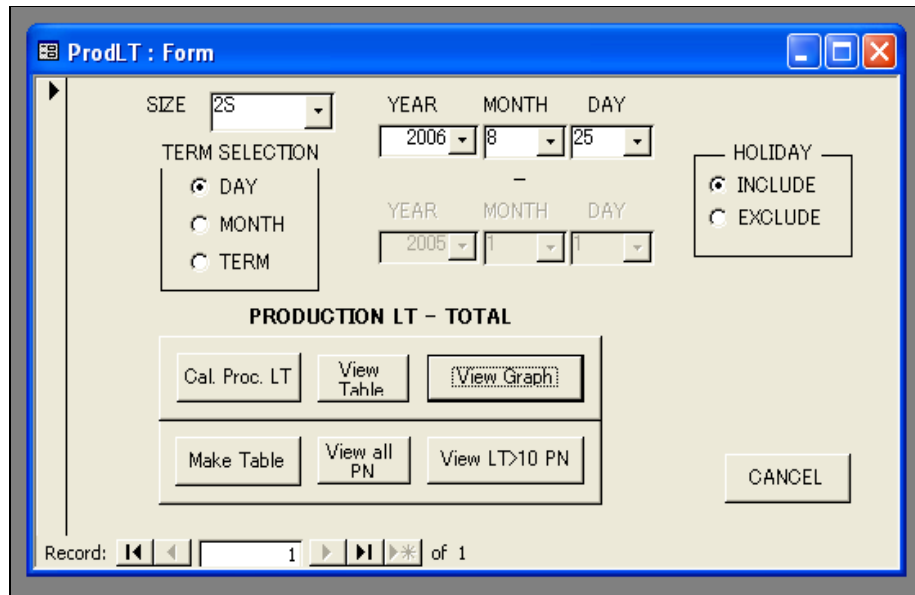


Figure 3.30

In order to calculate the production lead-time, some selections need to be completed:

- a) Product Group
- b) Term Selection, i.e. data for a one day, one month or for a specified period.
- c) Holidays included or excluded, i.e. to consider working or non-working days only.

When the selections have completed, click 'Cal. Proc. LT' button to generate the calculation. When the calculation has been completed, click 'View Graph' to display the result.

To view the products that has lead-time more than 10 days, click 'Make Table' and 'View LT>10 PN'.

More details on the results will be presented in 3.3.3 Result Generation.

3.3.3 Result Generation

Figure 3.31 shows the 'Production Master' Table named 'PROC' where all the production data, including all different product groups, will be added. The data fields have been identified in 3.3.2 Data Structure.

P	P	S	W	PF	PSLD	ACTDAY	ISSUEQTY	GOODQTY	USERCODE	SHIFT	GX
0	E	3	0	22	9/5/2005	9/16/2005 9:28:20 AM	3000	2500		A	X
0	E	3	3	22	9/5/2005	9/16/2005 9:29:44 AM	3000	2500		A	X
0	E	3	3	20	9/5/2005	9/13/2005 8:24:32 AM	3000	2600		C	X
0	E	3	2	20	9/5/2005	9/13/2005 8:24:11 AM	3000	2697		C	X
0	E	3	S	19	9/5/2005	9/12/2005 2:52:51 AM	3000	2700		C	X
0	E	3	S	16	9/5/2005	9/9/2005 1:37:45 AM	3000	2985		C	X
0	E	3	B	14	9/5/2005	9/5/2005 11:39:47 PM	3000	3000		C	X
0	E	3	B	14	9/5/2005	9/5/2005 11:43:22 PM	3000	3000		C	X
0	E	3	2	15	9/5/2005	9/6/2005 4:23:04 PM	3000	2995		A	X
0	E	3	3	22	9/5/2005	9/14/2005 4:47:58 PM	3000	2800		A	G
0	E	3	3	20	9/5/2005	9/13/2005 5:32:50 PM	3000	2800		A	G
0	E	3	2	20	9/5/2005	9/13/2005 5:32:20 PM	3000	2861		A	G
0	E	3	S	19	9/5/2005	9/11/2005 1:24:16 PM	3000	2864		A	G
0	E	3	S	16	9/5/2005	9/9/2005 1:36:33 AM	3000	2970		C	G
0	E	3	2	15	9/5/2005	9/6/2005 4:20:11 PM	3000	3000		A	G
0	E	3	B	14	9/5/2005	9/5/2005 11:47:36 PM	3000	3000		C	G
0	E	3	0	13	9/5/2005	9/5/2005 3:31:14 PM	3000	3000		A	G
0	E	3	2	15	9/5/2005	9/6/2005 4:21:23 PM	3000	3000		A	X

Record: 1 of 448590

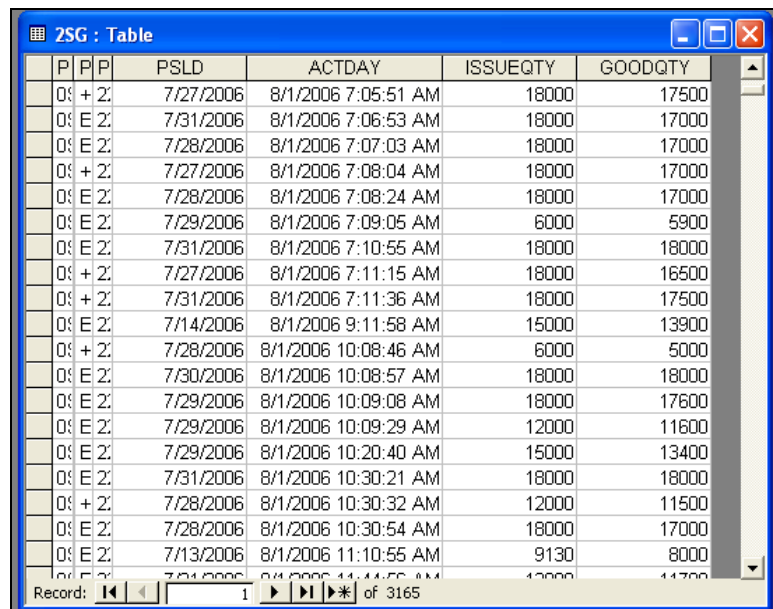
Figure 3.31

Every record is a transaction on the completion of one process.

Hence, for every product lot, the production lead-time will be from the date of withdrawing the material to the date of last process.

Based on the selection made at the calculation menu, the required data will be filtered out from the 'Production Master' Table.

For example, if the term selection is August 2006, all the data at the last process with end date, i.e. 'ACTDAY', of 1st August 2006 to 31st August 2006 will be filtered out as shown in Figure 3.32.



P	P	P	PSLD	ACTDAY	ISSUEQTY	GOODQTY
09	+	2:	7/27/2006	8/1/2006 7:05:51 AM	18000	17500
09	E	2:	7/31/2006	8/1/2006 7:06:53 AM	18000	17000
09	E	2:	7/28/2006	8/1/2006 7:07:03 AM	18000	17000
09	+	2:	7/27/2006	8/1/2006 7:08:04 AM	18000	17000
09	E	2:	7/28/2006	8/1/2006 7:08:24 AM	18000	17000
09	E	2:	7/29/2006	8/1/2006 7:09:05 AM	6000	5900
09	E	2:	7/31/2006	8/1/2006 7:10:55 AM	18000	18000
09	+	2:	7/27/2006	8/1/2006 7:11:15 AM	18000	16500
09	+	2:	7/31/2006	8/1/2006 7:11:36 AM	18000	17500
09	E	2:	7/14/2006	8/1/2006 9:11:58 AM	15000	13900
09	+	2:	7/28/2006	8/1/2006 10:08:46 AM	6000	5000
09	E	2:	7/30/2006	8/1/2006 10:08:57 AM	18000	18000
09	E	2:	7/29/2006	8/1/2006 10:09:08 AM	18000	17600
09	E	2:	7/29/2006	8/1/2006 10:09:29 AM	12000	11600
09	E	2:	7/29/2006	8/1/2006 10:20:40 AM	15000	13400
09	E	2:	7/31/2006	8/1/2006 10:30:21 AM	18000	18000
09	+	2:	7/28/2006	8/1/2006 10:30:32 AM	12000	11500
09	E	2:	7/28/2006	8/1/2006 10:30:54 AM	18000	17000
09	E	2:	7/13/2006	8/1/2006 11:10:55 AM	9130	8000

Figure 3.32

Then a calculation will be generated to determine the lead-time of the production for each product lot. As shown in Figure 3.33, 'PSLD' is the date where the material is being withdrawn from the warehouse and 'LT' is the lead-time of production.

2SG_LT : Table					
	FP	PSLD	ACTDAY	ISSUEQTY	LT
▶	C E	8/1/2006 11:41:49 AM	8/3/2006 12:52:16 AM	18000	2.00
	C E	8/1/2006 11:38:08 AM	8/3/2006 6:52:10 AM	18000	2.00
	C E	8/1/2006 11:38:44 AM	8/2/2006 7:50:19 PM	18000	1.00
	C E	8/1/2006 11:40:17 AM	8/3/2006 3:13:39 PM	18000	2.00
	C E	8/1/2006 11:40:55 AM	8/2/2006 7:51:03 PM	18000	1.00
	C E	8/1/2006 11:27:28 AM	8/2/2006 4:51:21 PM	15000	1.00
	C E	8/1/2006 11:28:32 AM	8/2/2006 11:48:25 AM	15000	1.00
	C E	8/1/2006 11:43:03 AM	8/3/2006 6:53:02 AM	15000	2.00
	C E	8/2/2006 4:30:55 PM	8/5/2006 1:05:36 PM	12000	3.00
	C E	8/2/2006 4:29:30 PM	8/5/2006 7:48:08 PM	12000	3.00
	C E	8/3/2006 12:12:15 PM	8/7/2006 2:26:08 PM	18000	4.00
	C E	8/3/2006 12:12:14 PM	8/5/2006 7:53:42 PM	18000	2.00
	C E	8/3/2006 12:12:45 PM	8/7/2006 5:23:01 AM	18000	4.00
	C E	8/3/2006 12:40:44 PM	8/7/2006 4:52:36 PM	18000	4.00
	C E	8/6/2006 1:03:19 PM	8/16/2006 6:58:15 AM	15000	10.00
	C E	8/3/2006 12:41:40 PM	8/5/2006 6:30:27 AM	15000	2.00
	C E	8/2/2006 4:03:25 PM	8/7/2006 3:08:46 PM	6000	5.00
	C +	8/2/2006 11:45:24 AM	8/6/2006 7:35:40 PM	18000	4.00
	C +	8/2/2006 11:53:50 AM	8/7/2006 4:43:46 AM	18000	5.00
	C +	8/2/2006 11:52:16 AM	8/5/2006 3:10:01 PM	18000	3.00
	C E	8/2/2006 11:51:01 AM	8/4/2006 3:24:07 AM	12000	2.00
	C E	8/2/2006 11:44:42 AM	8/4/2006 10:32:10 AM	15000	2.00
	C E	8/2/2006 4:45:01 PM	8/5/2006 2:28:24 AM	15000	2.00
	C E	8/5/2006 8:19:20 AM	8/8/2006 12:20:57 AM	6000	3.00
	C E	8/3/2006 12:09:22 PM	8/11/2006 12:25:52 AM	3000	8.00
	C E	8/6/2006 1:38:28 PM	8/12/2006 7:46:32 PM	3000	6.00
	C E	8/2/2006 4:12:11 PM	8/4/2006 3:11:10 AM	18000	1.00
	C E	8/2/2006 4:13:34 PM	8/7/2006 2:57:17 PM	18000	5.00
	C E	8/4/2006 7:52:08 AM	8/10/2006 6:46:26 AM	12000	6.00
	C E	8/2/2006 11:52:59 AM	8/6/2006 8:05:48 AM	3000	4.00

Record: 1 of 2845

Figure 3.33

After the lead-time calculation, the result is sorted and plotted by tabulating the number of counts against lead-time as shown in Figure 3.34 and Figure 3.35.

P_D	CNT	PAR
	1	0.04%
1	260	9.17%
2	603	30.37%
3	587	51.00%
4	432	66.19%
5	279	75.99%
6	227	83.97%
7	155	89.42%
8	98	92.86%
9	66	95.18%
10	47	96.84%
11	29	97.86%
12	17	98.45%
13	7	98.70%
14	6	98.91%
15	9	99.23%
16	7	99.47%
17	8	99.75%
18	1	99.79%
19	3	99.89%
22	3	100.00%
*	0	0.00%

Record: 1 of 21

Figure 3.34

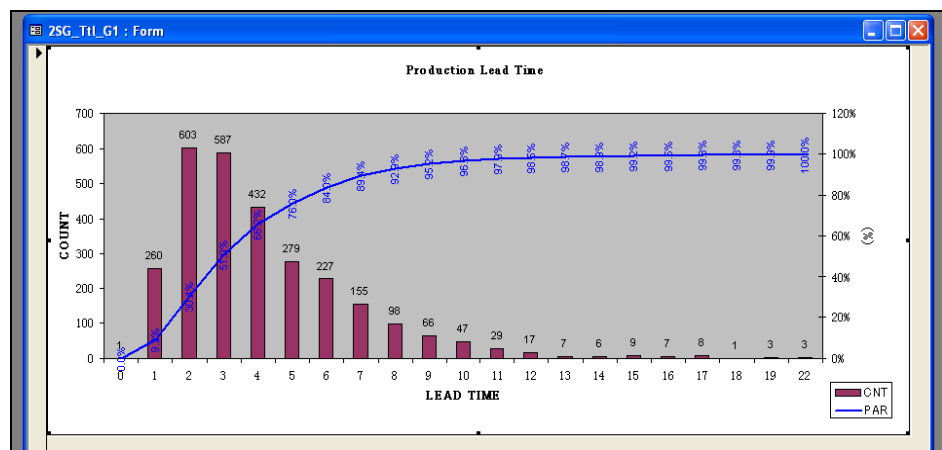


Figure 3.35

An additional function to have a better analysis of the data is to exclude non-working days for lead-time calculation. There is a table named 'Holiday' where all the non-working dates are stored, Figure 3.36. During the calculations, the total number of holidays within the term selection will be subtracted from the total number of production day. Figure 3.37 shows a comparison of the result with Figure 3.35 by not including the non-working days.

