Customer Service Methods Analysis and Improvement for Thai Pure Drinks Ltd.

by

Mr. Thanakorn Khunakitti

A Final Report of the Three-Credit Course
CE 6998 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer and Engineering Management
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ABSTRACT

This project examines the Customer Service Methods Analysis and Improvement for Thai Pure Drinks Ltd. At present, the company has to pay OT for workers of Customer service because the job is not finished on time. This kind of job involves directly the service level of customers. This is the reason why the company pays OT for finished job in time. So to reduce time and eliminate unnecessary tasks in process will help the company save cost and increase utilization of workers' efficiency.

To reduce working time, the first thing to do is to find the process activity. Drawing the flow chart and stopwatch study are done to measure time in each activity at random. After timing each activity, the next step is to find whether this sample size is accurate enough or not. If the sample size is not enough, it is necessary to collect more. Calculation of normal time and normal cycle time are checked by multiplying with performance rating factor and finding standard time by multiplying allowance factors. The process be can divided into 4 process 1) Receive order by fax until picking product 2) Cancel PO with receive order by fax 3) Receive order by EDI until picking product 4) Cancel PO with receive order by EDI.

Improving process can be done by eliminating and reducing time of some activity. Reducing time can be done by computer system. Process Cancel PO which receives order by fax and EDI is not necessary for improvement because it does not take time and does not do routine work. The improved process can reduce by 322 seconds per PO for process receiving order by fax and 217 seconds per PO for process receiving order by EDI. The working machine chart can improve operation utilize from 93% to 100% by worker works doing parallel activities with working machines. The future study will improve warehouse system, separate study on element picking products because this element affects the sample size of other elements.

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I. INTRODUCTION

1.1 Overview of Thai Pure Drink Ltd.

Thai Pure Drinks Ltd. is the first bottler in Thailand that formally cooperates with Coca-Cola in the USA. Coca-Cola is a quality refreshment product sold at a minimum price. It is easy to buy, support a new market continuously and find new software that helps production, logistics, management. At present , product of Coca-Cola is leader of beverage market in Thailand. Information from AC Nielsen Demur Thailand Retail Audit Service shows the result about Coca-Cola in Thailand that it has a share market over 60% in 1989 and a big market in South East Asia by customers consuming about 69 glass/people/year. Coca-Cola system is the same standard system all over the world and it is considered to give benefit to Thai society. The company tried to create activities for the society especially teenagers who are important to the country. At present, the company has over 12,000 employees and the head office is at North park Vipavadee Rungsit Rd..and there are 7 manufacturing plants at Huamark, Pathenthani , Rangsit , Bangchan, Lampang , Khonkean and Korat plant. There are 63 branch ware houses distributing in Thailand (except South province). For the product of the Thai Pure Drinks Ltd. it sells the soft drinks products produced on its own such as Coke, Coke diet, Fanta (Oranges, Strawberry, Fruit Punch, Grape, Pineapple ,Namthip, Qoo,etc and does not produce(only distribution by join venture with Nestle) such as Nescafe.The package can be divided according to the size of bottles and cans , 600 CC., 15 OZ., 2 Litres, 1.25 Liters, 10 Oz., 250 CC., 1500 CC., 180 CC.There are production lines according to Pathenthani =7 lines , Huamark = 6 lines ,Rangsit =3 lines , Khonkean =2 lines, Lampang =2 lines, Korat 2 lines.

1.2 Problems

Now Rangsit plant is the biggest plant and it is the only plant of Thai Pure Drinks Ltd. Customer service section is one part of transportation department in Rangsit plant. It supplies products to key account that consists of Hypermarket such as Lotus, Makro, Big C, Carrefour, and supermarket such as, Tops, Jusco, convenience & gas station stores such as 7-11. The process begins with receiving order until delivery to customers is done. From the sales volume and number of key accounts tend to increase every year. The demands of this key account are high and fluctuating. So now the processes take a long time and there are many mistakes. This affects customers' satisfaction and cost ,etc. Time motion study helps to identify the task unnecessary for work and manual work. It will eliminate unnecessary tasks and try to improve the system by computer. Some tasks may create problems that affect the work. So it is necessary to improve the process to help to increase sales volume, increase customer satisfaction, reduce cost of management, and reduce manpower.

1.3 Method Standard and Work Design Problem

The importance of work system design is underscored by the organization ' s dependence on human efforts to accomplish its goals. Work design is one of the oldest aspects of operations management. In the past , it has often been de-emphasized in operations management course in favor of other topics. Recent years, however, have seen renewed interest that has come from somewhat different directions: Some of the interest has resulted from studies that reveal a general dissatisfaction felt by many workers with their jobs. And some of the interest has been sparked by increasing concerns over productivity. It is perhaps ironic that one of the oldest fields of operations management is now an important key to productivity improvement and to continuous improvement.

It is important for management to make design of work systems a key element of its operations strategy. In spite of the major advances in computers and manufacturing technology, people are still the heart of a business; they can make or break it , regardless of the technology used. Technology is important, of course , but technology alone is not enough.

Workers can be a valuable source of insight and creativity because they actually perform the jobs and are closest to the problems that arise. All too often, managers have overlooked contributions and potential contributions of employees, sometimes from ignorance and sometimes from a false sense of pride. Union-management differences are also a factor. More and more , though , companies are attempting to develop a spirit of cooperation between employees and managers , based in part on the success of Japanese companies. In the same vein, an increasing number of companies are focusing some of their attention on improving the quality of work life and instilling pride and respect among workers. Many organizations are reaping surprising gains through worker empowerment , giving workers more say over their jobs.

People work for a variety of reasons. Economic necessity is among the most important, but beyond that, people work for socialization, to give meaning and purpose to their lives, for status, for personal growth, and for other reasons. These motivations can play an important role in the lives of workers, and management should accord them serious consideration in the design of work system.

1.4 Objectives

To study how a job is done and suggest possible improvements of customer service. To minimize the time required to perform tasks and eliminate unnecessary tasks.

1.5 Scope

The project scope covers identifying the process of receiving orders from customers until loading products on trucks. It will find the normal time, standard time, etc. identify unnecessary tasks and problematic tasks. Then it will improve by adapting software and eliminating unnecessary tasks and problematic tasks for more effective work.

II. LITERATURE REVIEW

2.1 Job Design (Russell and Taylor III, 2003)

Job design involves specifying the content and methods of jobs. In general , the goal of job design is to create a work system that is productive and efficient. Job designers are concerned with who will do a job , how the job will be done , and where the job will be done.

To be successful, job design must be:

(1) Carried out by experienced personnel who have the necessary training and back ground

(2) Consistent with the goals of the organization.

(3) In written form.

(4) Understood and agreed to by both management and employees.

The factors that affect job design and the implications of various alternatives are often so complex that a person without a good background in job design is likely to overlook important aspects of it. Workers and managers alike should be consulted in order to take advantage of their knowledge and to keep them informed. Because they are intimately involved with the work, employees are the source of valuable ideas for job improvements. Managerial support for job design depends on the commitment and involvement of managers. It is usually easier to sell a design to these two groups if they have been included in the process.

Current practice in job design contains elements of two basic schools of thought. One might be called the efficiency school because it emphasizes a systematic, logical approach to job design; the other is called the behavioral school because it emphasizes satisfaction of wants and needs.

The efficiency approach, a refinement of Frederick Winslow Taylor's scientific management concepts , received considerable emphasis in the past. The behavioral approach emerged during the 1950s and has continued to make inroads into many aspects of job design. A main contribution of the behavioral approach is that it has reminded managers of the complexity of human beings, and that the efficiency approach may not be appropriate in every instance.

The behavioral view received a shot in the arm in the 1970s when Work in America was released , a report detailing some of the problems that exist in our work systems. The report revealed an apparently widespread dissatisfaction on the part of workers across the spectrum of jobs. Two points were of special interest to job designers. One was that many workers felt that their jobs were not interesting; the other was that workers wanted more control over their jobs. The central issue seemed to be the degree of specialization associated with jobs : high specialization appeared to generate the most dissatisfaction. It is noteworthy that specialization is a primary issue of disagreement between the efficiency and behavioral approaches.

In an effort to make jobs more interesting and meaningful , job designers frequently consider job enlargement , job rotation , job enrichment , and increased use of mechanization.(Nadler,1995)

Job enlargement means giving a worker a larger portion of the total task. This constitutes horizontal loading the additional work is on the same level of skill and responsibility as the original job. The goal is to make the job more interesting by increasing the variety of skills required and by providing the worker with a more recognizable contribution to the overall output. For example , a production worker's job might be expanded so that he or she is responsible for a sequence of activities instead of only one activity. (Nadler,1995)

Job rotation means having workers periodically exchange jobs. A firm can use this approach to avoid having one or a few employees stuck in monotonous jobs. It works best when workers can be transferred to more interesting jobs; there is little advantage in having workers exchange one boring job for another. Job rotation allows workers to broaden their learning experience and enables them to fill in for other in the event of sickness or absenteeism. (Nadler,1995)

Job enrichment involves an increase in the level of responsibility for planning and coordination tasks. It is sometimes referred to as vertical loading. An example of this is to have stock clerks in supermarkets handle reordering of goods, thus increasing their responsibilities. The job enrichment approach focuses on the motivating potential of worker satisfaction. (Nadler, 1995)

The importance of these approaches to job design is that they have the potential to increase the motivational power of jobs by increasing worker satisfaction through improvement in the quality of work life. Many firms are currently involved in or seriously considering programs related to quality of work life. In addition to the aforementioned approaches , organizations are also experimenting with choice of locations, flexible work hours, and teams. (Nadler,1995)

The efforts of business organizations to become more productive , competitive , and customer-oriented have caused them to rethink how work is accomplished. Significant change in the structure of some work environments have been the increasing use of teams and the way workers are paid, particular in lean production systems. (Nadler,1995)

In the past , no routine job assignments , such as dealing with customer complaints or improving a process, were typically given to one individual or to several individuals who reported to the same manager. More recently, no routine assignments are being assigned to teams who develop and implement solutions to problems. Responsibility for the assignment is shared among team members, who often decide among themselves how the work is to be accomplished. (Nadler,1995)

Self-directed teams, sometimes referred to as self-managed teams, are designed to achieve a higher level of teamwork and employee involvement. Although such teams are not given absolute authority to make all decisions, they are typically empowered to make changes in the work processes under their control. The underlying concept is that the workers, who are close to the process and have the best knowledge of it , are better suited than management to make the most effective changes to improve the process. (Nadler,1995)

Moreover, because they have a vested interest and and personal involvement in the changes, they tend to work harder to ensure that the desired results are achieved than they would if management had implemented the changes. For these teams to function properly, team members must be trained in quality, process improvement, and teamwork. Self-direct teams have a number of benefits. One is that fewer managers are necessary; very often one manager can handle several teams. Also, self-directed team can provide improved responsiveness to problems, they have a personal stake in making the process work, and they require less time to implement improvement. (Nadler,1995)

Steps to be followed in making a Process Flowchart

(1) Determine the activity to be studied. Decide whether the subject to be followed is a person, product, part, material, or printed form. Do not change subjects during the construction of the process flowchart.

(2) Choose a definite starting point and ending point in order to make certain that you will cover the activity that you want to study.

(3) Draw the process flowchart on a sheet of paper of sufficient size to allow space for (a) the heading, (b) the description, and (c) the summary. The heading should identify the process being studied. The body of the process flowchart should contain a column for Travel (distance in feet), Symbol, Description, and possibly Time. The five process flowchart symbols should be used. Every step in the process should be shown if the analysis is to be of real value. Unnecessary steps and inefficiencies in the work must first be 'seen' before they can be eliminated.

(4) Include on the process flowchart a tabular summary showing the number of operations, number of moves of each kind, distance the part moves, number of inspections, and number of storages and delays. After improvements have been old method, the proposed method, and the difference.

(5) Obtain floor plans of the department or the plant, showing location of machines and equipment used in making the part. If these are not available, draw floor plans to scale. It is frequently desirable to mount the floor plans on a drawing board or table, cut out cardboard templates the size of the machines (scale 0.25 inch = 1 foot), and use these when new arrangements for the equipment are suggested. Sometimes three-dimensional scale models of machines and equipment are used instead of templates.

(6) Draw on the floor plans in pencil the path of the part through the plant, noting the direction of travel by means of arrows. The flow diagram should be made on location and not from memory at a desk. Distances should be measured or paces off.

Often a process flowchart is used in combination with other types of methods analysis charts and a written job description to form a comprehensive and detailed picture of a job. Essentially, the methods analyst is a 'job detective', who wants to get as much evidence as possible about a job from as many perspectives as possible in order to improve the job.

2.2 Selecting an Operation to Study (Russell and Taylor III, 2003)

Sometimes a foreman or supervisor will request that a certain operation be studied. At other times, methods analysis will be part of an overall program to increase productivity and reduce costs. Some general guidelines for selecting a job to study are to consider jobs that:

(1) Have high labor content.

(2) Are done frequently.

(3) Are unsafe, tiring, unpleasant, and/or noisy.

(4) Are designated as problems.(e.g., quality problems, scheduling bottlenecks).

The Selection of Method is according to

(1) Documenting the Present Method. Use charts, graphs, and verbal descriptions of the way the job is now being performed. This will provide a good understanding of the job and serve as a basis of comparison against which revisions can be judged.

(2) Analyzing the job and proposing new methods. Analysis requires careful thought about what, why, when, where, and who of the job. Often , simply going through these questions will clarify the review process by encouraging the analyst to take a devil's advocate attitude toward both present and proposed methods. Analyzing and improving methods is facilitated by the use of various charts such as flow process charts and worker-machine charts. Flow process charts are used to review and critically examine the overall sequence of and operation by focusing on the movements of the operator or

the flow of materials. These charts are helpful in identifying nonproductive parts of the process (e.g., delays, temporary storages, distances traveled).The uses for flow process charts include studying the flow of material through a department, studying the sequence that documents or forms take, analyzing movement and care of surgical patients, layout of department and grocery stores, and mail handling. Experienced analysts usually develop a checklist of questions they ask themselves to generate ideas for improvements. Some representative questions are:

(a) Why is there a delay or storage at this point?

(b) How can travel distances be shortened or avoided?

(c) Can materials handling be reduced?

(d) Would a rearrangement of the workplace result in greater efficiency?

(e) Can similar activities be grouped?

(f) Would the use of additional or improved equipment be helpful?

(g) Does the worker have any ideas for improvements?

A worker-machine chart is helpful in visualizing the portions of a work cycle during which an operator and equipment are busy or idle. The analyst can easily see when the operator and machine are working independently and when their work overlaps or is interdependent. One use of this type of chart is to determine how many machines or how much equipment the operator can manage.

(3) Installing the Improved Method. Successful implementation of proposed method changes requires convincing management of the desirability of the new method and obtaining the cooperation of the worker. If the worker has been consulted throughout the process and has made suggestions that are

incorporated in the proposed changes , this part of the task will be considerably easier than if the analyst has assumed sole responsibility for the development of the proposal.If the proposed method constitutes a major change from the way the job has been performed in the past , workers may have to undergo a certain amount of retraining, and full implementation may take some time to achieve.

2.3 The Elements of Job Design (Russell and Taylor III, 2003)

The Elements of Job Design fall into three categories according to

(1) An analysis of the tasks included in the job

Task analysis determines:

(a) how to do each task and how all the tasks fit together to form a job.

(b) defining the individual tasks.

(c) determining their most efficient sequence, their duration, their relationship with other tasks, and their frequency.

The task results in a step-by-step procedure for the job because the task analysis should be sufficiently detailed. The sequence of tasks in some job is logical ordering. The performance requirements of a task:

(a) Time required to complete the task

(b) The accuracy in performing the task to specifications

(c) The output level of productivity yield

(d) The quality performance

(e) Some tasks require information such as a measurement, temperature, weight, or a litmus test (for a chemical process).

(2) An analysis of employee requirements

Worker Analysis determines:

(a) The characteristics the worker must possess to meet the job requirements

(b) The responsibilities the worker will have in the job

(c) How the worker will be rewarded

(d) Environmental Analysis

(3) An analysis of the environment in which the job takes place refers to the physical location of the job in the production or service facility and the environmental conditions that must exist.These conditions include things such as proper temperature, lighting, ventilation, and noise. The production of microchips requires an extremely clean, climatically controlled, enclosed environment. Details work, such as engraving or sewing, requires proper lighting; some jobs that create dust levels, such as lint in textile operations, require proper ventilation. Some jobs require a large amount of space around the immediate job area.

For job analysis, part of job designs is to study the methods used in the work included in the job to see how it should be done. This has traditionally been referred to as Methods Analysis, or simply Work Methods.

These categories address the questions of how the job is performed, who does it, and where it is done. It is shown in Table 2.1

Table 2.1. Categories of Task, Worker, and Environmental Analysis.

Task Analysis	Worker Analysis	Environmental Analysis
- Description of tasks to be performed	- Capabilities requirements	- Workplace location
- Task sequence	- Performance requirements	- Process location
- Function of tasks	- Evaluation	- Temperature and humidity
- Criticality of tasks	- Skill level	- Lighting
- Relationship with other jobs/tasks	- Job training	- Ventilation
- Performance requirements	- Physical requirements	- Safety
- Information requirements	- Mental stress	- Logistics
- Control requirements	- Boredom	- Space requirements
- Error possibilities	- Motivation	- Noise
- Task duration(s)	- Number of workers	- Vibration
- Equipment requirements	- Level of responsibility	
	- Monitoring level	
	- Quality responsibility	
	- Empowerment level	

2.4 **Methods Analysis** (Russell and Taylor III, 2003)

Methods Analysis is used to redesign or improve existing jobs. An analysis will study an existing job to determine if the work is being done in the most efficient manner possible; if all the present tasks are necessary; or if new tasks should be added. The analyst might also want to see how the job fits in with other jobs – that is, how well a job is integrated into the overall production process or a sequence of jobs. The development and installation of new machinery or equipment, new products or products or product changes, and changes in quality standards can all require that a job be analyzed for redesign.

Methods Analysis is also used to develop new jobs. In this case the analyst must work with a description or outline of a proposed job and attempt to develop a mental picture of how the job will be performed.

Methods analysis focuses on how a job is done. Job design after begins with a methods analysis of an overall operation. It then moves from general to specific details of the job, concentrating on arrangement of the workplace and movements of materials and workers. Methods analysis can be a goof source of productivity improvements.

The need for methods analysis can come form a number of difference sources: (Barnes, 1980)

(1) Change in tool and equipment

(2) Change in product design, or new product.

(3) Change Me materials or procedures.

(4) Government regulations or contractual agreements.

(5) Other factors (e.g. accidents, quality problems.)

Methods analysis is done both for existing jobs and new jobs. Although it might seem strange to analyze methods of a new job, it is needed to establish a method for a new job. For an existing job, the procedure usually is to have the analyst observe the job as it is currently being performed and they devise improvements. For a new job, the analyst must rely on a job description and an ability to visualize the operation.

The basic procedures in methods analysis are:

(1) Identify the operation to be studied, and gather all pertinent facts about tools,

equipment, materials, and so on.

(2) For existing jobs, discuss the job with the operator and supervisor to get their input.

(3) Study and document the present method of an existing job using process charts. For new jobs, develop charts based on information about the activities involved.

(4) Analyze the job.

(5) Propose new methods.

(6) Install the new methods.

(7) Follow up installation to assure that improvements have been achieved

Tools of Methods Analysis. (Barnes, 1980)

The primary tools of methods analysis are a variety of charts that illustrate in different ways how a job or a work process is done. These charts allow supervisors, managers, and workers to see how a job is accomplished and to get their input and feedback on the design or redesign process.

Two of the more popular charts are:

(1) Process Flowchart.A process flowchart is used to analyze how the steps of a job or how a set of jobs fit together into the overall flow of the production process. Examples might include the flow of a product through a manufacturing assembly process, the making of a pizza, the activities of a surgical team in an operating room, or the processing of a catalog mail or telephone order. The process flowchart may profitably be almost anyone in an organization. The supervisors and the process and layout engineers should be as familiar with the process flowchart as the industrial engineer and should be able to use it.Many years ago the Gilberts devised a set of 40

symbols which they used in making process flowcharts. The American Society of Mechanical Engineers has established as a standard of the five symbols. It is shown in Table 2.2.

Table 2.2. The Symbols of The Process Chart.

○	**Operation**: An activity directly contributing to the product or service.	An operation occurs when an object is intentionally changed in one or more of its characteristics. An operation represents a major step in the process and usually occurs at a machine or work station.
⇨	**Transportation**: Moving of the product or service from one location to another.	A transportation occurs when an object is moved from one place to another, except when the movement is and integral part of an operation or an inspection.
□	**Inspection**: Examining the product or service for completeness, irregularities, or quality.	An inspection occurs when an object is examined for identification or is compared with a standard as to quantity or quality.
D	**Delay**: The process having to wait.	A delay occurs when the immediate performance of the next planned action does not take place.
▽	**Storage**: Storing of the product or service.	A storage occurs when an object is kept under control such that its withdrawal requires authorization.

The five symbols are shown in Figure below to describe the tasks or steps in a job or a series of jobs.

(2) Worker-Machine Chart.A Worker-Machine Chart illustrates the amount of time a worker and a machine are working or idle in a job. This type of chart is occasionally used in conjunction with a process flowchart when the job

process includes equipment or machinery. A Worker-Machine Chart shows if the worker's time and the machine time are being used efficiently – that is, if the worker or machine is idle an excessive amount of time. The worker and the machine work intermittently on some types of work. That is, the machine is idle while the operator leads it and while he or she removes the finished work from it and the worker is idle while the machine is in operation. It is desirable to eliminate idle time for the worker, but it is equally important that the machine be kept operating as near capacity as possible.The first step in eliminating unnecessary waiting time for the operator and for the machine is to record exactly when each works and what each does. Many operations consist of three main steps: (1) GET READY, such as putting material in the machine; (2) DO(doing the work), such as drilling a hole; and (3) PUT AWAY or clean up, such as removing the finished piece from the machine.Very often a clearer picture of the relationship of the operator's working time and the machine times can be obtained by showing the information graphically to scale.

2.5 Motion Study (Martinich, 1997)

The most detailed form job analysis is Motion Study, the study of the individual human motions used in a task.

The purpose of motion study is:

(1) To make sure that a job task does not include any unnecessary motion by the worker

(2) To select the sequence of motions that ensure that the task is being performed in the most efficient way.

Motion study is a formalized procedure for observation and timing worker movements to determine the time required for each movement or task. In some cases, information can be timed and recorded as the work is being done. In other cases, it is better to videotape the worker and record the times of movements afterward. If the number of distinct movements or activities is small enough and the amount of time spent doing each one is long enough , then real-time recording of the data is feasible .This approach has the advantages of low cost, flexibility, and adaptability. For example. If a worker moves away from his normal work area or repositions his body to make it direful to see exactly what is being done, a human observer can often move accordingly to identify and time the action. Real-time motion studies do not work well, however , if several tasks are being performed, with little time spent on each. The observer/recorder simply cannot watch and time raped movements quickly enough. In adition, workers may change their behavior when observed; they may intentionally slow down or misrepresent the difficulty of the work to discourage establishment of excessively fast work standards, or they may simply be distracted.(Martinich, 1997)

Videotaped motion studies are usually performed using a stationary camera (having someone walking around with a camera can be even more distracting and intimidating to a worker than having a human observer).Videotaped times studied are more accurate because the timing and recording can be done after the fact and checked. By slowing the videotape and retiming the activities, it is possible to measure more raped and refined movements. However, this is a more expensive process and is less will suited for jobs that require workers to move around. (Martinich, 1997)

2.6 Job Measurement (Mundel, 1980)

Job measurement is determining how long it takes to do a job. Managing human resources requires managers to know how much work employees can do during a specific period. Otherwise they cannot plan production schedules or output. Without a good idea of how long it takes to do a job, a company will not know if it can meet customer expectations for delivery or service time. Despite the unpopularity of wage-incentive systems among some TQM proponents, they are still widely used in the United States, and job measurement is required to set the output standards in which inventive rates are based. These wage rates determine the cost of a product or service.

The traditional means for determining an estimate of the time to do a job has been the time study, in which a stopwatch is used to time the individual elements of a job. These elemental times are summed to get a time estimate for a job and then adjusted by a performance rating of the worker and an allowance factor for unavoidable delays, resulting in a standard time.

The standard time is the time required by an 'average' worker to perform a job once under normal circumstances and conditions.

Time study and the other methods of job measurement are now used for many purposed including:

(1) Determining Schedules and planning work.

(2) Determining standard costs and as an aid in preparing budgets.

(3) Estimating the cost of a product before manufacturing it. Such information is of value in preparing bids and in determining selling price.

(4) Determining machine effectiveness, the number of machines which one person can operated, and as an aid in balancing assembly lines and work done on a conveyor.

(5) Determining time standards to be used as a basis for the payment of a wage incentive to direct labor and indirect labor.

(6) Determining time standards to be used as a basis for labor cost control.

Time study, predetermined time systems, standard data, and work sampling are used for measuring work in industry. Time study is the most versatile and the most widely used. Although work sampling has limited use for determining time standards, it is very effective for obtaining information about activities of operators and machines. There are several methods and devices used for measuring work. It is shown in Table 2.4

Table 2.3. Methods and Devices for Measuring Work.

• Time Study	Data obtained by means of (1)Stop watch-electronic timer (a) Decimal-minute stop watch (b) Decimal-hour stop watch (c) Decimal-minute electronic timer (2) Electroning data collector-computer-aided (a) Datamyte (3) Motion picture cameras (a)Spring-driven or battery-driven (b)Electric motor-driven (c)Time-lapse (4)Video cameras and recorders (5)Machine using moving tape or disc (6)Odometer-type counters
• Standard Data	Information obtained from time study or predetermined time systems
• Predetermined Time Systems	(1)The work- Factor System (2) Methods- Time Measurement
• Work Sampling	Measurement by sampling methods (1) Observer obtains and records data (2) Motion picture camera records information (3) Video camera and recorder (3) Electronic data collector-computer aided

2.7 Stopwatch Time Study (Mundel, 1980)

The stopwatch time study approach for work measurement was popular and widespread in the 1970s. Many union contracts in the automotive, textile, and other manufacturing industries for virtually every production job in a company were based almost entirely on standard times developed from time studies. However, the basic principle pointed out earlier in this chapter that this principle has been disproved. In fact, in recent years incentive wage systems have been shown to inhibit quality improvement.

The result of a time study is a standard time for performance a repetitious job once. Time study is a statistical technique that is accurate for jobs that are highly repetitive.

The basic steps in a time study are:

(1) Establish the standard job method. The job should be analyzed using methods analysis to make sure the best method is being used.

(2) Break down the job into elements. The job is broken down into short, elemental tasks with obvious 'break points' between them.

(3) Study the job. Times studies have traditionally been conducted using a stopwatch attached to a clipboard, although hand-held electronic time study machines are now available. To conduct a time study with a stopwatch, the industrial engineer or technician takes a position near the worker and records each elemental time on an observation sheet.

(4) Rate the worker's performance. The objective of the study is to determine a 'normal', or average, time for the job, so the engineer/technician must adjust the elemental times up or down with a rating factor. The observer

conducting the study must 'judge' the difficulty of the job and mentally assess what normal performance is, primarily in terms of 'speed'.

(5) Compute the average time. Once a sufficient number of job cycles have been observed, an average time for each work element is calculated.

(a) Compute the normal time.

The normal time is calculated by :

Normal time = (elemental average time)(rating factor)

$$\text{or} \quad \text{Nt} = (\bar{t})(\text{RF})$$

The normal cycle time (NT) is computed by summing the elemental normal times, $\text{NT} = \sum \text{N}t$

(b) Compute the standard time. The standard time is computed by adjusting the normal cycle time by an allowance factor for unavoidable work delays, and normal mental or physical fatigue. The allowance factor is a percentage increase in the normal cycle time. The standard time is calculated as follows:

Standard time = (normal cycle time)(1+allowance factor)

$$\text{or} \quad \text{ST} = (\text{NT})(1+\text{AF})$$

Before the calculation the first thing that we have to know is the sample size. This is sufficient for us to have confidence that the standard time was accurate. The time study is actually a statistical sample distribution, where the number of cycles is the sample size.

(c) Compute the Number of Cycles calculation. assuming that this distribution of sample times is normally distributed(a traditional assumption for time study), we can use the following formula to determine the sample size, *n*, for a time study:

$n \quad = \quad [zs/e\bar{T}]^2$ where

z = the number of standard deviations from the mean in a normal distribution reflecting a level of statistical confidence

$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$ = sample standard deviation from the sample time study

$\bar{T}$ = the average job cycle time form the sample time study

e = the degree of error from the true mean of the distribution

Approach for developing time standards:

(1) Elemental Time Files.Time studies can also be time-consuming and costly. So many companies have accumulated large files of time study data conducting an actual time study, these Elemental Standard Time Files can be accessed to derive the standard time, or the elemental times in the files can be used in conjunction with current time study data, reducing the time and cost required for the study.