H_DAY
7/29/2006
7/30/2006
8/5/2006
8/6/2006
8/12/2006
8/13/2006
8/17/2006
8/19/2006
8/20/2006
8/21/2006
8/26/2006
8/27/2006
9/2/2006
9/3/2006
9/9/2006
9/10/2006
9/16/2006
9/17/2006

Figure 3.36

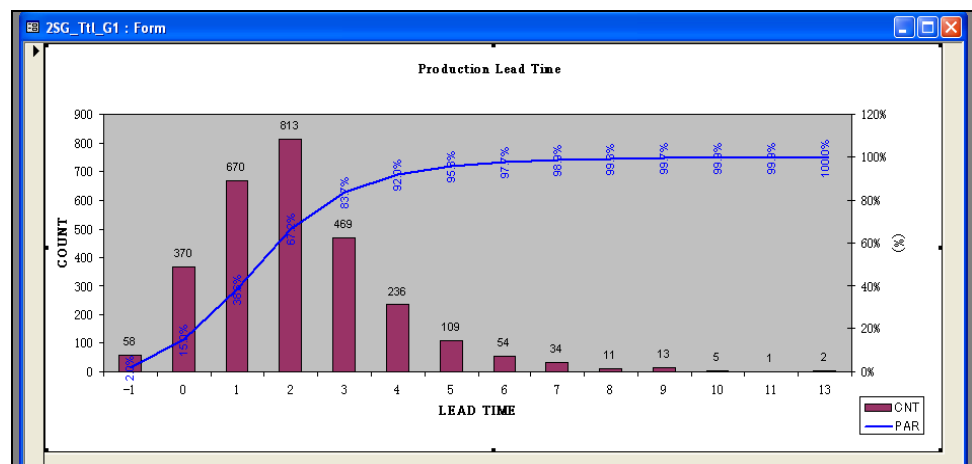


Figure 3.37

From the graphical results, some observation points are highlighted:

- The x-axis is the count of orders whereas the y-axis is the number of days for production.
- The total number of orders completed in the month of August 2006 is equal to the sum of all the values that appear on top of every bar graph.
- In Figure 3.35, a number of 260 orders completed less than one day, 603 orders completed less than two days, and so on and so forth.
- Comparing both graphs in Figure 3.35 and Figure 3.37, the lead-time is longer if holidays are included whereas it is shorter when holidays are excluded.
- In Figure 3.37, a number of 58 orders complete in '-1' day's lead-time, this is probably due to over-time operations on a non-working day.

For orders that experience more than ten days production lead-time, the records will be conveniently tabulated and displayed, Figure 3.38, using the 'Queries' function, as shown in Figure 3.39, in the Microsoft Access Database.

ProdLT>10 PN : Select Query

PI	PN	ISSUEQTY	Process 1	Process 2	Process 3	Process 4	Process 5	Process 6	Process 7	Process 8
▶	05	15000	2	4	0	1	3	5	8	22
EI	05	15000	1	0	21	0	0	0	0	22
EI	05	9000	20	1	0	0	0	0	0	22
+	05	18000	4	2	0	0	0	4	8	19
+	05	6000	1	1	0	1	13	2	1	19
EI	05	18000	1	0	0	0	3	0	15	19
EI	05	12000	11	3	0	0	3	0	0	18
EI	05	6000	15	0	0	2	0	0	0	17
+	05	9000	1	0	0	0	15	0	1	17
EI	05	3000	15	0	0	1	0	0	0	17
+	05	12000	1	2	3	10	1	0	0	17
EI	05	3000	2	0	0	0	3	4	8	17
EI	05	3000	2	0	3	0	11	0	0	17
EI	05	18000	2	2	0	0	4	0	8	16
+	05	9000	1	2	0	0	5	0	8	16
+	05	6000	4	2	0	0	3	0	7	16
EI	05	6000	0	3	0	0	5	0	8	16
EI	05	15000	3	1	0	0	3	0	8	16
+	05	18000	1	2	0	0	3	0	8	15
+	05	3000	3	3	0	3	0	0	7	15
EI	05	9000	1	2	0	0	3	0	8	15
EI	05	9000	2	1	0	0	2	3	8	15
+	05	12000	7	2	1	0	3	0	2	15
+	05	18000	1	2	0	0	2	2	8	15
+	05	1000	1	3	1	0	8	1	0	15
+	05	3000	1	1	0	1	9	2	0	15
+	05	12000	2	3	0	0	2	0	7	14

Record: 1 of 93

Figure 3.38

ProdLT>10 PN : Select Query

25G_tbLTbyPN

*
PN
POSNO
ISSUEQTY
130

Field:	PN	POSNO	ISSUEQTY	Spiral	Welding
Table:	25G_tbLTbyPN	25G_tbLTbyPN	25G_tbLTbyPN	25G_tbLTbyPN	25G_tbLTbyPN
Sort:					
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Criteria:					
or:					

Figure 3.39

3.4 Order Lead-Time

In this competitive market, we have to constantly minimized waste to keep the cost of production low and at the same time provide good customers' satisfaction. One of the ways to minimize waste is to keep a low inventory level where only 'sellable' goods are stored in the warehouse. However, it is not easy to keep low inventory and yet fulfill urgent request by customers. Understanding and study of the market demand and production condition is very important.

Order lead-time starts from the day the order is being accepted by the Sales Representative to the day the order is ready for delivery to the customer, which usually is the day when the order reaches the warehouse. As mentioned earlier that the overall production lead-time is 5 working days, the order will be considered short order lead-time if order lead-time is less than 5 days. As order cannot be rejected (due to customers' satisfaction indicator), the only way to countermeasure this issue is to keep safety stock in the warehouse.

In this measuring indicator, the purpose is to identify products that are often requested by customers urgently. At the same time, identify customers who often request for urgent products. If necessary, counteract by communicating often with the customers to understand their conditions as well.

3.4.1 Data Structure

To study the order trend, we need past order records whereby the following data fields are required:

- a) Product Group
- b) Item Group
- c) Item Type
- d) Customer Code
- e) Appointed Delivery Date (request by customer)
- f) Order Acceptance Date (Confirm order date by Sales Representative)

- g) Shipping Designated Date (Date to deliver goods)
- h) Delivery Answer Date (Reply date by Sales Representative)
- i) Order Quantity
- j) Order Number

This data table in text format is set by ISD member to automatically generate in the server every month based on the ‘Shipping Designated Date’. The filename always starts with ‘order’ and followed by the year and month of the data, e.g. ‘order200608.txt’ as shown in Figure 3.40.

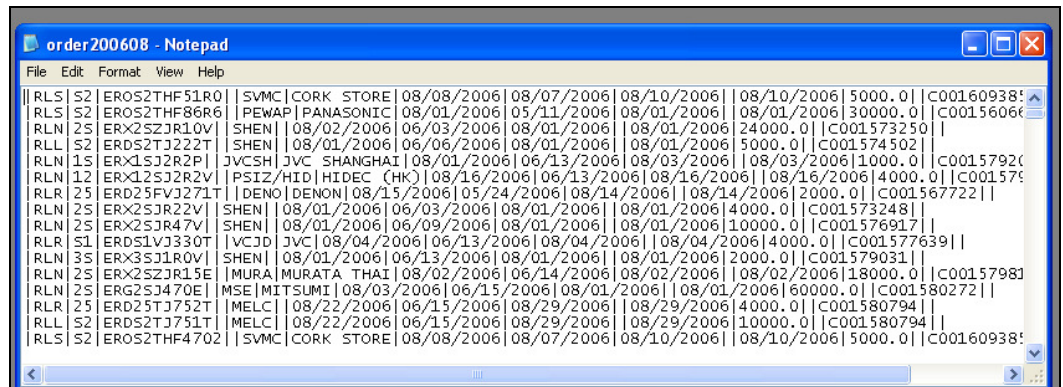


Figure 3.40

Same as DOT data, Order data also needs to download from the Data Server A using Tool A Interface and then be transferred to the tables in the Microsoft Access Database using the functions created. Always download the text-file Order data from the server before using the Microsoft Access Database.

3.4.2 User Interface

First, there is a Main Menu as shown in Figure 3.41.

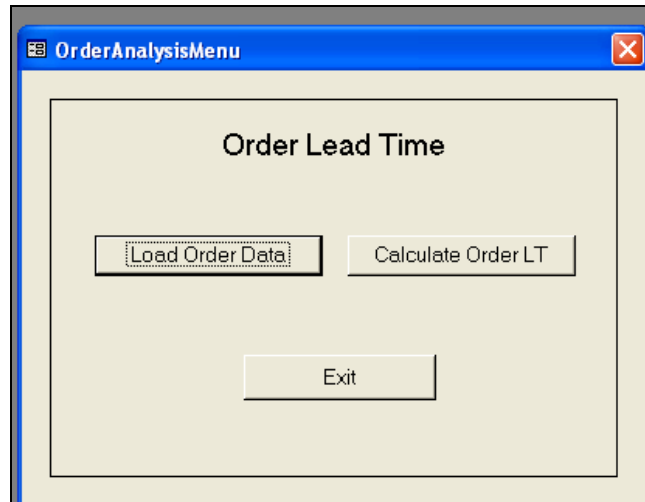


Figure 3.41

Click 'Load Order Data' to transfer data into the database, Figure 3.42.

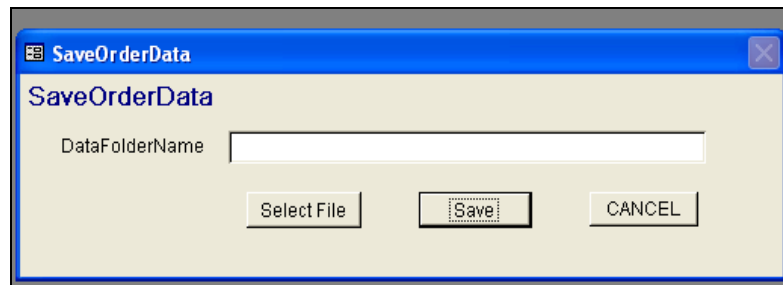


Figure 3.42

Click 'Select File' and open the required text file to be added into the 'Order Master' Table in the database as shown in Figure 3.40.

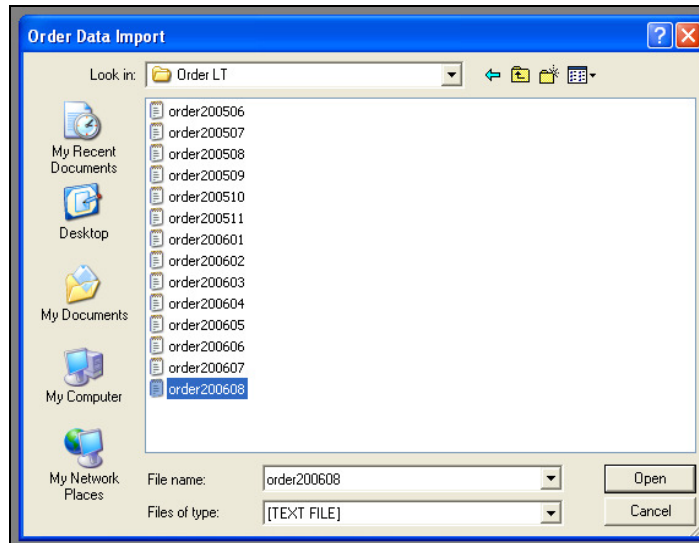


Figure 3.43

The file location will be registered as shown in Figure 3.44.

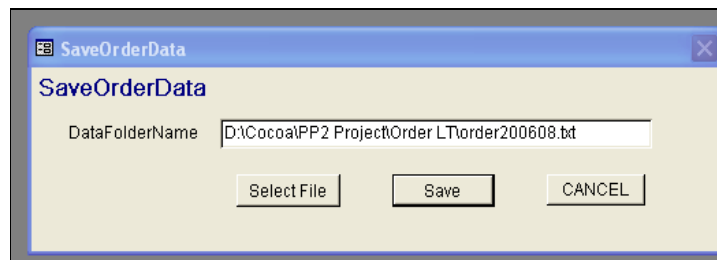


Figure 3.44

Click 'Save' to start transferring the data and 'Yes' confirm the execution respectively, as shown in Figure 3.45.

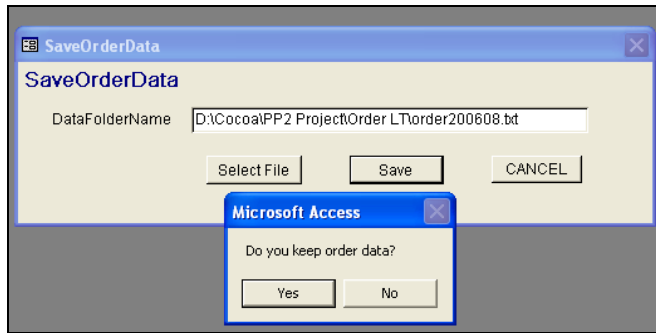


Figure 3.45

When it has been completed, click 'OK' and 'Cancel' to exit to Main Menu, Figure 3.46.

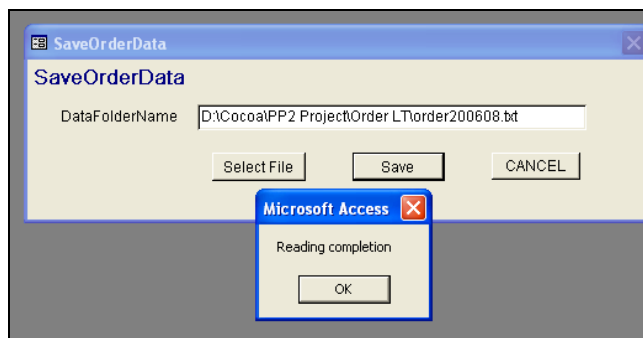


Figure 3.46

Check the Order Master Table at the 'Shipping Designated Date' column for the additional of order data, Figure 3.47.