(2) Predetermined Motion Times. The predetermined motion time system provides normal times for basic, generic micro-motion, such as reach, grasp, move, position, and release, that are common to many jobs. To develop a standard time using predetermined motion times, a job must be broken down into its basic micro-motions. Then the appropriate motion time is selected form a set of tables(or a computerized database), taking into account job conditions such as the weight of an object moved and the distance it might

be moved. The standard time is determined by summing all the motion times. As might be suspected, even a very short job can have many motions; a job of only 1 minute can have more than 100 basic motions.

Advantages

(1) It enables a standard time to be developed for a new job before the job is even part of the production process.

Disadvantages

(1) It ignores the job context within which a single motion takes place- that is, where each motion is considered independently of all others.

(2) Although predetermined motion times are generally determined from a broad sample of workers across several industries, they may not reflect the skill level, training, or abilities of workers in specific company.

Work Sampling is a technique for determining the proportion of time a worker or machine spends on various activities. The procedure for work sampling is to make brief, random observations of a worker or machine over a period of time and record the activity in which they are involved. An estimate of the proportion of time that is being spent on an activity is determined by dividing the number of observations recorded for that activity by the total number of observations.The primary uses of work sampling are to determine ratio delay, which is the percentage of time a worker or machine is delayed or idle, and to analyze jobs that have nonrepetitive tasks. (Martinich,1997)

The steps in work sampling are summarized as follows: (Martinich,1997)

(1) Defined the job activities. The activities that are to be observed must be exhaustive so that any time an observation is made, an activity is clearly indicated.

(2) Determine the number of observations in the work sample. The purpose is to calculate a proportion of time that a worker is performing a specific job activity. The degree of accuracy of the work sample depends on the number of observations, or sample size. The larger the sample size, the more accurate the proportion estimate will be. The accuracy of the proportion, *p*, is usually expressed in terms of an allowance degree of error, *e*, with a degree of confidence of 95 to 98 percent. Assuming the sample is approximately normally distributed, the sample size can be determined using the formula:

$$n = [z]^2\, \bar{p}(1-\bar{p})/e^2$$

where

n= the sample size (number of sample observations)

z= the number of standard deviations from the mean for the desired level of confidence

e= the degree of allowable error in the sample estimate

p= the production of time spent on a work activity estimated prior to calculating the work sample

(3) Determine the length of the sampling period. The length of the work sampling study must be sufficient to record the number of observations for the work activity determine in step 2. The most direct way to achieve randomness is to tie the observation schedule to a table to computer program of random numbers.

(4) Conduct the work sampling study and observations. In the final step the observations are tallied and the proportion, p, is computed by dividing the number of activity observations by the total number of observations.

(5) Periodically recompute the number of observations. It is beneficial periodically to recompute the sample size, n, based on preliminary values of p to see if more or fewer observations are needed than first determined. Work sampling is an easier, cheaper, and quicker approach to work measurement than time study. It tends to be less disruptive of the workplace and less annoying to workers, because it requires much less time to sample than time study. Also, the 'symbolic' stopwatch is absent. A disadvantage is the large number of observations needed to obtain an accurate sample estimate, sometimes requiring the study to span several days or weeks.

2.8 Learning Curve (Russell & Taylor III, 2003)

A learning curve, or improvement curve, is a graph that reflects the fact that as workers repeat their tasks, they will improve performance.

The learning curve effect was introduced in 1936 in an article in the Journal of Aeronautical Sciences by T.P.Wright, who described how the direct labor cost for producing airplanes decreased as the number of planes produced increased. This observation and the rate of improvement were found to be strikingly consistent across a number of airplane manufacturers. The promise of the learning curve is that improvement occurs because workers learn how to do a job better as they produce more and more units. However, it is generally recognized that other production-related factors also improve performance over time, such as methods analysis and improvement, job redesign, retooling, and worker motivation. It is shown in Figure 2.1.

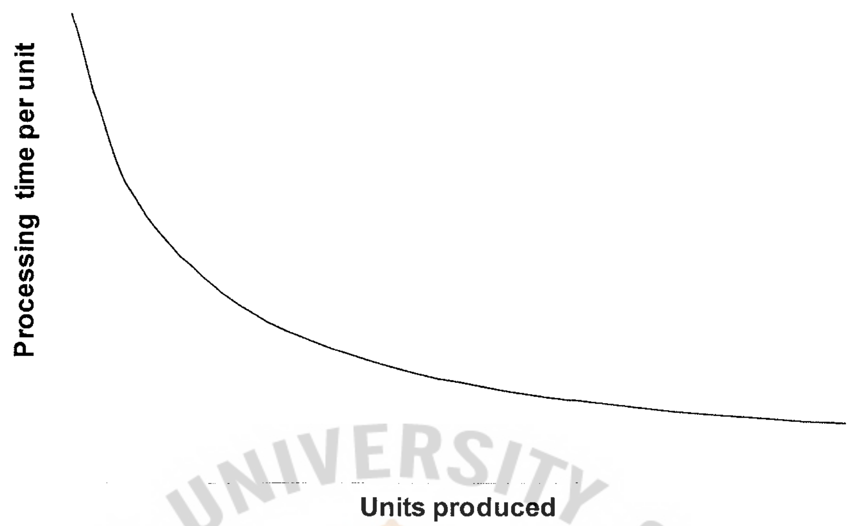


Figure 2.1. A Learning Curve.

The learning curve illustrates the general relationship defined by the learning curve; as the number of cumulative units produced increases, the labor time per unit decreases. Specifically, the learning curve reflects the fact that each time the number of units produced doubles, the processing time per unit decreased by a constant percentage.

The decrease in processing time per unit as production doubles will normally range from 10 to 20 percent. The convention is to describe a learning curve in terms of 1, or 100 percent, minus the percentage rate of improvement.

The learning curve in the figure above is similar to an exponential distribution. The corresponding learning curve formula for computing the time required for the *n*th unit produced is

$$t_n = t_1 n^b$$

where

t_n = the time required for the nth unit produced

t_1 = the time required for the first unit produced

n = the cumulative number of units produced

$b = \ln r / \ln 2$, where r is the learning curve percentage (decimal coefficient)

Learning curves are useful for measuring work improvement for non repetitive, complex jobs requiring a long time to complete, such as building airplanes.

For short, repetitive, and routine jobs, there may be little relative improvement, and it may occur in a brief time span during the first (of many) job repetitions. For that reason, learning curves can have limited use for mass production and assembly-line-type jobs. A learning curve for this type of operation sometimes achieves any improvement early in the process and then flattens out and shows virtually no improvement, as reflected in Figure 2.2 below:

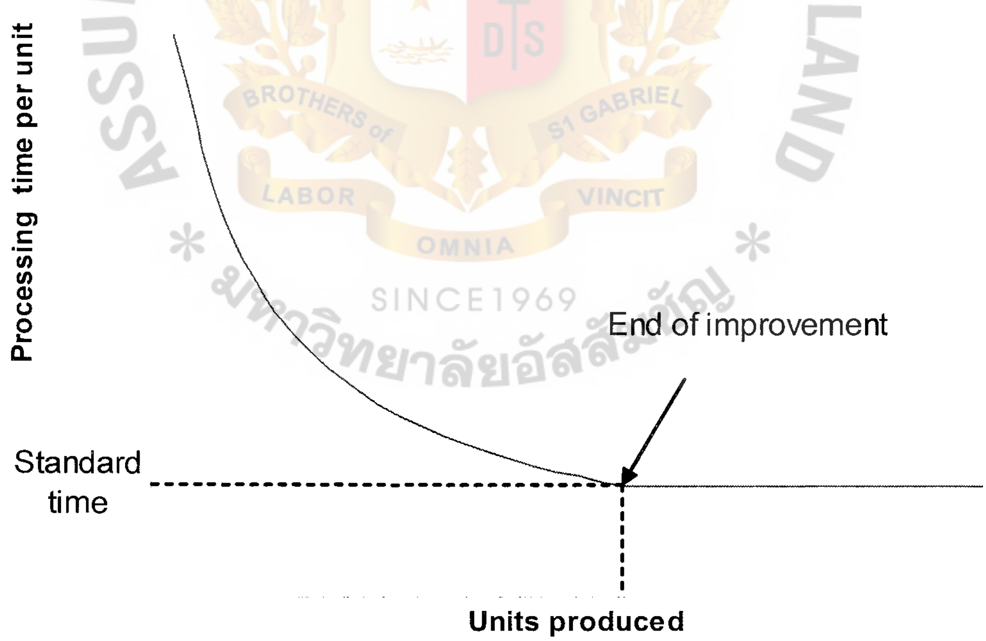


Figure 2.2. A learning curves for mass production and assembly-line

Learning curves help managers project labor and budgeting requirements in order to develop production scheduling plans. Knowing how many production labor hours will be required over time can enable managers to determine the number of workers to hire. Also, knowing how many labor hours will eventually be required for a product can help managers make overall product cost estimates to use in biffing for jobs and later for determining the product selling price. However, product or other change during the production process can negate the learning curve effect.

III. DATA ANALYSIS

3.1 Overview

Data analysis process of customer Service is the responsibility of Key Account (Makro, Lotus, etc.). The Customer service section is under the logistic department of Thai Pure Drinks Ltd (TPDL). Now the customer service center is located at Rangsit plant. That is the center which receives order from Purchase Order (PO) and deliver products to customers. Nowadays the Key Account customers have increased sales volume every year that causes an increase in purchasing order. So the work load of customer service increases every year too but the number of workers is the same. This is the reason why overtime (OT) working hours are required for customer service section. So it is necessary to reduce time to do job and eliminate some tasks to save cost and increase service level.

Customer services section is responsible for taking order from customers. So it has to take care of about purchase orders, invoices, load paper to control picking up products , pallet, shelf life and etc.

There are numerous varieties of products in this company. The company sells only non- alcoholic products. The products can be classified in to 2 main kinds 1) Returnable products such as 10 oz bottles that can be returned to company 2) Non returnable products. Almost all products sold to Key Accounts are non returnable products. For some products TPDL does not produce itself but it buys from other companies such as Nestle. The products bought form Nestle are Nescafe products. The bottle size of the products can be classified according to Litres bottles:1.25 Liters bottle, Can 300 cc,10 Oz, Buddy 250 CC., Post Mix (Tank & BIB),600 cc,1500cc , 180 cc and etc.The main flavor of products that have a high sales volume are Coca Cola flavor, Diet Coke, Oranges, Strawberry, Fruit Punch, Grape, Nescafe, Orange juice (Qoo), Grape juice,etc. The brands of TPDL are Coke, Sprite, Qoo, Namthip and etc .The constraints of products delivery to key account are quality, shelf life and etc because the products sold in Key Accounts are controlled by the government. Shelf life of products is shown in Table 3.1(a). The shelf life is necessary for delivery products to customers to guarantee. The Thai Pure Drinks Ltd. sells products to Key Account in terms of units but delivery products are sold in pallets.

A pallet is a container used to hold items during handling and transferring products to customers. The sales volume of products to Key Accounts is high so delivery products are sent in pallets. There are two kinds of pallet delivery products

(1) Plastic Pallet (TPDL Plastic).This pallet is used internally in TPDL. When it is sent to customers, it will be returned to the company. Normally the pallets are used to deliver products to customers' stores.

(2) Wooden Pallet(GE Loscam company). Now GE company has pallet renting business. It is called Loscam pallet. The TPDL pays to rent this kind of pallets. The pallets are used to hold products and are not returned to the company. When pallets are with customers, they will return them to GE. This kind of pallets is called one way flow system. At present the customers who use loscam pallets are Tops and Lotus.

TPDL pallets and Loscam pallets are of the same standard See Table 3.1(b).

Table 3.1. Product Characteristics.

(a) Shelf Life of Products.

Package	Manufacturing Shelf Life(days)	Guaranteed Remaining On delivery (days)
1.25 L PET	90	60
2L PET	90	60
Cans(Excludes Diet Coca-Cola)	270	180
Coke Light (cans)	60	40
250 ml "Buddy"	270	180
Nam Thip" Water	360	240
"Nescafe: canned liquid coffee	360	240
Postmix Syrup	75	50

(b) Standard Product of TPDL per Pallet

	Product	Cases/Layer	No. of Layer	Total Cases in 1 Pallet
1	1 LT	9	4	36
2	600 CC	9	4	36
3	2 LT	14	4	56
4	1.25 LT	10	5	50
5	Buddy 250 CC. (Tray)	10	7	70
6	Can (325 CC.)	10	11	110
7	Water 600 CC	22	6	132
8	Water 1,500 CC	23	5	115
9	Nescafe (180 CC.)	12	14	168
10	CO-2 Gas (9 Kgs)*	24	1	24
11	CO-2 Gas (22 Kgs)	20	1	20
12	BIB 10 LT	16	5	80
13	BIB 20 LT	8	4	32
14	Nestea	10	7	70
15	PET 390	10	7	70
16	Qoo 1LT	12	6	72
17	Qoo 250	17	10	170

For customer service Thai Pure Drinks Ltd. is responsible for receiving orders from Key Account. The company receives the customers' orders in two ways.

(1) Fax Order

(2) EDI (Electronic Data Interchange)

The order comes from the center office of customers (Buyer) and stores of customers. If the order comes from stores of customers, the delivery is made to the store of customers. There are three direct delivery customers 1) Makro uses EDI system to order products. Makro has 8 stores in Bangkok , 4 stores in central area, 2 stores in north area and 5 stores in northeast area. There are 19 stores in total. 2) Big C uses EDI system to order products. Big C has 17 stores in Bangkok, 6 stores in central area, 4 stores in north area, 4 stores in northeast area. There are 31 stores in total. 3) Carrefour uses fax to order products. Carrefour has 16 stores in Bangkok and 1 store in the northern area. There are 17 stores in total. The order comes from head offices and the products are delivered to DC (Distribution Center). There are 10 customers. 1) Lotus has 1 distribution center in Bangkok and uses EDI system to order products. 2)Tops has 1 distribution center and uses EDI system to order products. 3) 7-11 has 1 distribution center and uses EDI system to order products. 4) Family Mart has 1 distribution center and uses fax to order products. 5) Jusco has 1 distribution center and uses EDI system to order products. 6) Winstore has 1 distribution system and uses fax to order product. 7) Havi has 1 distribution center and uses fax to order products. 8) Haddthip receives products at Rangsit plant by themselves and uses fax to order products. 9) Sila has 1 distribution system and uses fax to order products. 10) Watson has 1 distribution system and uses fax to order products. It takes approximate by 2 days to delivery the products to customers.

For input of customer service, Purchase Orders (PO) comes from customers shown in Table 3.1. The out put of this process is invoice, load(Control picking products on truck). There are three kinds of loading 1) Main Load controls the products and quantity 2) Load picking controls picking products. The quantity of PO, invoice and load per 100 days is shown in Table 3.2.

Table 3.2. Kind and Quantity of Purchase Order, Invoice and Loading.

Customer	Qty		QTY. Copy				Data of Paper of Work Load				Total	Avg Per Day
	Trip	PO	P/O	INV	Load		Qty.PO.	Qty. INV	Qty LOAD			
					M	P			M	P		
Makro	6074	2897	2	7	6	6	5794	42518	36444	36444	121200	1212
Big C	2439	2304	2	9	2	2	4608	20736	4878	4878	35100	351
Carrefour	994	2139	2	7	6	6	4278	6958	5964	5964	23164	231.64
Lotus	1951	1838	2	10	6	6	3676	19510	11706	11706	46598	465.98
Top	453	562	2	9	6	6	1124	4077	2718	2718	10637	106.37
7-11	291	342	2	9	6	6	684	2619	1746	1746	6795	67.95
Suncolor	149	231	2	10	6	6	462	1490	894	894	3740	37.4
Jusco	82	170	2	9	2	2	340	1530	164	164	2198	21.98
Havi	92	94	2	4	2	2	188	368	184	184	924	9.24
Hadd thip	571	571	1	4	6	6	571	2284	3426	3426	9707	97.07
Sila	54	19	2	7	2	2	38	133	108	108	387	3.87
Other	11	38	2	7	1	1	76	266	11	11	364	3.64
Winstore	18	52	2	7	1	1	104	364	18	18	504	5.04
Total	13179	11257	25	99	52	52	21943	102853	68261	68261	261318	2613.18

The quantity of PO ,invoice, loading per 100 days are 11,257 , 102,853 and 136,522=(68261+68261) from Table 3.2. EDI PO = 2897+2304+1838+562+342+170= 8113 per 100 days or 81 PO per day and Fax PO = 113-81= 32 PO per day. Example of PO by fax, PO by EDI, Picking load, Invoice and Load shown in Appendix B,C, D, E, F. For quantity of PO, invoice and loading per day is shown below.

(1) The quantity PO per day is 113 PO

(2) The quantity of Invoice per day is 1029 invoices

(3) The quantity of (Load + Picking Load) per day is 1365 loads paper

The trucks, which are used for delivery product to Key Account, are sub contractors (third party). The trucks deliver products to Key Account 4 wheels can load 4 pallets, 6 wheels can load 6 pallets, 6 wheels can load 10 pallets, trailer can load 20 pallets. Most frequently There are 6-wheels trucks load 10 pallets. The other kinds of trucks are used, when there are extra orders. Thee are 2 four-wheel trucks which can load 4 pallets each, 2 six-wheel trucks which can load 6 pallets each, 93 6-wheel trucks which can load 10 pallets each and 20 trailers. Normally customer place an order according to the size of the trucks. The system is called one invoice one truck.

In consideration this project, normal situation processes (Routine process) are focused on

Main activities of customer service can be divided into 4 kinds.

(1) Receive Order by Fax

(1) Receive order by fax. This activity is to receive order by fax machine. The time is measured fax machine feeding paper until the order is complete. Customer service staff are responsible for this task.

(2) Check receives date and delivery date. Customer service staff are responsible for checking the order date and delivery date and making sure of the delivery on the appointed date.

(3) Check the correct price. Check the price of each purchase order to make sure it is correct with the discount and the price of TPDL or not. It is the responsibility of Customer service staff.

(4) Calculation of promotion. Promotion means free gifts to customers. If they buy 10 cases, one free sprite case or other things are offered. The quantities of purchase order do not have details of promotion. So the workers calculate the rate of promotion. It is the responsibility of Customer service staff.

(5) Check stock floor. Before issuing an invoice and loading, the workers check products to make sure there is enough for delivery. The products have shelf life or date code is not less than the guaranteed period (Table3.1a). It is the responsibility of customer service staff.

(6) Key data of PO to computer. After checking and confirming everything, the workers pack the products, check quantity, promotion, the number of invoice and load. It is responsibility of order processing staff.

(7) Generate load picking. The computer system generates data and reports.

(8) Feed paper to printer. Bring the paper to printer machine. It is responsibility of order processing staff.

(9) Printing. This activity is done by machine to print out the data on paper.

(10) Load picking out from printer. Bring paper out from the printer. Order processing staff take care of this.

(11) Bring load picking to checker. Bring the load paper to checker at ware house. The distance between ware house and customer service is quite far. It is the responsibility of order processing staff.

(12) Checker picking product on trucks. The checker loads products on to trucks according to the kind and quantity of products. It is the responsibility of the checker.

(13) Correct data in computer and confirm picking. Correct and confirm products on trucks to match with the system or load. It is the responsibility of checker.

(14) Generate load and invoice. The computer system generates load and invoice. It is the responsibility of checker.

(15) Feed load paper to printer. Bring the paper to printer machine. It is the responsibility of checker.

(16) Printing. This activity is done by machine to print out the data on paper.

(17) Load paper out from printer. Bring paper out from the printer. Checkers take care of this.

(18) Feed invoice paper to printer. Bring the paper to printer machine. It is responsibility of checker.

(19) Printing. This activity is done by machine to print out the data on paper.

(20) Invoice paper out from printer. Bring paper out from the printer. Checkers take care of this.

(21) Copy load and invoice. Copy load and invoice for customers. The customer requires a copy of load and invoice. It is the responsibility of the checker.

(22) Check and prepare document for the driver. Check invoice and load and bind together. It is the responsibility of the driver.

(2) Cancel PO with Receive PO by Fax.

(1) Receive order by fax. This activity is to receive order by fax machine. The time is measured for fax machine feeding paper until the order is complete. Customer service staff are responsible for this task.

(2) Check receives date and delivery date. Customer service staff are responsible for checking the order date and deliver date and making sure of the delivery on the appointed date.

(3) Check the correct price. Check the price of each purchase order to make sure it is correct with the discount and the price of TPDL or not. It is the responsibility of Customer service staff.

(4) Calculation of promotion. Promotion means free gifts to customers. If they buy 10 cases, one free sprite case or other things are offered. The quantities of purchase order do not have details of promotion. So the workers calculate the rate of promotion. It is the responsibility of Customer service staff.

(5) Check stock floor and date code. Before issuing invoice and load, the workers check products to make sure there is enough for delivery. The products have shelf life or date code is not less than the guaranteed period (Table3.1a). It is responsibility of customer service staff.

(6) Check production plan. After the worker knows that there are not enough products. The worker has to check when this product will be produced. It is the responsibility of customer service staff.

(7) Calling to customers to cancel PO and tell customers to order by new PO. Calling to customers to cancel purchase order and tell customers when they should order a new PO according to the production plan. It is the responsibility of customer service staff.

(3) Receive Order by EDI

(1) Receive order by EDI. This order is received by computer. This data of purchase order is kept in computer database. It is the responsibility of customer service staff.

(2) Print from EDI. Printing the Purchase Order from computer data base to paper. It is the responsibility of customer service staff.

(3) Check receives date and delivery date. Customer service staff are responsible for checking the order date and deliver date and making sure of the delivery on the appointed date.

(4) Check the correct price. Check the price of each purchase order to make sure it is correct with the discount and the price of TPDL or not. It is the responsibility of Customer service staff.

(5) Calculation of promotion. Promotion means free gifts to customers. If they buy 10 cases, one free sprite case or other things are offered. The quantities of purchase order do not have details of promotion. So the workers calculate the rate of promotion. It is the responsibility of Customer service staff.

(6) Check stock floor and date code. Before issuing invoice and load, the workers check products to make sure there is enough for delivery. The products have shelf life or date code is not less than the guaranteed period (Table3.1a). It is the responsibility of customer service staff.

(7) Down load data from EDI to Order entry. Down load data (Purchase order) from database to order entry to generate Load picking. It is the responsibility of order processing staff.

(8) Generate load picking. The computer system generates data and reports.

(9) Feed paper to printer. Bring the paper to printer machine. It is the responsibility of order processing staff.

(10) Printing. This activity is done by machine to print out the data on paper.

(11) Load picking out from printer. Bring paper out from the printer. Order processing staff take care of this.

(12) Bring load picking to checker. Bring the load paper to checker at ware house. The distance between ware house and customer service is quite far. It is the responsibility of order processing staff.

(13) Checker picking product on trucks. The checker load products on to trucks according to the kind and quantity of products. It is the responsibility of the checker.

(14) Correct data in computer and confirm picking. Correct and confirm products on trucks to match with the system or load. It is the responsibility of the checker.

(15) Generate load and invoice. The computer system generates load and invoice. It is the responsibility of the checker.

(16) Feed load paper to printer. Bring the paper to printer machine. It is the responsibility of the checker.

(17) Printing. This activity is done by machine to print out the data on paper.

(18) Load paper out from printer. Bring paper out from the printer. Checkers take care of this.

(19) Feed invoice paper to printer. Bring the paper to printer machine. It is the responsibility of the checker.

(20) Printing. This activity is done by machine to print out the data on paper.

(21) Invoice paper out from printer. Bring paper out from the printer. Checkers take care of this.

(22) Copy load and invoice. Copy load and invoice for customers. The customer requires a copy of load and invoice. It is the responsibility of the checker.

(23) Check and prepare document for the driver. Check invoice and load and bind together. It is the responsibility of driver.

(4) Cancel PO with Receive PO by EDI

(1) Receive order by EDI. This order is received by computer. This data of purchase order is kept in computer database. It is the responsibility of customer service staff.

(2) Print from EDI. Printing the Purchase Order from computer data base to paper. It is the responsibility of customer service staff.

(3) Check receives date and delivery date. Customer service staff are responsible for checking the order date and deliver date and making sure of the delivery on the appointed date.

(4) Check the correct price. Check the price of each purchase order to make sure it is correct with the discount and the price of TPDL or not. It is the responsibility of Customer service staff.

(5) Calculation of promotion. Promotion means free gifts to customers. If they buy 10 cases, one free sprite case or other things are offered. The quantities of purchase order do not have details of promotion. So the workers calculate the rate of promotion. It is the responsibility of Customer service staff.

(6) Check stock floor and date code. Before issuing invoice and load, the workers check products to make sure there is enough for delivery. The products have shelf life or date code is not less than the guaranteed period (Table3.1a). It is responsibility of customer service staff.

(7) Check production plan. After the worker knows that there are not enough products. The worker has to check when this product will be produced. It is responsibility of customer service staff.

(8) Calling to customers to cancel PO and tell customers to order by new PO. Calling to customers to cancel purchase order and tell customers when they should order a new PO according to the production plan. It is responsibility of customer service staff.

3.2 The Process Flow Diagram

The process of Customer service is receiving order and delivering products to customers but transportation cannot be controlled because some factors cause delays such as traffic jams, etc. So for this process the company has to consider the processes from consider receiving order to loading product on trucks . Customers place an order or send purchase order to customer service staff by fax and EDI. The customer service staff verifies PO about price, quantity, promotion and etc. After that the order processing staff input order entry to system and generate invoice and loading. The checker loads products on truck in pallets. The driver prepares documents and make ready to deliver products to customers. The flow diagram of these processes is shown in Figure 3.1.

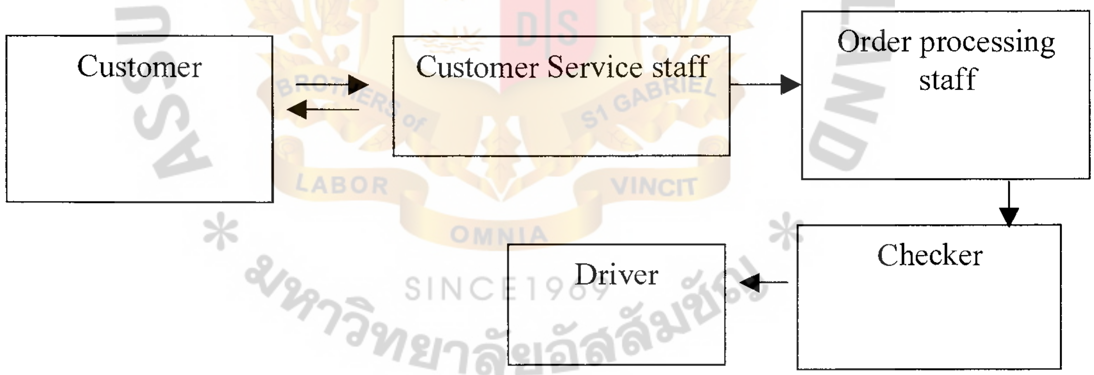


Figure3.1. Process Flow Diagram of Customer Service.