	AppointedDeliveryDate	OrderAcceptanceDate	ShippingDesignatedDate	DeliveryAnswerDate	OrderQuantity	OrderNo	OrderLT
F S E M N	8/21/2006	8/8/2006	8/31/2006	8/31/2006	10000	C001610257	23
F 2 E Y	8/31/2006	8/1/2006	8/31/2006	8/31/2006	2000	C001606919	30
F S E M		8/11/2006	8/31/2006	8/31/2006	5000	C001613160	20
F 2 E K	8/31/2006	8/3/2006	8/31/2006	8/31/2006	2000	C001606099	28
F S E M N	8/16/2006	8/8/2006	8/31/2006	8/31/2006	4000	C001610261	13
F 2 E M	8/30/2006	8/15/2006	8/31/2006	8/31/2006	1000	C001614831	16
F S E M N	8/31/2006	7/19/2006	8/31/2006	8/31/2006	2000	C001598969	43
F 2 E M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	100	C001614698	16
F V E M		8/15/2006	8/31/2006	8/31/2006	900	C001615255	16
F S E P P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608584	27
F S E M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	2000	C001615193	16
F S E P P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608584	27
F 2 E M N	8/22/2006	8/11/2006	8/31/2006	8/31/2006	2000	C001612276	20
F 2 E M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	4000	C001615239	16
F 2 E S	8/31/2006	8/12/2006	8/31/2006	8/31/2006	1000	C001613038	19
F 2 E M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	200	C001614726	16
F 2 E M	8/29/2006	8/8/2006	8/31/2006	8/31/2006	1000	C001610985	23
F S E P P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608584	27
F S E P P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608586	27
F S E P P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608586	27
F S E P P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608586	27
F 2 E Y	8/31/2006	8/18/2006	8/31/2006	8/31/2006	2000	C001617324	13
F 2 E M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	2000	C001615065	16

Figure 3.47

To calculate the order lead-time trend, click 'Calculate Order LT' button and input the desired year and month as shown in Figure 3.48. For example, '2006' and '8' for August 2006 data. Click 'OK' to start calculation.

Figure 3.48

When the calculation is completed, a tabulated result will be shown as in Figure 3.49. Click 'Disp Graph' to view the result in graph format, Figure 3.50.

OrderLT	OrderLTCount	Accumulation(%)
-19	3	0.016%
-11	5	0.042%
-10	55	0.328%
-8	1	0.333%
-7	28	0.479%
-6	78	0.885%
-5	97	1.390%
-4	123	2.030%
-3	34	2.207%
-2	51	2.473%
-1	73	2.853%
0	208	3.935%
1	197	4.961%
2	168	5.836%

Record: 1 of 109

Figure 3.49

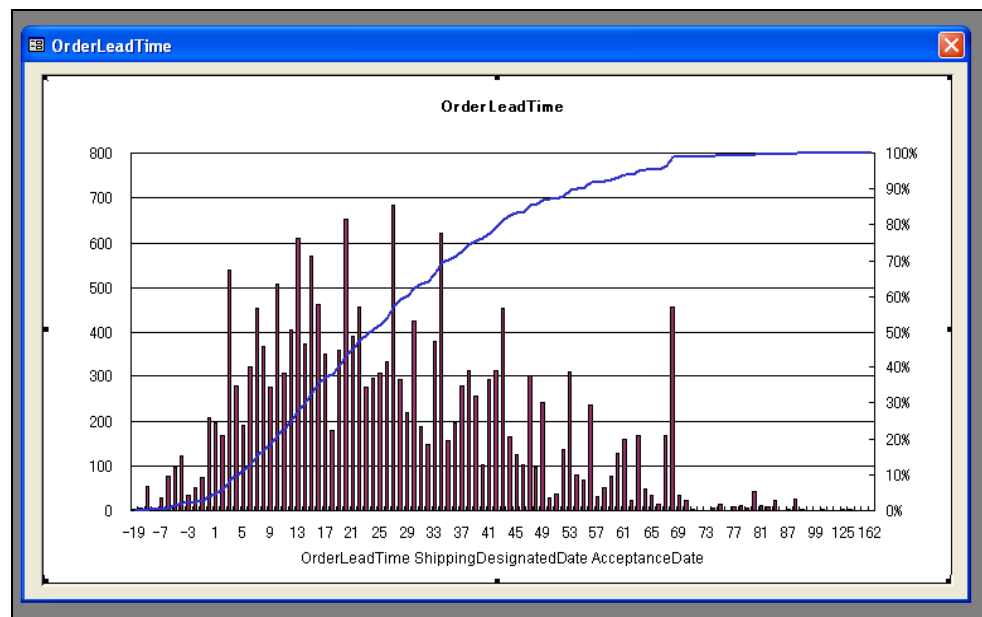


Figure 3.50

3.4.3 Result Generation

As seen from Figure 3.49, the table shows the number of lead-time days against the corresponding number of counts of order.

Basically, when adding the data from text file format to the database, there is a calculation of order lead-time for every order. An additional column, named 'OrderLT', is created in the 'Order Master' Table, named 'MasterTable_OLT', again as shown in Figure 3.51.

K	It	C	AppointedDeliveryDate	OrderAcceptanceDate	ShippingDesignatedDate	DeliveryAnswerDate	OrderQuantity	OrderNo	OrderLT		
R	S	E	M	8/21/2006	8/8/2006	8/31/2006	8/31/2006	10000	C001610257	23	
R	2	E	Y	8/31/2006	8/1/2006	8/31/2006	8/31/2006	2000	C001608919	30	
R	S	E	M		8/11/2006	8/31/2006	8/31/2006	5000	C001613160	20	
R	2	E	K	8/31/2006	8/3/2006	8/31/2006	8/31/2006	2000	C001608099	28	
R	S	E	M	8/16/2006	8/8/2006	8/31/2006	8/31/2006	4000	C001610261	13	
R	2	E	M	8/30/2006	8/15/2006	8/31/2006	8/31/2006	1000	C001614831	16	
R	S	E	M	8/31/2006	7/19/2006	8/31/2006	8/31/2006	2000	C001598969	43	
R	2	E	M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	100	C001614698	16	
R	V	E	M		8/15/2006	8/31/2006	8/31/2006	900	C001615255	16	
R	S	E	P	P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608584	27
R	S	E	M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	2000	C001615193	16	
R	S	E	P	P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608584	27
R	2	E	M	8/22/2006	8/11/2006	8/31/2006	8/31/2006	2000	C001612276	20	
R	2	E	M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	4000	C001615239	16	
R	2	E	S	8/31/2006	8/12/2006	8/31/2006	8/31/2006	1000	C001613038	19	
R	2	E	M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	200	C001614726	16	
R	S	E	M	8/29/2006	8/8/2006	8/31/2006	8/31/2006	1000	C001610965	23	
R	S	E	P	P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608584	27
R	S	E	P	P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608586	27
R	S	E	P	P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608586	27
R	S	E	P	P	8/17/2006	8/4/2006	8/31/2006	8/31/2006	5000	C001608586	27
R	2	E	Y	8/31/2006	8/18/2006	8/31/2006	8/31/2006	2000	C001617324	13	
R	2	E	M	8/31/2006	8/15/2006	8/31/2006	8/31/2006	2000	C001615065	16	

Figure 3.51

This involves a mathematics calculation of subtracting 'Order Acceptance Date' from 'Shipping Designated Date'.

From this, after the sorting of the number of lead-time days against the number of counts of order, the tabulated result will be generated.

3.5 Sales vs. Capacity

This measuring indicator presents the condition of market demand against our own production capacity and also acts as a guide to reply customers of delivery dates. Hence the data to be used consists of orders that have not been issued for production. On top of that, the required data also consist of orders up to 3 months ahead because we want to get prepared for the sales condition up to 3 months' time. If less than 3 months, we might not have time to get ready; but if more than 3 months, it may be too far ahead which might not be accurate. Another reason is also because our safety stock inventory has been calculated based on the past 3 months' records, so it is enough to standby for any urgent order one month down the road.

3.5.1 Data Structure

For this purpose, two groups of data are needed. One is the order data and the other is the production data – machine capacity.

The data field require for the order data is as follows:

- a) Identification Number
- b) Product Group
- c) Item Group
- d) Item Type
- e) Part Number
- f) Customer Number
- g) Whout_date (Warehouse stock-out date)
- h) Accept_date (Confirm order date by Sales Representative)
- i) Whin_date (Warehouse stock-in date)
- j) Expected_date (Request date by customer)
- k) Reply_date (By Sales Representative)
- l) Order Quantity
- m) Invoice Number
- n) Warehouse Number

- o) Order_class ('0' – Confirmed orders only, '1' – Indicative orders included, '2' – Forecast orders included)

These order data in the Data Server A is real-time and can be obtained any time using the authorized IP address and password, Figure 3.52. The data in text file format is named 'RplyData390.txt'. The data will be downloaded and transferred to the table in the Microsoft Access Database. Details will be shown in the section 3.5.2.

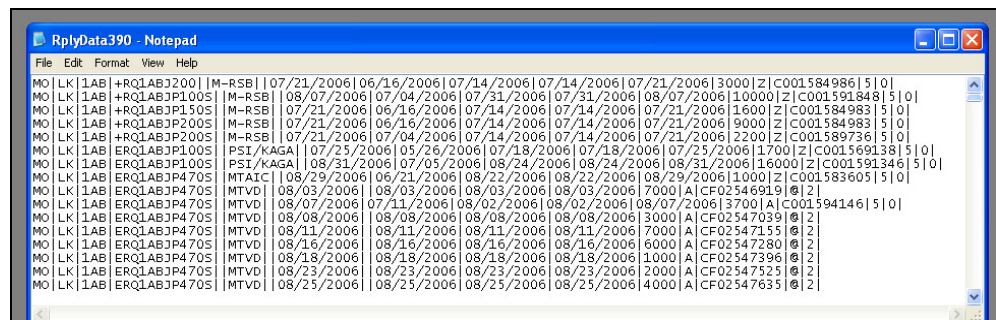


Figure 3.52

The other group of data required is the production machine capacity data, Figure 3.53.

Prd	lte	wc	capa	wcgno
160	EF 1		466875	1
150	EF 241		378000	1
140	EF 1A1		28350	1
200	EF 2S		141750	1
200	EF "SE		222075	1
150	EF 241		236250	2
160	EF 6		466875	2
200	EF "W		113400	2
140	EF 1A1		47250	2
150	EF 241		77490	3
140	EF 2 L		28350	3
200	EF "X\		141750	3
160	EF 9		429525	3
140	EF 2 L		28350	4
150	EF 242		60480	4
200	EF J		113400	4
200	EF JE		283500	5
140	EF 2 L		35910	5
150	EF 242		378000	5
150	EF Do		472500	6
200	EF JV		472500	6
140	EF DH		32130	6
200	EF PD		137025	7
140	EF GF		374850	7
200	EF PR		483840	8
140	EF GH		176715	8
200	EF RD		94500	9
140	EF GH		107100	9

Figure 3.53

The data fields required for the production data are as follows:

- a) Process Number
- b) Item Group
- c) Machine Group Code
- d) Machine Capacity
- e) Number of Machines

To calculate the machine capacity, 'Capa' as shown in Figure 3.53, another table of data shown in Figure 3.54 is required. 'Count' is the number of

machine. 'Time' is the number of working minutes per day. 'Tact' is the number of product produced per minute.

Pr	lte	wc	Wc	Count	time	tact	efficiency
20	EF	"S	56	1	1260	100	0.75
20	EF	"S	15	1	1260	135	0.75
20	EF	"W	18	1	1260	120	0.75
20	EF	"X	44	1	1260	150	0.75
1E	EF	1	1	1	1245	500	0.75
14	EF	1A	1A	1	1260	30	0.75
14	EF	1A	1A	1	1260	50	0.75
1E	EF	24	24'	1	1260	400	0.75
1E	EF	24	24'	1	1260	250	0.75
1E	EF	24	24'	1	1260	82	0.75
1E	EF	24	24'	1	1260	64	0.75
1E	EF	24	24'	1	1260	400	0.75
14	EF	2C	DH	3	1260	10	0.75
14	EF	2L	XF	1	1260	30	0.75
14	EF	2L	XH	1	1260	38	0.75
20	EF	2S	2S	1	1260	150	0.75

Figure 3.54

The data is fixed and saved in the table of the Microsoft Access Database. It is only required to change when there are changes to the machine capacities or quantities.

3.5.2 User Interface

First, there is the Main Menu as shown in Figure 3.55.

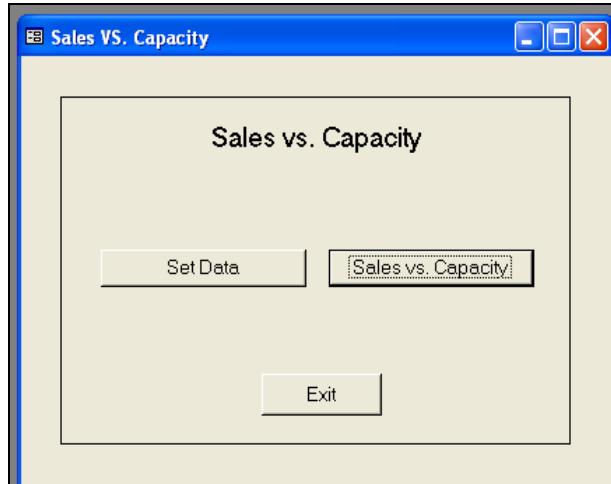


Figure 3.55

Click 'Set Data' to download the order data from the Data Server A using the File Transfer Protocol and save it in the same directory as the Database.