3.3 **The Process Chart** can be divided into 4 main activities as follows:

(1) The process flow chart of receive order by Fax is shown in figure 3.2

(See calculation in Tables 3.3,3.4,3.5)

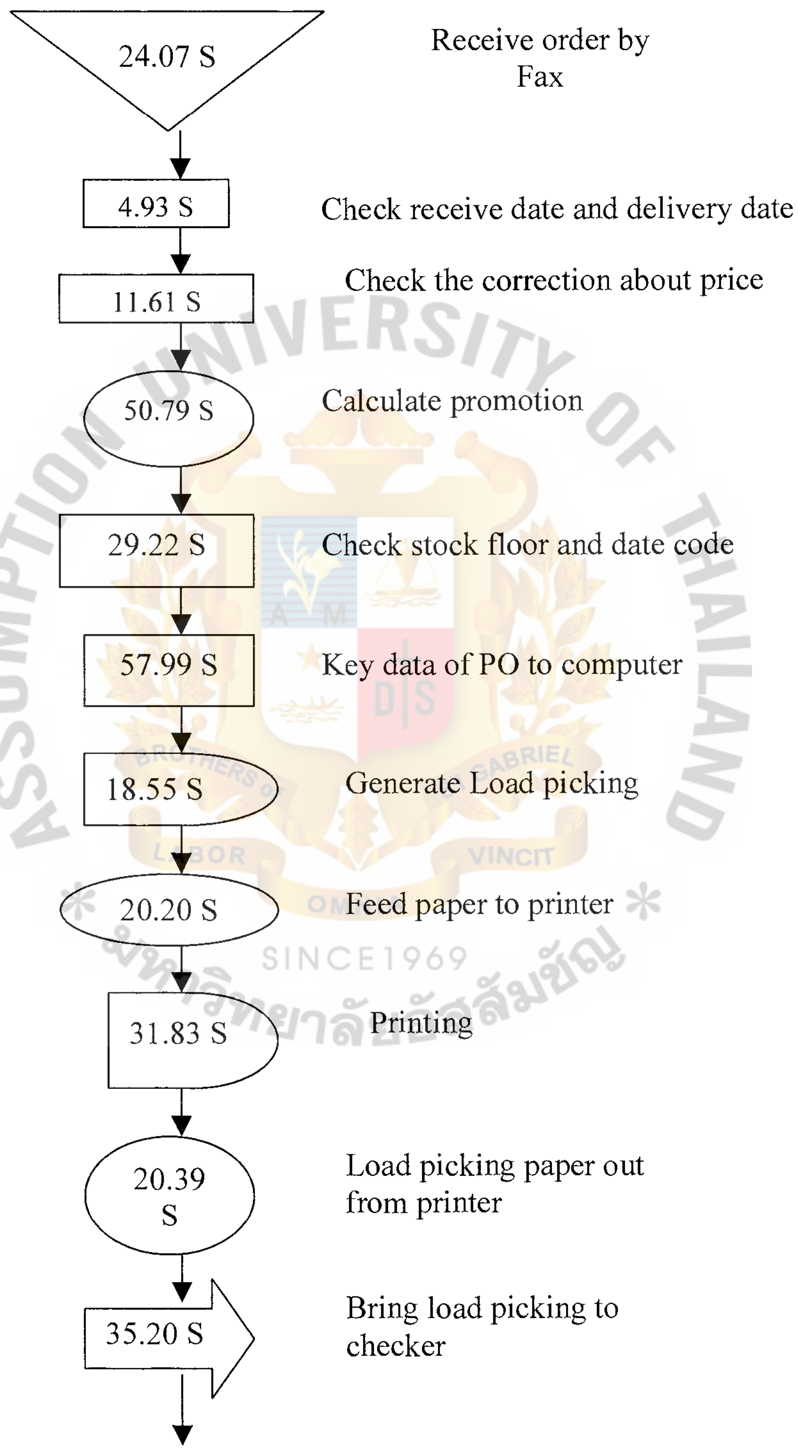


Figure 3.2. The Process Flow Chart Receive Order by Fax.

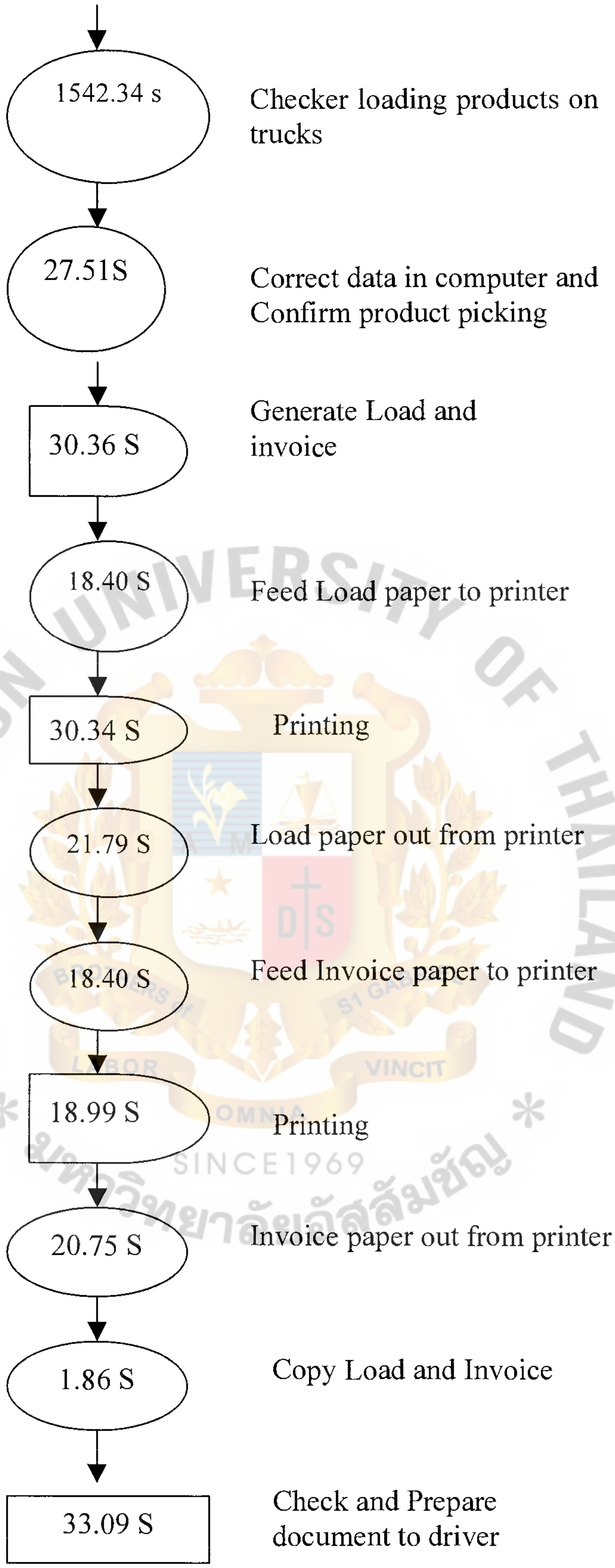


Figure 3.2. The Process Flow Chart Receive Order by Fax. (Continued)

(2) The process flow chart cancel PO received by fax. It is shown in Figure 3.3 (See calculation in Tables 3.6,3.7,3.8)

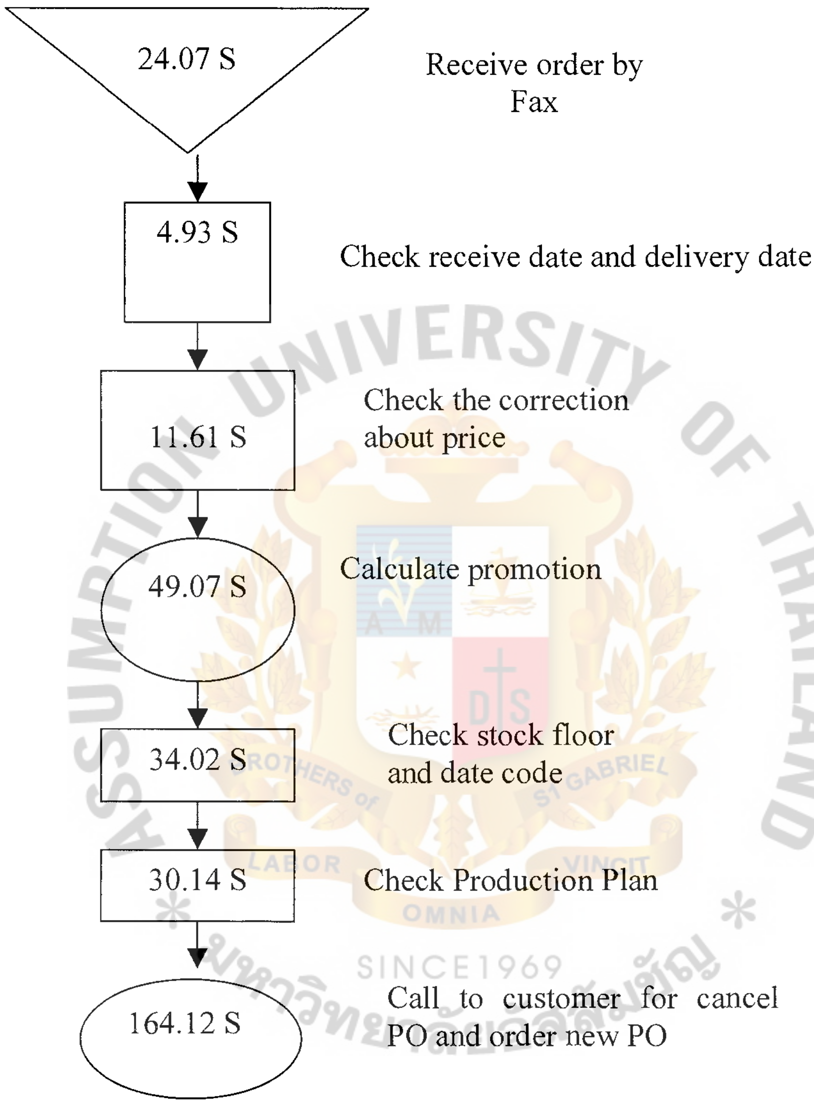


Figure 3.3. The Process Flow Chart Cancel PO Received by Fax.

(3) The process flow chart receive order by EDI. It is shown in Figure 3. 4 (See Calculation in Tables 3.9,3.10,3.11)

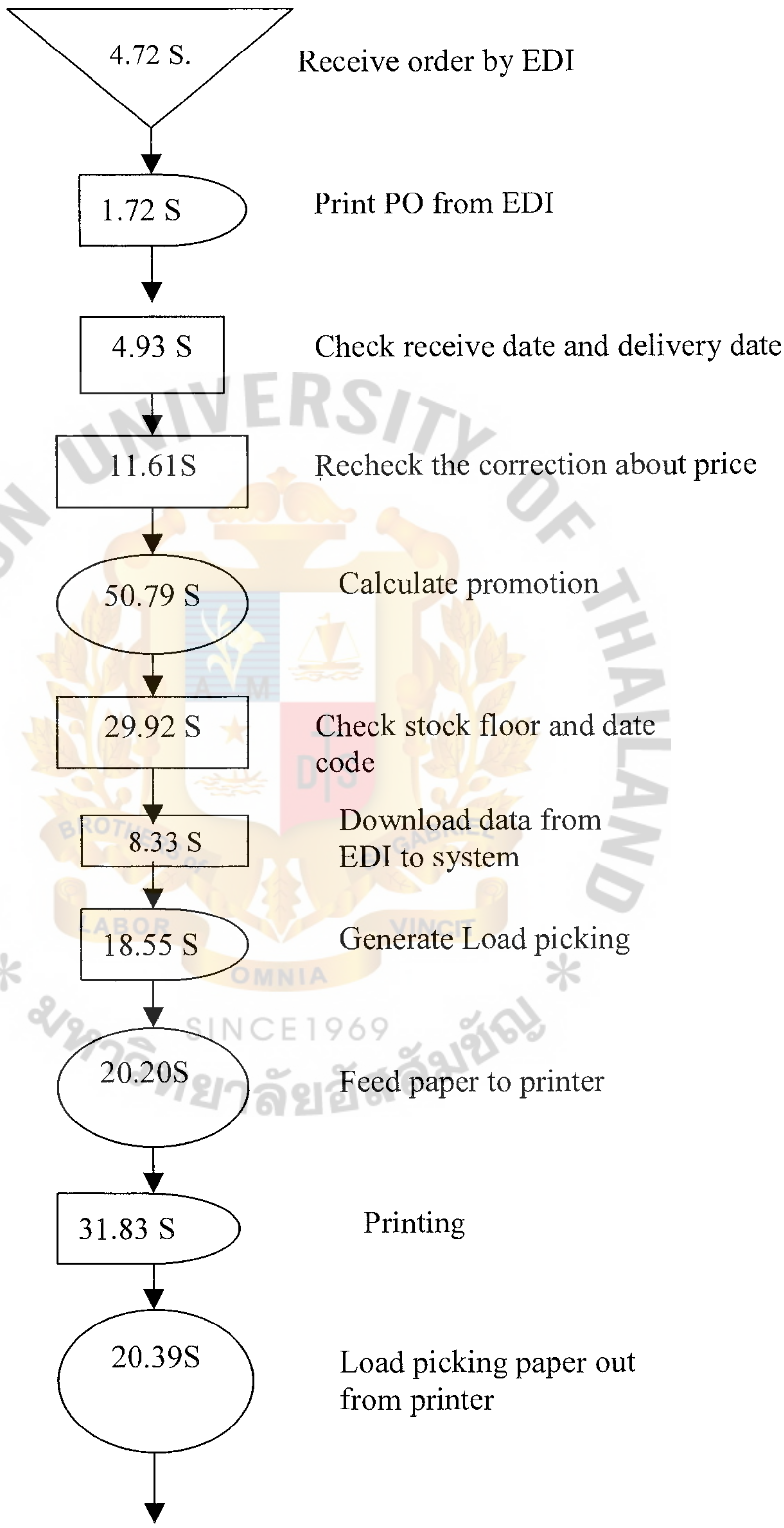


Figure3.4. The Process Flow Chart Receive Order by EDI.