Figure 3.56 shows the source code when 'Set Data' button is clicked:

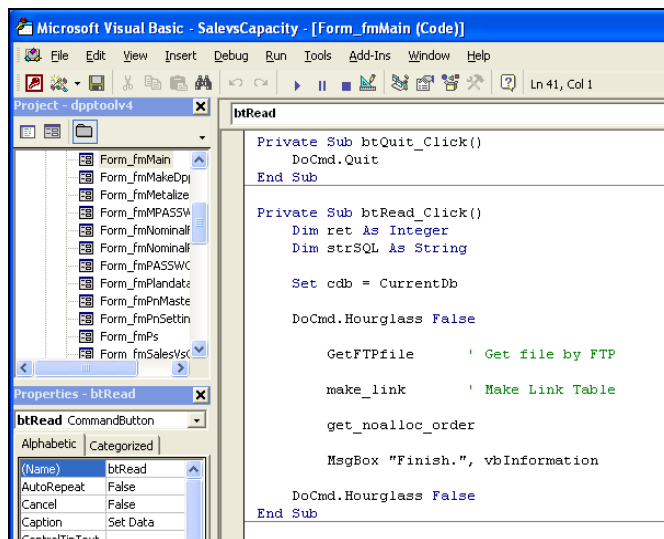
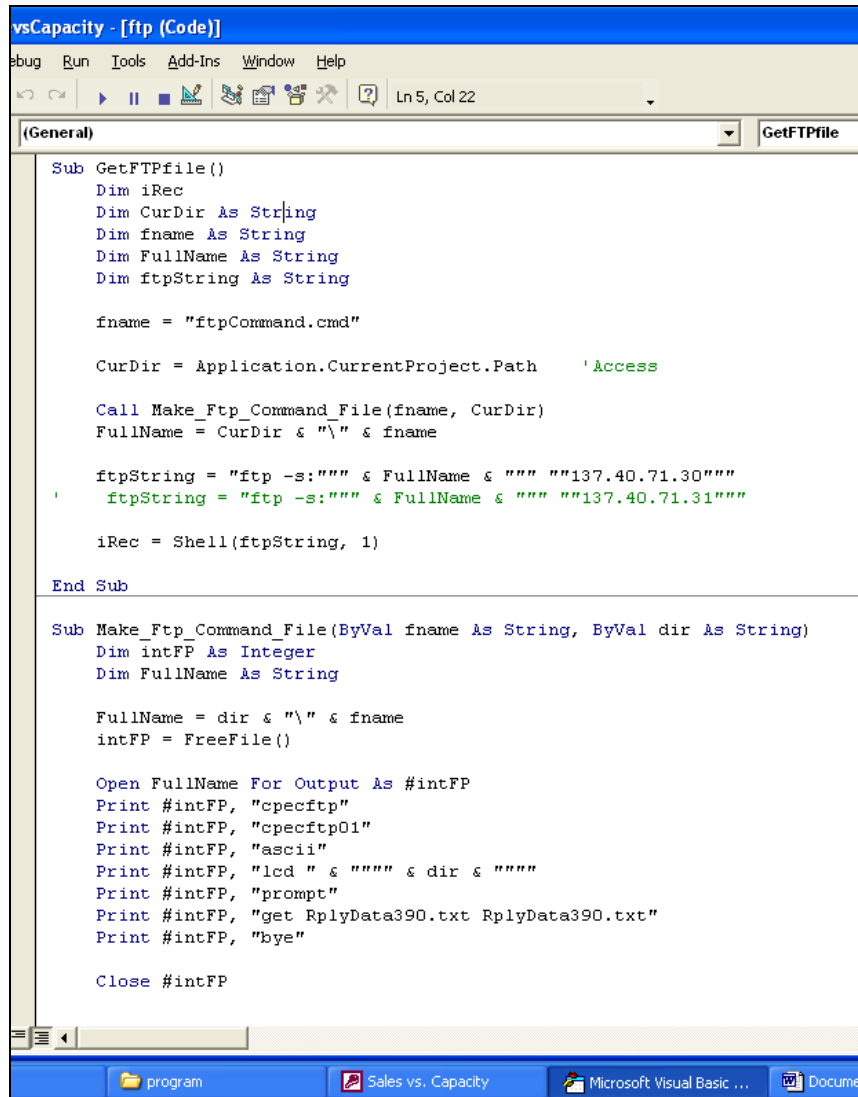


Figure 3.56

Figure 3.57 shows the source code for 'GetFTPfile' which calls the FTP command and *Make_Ftp_Command_File* which prints the FTP commands to get the data.



```
vsCapacity - [ftp (Code)]
Debug Run Tools Add-Ins Window Help
Ln 5, Col 22
(GetGeneral) GetFTPfile
Sub GetFTPfile()
    Dim iRec
    Dim CurDir As String
    Dim fname As String
    Dim FullName As String
    Dim ftpString As String

    fname = "ftpCommand.cmd"

    CurDir = Application.CurrentProject.Path 'Access

    Call Make_Ftp_Command_File(fname, CurDir)
    FullName = CurDir & "\ " & fname

    ftpString = "ftp -s:" & FullName & " "" ""137.40.71.30""
    ' ftpString = "ftp -s:" & FullName & " "" ""137.40.71.31""

    iRec = Shell(ftpString, 1)

End Sub

Sub Make_Ftp_Command_File(ByVal fname As String, ByVal dir As String)
    Dim intFP As Integer
    Dim FullName As String

    FullName = dir & "\ " & fname
    intFP = FreeFile()

    Open FullName For Output As #intFP
    Print #intFP, "cpecftp"
    Print #intFP, "cpecftp01"
    Print #intFP, "ascii"
    Print #intFP, "lcd " & " "" "" & dir & " "" ""
    Print #intFP, "prompt"
    Print #intFP, "get RplyData390.txt RplyData390.txt"
    Print #intFP, "bye"

    Close #intFP
End Sub
```

Figure 3.57

Figure 3.58 shows the source code for 'make_link()' that links the 'RplyData390.txt' in the same directory as the Database to the table in the Database.

```

alevsCapacity - [Module1 (Code)]
Debug Run Tools Add-Ins Window Help
Ln 206, Col 1
(General) make_link

Sub make_link()
    Dim cdb As Database
    Dim strSQL As String
    Dim rsSystem As Recordset
    Dim linkfolder As String

    Set cdb = CurrentDb

    Set rsSystem = cdb.OpenRecordset("tbSystemset")
    linkfolder = "C:\2S DPP\program"

    On Error Resume Next:

    DoCmd.DeleteObject acTable, "RplyData390txt"

    On Error GoTo ERR:

    DoCmd.TransferText acLinkDelim, "RplyData390Link", "RplyData390txt", linkfolder & "\RplyData390.txt"
    On Error GoTo 0
    Exit Sub
ERR:
MsgBox "folder don 't exist. Check SYSTEM SETTING. (Master file FOLDER) ", vbInformation + vbOKOnly, "ERROR"
    On Error GoTo 0
End Sub

```

Figure 3.58

Figure 3.59 shows the linking table 'RplyData390txt': Check for the latest data to confirm.

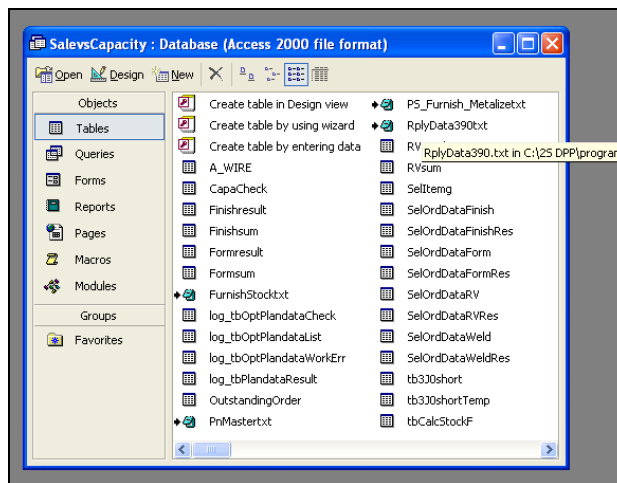


Figure 3.59

After making the linking table, referring to source code in Figure 3.56, 'get_noalloc_order' will transfer the data from the linking table to the 'tbNoallocorder' table as shown in Figure 3.60. Check that the data is updated.

ID	U	T	U	P	C	whout_date	accept_date	whin_date	expected_date	reply_date	orderqty	u	o	wh_code	orderclass	term		
1	N	L	J	+	M	7/21/2006	6/16/2006	7/14/2006	7/14/2006	7/21/2006	3000	Z	C	5	0	28		
2	N	L	J	+	M	8/7/2006	7/4/2006	7/31/2006	7/31/2006	8/7/2006	10000	Z	C	5	0	31		
3	N	L	J	+	M	7/21/2006	6/16/2006	7/14/2006	7/14/2006	7/21/2006	1600	Z	C	5	0	28		
4	N	L	J	+	M	7/21/2006	6/16/2006	7/14/2006	7/14/2006	7/21/2006	9000	Z	C	5	0	28		
5	N	L	J	+	M	7/21/2006	7/4/2006	7/14/2006	7/14/2006	7/21/2006	2200	Z	C	5	0	28		
6	N	L	J	+	E	P	7/25/2006	5/26/2006	7/18/2006	7/18/2006	1700	Z	C	5	0	29		
7	N	L	J	+	E	P	8/31/2006	7/5/2006	8/24/2006	8/24/2006	8/31/2006	16000	Z	C	5	0	34	
8	N	L	J	+	E	M	8/29/2006	6/21/2006	8/22/2006	8/22/2006	8/29/2006	1000	Z	C	5	0	34	
9	N	L	J	+	E	M	8/3/2006		8/3/2006	8/3/2006	8/3/2006	7000	A	C	@	2	31	
0	N	L	J	+	E	M	8/7/2006	7/11/2006	8/2/2006	8/2/2006	8/7/2006	3700	A	C	5	0	31	
1	N	L	J	+	E	M	8/8/2006		8/8/2006	8/8/2006	8/8/2006	3000	A	C	@	2	32	
2	N	L	J	+	E	M	8/11/2006		8/11/2006	8/11/2006	8/11/2006	7000	A	C	@	2	32	
3	N	L	J	+	E	M	8/16/2006		8/16/2006	8/16/2006	8/16/2006	6000	A	C	@	2	33	
4	N	L	J	+	E	M	8/18/2006		8/18/2006	8/18/2006	8/18/2006	1000	A	C	@	2	33	
5	N	L	J	+	E	M	8/23/2006		8/23/2006	8/23/2006	8/23/2006	2000	A	C	@	2	34	
6	N	L	J	+	E	M	8/25/2006		8/25/2006	8/25/2006	8/25/2006	4000	A	C	@	2	34	
7	N	L	J	+	E	M	8/30/2006		8/30/2006	8/30/2006	8/30/2006	3000	A	C	@	2	35	
8	N	L	J	+	E	M	9/1/2006		9/1/2006	9/1/2006	9/1/2006	8000	A	C	@	2	35	
9	N	L	J	+	E	M	9/6/2006		9/6/2006	9/6/2006	9/6/2006	3000	A	C	@	2	36	
0	N	L	J	+	E	M	9/8/2006		9/8/2006	9/8/2006	9/8/2006	3000	A	C	@	2	36	
1	N	L	J	+	E	P	7/31/2006	5/24/2006	7/26/2006	7/26/2006	7/31/2006	9000	Z	C	5	0	30	
2	N	L	J	+	E	P	8/28/2006	6/21/2006	8/23/2006	8/23/2006	8/28/2006	10000	Z	C	5	0	34	
3	N	L	J	+	E	P	8/25/2006	7/4/2006	8/18/2006	8/18/2006	8/25/2006	1000	Z	C	5	0	33	
4	N	L	J	+	E	S	I	8/23/2006	7/11/2006	8/16/2006	8/16/2006	8/23/2006	39000	Z	C	5	0	33
5	N	L	J	+	E	T	8/1/2006	6/22/2006	7/25/2006	7/25/2006	8/1/2006	1000	Z	C	5	0	30	

Figure 3.60

After transferring the data, click 'Sales vs. Capacity' button to enter the calculation menu, Figure 3.61.

Item Group: ERG25

Year: 2006 Month: 10 Day: 27

Based on: Request Reply

Order: Confirmed only Include Indication Include Indication and Forecast

Process 1: WC_code: XHC By: XHC

Process 2: WC_code: 2413 By: Welding

Process 3: WC_code: 6 By: Finishing

Process 4: WC_code: JE By: Forming

Record: 1 of 1

Figure 3.61

There are a few selections to be made:

- a) Item Group
- b) Term Selection – the starting date will be the day of usage and the end date can be selected.
- c) By Request Date or by Reply Date
- d) Confirmed Order only, Indication Included or Forecast Included
- e) Different Process Type

Once completed, click the individual process button to view the result. An example of the graphical result is shown in Figure 3.62.

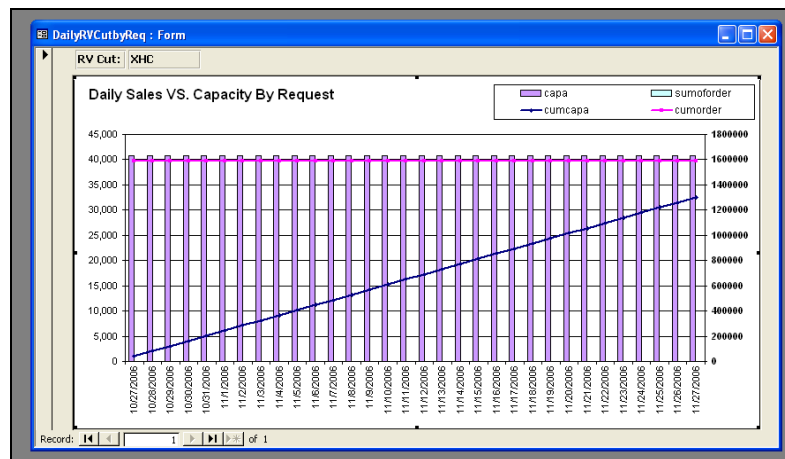


Figure 3.62

3.5.3 Result Generation

Figure 3.63 shows the data flow of the Sales versus Capacity data calculation.

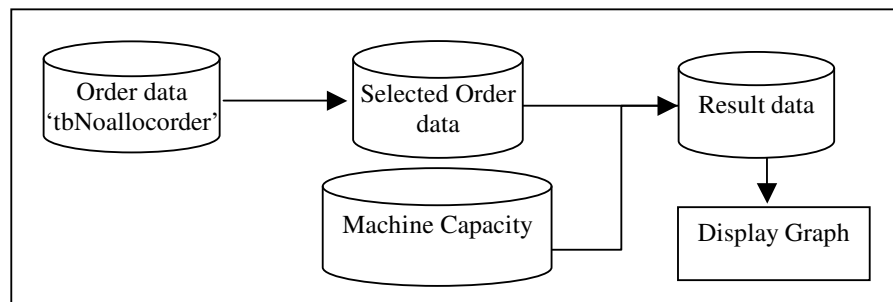


Figure 3.63

From the many data in 'tbNoallocorder' table, based on the term selection (time duration) made at the calculation menu, the desired data will be filtered out. If the selection is based on 'Request', then the data will be filtered out based on Warehouse-In Date, which is 'whin_date'. Otherwise, if it is based on 'Reply', then the data will be filtered out based on Expected Date, which is 'expected_date'.

For example in Figure 3.64, the 'SelOrdDataRV' table suggests the data is for 'RV' process. From the 10th columns of the table, 'RVCut' is the different machine groups in the 'RV' process.

IC	ite	ite	ite	pr	whin_date	expected_date	orderqty	orderclass	RVCut	Cl	Oj	FormingMCG
7	EI	LJ	1A	EI	7/18/2006	7/18/2006	1700	0	1ABQF	P	CI	PR
8	EI	LJ	1A	EI	8/24/2006	8/24/2006	16000	0	1ABQF	P	CI	PR
9	EI	LJ	1A	EI	8/22/2006	8/22/2006	1000	0	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/3/2006	8/3/2006	7000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/2/2006	8/2/2006	3700	0	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/8/2006	8/8/2006	3000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/11/2006	8/11/2006	7000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/16/2006	8/16/2006	6000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/18/2006	8/18/2006	1000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/23/2006	8/23/2006	2000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/25/2006	8/25/2006	4000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	8/30/2006	8/30/2006	3000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	9/1/2006	9/1/2006	8000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	9/6/2006	9/6/2006	3000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	9/8/2006	9/8/2006	3000	2	1ABQF	M	CI	PR
11	EI	LJ	1A	EI	7/26/2006	7/26/2006	9000	0	1ABQF	P	CI	PR
11	EI	LJ	1A	EI	8/23/2006	8/23/2006	10000	0	1ABQF	P	CI	PR
11	EI	LJ	1A	EI	8/18/2006	8/18/2006	1000	0	1ABQF	P	CI	PR
11	EI	LJ	1A	EI	8/16/2006	8/16/2006	39000	0	1ABQF	SI	CI	PR
11	EI	LJ	1A	EI	7/25/2006	7/25/2006	1000	0	1ABQF	T	CI	PR
11	EI	LJ	2C	EI	8/31/2006	8/31/2006	1200	2	2DDHV	M	7	J
11	EI	LJ	2C	EI	9/1/2006	9/1/2006	690	2	2DDHV	JE	5	PR
11	EI	LJ	2C	EI	7/5/2006	7/25/2006	1000	0	2DDHV	HI	CI	JE

Figure 3.64

The source code for the above is as shown in Figure 3.65.

```

Capacity - [Form_fmSalesVsCapa (Code)]
Run Tools Add-Ins Window Help
Ln 335, Col 10

General Sel_ordDataRV

cdb.Execute (strSQL)

set_Order
set_Term
set_Date

'SelOrdDataRV
strSQL = "SELECT [tbNoallocorder].ID, [SelItemg].itemg, [SelItemg].itemcls, " & _
        "[tbNoallocorder].itemtype, [tbNoallocorder].customercode, " & _
        "[tbNoallocorder].orderclass, [tbNoallocorder].whin_date, " & _
        "[tbNoallocorder].expected_date, [tbNoallocorder].pn, " & _
        "[tbNoallocorder].orderqty, [tbNoallocorder].orderno, " & _
        "[tbPnMaster].RVcut, [tbPnMaster].FormingMCG" & _
        " FROM ([SelItemg] INNER JOIN [tbNoallocorder] ON [SelItemg].itemcls = [tbNoallocorder].itemcls) " & _
        " INNER JOIN tbPnMaster ON tbNoallocorder.pn = tbPnMaster.PN" & _
        " WHERE (" & TERM & ") and (" & Order & ");"

Set rstu = cdb.OpenRecordset(strSQL)
Set rstt = cdb.OpenRecordset("SelOrdDataRV", dbOpenDynaset)

Do While Not rstu.EOF
    rstt.AddNew
    rstt!id = rstu!id
    rstt!itemgrp = rstu!ItemG
    rstt!itemcls = rstu!itemcls
    rstt!itemtype = rstu!itemtype
    rstt!orderclass = rstu!orderclass
    rstt!whin_date = rstu!whin_date
    rstt!expected_date = rstu!expected_date
    rstt!pn = rstu!pn
    rstt!orderqty = rstu!orderqty
    rstt!RVcut = rstu!RVcut
    rstt!FormingMCG = rstu!FormingMCG
    rstt!Customercode = rstu!Customercode
    rstt!Orderno = rstu!Orderno

    rstt.Update
    rstu.MoveNext
Loop

```

Figure 3.65

Next, referring to Figure 3.66, the filtered data will be sorted based on the machine group code, 'RVCut', and the quantity of all the orders on the same day will be added together, 'SumofOrder'. Also, the capacity of the selected machine group will be created based on the relationship table from the Microsoft Access Database.

whin_date	expected_date	SumofOrder	RVCut	Capa
6/23/2006		18000	LHV	136080
6/27/2006		4000	LHV	136080
6/28/2006		1000	LHV	136080
7/5/2006		22000	LHV	136080
7/7/2006		55825	LHV	136080
7/12/2006		4000	LHV	136080
7/14/2006		20000	LHV	136080
7/17/2006		8060	LHV	136080
7/18/2006		66500	LHV	136080
7/19/2006		24000	LHV	136080
7/20/2006		8000	LHV	136080
7/21/2006		41000	LHV	136080
7/25/2006		51000	LHV	136080
7/26/2006		10310	LHV	136080
7/27/2006		91970	LHV	136080
7/28/2006		47850	LHV	136080
7/31/2006		19360	LHV	136080
8/1/2006		108893	LHV	136080
8/2/2006		23500	LHV	136080
8/3/2006		108642	LHV	136080
8/4/2006		2000	LHV	136080

Figure 3.66

Lastly, the result table, as shown in Figure 3.67, is generated by:

- Selecting the start date and end date based on the term selection
- Accumulating the orders in 'CumOrder' column
- Accumulating the capacities in 'CumCapa' column
- Identifying the OK or NG result when 'CumCapa' is more than 'CumOrder' or vice versus respectively.

expected_date	whin_date	SumofOrder	Capa	CumCapa	CumOrder	Result	RVCut
10/28/2006		0	136080	136080	1607752	NG	LHV
10/29/2006		0	136080	272160	1607752	NG	LHV
10/30/2006		1000	136080	408240	1608752	NG	LHV
10/31/2006		0	136080	544320	1608752	NG	LHV
11/1/2006		0	136080	680400	1608752	NG	LHV
11/2/2006		0	136080	816480	1608752	NG	LHV
11/3/2006		0	136080	952560	1608752	NG	LHV
11/4/2006		0	136080	1088640	1608752	NG	LHV
11/5/2006		0	136080	1224720	1608752	NG	LHV
11/6/2006		3000	136080	1360800	1611752	NG	LHV
11/7/2006		0	136080	1496880	1611752	NG	LHV
11/8/2006		0	136080	1632960	1611752	OK	LHV
11/9/2006		0	136080	1769040	1611752	OK	LHV
11/10/2006		0	136080	1905120	1611752	OK	LHV
11/11/2006		0	136080	2041200	1611752	OK	LHV
11/12/2006		0	136080	2177280	1611752	OK	LHV
11/13/2006		0	136080	2313360	1611752	OK	LHV
11/14/2006		0	136080	2449440	1611752	OK	LHV
11/15/2006		0	136080	2585520	1611752	OK	LHV
11/16/2006		0	136080	2721600	1611752	OK	LHV
11/17/2006		0	136080	2857680	1611752	OK	LHV

Figure 3.67

The source code for the above operation is as shown in Figure 3.68.

```
levsCapacity - [Form_fmSalesVsCapa (Code)]
Debug Run Tools Add-Ins Window Help
Ln 405, Col 12
RV_Req

'RVsum
strSQL = "INSERT INTO " & Thame5 & " SELECT SelOrdDataRV.whin_date, " & _
"Sum(SelOrdDataRV.orderqty) AS SumOforder, SelOrdDataRV.RVCut, tbWcgMaster.capa" & _
" FROM SelOrdDataRV INNER JOIN tbWcgMaster ON SelOrdDataRV.RVCut = tbWcgMaster.wc_code" & _
" GROUP BY SelOrdDataRV.whin_date, SelOrdDataRV.RVCut, tbWcgMaster.capa" & _
" HAVING SelOrdDataRV.RVCut = '" & wc_code & "' " & _
" ORDER BY SelOrdDataRV.whin_date, SelOrdDataRV.RVCut;"
cdb.Execute (strSQL)

sumofcapa = 0

'Outstandingorder modified on 24/05/06
strSQL = "SELECT * FROM RVsum;"
Set rstu = cdb.OpenRecordset(strSQL)
a = 0

While Not rstu.EOF
If rstu!whin_date < start_date Then
SumOforder = rstu!SumOforder + a
a = SumOforder
End If
rstu.MoveNext
Wend

'RVresult
Set rstt = cdb.OpenRecordset("RVresult", dbOpenDynaset)
Do While start_date <= end_date
rstt.AddNew
rstt!whin_date = start_date

strSQL = "SELECT RVsum.whin_date, RVsum.SumofOrder, RVsum.Capa, RVsum.RVCut FROM RVsum;"
Set rstw = cdb.OpenRecordset(strSQL)

While Not rstw.EOF
If rstt!whin_date >= Date Then
rstt!capa = rstw!capa
```

Figure 3.68

3.6 Plan vs. Actual Production

This indicator shows how much the production plan is fulfilled every day. It is a gauge of how well the production performs and also a monitoring tool to arrest problems if any arise. It is more for the use of production in-charge who takes care of the daily production.

The tool for this item is currently at discussion and confirmation stage. However, some details on the data structure and results generation will be documented.

3.6.1 Data Structure

Figure 3.69 shows part of the existing tabulation of the data by manual recording.

HISTOR-ERG(X) PRODUCTION RECORD									
production 2005			Saturday	Sunday				PUBLIC HOLIDAY	
Product Type	PROCESS	WK.DAT	11	12	13	14	15	16	17
		DATE	12-Aug-05	13-Aug-05	14-Aug-05	15-Aug-05	16-Aug-05	17-Aug-05	18-Aug-05
PRODUCT A	130	ERG	0	416	585	953	793	0	881
		ERG	903	704	0	0	0	0	0
		ACCUM PROD	14,334	15,454	16,039	16,392	17,785	17,785	18,6
	140	ERG	885	860	228	276	513	0	491
		ERG	129	281	114	248	189	0	231
		ACCUM PROD	12,567	13,709	14,050	14,574	15,276	15,276	16,0
	150	ERG	586	696	712	370	289	0	281
		ERG	732	706	362	671	741	0	644
		ACCUM PROD	11,911	12,866	13,314	14,116	15,168	15,168	16,0
	160	ERG	67	261	9	108	257	0	261
ERG		799	701	219	512	801	0	911	
ACCUM PROD		11,849	12,811	13,038	13,658	14,716	14,716	15,8	
190	ERG	219	172	0	370	435	0	581	
	ERG	729	592	514	428	649	0	581	
	ACCUM PROD	11,719	12,427	13,053	13,586	14,367	14,367	15,1	
200	ERG	335	0	688	563	570	0	431	
	ERG	781	0	203	124	104	0	151	
	ACCUM PROD	8,887	8,887	9,778	10,465	11,138	11,138	11,7	
205	ERG	608	0	486	268	199	0	199	
	ERG	889	0	948	636	672	0	561	
	ACCUM PROD	11,406	11,406	12,559	13,329	14,145	14,145	14,8	
220	ERG	52	0	188	164	164	0	164	
	ERG	623	281	817	687	673	0	631	
	ACCUM PROD	11,067	11,347	12,359	13,194	13,997	13,997	14,8	
DAILY PROD		7,112	5,167	5,283	5,723	6,679	0	6,6	
ACCUM PROD		93,740	98,906	104,190	109,913	116,592	116,592	123,2	
TOTAL WIP		5,441	2,666	2,767	5,725	5,286	0	5,14	
REMARK									
ERG		234	335	42	0	176	0	251	
ACCUM PROD		0	0	85	216	182	0	0	

Figure 3.69

From the figure, it shows a daily tabulation of Product A at different processes, i.e. '130', '140', '150', etc, recorded with the different item type production quantity, accumulated production quantity and work-in-progress quantity.

For this measuring indicator, five data tables are required. They are as follow:

- a) Process Summary
- b) Process Summary By Machine
- c) Process Summary By Work Shift
- d) By Work-In-Process Summary
- e) Work-In-Process By Part Number Summary

The following data table information will be given to the ISD member to create automatic generation in the Data Server with the assigned filename.

Process Summary, Table 3.1 (Filename: 'MOProc_sum_YYYYMM')

Date	Product Group	Item Group	Item Type	Process	Total Qty
------	---------------	------------	-----------	---------	-----------

Table 3.1

Process Summary By Machine, Table 3.2 (Filename: 'MOProc_mc_YYYYMM')

Date	Product Group	Item Group	Item Type	Process	Machine No.	Total Qty
------	---------------	------------	-----------	---------	-------------	-----------

Table 3.2

Process Summary By Work Shift, Table 3.3 (Filename: 'MOProc_shf_YYYYMM')

Date	Product Group	Item Group	Item Type	Process	Shift	Total Qty
------	---------------	------------	-----------	---------	-------	-----------

Table 3.3

By Work-In-Process Summary, Table 3.4 (Filename:
 'MOWIP_sum_YYYYMM')

Date	Product Group	Item Group	Item Type	Process	Total WIP Qty
------	---------------	------------	-----------	---------	---------------

Table 3.4

Work-In-Process By Part Number Summary, Table 3.5 (Filename:
 'MOWIP_pn_YYYYMM')

Date	Product Group	Item Group	Item Type	Process	PN (by forming type)	Total Qty
------	---------------	------------	-----------	---------	----------------------	-----------

Table 3.5

When the data tables are ready, test the downloading of the data and check the accuracy of the data by comparing with the physical quantity at the production site.

3.6.2 Result Generation Proposal

Figure 3.70 shows the data relationship for the calculation of the Plan versus Actual indicator.