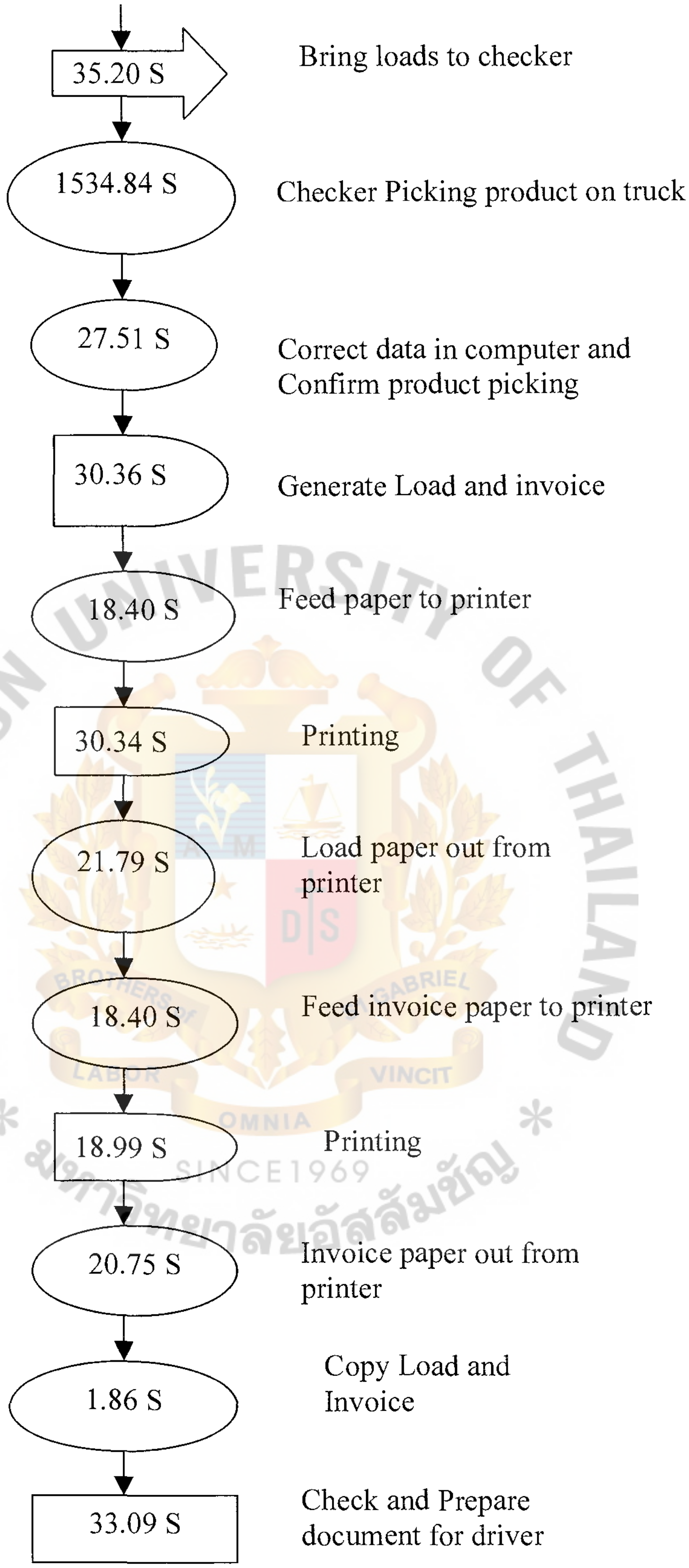


Figure3.4. The Process Flow Chart Receive Order by EDI. (Continued)

(4) The process flow chart cancel PO received by EDI. It is shown in Figure 3.5 (See Calculation in Tables 3.12, 3.13, 3.14)

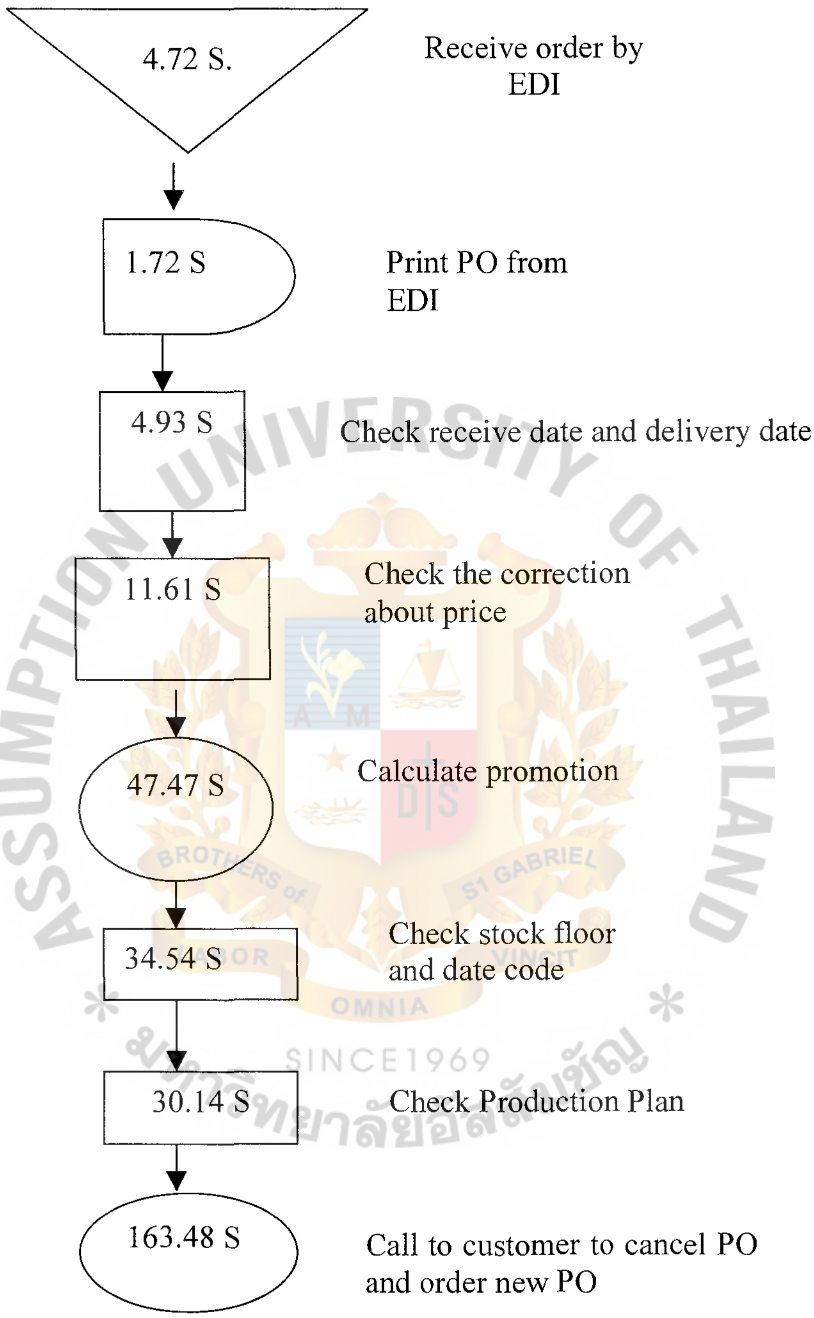


Figure 3.5. The Process Flow Chart Cancel PO Received by EDI.

3.4. Calculation of Standard Time and Normal Time

For the procedures of calculation standard time, normal time is shown.

(1) The fist step is to find the time of each activity by stopwatch and to measure time of each activity by random sample. Take sample size by purchase order. Firstly 5 cycles of each activity (element) are taken at random and each cycle take the quantity of samples (purchase order, invoice and loading) at random. Time of each cycle is measured by stopwatch. The result average time of each cycle =Time of each cycle is divided by the number of samples. The results are shown in Table 3.3 'receive order by fax', Table 3.6 for 'cancel PO with received by fax', Table 3.9 for 'receive PO by EDI' and Table 3.12 for 'cancel PO received by EDI'. For , in ' receive order by fax', the result average time of each cycle (Element 1). The number of cycle is 5 cycles. Cycles 1 is to take the 5 samples and it takes 157 seconds, Cycle 2 is 13 samples in 299 seconds, Cycle 3 is 4 samples in 84 seconds, Cycle 4 is 7 samples in 129 seconds and the last Cycle 5 is 4 samples in 106 seconds. The average cycle time of cycle 1,2,3,4,5 is 31.40,23,21,18.43,26.50

(2) After getting average cycle time, we find the total time of each element by summation average cycles time. After getting total time of each element. we find the average element time by total time of each element divided by the number of cycles. The results are shown in Table 3.4, 3.7, 3.10, 3.13 After getting average element time. We find the total job cycle time by the summation average element time. There are shown in Table 3.4 for 'process receive order by fax', Table 3.7 for 'process cancel PO received by fax', Table 3.10 for 'process receive PO by EDI', Table 3.13 for process cancel PO received by EDI'.

(3) Finding the number of cycle is enough for accuracy by. From the formula, We can get the number of cycles in Table 3.3, 3.6, 3.9, 3.12. Assume the degree of error from the true mean of the distribution is 0.04 or 4%.The result is 98 percent confident that the average time computed from the study. Calculation Z (The number of standard deviations from the mean in a normal distribution reflecting a level of confidence) by 100%-98%= 2%/2=1% after that 98%+1%=99% or 0.99 So we can find Z=2.33 from Appendix A.(Cumulative Probabilities of the Normal Distribution).Find the sample standard deviation by formula in literature review. We can find the summation of $(t-\bar{t})^2$. This result is shown in Table 3.3 for 'process receive order by fax', Table 3.6 for 'Process cancel PO received PO by fax', Table 3.9 for 'Process receive PO by EDI', Table 3.12 for 'Process cancel PO received by EDI'. Example of the number of cycle calculation process receive order by fax element 1s= $(\sum(t_i-\bar{t})^2/n-1)^{1/2}$ When $\sum(t_i-\bar{t})^2 = 9266.48$,n=5,So $(9266.45/(5-1))^{1/2} = 48.13$, n (The numbly of cycle) from $n=(ZS/eT)^2$ when e=0.04,$\bar{T}$ = 1855.45 The result n=2.21 or 3 cycle.

(4) After getting the number of cycles, if the element has more than 5 cycles, take the cycle until it is equal to the result. In case the number of cycles are less or equal than 5 cycles, the average job cycle time is enough accuracy. Table 3.3 for Element 12 loading products on trucks. The number of cycle is 19 cycles so take the number of cycle in addition to 14 cycles.

(5) After revising the new average time, the normal time can be checked by element average time multiplied by performance rating (Find from study working and experience).Find the Normal cycle time(NT) by the summation of normal times. The result is shown in Table 3.5 for 'process receive order

by fax', Table 3.8 for 'Process Cancel PO received by fax', Table 3.11 for 'Process receive order by EDI' and Table 3.14 for 'Process cancel PO received by EDI'.

(6) Calculation of standard time form formula standard time=(normal cycle time)(1+ allowance). Allowance is 0.4 because this process is delayed or there is non productive time due to printer break -down , telephone and etc. This result is shown in Table 3.5 for 'process receive order by fax', Table 3.8 for 'Process Cancel PO received by fax', Table 3.11 for 'Process receive order by EDI' and Table 3.14 for 'Process cancel PO received by EDI.

Table 3.3. Time Study Process Receive Order by Fax.

(PR=1) $\bar{t}$

(1) Receive order by Fax 24.066 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	5	157	31.40	53.79	e=	4%
2	13	299	23.00	1.14	S=	48.13
3	4	84	21.00	9.40	T=	1885.476
4	7	129	18.43	31.78	n=	2.21
5	4	106	26.50	5.92		or 3 cycle
Total			120.33	9266.48		

(PR=0.95) $\bar{t}$

(2) Check receive date and delivery date 5.19 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	97	4.22	0.96	e=	4%
2	9	32	3.56	2.69	S=	1.46
3	13	96	7.38	4.79	T=	1885.48
4	31	170	5.48	0.08	n=	0.00
5	18	96	5.33	0.02		or 1 cycle
Total			25.97	8.54		

(PR=0.95) $\bar{t}$

(3) Check the correction about price 12.22 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	312	13.57	1.82	e=	4%
2	9	67	7.44	22.77	S=	4.405
3	13	141	10.85	1.88	T=	1885.476
4	31	315	10.16	4.22	n=	0.01852
5	15	286	19.07	46.92		or 1 cycle
Total			61.08	77.62		

Table 3.3. Time Study Process Receive Order by Fax. (Continued)

(PR=1.10) $\bar{t}$

(4) Calculation promotion 46.17 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	1610	70.00	567.88	e=	4%
2	9	412	45.78	0.15	S=	15.76
3	13	372	28.62	308.16	T=	1885.476
4	31	1560	50.32	17.25	n=	0.2370622
5	15	542	36.13	100.73		or 1 cycle
Total			230.85	994.17		

(PR=1.05) $\bar{t}$

(5) Check stock floor and date code 28.50 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	458	19.91	73.68	e=	4%
2	9	177	19.67	77.97	S=	13.3
3	13	650	50.00	462.40	T=	1885.476
4	31	617	19.90	73.85	n=	0.1688314
5	15	495	33.00	20.28		or 1 cycle
Total			142.48	708.17		

(PR=0.95) $\bar{t}$

(6) Key data of PO to computer 61.04 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	1267	55.09	35.46	e=	4%
2	9	724	80.44	376.46	S=	14.65
3	13	754	58.00	9.25	T=	1885.476
4	31	2160	69.68	74.57	n=	0.2048449
5	15	630	42.00	362.59		or 1 cycle
Total			305.21	858.34		

Table 3.3. Time Study Process Receive Order by Fax. (Continued)

(PR=1) $\bar{t}$

(7) Generate load picking 18.55 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	345	15.00	12.59	e=	4%
2	9	182	20.22	2.80	S=	2.56
3	13	221	17.00	2.40	T=	1885.476
4	31	663	21.39	8.06	n=	0.006255
5	15	287	19.13	0.34		or 1 cycle
Total			92.74	26.19		

(PR=1) $\bar{t}$

(8) Load paper to printer 20.20 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	23	23.00	7.84	e=	4%
2	1	17	17.00	10.24	S=	4.76
3	1	26	26.00	33.64	T=	1885.476
4	1	14	14.00	38.44	n=	0.0216254
5	1	21	21.00	0.64		or 1 cycle
Total			101.00	90.80		

(PR=1.05) $\bar{t}$

(9) Printing 30.32 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	30	938	31.27	0.90	e=	4%
2	50	1612	32.24	3.70	S=	1.55
3	17	478	28.12	4.84	T=	1885.476
4	26	781	30.04	0.08	n=	0.002293
5	76	2274	29.92	0.16		or 1 cycle
Total			151.58	9.67		

Table 3.3. Time Study Process Receive Order by Fax. (Continued)

(PR=1) $\bar{t}$

(10) Load paper out 20.39 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	30	660	22.00	2.60	e=	4%
2	50	1137	22.74	5.54	S=	2.58
3	17	306	18.00	5.70	T=	1885.476
4	26	447	17.19	10.20	n=	0.0063532
5	76	1672	22.00	2.60		or 1 cycle
Total			101.93	26.64		

(PR=1) $\bar{t}$

(11) Bring load picking to checker 35.20 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	35	35.00	0.04	e=	4%
2	1	23	23.00	148.84	S=	8.5
3	1	45	45.00	96.04	T=	1885.476
4	1	32	32.00	10.24	n=	0.0689585
5	1	41	41.00	33.64		or 1 cycle
Total			176.00	288.80		

(PR=1.05) $\bar{t}$

(12) Loading products on trucks 1364.40 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	1560	1560.00	38259.36	e=	4%
2	1	1370	1370.00	31.36	S=	139.02
3	1	1220	1220.00	20851.36	T=	1885.476
4	1	1427	1427.00	3918.76	n=	18.446094
5	1	1245	1245.00	14256.36		or 19 cycles
Total			6822.00	77,317.20		

Table 3.3. Time Study Process Receive Order by Fax. (Continued)

Additional

Cycle	No of Sample	t(seconds)	Time/Sample
6	1	1533	1533
7	1	1731	1731
8	1	1424	1424
9	1	1535	1535
10	1	1631	1631
11	1	1702	1702
12	1	1241	1241
13	1	1561	1561
14	1	1432	1432
15	1	1235	1235
16	1	1652	1652
17	1	1356	1356
18	1	1485	1485
19	1	1569	1569
	Total		27909.00

(PR=1) $\bar{t}$

(13) Correct data incomputer and confirm 27.51 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	20	643	32.15	21.53	e=	4%
2	45	946	21.02	42.09	S=	6.33
3	11	275	25.00	6.30	T=	1885.476
4	7	212	30.29	7.71	n=	0.0382435
5	11	320	29.09	2.50		or 1 cycle
Total			137.55	80.12		

Table 3.3. Time Study Process Receive Order by Fax (Continued)

(PR=1) $\bar{t}$

(14) Generate load and invoice 30.36 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	5	166	33.20	8.05	e=	4%
2	12	328	27.33	9.18	S=	2.2
3	4	117	29.25	1.24	T=	1885.476
4	8	247	30.88	0.26	n=	0.0046195
5	13	405	31.15	0.63		or 1 cycle
Total			151.81	19.35		

(PR=1) $\bar{t}$

(15) Put load paper to printer 18.40 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	21	21.00	6.76	e=	4%
2	1	16	16.00	5.76	S=	4.04
3	1	17	17.00	1.96	T=	1885.476
4	1	24	24.00	31.36	n=	0.015578
5	1	14	14.00	19.36		or 1 cycle
Total			92.00	65.20		

(PR=1.05) $\bar{t}$

(16) Printing 28.89 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	32	996	31.13	4.98	e=	4%
2	27	812	30.07	1.40	S=	1.82
3	14	378	27.00	3.58	T=	1885.476
4	17	496	29.18	0.08	n=	0.0031615
5	23	623	27.09	3.26		or 1 cycle
Total			144.46	13.30		

Table 3.3. Time Study Process Receive Order by Fax. (Continued)

(PR=1) $\bar{t}$

(17) Load paper out 21.79 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	32	632	19.75	4.17	e=	4%
2	27	756	28.00	38.53	S=	4.21
3	14	339	24.21	5.86	T=	1885.476
4	17	306	18.00	14.39	n=	0.0169166
5	23	437	19.00	7.80		or 1 cycle
Total			108.96	70.75		

(PR=1) $\bar{t}$

(18) Put invoice paper to printer 18.40 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	22	22.00	12.96	e=	4%
2	1	14	14.00	19.36	S=	5.85
3	1	27	27.00	73.96	T=	1885.476
4	1	15	15.00	11.56	n=	0.0326634
5	1	14	14.00	19.36		or 1 cycle
Total			92.00	137.20		

(PR=1.05) $\bar{t}$

(19) Printing 18.09 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	418	12.67	29.39	e=	4%
2	17	286	16.82	1.60	S=	5.04
3	18	432	24.00	34.95	T=	1885.476
4	10	227	22.70	21.27	n=	0.0242444
5	12	171	14.25	14.73		or 1 cycle
Total			90.44	101.94		

Table 3.3. Time Study Process Receive Order by Fax. (Continued)

(PR=1) t̄
(20) Load paper out 20.75 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	726	22.00	1.55	e=	4%
2	17	282	16.59	17.35	S=	3.1
3	18	416	23.11	5.56	T=	1885.476
4	10	184	18.40	5.54	n=	0.0091722
5	12	284	23.67	8.49		or 1 cycle
Total			103.77	38.49		

(PR=0.95) t̄
(21) Copy load and invoice 1.96 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	68	2.06	0.01	e=	4%
2	17	39	2.29	0.11	S=	0.3
3	18	27	1.50	0.21	T=	1885.476
4	10	21	2.10	0.02	n=	8.59E-05
5	12	22	1.83	0.02		or 1 cycle
Total			9.79	0.37		

(PR=1) t̄
(22) Check and prepare document for driver 33.09 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	827	25.06	64.40	e=	4%
2	17	374	22.00	122.89	S=	9.8
3	18	723	40.17	50.14	T=	1885.476
4	10	452	45.20	146.76	n=	0.0916647
5	12	396	33.00	0.01		or 1 cycle
Total			165.43	384.20		

Table 3.4. The Average Job Cycle Time of Receive Order by Fax.

Element	$\sum t$	No of Cycle	$\bar{t}$
1	120.33	5.00	24.07
2	25.97	5.00	5.19
3	61.08	5.00	12.22
4	230.85	5.00	46.17
5	142.48	5.00	28.50
6	305.21	5.00	61.04
7	92.74	5.00	18.55
8	101.00	5.00	20.20
9	151.58	5.00	30.32
10	101.93	5.00	20.39
11	176.00	5.00	35.20
12	6822.00	5.00	1364.40
13	137.55	5.00	27.51
14	151.81	5.00	30.36
15	92.00	5.00	18.40
16	144.46	5.00	28.89
17	108.96	5.00	21.79
18	92.00	5.00	18.40
19	90.44	5.00	18.09
20	103.77	5.00	20.75
21	9.79	5.00	1.96
22	165.43	5.00	33.09
Total			1885.48

Table 3.5. Normal Time and Standard Time of Receive Order by Fax.

Element	$\sum t$	No of Cycle	$\bar{t}$	PR	Nt
1	120.33	5	24.07	1	24.07
2	25.97	5	5.19	0.95	4.93
3	61.08	5	12.22	0.95	11.61
4	230.85	5	46.17	1.1	50.79
5	142.48	5	28.50	1.05	29.92
6	305.21	5	61.04	0.95	57.99
7	92.74	5	18.55	1	18.55
8	101	5	20.20	1	20.20
9	151.58	5	30.32	1.05	31.83
10	101.93	5	20.39	1	20.39
11	176	5	35.20	1	35.20
12	27909	19	1468.89	1.05	1542.34
13	137.55	5	27.51	1	27.51
14	151.81	5	30.36	1	30.36
15	92	5	18.40	1	18.40
16	144.46	5	28.89	1.05	30.34
17	108.96	5	21.79	1	21.79
18	92	5	18.40	1	18.40
19	90.44	5	18.09	1.05	18.99
20	103.77	5	20.75	1	20.75
21	9.79	5	1.96	0.95	1.86
22	165.43	5	33.09	1	33.09
Total			1989.97		2069.30

Compute the normal Cycle time

NT= 2069.302 seconds

Calculate the standard time Allowance factor=0.4

ST=NT(1+AF)

= (2069.302(1+0.4)

= 2897.02 Seconds

Table 3.6. Time Study Process Cancel PO Received by Fax.

(PR=1) $\bar{t}$

(1) Receive order by Fax (PR=1) 24.066 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	5	157	31.40	53.79	e=	4%
2	13	299	23.00	1.14	S=	5.05
3	4	84	21.00	9.40	T=	330.68
4	7	129	18.43	31.78	n=	0.79133205
5	4	106	26.50	5.92		or 1 cycle
Total			120.33	102.03		

(PR=0.95) $\bar{t}$

(2) Check receive date and delivery date 5.19 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	97	4.22	0.96	e=	4%
2	9	32	3.56	2.69	S=	1.46
3	13	96	7.38	4.79	T=	330.68
4	31	170	5.48	0.08	n=	0.07
5	18	96	5.33	0.02		or 1 cycle
Total			25.97	8.54		

PR=0.95 $\bar{t}$

(3) Check the correction about price 12.22 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	312	13.57	1.82	e=	4%
2	9	67	7.44	22.77	S=	4.405
3	13	141	10.85	1.88	T=	330.68
4	31	315	10.16	4.22	n=	0.60
5	15	286	19.07	46.92		or 1 cycle
Total			61.08	77.62		

Table 3.6. Time Study Process Cancel PO Received by Fax. (Continued)

PR=1.10

		$\bar{t}$	
(4)	Calculation promotion	46.17	98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	1610	70.00	567.88	e=	4%
2	9	412	45.78	0.15	S=	15.76
3	13	372	28.62	308.16	T=	330.68
4	31	1560	50.32	17.25	n=	7.71
5	15	542	36.13	100.73		or 8 cycles
Total			230.85	994.17		

Additional

6	26	1435	55.19			
7	16	589	36.81			
8	18	612	34.00			
Total			356.85			

(PR=1.05)

		$\bar{t}$	
(5)	Check stock floor and date code	28.50	98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	458	19.91	73.68	e=	4%
2	9	177	19.67	77.97	S=	13.3
3	13	650	50.00	462.40	T=	330.68
4	31	617	19.90	73.85	n=	5.48882372
5	15	495	33.00	20.28		or 6 cycle
Total			142.48	708.17		

Additional

6	13	675	51.92			
Total			194.41			

Table 3.6. Time Study Process Cancel PO Received by Fax. (Continued)

(PR=1) $\bar{t}$

(6) Check the production plan 30.14 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	3	87	29.00	1.31	e=	4%
2	2	64	32.00	3.45	S=	3.45
3	7	201	28.71	2.04	T=	330.68
4	4	140	35.00	23.59	n=	0.37
5	3	78	26.00	17.16		or 1 cycle
Total			150.71	47.55		

(PR=0.95) $\bar{t}$

(7) Call to customer to cancel PO and order new PO 184.40 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	150	150.00	1183.36	e=	4%
2	1	195	195.00	112.36	S=	25.94
3	1	173	173.00	129.96	T=	330.68
4	1	220	220.00	1267.36	n=	20.88
5	1	184	184.00	0.16		or 21 cycle
Total			922.00	2693.20		

Additional

6	1	164	164
7	1	152	152
8	1	175	175
9	1	173	173
10	1	224	224
11	1	252	252
12	1	193	193
13	1	186	186
14	1	144	144
15	1	150	150
16	1	148	148
17	1	140	140
18	1	135	135
19	1	146	146
20	1	155	155
21	1	169	169
Total			3628.00

Table 3.8. Normal Time and Standard Time of Cancel PO Received by Fax.

Element	$\sum t$	No of Cycle	t-	PR	Nt
1	120.33	5	24.07	1.00	24.07
2	25.97	5	5.19	0.95	4.93
3	61.08	5	12.22	0.95	11.61
4	356.85	8	44.61	1.10	49.07
5	194.41	6	32.40	1.05	34.02
6	150.71	5	30.14	1.00	30.14
7	3628	21	172.76	0.95	164.12
Total			321.39		317.96

Compute the normal Cycle time

NT= 317.95

Calculate the standard time Allowance factor=0.4

ST=NT(1+AF)

= (317.95(1+0.4)

= 445.13 Seconds

Table 3.9. Time Study Process Receive Order by EDI.

(PR=1) $\bar{t}$

(1) Receive order by EDI 4.72 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	44	212	4.82	0.01	e=	4%
2	54	312	5.78	1.11	S=	1.62
3	72	486	6.75	4.10	T=	1815.148
4	48	132	2.75	3.90	n=	0.0027027
5	36	127	3.53	1.43		or 1 cycle
Total			23.62	10.55		

(PR=1) $\bar{t}$

(2) Print PO from EDI 1.72 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	44	68	1.55	0.03	e=	4%
2	54	94	1.74	0.00	S=	0.57
3	72	86	1.19	0.28	T=	1815.148
4	48	129	2.69	0.93	n=	0.00033459
5	36	52	1.44	0.08		or 1 cycle
Total			8.61	1.32		

(PR=0.95) $\bar{t}$

(3) Check receive date and delivery date 5.19 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	97	4.22	0.96	e=	4%
2	9	32	3.56	2.69	S=	1.46
3	13	96	7.38	4.79	T=	1815.148
4	31	170	5.48	0.08	n=	0.0021952
5	18	96	5.33	0.02		or 1 cycle
Total			25.97	8.54		

Table 3.9. Time Study Process Receive Order by EDI.(Continued)

(PR=0.95) $\bar{t}$

(4) Check the correction about price 12.22 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	312	13.57	1.82	e=	4%
2	9	67	7.44	22.77	S=	4.405
3	13	141	10.85	1.88	T=	1815.148
4	31	315	10.16	4.22	n=	0.01998295
5	15	286	19.07	46.92		or 1 cycle
Total			61.08	77.62		

(PR=1.10) $\bar{t}$

(5) Calculation promotion 46.17 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	1610	70.00	567.88	e=	4%
2	9	412	45.78	0.15	S=	15.76
3	13	372	28.62	308.16	T=	1815.148
4	31	1560	50.32	17.25	n=	0.25578802
5	15	542	36.13	100.73		or 1 cycle
Total			230.85	994.17		

(PR=1.05) $\bar{t}$

(6) Check stock floor and date code 28.50 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	458	19.91	73.68	e=	4%
2	9	177	19.67	77.97	S=	13.3
3	13	650	50.00	462.40	T=	1815.148
4	31	617	19.90	73.85	n=	0.18216757
5	15	495	33.00	20.28		or 1 cycle
Total			142.48	708.17		

Table 3.9. Time Study Process Receive Order by EDI.(Continued)

(PR=1) $\bar{t}$

(7) Download data from EDI to system 8.33 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	188	8.17	21.78	e=	4%
2	9	117	13.00	1.22	S=	16.91
3	13	94	7.23	10.27	T=	1815.148
4	31	159	5.13	0.04	n=	0.29447945
5	15	122	8.13	1111.13		or 1 cycle
Total			41.67	1144.43		

(PR=1) $\bar{t}$

(8) Generate load picking 18.55 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	345	15.00	12.59	e=	4%
2	9	182	20.22	2.80	S=	2.56
3	13	221	17.00	2.40	T=	1815.148
4	31	663	21.39	8.06	n=	0.00674913
5	15	287	19.13	0.34		or 1 cycle
Total			92.74	26.19		

(PR=1) $\bar{t}$

(9) Load paper to printer 20.20 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	23	23.00	7.84	e=	4%
2	1	17	17.00	10.24	S=	4.76
3	1	26	26.00	33.64	T=	1815.148
4	1	14	14.00	38.44	n=	0.0233336
5	1	21	21.00	0.64		or 1 cycle
Total			101.00	90.80		

Table 3.9. Time Study Process Receive Order by EDI.(Continued)

(PR=1.05) $\bar{t}$

(10) Printing 30.32 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	30	938	31.27	0.90	e=	4%
2	50	1612	32.24	3.70	S=	1.55
3	17	478	28.12	4.84	T=	1815.148
4	26	781	30.04	0.08	n=	0.00247418
5	76	2274	29.92	0.16		or 1 cycle
Total			151.58	9.67		