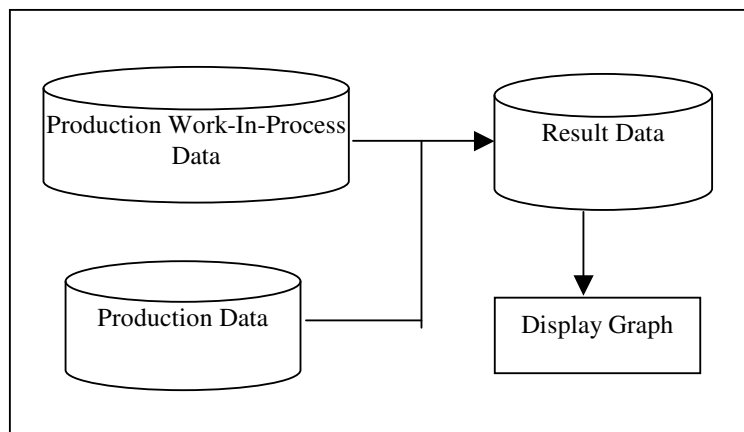
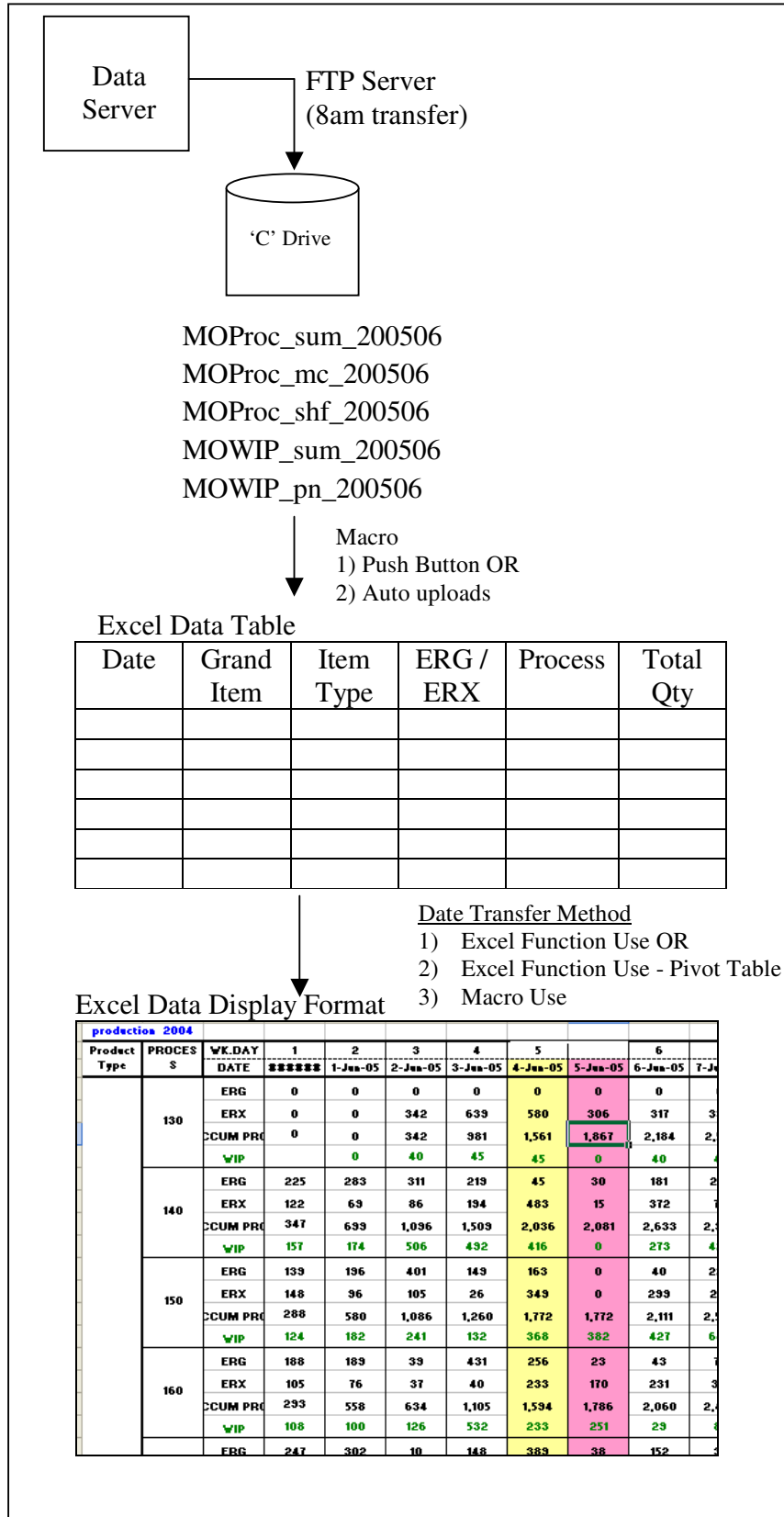


Figure 3.70

The data tables will be updated every morning 8am in the Data Server. Using the File Transfer Protocol command, download the data to the 'C' drive of the computer. Then, open the excel file to transfer the data to the excel table. This data transfer operation can be fulfilled by using Excel function, Pivot Table or Macro through the use of a command button.

The data transfer sequence is illustrated as follows:



A graphical result, Figure 3.71, will be created using the 'Graph' function in Excel.

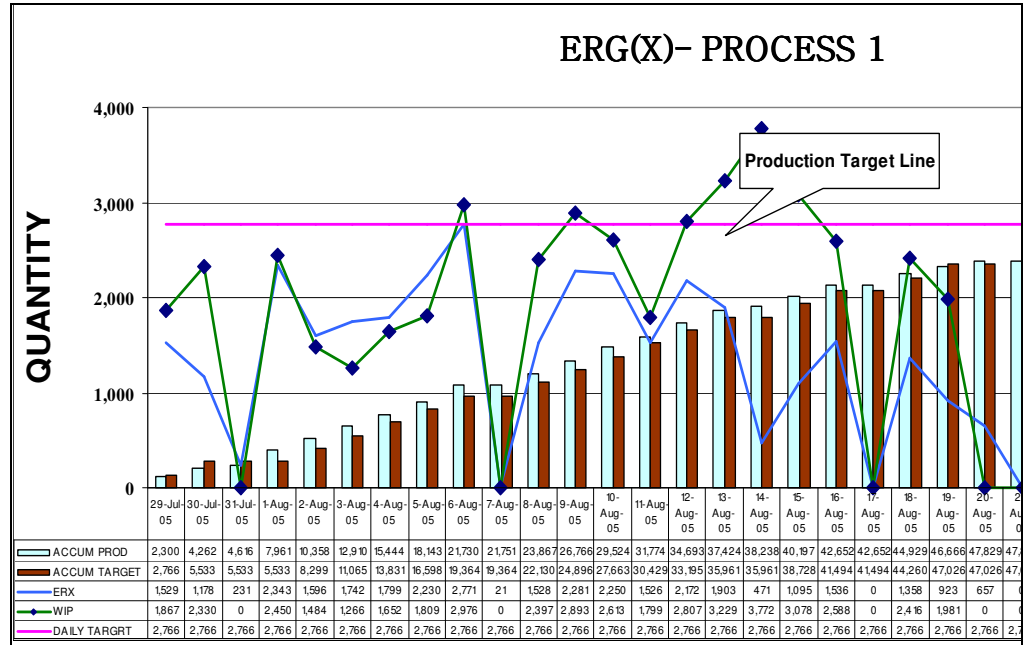


Figure 3.71

Basically the graph shows the comparison between the plan and the actual production result.

3.7 Work-In-Progress & Inventory

This indicator shows how much stock there is in the production line and warehouse. It is an important indicator to monitor because excess inventory may tie up cash and create waste in many forms as explained in 2.2.2.

The tool for this item is currently at discussion and confirmation stage. However, some details on the data structure and results generation will be documented.

3.7.1 Data Structure

The data fields required for WIP data are as follow:

- a) Transaction Date
- b) Product Group
- c) Item Group
- d) Item Type
- e) Process Number
- f) Part Number
- g) Quantity
- h) Number of Lots

The data will be automatically updated every morning 8am. WIP data makes up of the products that started production but have not reached the warehouse.

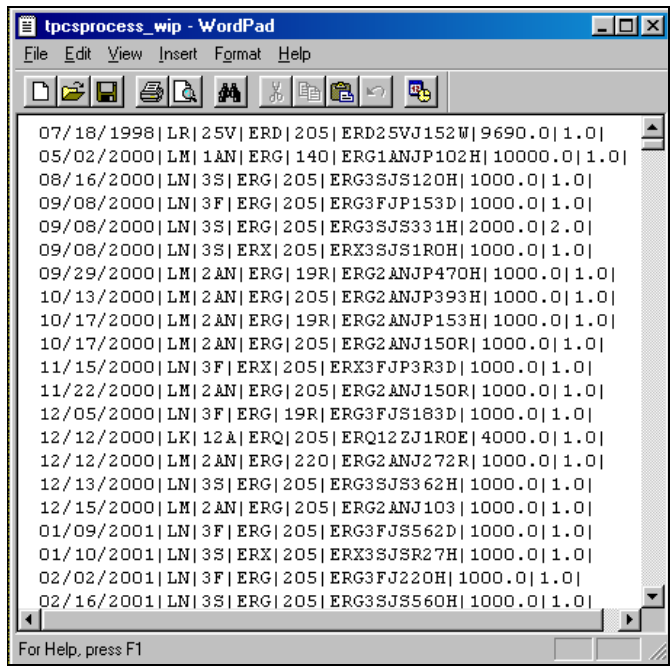


Figure 3.72

The Inventory data will be the sum of quantity from the five warehouses as shown in Figure 2.3. The data table must be able to get data from the warehouses and sum the quantity up based on the same product.

3.7.2 Data Generation Proposal

Figure 3.73 shows the data flow for WIP and Inventory calculation.

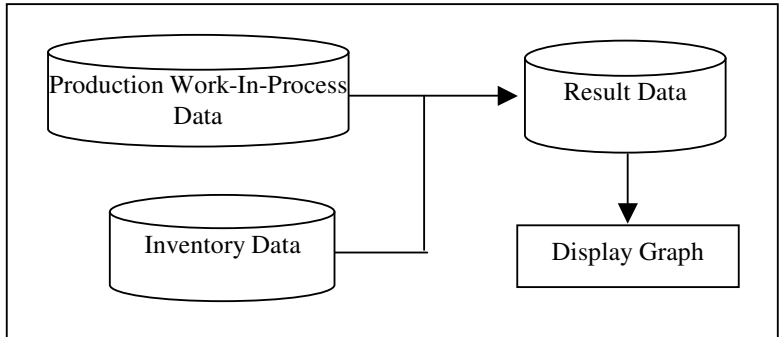


Figure 3.73

Figure 3.74 shows the tabulated result of the indicator by manual calculation and recording. It shows the total quantity for different item group.

Inventory + WIP	Item Group	Item Code	200604	200605	200606	200607
	2S	2S, 2F, 2V	42,269	31,607	39,375	35,369
		2D	2,245	2,555	1,983	1,834
		2L	129	33	66	66
	1AN	1N	3,794	3,683	4,030	3,854
	1AB		146	151	289	282
	TOTAL		48,582	38,028	45,743	41,406
	Target		32,000	32,000	32,000	32,000
Inventory	Item Group	Item Code	200604	200605	200606	200607
		2S, 2F, 2V	8,394	9,197	11,350	11,358
		2D	60	52	13	51
		2L	129	33	66	66
		1AB	72	71	80	90
		1N	1,310	1,165	1,422	1,422
	TOTAL		9,965	10,517	12,930	12,986
WIP	Item Group	Item Code	200604	200605	200606	200607
		2S	33,874	22,410	28,025	24,011
		2D	2,185	2,503	1,970	1,783
		2L				
	1AN		2,483	2,518	2,608	2,432
	1AB		74	80	209	192
	TOTAL STOCK		38,617	27,511	32,812	28,419

Figure 3.74

The method of data transfer will be very similar to the Plan versus Actual Production indicator using Excel function, Pivot Table or Macro through the use of a command button.

The graphical result for the Inventory and WIP data is shown in Figure 3.75. The different colour graphs differentiate between Inventory and WIP data.

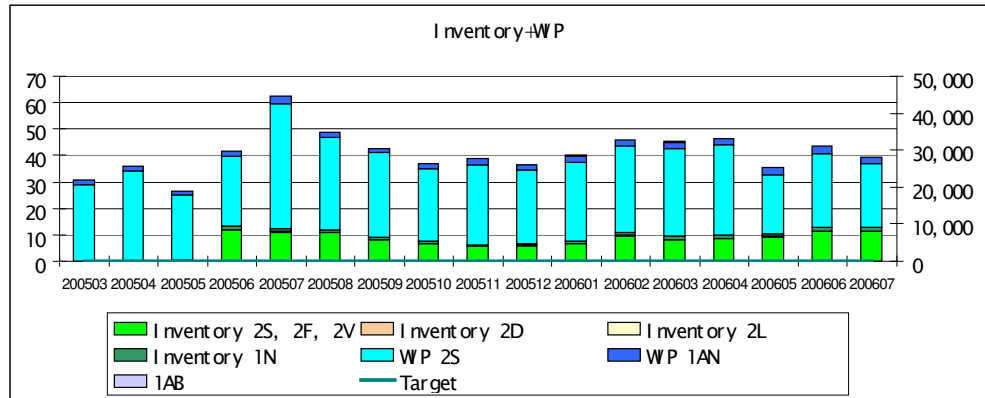


Figure 3.75

Another possible graphical result is shown in Figure 3.76 where only WIP data is shown. The different colours of bar graphs represent the different process or station in the production area.

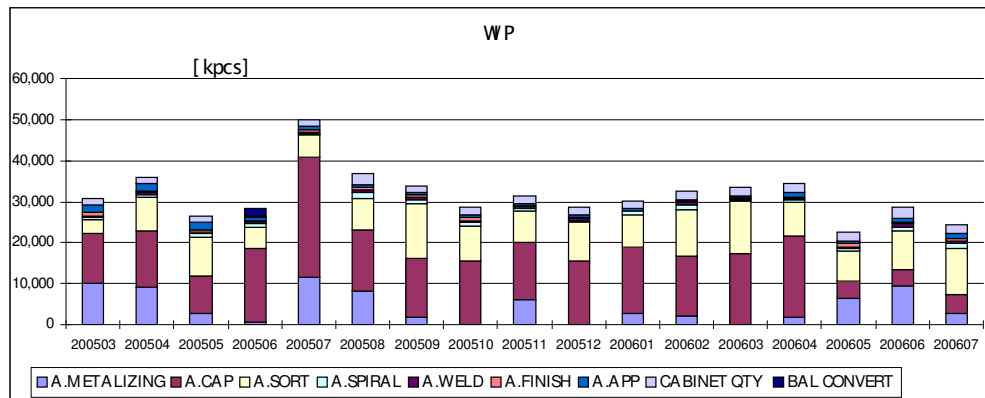


Figure 3.76

3.8 Conclusions: Chapter 3

Chapter 3 shows the detailed design methodology for the research and the step-by-step manipulation of the tools and data. The next chapter will be on the discussion and analysis of the results generated from the measuring tools.

CHAPTER 4

CONCLUSIONS

4.1 Introduction

This chapter will discuss the achievements of this research project and whether they have met the objectives set in the *Project Specification*¹. The latest results achieved from the tools will be presented. Those objectives which have not been accomplished or do not fulfill the criteria will be discussed in 4.4 Future Work.

4.2 Discussions

Finally, after having done so many activities, it is necessary to compare how much has been done so far. By referring to the objectives set in the Project Specification:

- a) This research project has intensively covered the background information on Production and Operation in Key Performance Indicator System relating to production operation performance and customers' satisfaction. Chapter 1 provides an introduction of how 'lean' evolves and why lean enterprises use information technology to manipulate the data. It also presents some lean manufacturing concepts and the importance of performance measurement systems in guiding and shaping the company by reflecting business factors. Chapter 2 also provides a literature review on how lean operations shorten lead-time, improve quality, reduce production cost, increase profit, boost productivity and better customer service.

- b) An evaluation of Sales and Production Systems in Panasonic Electronic Devices has been conducted, illustrated by Figure 2.3. It explains the job flow between the sales section, planner section, purchasing section and production section when an order is made by a customer.

- c) After evaluating the Sales and Production Systems, significant problems are identified in Figure 2.4 and improvements on the hardware i.e. the Data Server and implementations of additional operation systems i.e. the Material Order System, Key Performance Indicator, etc are carried out.

- d) New tools for measuring key performance indicators like Delivery-On-Time, Production Lead-Time, Order Lead-Time and Sales versus Capacity are designed, tested and implemented for data collection and analysis. However, there are two measuring indicators i.e. Plan versus Actual production and Work-In-Process & Inventory that are still under discussion and confirmation stage due to the implementation of the previous four measuring indicators. With these two measuring indicators implemented, the KPI system will be more complete.

- e) Delivery-On-Time and Order Lead-Time tools are modified from 'existing' tools because their data manipulations are previously done manually by using Pivot-Table. The logic of results generation is the same but the manipulation of data is different. The previous one is by manual filtering of data and the latter is through the use of command button and Visual Basic Applications in Microsoft Access Database. A very good advantage of having it automatic is to reduce one of the seven wastes i.e. waiting time.

- f) A proper cost benefit analysis has not been conducted because improvement jobs through the data analysis have not been done on the data collected. Currently the data collected is only used to produce monthly reports and understand market conditions. No improvement activities have been suggested to be carried out. A more concrete cost benefit analysis can be obtained when improvement activities are being implemented, only then can the cost benefit be analyzed correctly.

Just by creating measuring systems will not generate benefits unless people use them to improve on areas which link directly to sales. However, the suggested improvements and new functions do save a lot of time on manual work, especially for Delivery-On-Time and Order Lead-Time tools. Another advantage is that real and accurate data is being collected which will give a more correct analysis thus more appropriate improvement actions.

- g) Up till now, the four completed measuring tools have been used by the respective sections to generate reports and study on improvement activities to be carried out. Once the improvement activities are carried out, a period of monitoring time will be required before evaluation of the new production operation systems and KPI measuring tools.

4.3 Results

The following reports are generated using the database measuring tools.

Figure 4.1 shows the monthly results for delivery-on-time based on 'Request' whereas Figure 4.2 shows the monthly results based on 'Reply'

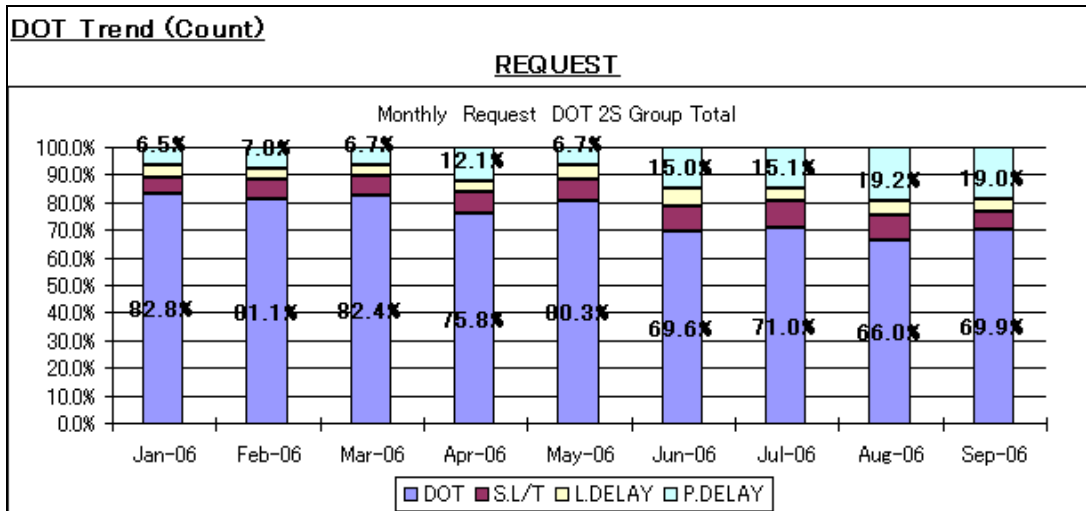


Figure 4.1

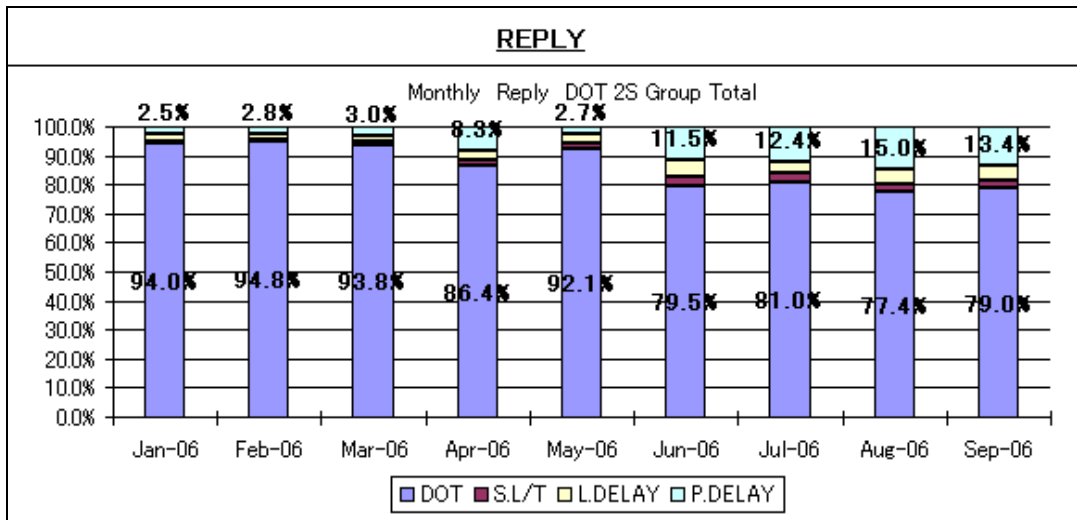


Figure 4.2

From the monthly records, there is a trend of DOT decreasing based on both request and reply. Production delays have increased about 10%. Analysis should focus on production delays products.

Figure 4.3 and Figure 4.4 shows the comparison of Production Lead-Time for August 2006 and September 2006 respectively.

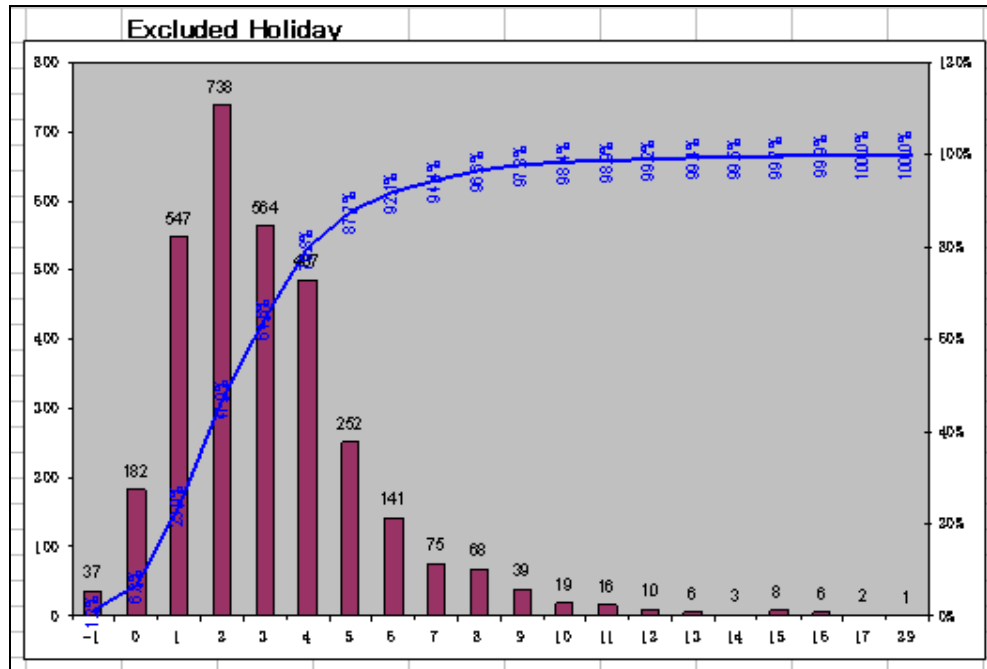


Figure 4.3

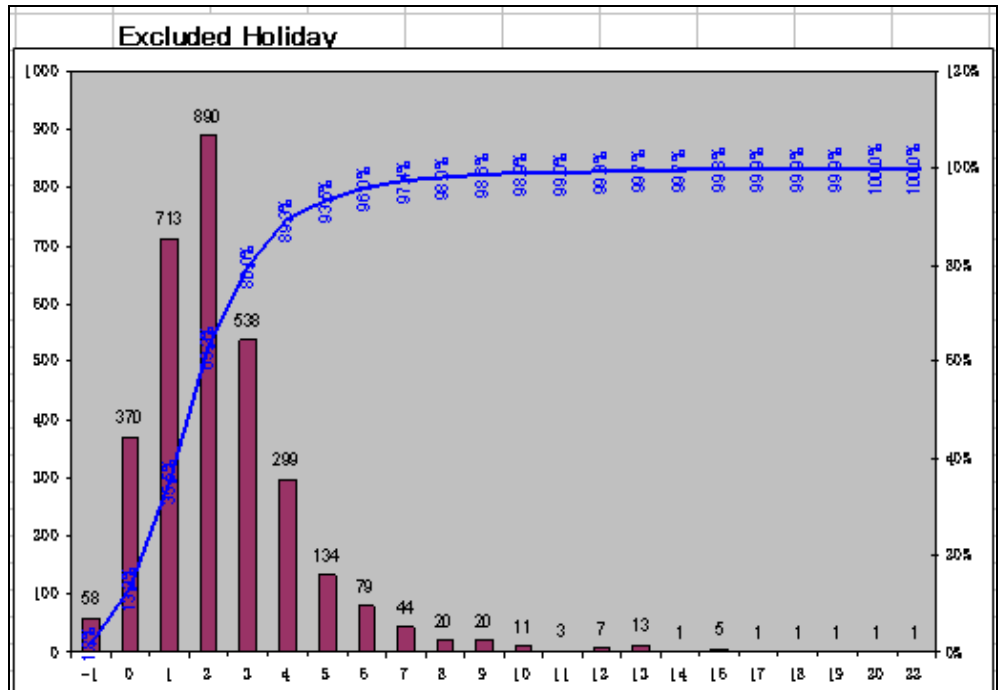


Figure 4.4

Figure 4.5 shows a comparison of Order Lead-Time data between August 2006 and September 2006 respectively.

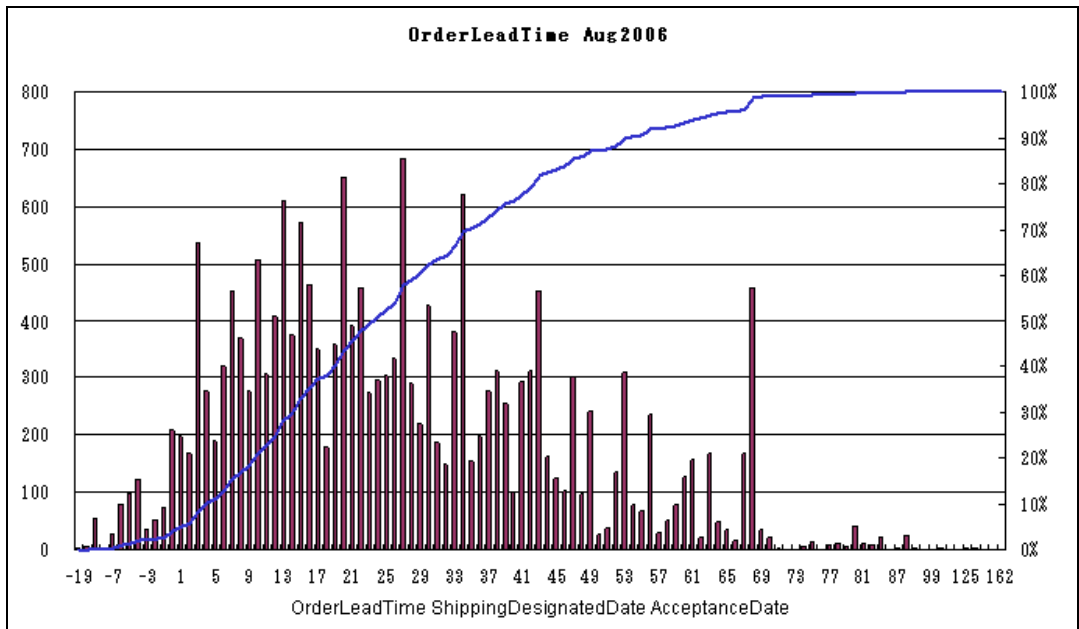


Figure 4.5

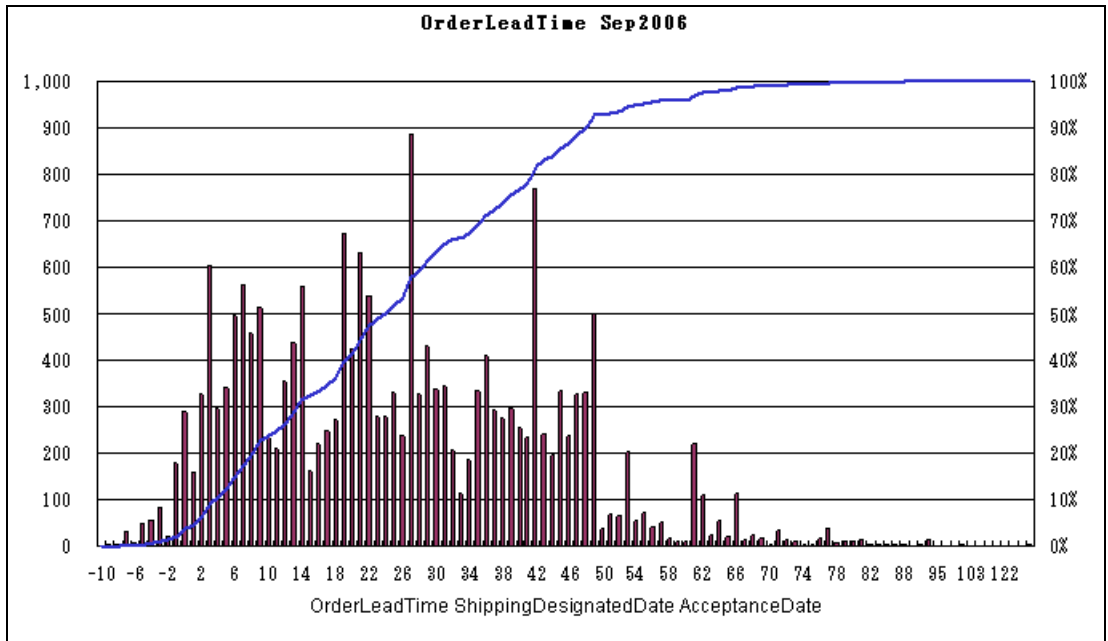


Figure 4.6

From the graphs, the 'negative' lead-time is due to short lead-time order. Hence, in August, there are more counts of delay due to short lead-time.

4.4 Future Work and New Ideas

This research project does not end here; there are a few tasks to be continued and a few enhancements on the new tools to make them more efficient. They are:

- a) WIP & Inventory and Plan versus Actual Production activities will be continued to complete the measuring tool.
- b) Improvement activities need to be carried out after KPI data analysis
- c) An evaluation on new measuring tools will be conducted by assessing the values created from the improvement actions carried out.
- d) For Delivery-On-Time measuring tool, after sorting the data into OK and NG delivery, and breaking down the NG data into short lead-time, production delay and logistic delay, details, e.g. lot number and part number, should be listed out so that studies can be done on why these lots or products encounter long production lead-time. This is to aid in focusing the problem products or maybe machines.
- e) For Production Lead-Time measuring tool, a couple of enhancements can be added because the production data consists of many other data fields which is useful. For example, there is process number data in the production data which can calculate the average lead-time of each process. We can also calculate the production lead-time for each machine since the machine number is available. In this way, we will be able to see which process is the bottleneck or identify machines that need to be serviced or modified.

4.5 Summary of Chapter 4

Chapter 4 summarizes the activities done in this research project and assesses how many of the objectives have been fulfilled. The more recent results have been shown to understand the sales and production conditions. Any incomplete tasks will be continued and improvement activities will be continuous. Constant evaluating and improvement actions are necessary lean operations.

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APPENDIX A

Faculty of Engineering and Surveying

Courses ENG4111/4112 RESEARCH PROJECT Part 1 & 2

Project Specification 2006

Student: Chua Poh Lian

Student No.: D1231790X

Title: Production and Operation – Key Performance Indicator System

Supervisor: R Fulcher

Project Aim: This project seeks to increase customers' satisfaction and improve production operation system through customising analysis tools to monitor various factor e.g. delivery time, production lead time, order lead time, order, sales and inventory.

Programme: Issue A, 24th March 2006

1. Research the background information relating to production operation performance and customers' satisfaction.
2. Evaluate current system in use for measuring the performance of production operation and customers' satisfaction.
3. Identify significant problems with current system and consider alternate methods to measure production operation system and customers' satisfaction.
4. Design new tools for performance indicators to analyse production systems.
5. Make proposed improvements to an existing system
6. Conduct a cost benefit analysis of the suggested improvements and new indicators.
7. Write a dissertation of the project work.

If time permits:

8. Implement the new production operation systems and collect data for the indicators
9. Evaluate the new production operation systems and key performance indicators' tools

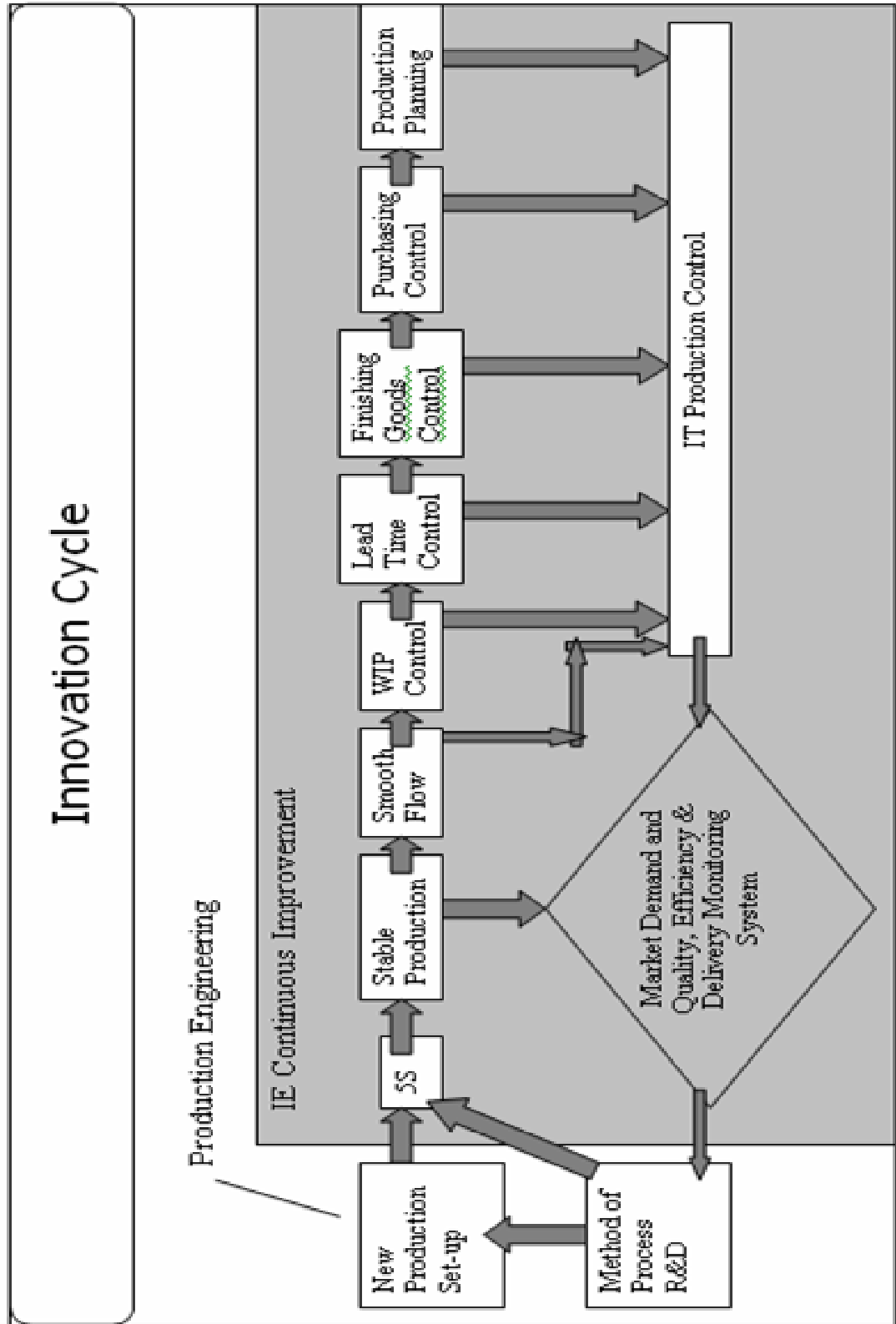
AGREED: Chua Poh Lian (Student)

(Dated) 24 / 03 / 2006

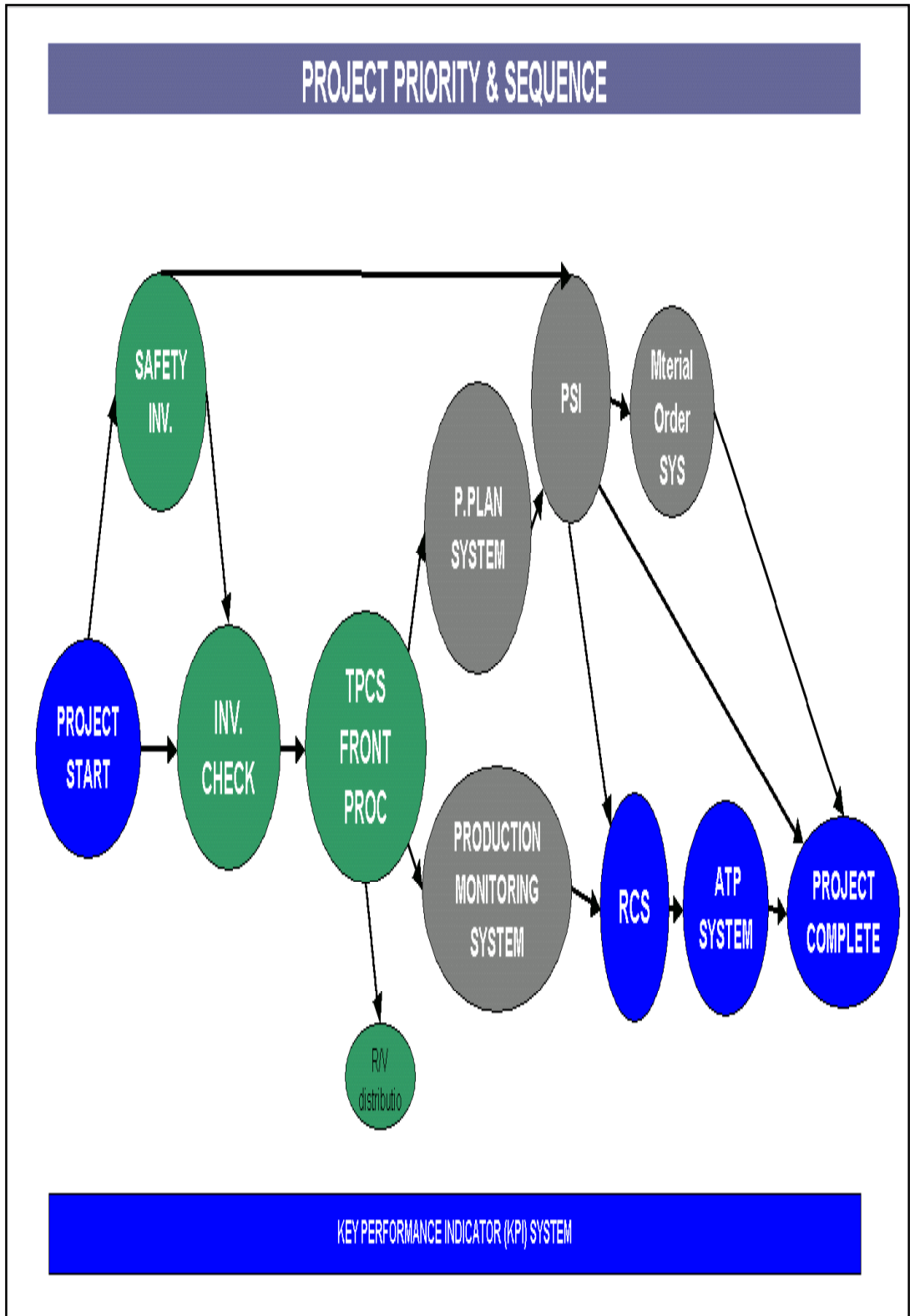
Mr. Bob Fulcher (Supervisor)

(Dated) 04 / 04 / 2006

APPENDIX B



APPENDIX C



GLOSSARY

5S --- Five terms beginning with 'S' utilized to create a workplace suited for visual control and lean production. *Seiri* means to separate needed tools, parts, and instructions from unneeded materials and to remove the latter. *Seiton* means to neatly arrange and identify parts and tools for ease of use. *Seiso* means to conduct a clean-up campaign. *Seiketsu* means to conduct *seiri*, *seiton* and *seiso* at frequent, indeed daily, intervals to maintain a workplace in perfect condition. *Shitsuke* means to form the habit of always following the first four Ss.

7 Wastes --- Taiichi Ohni's original enumeration of the wastes commonly found in physical production. These are *overproduction* ahead of demand, *waiting* for the next processing step, unnecessary *transport* of materials (for example, between process villages or facilities), *overprocessing* of parts due to poor tool and product design, *inventories* more than the absolute minimum, unnecessary *movement* by employees during the course of their work (looking for parts, tools, prints, help, etcetera), and production of *defective parts*.

Just-in-Time --- A system for producing and delivering the right items at the right time in the right amounts. Just-in-Time approaches just-on-time when upstream activities occur minutes or seconds before downstream activities, so single-piece flow is possible. The key elements of Just-in-Time are flow, pull, standard work (with standard in-process inventories), and takt time.

Total Production Maintenance (TPM) --- A series of methods, originally pioneered by Nippondenso (a member of the Toyota group), to ensure that every machine in a production process is always able to perform its required tasks so that production is never interrupted.