(PR=1) $\bar{t}$

(11) Load paper out 20.39 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	30	660	22.00	2.60	e=	4%
2	50	1137	22.74	5.54	S=	2.58
3	17	306	18.00	5.70	T=	1815.148
4	26	447	17.19	10.20	n=	0.006855
5	76	1672	22.00	2.60		or 1 cycle
Total			101.93	26.64		

(PR=1) $\bar{t}$

(12) Bring load picking to checker 35.20 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	35	35.00	0.04	e=	4%
2	1	23	23.00	148.84	S=	8.5
3	1	45	45.00	96.04	T=	1815.148
4	1	32	32.00	10.24	n=	0.0744056
5	1	41	41.00	33.64		or 1 cycle
Total			176.00	288.80		

Table 3.9. Time Study Process Receive Order by EDI.(Continued)

(PR=1.05) t^{-}

(13) Loading products on trucks 1364.40 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-t^{-})^2$	Z=	2.33
1	1	1560	1560.00	38259.36	e=	4%
2	1	1370	1370.00	31.36	S=	139.02
3	1	1220	1220.00	20851.36	T=	1815.148
4	1	1427	1427.00	3918.76	n=	19.9031742
5	1	1245	1245.00	14256.36		or 20 cycle
Total			6822.00	77,317.20		

Additional

6	1	1533	1533
7	1	1731	1731
8	1	1424	1424
9	1	1535	1535
10	1	1631	1631
11	1	1702	1702
12	1	1241	1241
13	1	1561	1561
14	1	1432	1432
15	1	1235	1235
16	1	1652	1652
17	1	1356	1356
18	1	1485	1485
19	1	1569	1569
20	1	1326	1326
Total			29235.00

(PR=1) t^{-}

(14) Correct data incomputer and confirm 27.51 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-t^{-})^2$	Z=	2.33
1	20	643	32.15	21.53	e=	4%
2	45	946	21.02	42.09	S=	6.33
3	11	275	25.00	6.30	T=	1815.148
4	7	212	30.29	7.71	n=	0.04126437
5	11	320	29.09	2.50		or 1 cycle
Total			137.55	80.12		

Table 3.9. Time Study Process Receive Order by EDI.(Continued)

(PR=1) $\bar{t}$

(15) Generate load and invoice 30.36 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	5	166	33.20	8.05	e=	4%
2	12	328	27.33	9.18	S=	2.2
3	4	117	29.25	1.24	T=	1815.148
4	8	247	30.88	0.26	n=	0.0049844
5	13	405	31.15	0.63		or 1 cycle
Total			151.81	19.35		

(PR=1) $\bar{t}$

(16) Put load paper to printer 18.40 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	21	21.00	6.76	e=	4%
2	1	16	16.00	5.76	S=	4.04
3	1	17	17.00	1.96	T=	1815.148
4	1	24	24.00	31.36	n=	0.01680856
5	1	14	14.00	19.36		or 1 cycle
Total			92.00	65.20		

(PR=1.05) $\bar{t}$

(17) Printing 28.89 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	32	996	31.13	4.98	e=	4%
2	27	812	30.07	1.40	S=	1.82
3	14	378	27.00	3.58	T=	1815.148
4	17	496	29.18	0.08	n=	0.00341123
5	23	623	27.09	3.26		or 1 cycle
Total			144.46	13.30		

Table 3.9. Time Study Process Receive Order by EDI.(Continued)

(PR=1) $\bar{t}$
(18) Load paper out 21.79 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	32	632	19.75	4.17	e=	4%
2	27	756	28.00	38.53	S=	4.21
3	14	339	24.21	5.86	T=	1815.148
4	17	306	18.00	14.39	n=	0.0182529
5	23	437	19.00	7.80		or 1 cycle
Total			108.96	70.75		

(PR=1) $\bar{t}$
(19) Put invoice paper to printer 18.40 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	1	22	22.00	12.96	e=	4%
2	1	14	14.00	19.36	S=	5.85
3	1	27	27.00	73.96	T=	1815.148
4	1	15	15.00	11.56	n=	0.03524354
5	1	14	14.00	19.36		or 1 cycle
Total			92.00	137.20		

(PR=1.05) $\bar{t}$
(20) Printing 18.09 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	418	12.67	29.39	e=	4%
2	17	286	16.82	1.60	S=	5.04
3	18	432	24.00	34.95	T=	1815.148
4	10	227	22.70	21.27	n=	0.02615946
5	12	171	14.25	14.73		or 1 cycle
Total			90.44	101.94		

Table 3.9. Time Study Process Receive Order by EDI.(Continued)

(PR=1) $\bar{t}$

(21) Load paper out 20.75 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	726	22.00	1.55	e=	4%
2	17	282	16.59	17.35	S=	3.1
3	18	416	23.11	5.56	T=	1815.148
4	10	184	18.40	5.54	n=	0.00989672
5	12	284	23.67	8.49		or 1 cycle
Total			103.77	38.49		

(PR=0.95) $\bar{t}$

(22) Copy load and invoice 1.96 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	68	2.06	0.01	e=	4%
2	17	39	2.29	0.11	S=	0.3
3	18	27	1.50	0.21	T=	1815.148
4	10	21	2.10	0.02	n=	9.2685E-05
5	12	22	1.83	0.02		or 1 cycle
Total			9.79	0.37		

(PR=1) $\bar{t}$

(23) Check and prepare document for driver 33.09 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	33	827	25.06	64.40	e=	4%
2	17	374	22.00	122.89	S=	9.8
3	18	723	40.17	50.14	T=	1815.148
4	10	452	45.20	146.76	n=	0.09890538
5	12	396	33.00	0.01		or 1 cycle
Total			165.43	384.20		

Table 3.10. The Average Job Cycle Time of Receive Order by EDI.

Element	$\sum t$	No of Cycle	$\bar{t}$
1	23.62	5	4.72
2	8.61	5	1.72
3	25.97	5	5.19
4	61.08	5	12.22
5	230.85	5	46.17
6	142.48	5	28.50
7	41.67	5	8.33
8	92.74	5	18.55
9	101	5	20.20
10	151.58	5	30.32
11	101.93	5	20.39
12	176	5	35.20
13	6822	5	1364.40
14	137.55	5	27.51
15	151.81	5	30.36
16	92	5	18.40
17	144.46	5	28.89
18	108.96	5	21.79
19	92	5	18.40
20	90.44	5	18.09
21	103.77	5	20.75
22	9.79	5	1.96
23	165.43	5	33.09
Total			1815.15

Table 3.11. Normal Time and Standard Time for Receive Order by EDI.

Element	$\sum t$	No of Cycle	t-	PR	Nt
1	23.62	5	4.72	1.00	4.72
2	8.61	5	1.72	1.00	1.72
3	25.97	5	5.19	0.95	4.93
4	61.08	5	12.22	0.95	11.61
5	230.85	5	46.17	1.10	50.79
6	142.48	5	28.50	1.05	29.92
7	41.67	5	8.33	1.00	8.33
8	92.74	5	18.55	1.00	18.55
9	101	5	20.20	1.00	20.20
10	151.58	5	30.32	1.05	31.83
11	101.93	5	20.39	1.00	20.39
12	176	5	35.20	1.00	35.20
13	29235	20	1461.75	1.05	1534.84
14	137.55	5	27.51	1.00	27.51
15	151.81	5	30.36	1.00	30.36
16	92	5	18.40	1.00	18.40
17	144.46	5	28.89	1.05	30.34
18	108.96	5	21.79	1.00	21.79
19	92	5	18.40	1.00	18.40
20	90.44	5	18.09	1.05	18.99
21	103.77	5	20.75	1.00	20.75
22	9.79	5	1.96	0.95	1.86
23	165.43	5	33.09	1.00	33.09
Total			1912.50		1994.52

Compute the normal Cycle time
NT= 1994.524 seconds

Calculate the standard time Allowance factor=0.4
ST=NT(1+AF)
= (1994.524(1+0.4)
= 2792.33 Seconds

Table 3.12. Time Study Process Cancel PO Received by EDI.

(PR=1) $\bar{t}$

(1) Receive order by EDI 4.72 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	44	212	4.82	0.01	e=	4%
2	54	312	5.78	1.11	S=	1.62
3	72	486	6.75	4.10	T=	313.064
4	48	132	2.75	3.90	n=	0.09
5	36	127	3.53	1.43		or 1 cycle
Total			23.62	10.55		

(PR=1) $\bar{t}$

(2) Print PO from EDI 1.72 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	44	68	1.55	0.03	e=	4%
2	54	94	1.74	0.00	S=	0.57
3	72	86	1.19	0.28	T=	313.064
4	48	129	2.69	0.93	n=	0.01
5	36	52	1.44	0.08		or 1 cycle
Total			8.61	1.32		

(PR=0.95) $\bar{t}$

(3) Check receive date and delivery date 5.19 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	97	4.22	0.96	e=	4%
2	9	32	3.56	2.69	S=	1.46
3	13	96	7.38	4.79	T=	313.064
4	31	170	5.48	0.08	n=	0.07
5	18	96	5.33	0.02		or 1 cycle
Total			25.97	8.54		

Table 3.12. Time Study Process Cancel PO Received by EDI. (Continued)

PR=0.95 $\bar{t}$

(4) Check the correction about price 12.22 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	312	13.57	1.82	e=	4%
2	9	67	7.44	22.77	S=	4.405
3	13	141	10.85	1.88	T=	313.064
4	31	315	10.16	4.22	n=	0.67
5	15	286	19.07	46.92		or 1 cycle
Total			61.08	77.62		

PR=1.10 $\bar{t}$

(5) Calculation promotion 46.17 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	1610	70.00	567.88	e=	4%
2	9	412	45.78	0.15	S=	15.76
3	13	372	28.62	308.16	T=	313.064
4	31	1560	50.32	17.25	n=	8.60
5	15	542	36.13	100.73		or 9 cycles
Total			230.85	994.17		

Additional

6	26	1435	55.19			
7	16	589	36.81			
8	18	612	34.00			
9	20	630	31.50			
Total			388.35			

Table 3.12. Time Study Process Cancel PO Received by EDI. (Continued)

(PR=1.05) $\bar{t}$

(6) Check stock floor and date code 28.50 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	23	458	19.91	73.68	e=	4%
2	9	177	19.67	77.97	S=	13.3
3	13	650	50.00	462.40	T=	313.064
4	31	617	19.90	73.85	n=	6.12
5	15	495	33.00	20.28		or 7 cycles
Total			142.48	708.17		

Additional

6	13	675	51.92			
7	18	645	35.83			
Total			230.24			

(PR=1) $\bar{t}$

(7) Check the production plan 30.14 98% Confident

Cycle	No of Sample	t(seconds)	Time/Sample	$(t-\bar{t})^2$	Z=	2.33
1	3	87	29.00	1.31	e=	4%
2	2	64	32.00	3.45	S=	3.45
3	7	201	28.71	2.04	T=	313.064
4	4	140	35.00	23.59	n=	0.41
5	3	78	26.00	17.16		or 1 cycle
Total			150.71	47.55		

Table 3.13. The Average Job Cycle Time of Cancel PO Received by EDI.

Element	$\sum t$	No of Cycle	$\bar{t}$
1	23.62	5	4.724
2	8.61	5	1.722
3	25.97	5	5.194
4	61.08	5	12.216
5	230.85	5	46.17
6	142.48	5	28.496
7	150.71	5	30.142
8	922	5	184.4
Total			313.064

The average job cycle time of each element can be found by total time of each element divided by the number of cycle time. The total time is 23.62 and the number of cycle time is 5. So 23.62/5=4.724 seconds. The total average job cycle time of cancel Purchase order with receive Purchase order by EDI is 4.72 + 1.72 + 5.19 + 12.21 + 46.17 + 28.49 +30.14+184.4=313.06 seconds.

Table 3.14. Normal Time and Standard Time of Cancel PO Received by EDI.

Element	$\sum t$	No of Cycle	t-	PR	Nt
1	23.62	5	4.724	1.00	4.72
2	8.61	5	1.722	1.00	1.72
3	25.97	5	5.194	0.95	4.93
4	61.08	5	12.216	0.95	11.61
5	388.35	9	43.15	1.10	47.47
6	230.24	7	32.8914	1.05	34.54
7	150.71	5	30.142	1.00	30.14
8	4130	24	172.083	0.95	163.48
Total			302.123		298.61

Compute the normal Cycle time

NT= 298.608 seconds

Calculate the standard time Allowance factor=0.4

ST=NT(1+AF)

= (298.608(1+0.4)

= 418.051 Seconds

3.5 Improving Process

There are 4 processes in customer service 1) Process Receive order by fax 2) Process cancel PO received by fax 3) Process receive order by EDI 4) Process cancel PO received by EDI. Process 2 and 4 have the standard time = 445.13 seconds or 6 minutes 25 seconds and 418.051 second s or 5 minutes 58 seconds. The result shows this process does not take too much time and delay happens in process and both processes are not the main activity. There is only a slim chance of this problem. So it is not necessary to improve these processes.

So it is important to improve main processes. 1) Process Receive order by fax 3) Process receive order by EDI too according. Because both processes are main activities (Routine actives), it takes time. So the first step in improving. this is improving 'process receive order and process receive order by EDI'. Because the standard time of 'receiving order by EDI' takes less time than 'process receive order by fax'.

We can improve 1) 'Receive order by fax' by switching to process receive order by EDI. Process Receive order by fax has a standard time =2897.02 seconds or 48 minutes 17 seconds. When compared with process EDI is =2792.33=46minutes 32 seconds and takes 2 minutes. It is shown in Table 3.15.

Table 3.15. Compare Process Receive Order by Fax and Receive Order by EDI.

Element	Activities(fax)	Nt	Activities(EDI)	Nt
1	Receive order by fax	24.07	Receive order by EDI	4.72
2			Print to from EDI	1.72
3	Check receive date and delivery	4.93	Check receive date and delivery	4.93
4	Check the correction about price	11.61	Check the correction about price	11.61
5	Calculation promotion	50.79	Calculation promotion	50.79
6	Check stock floor and date code	29.92	Check stock floor and date code	29.92
7	Key data of PO to computer	57.99	Down load data from EDI to Order entry	8.33
8	Generate load picking	18.55	Generate load picking	18.55
9	Feed paper to printer	20.20	Feed paper to printer	20.20
10	Printing	31.83	Printing	31.83
11	Load picking paper out from printer	20.39	Load picking paper out from printer	20.39
12	Bring load picking to checker	35.20	Bring load picking to checker	35.20
13	Checker loading product on truck	1542.34	Checker picking product on truck	1534.84

Table 3.15. Compare Process Receive Order by Fax and Receive Order by EDI. (Continued)

Element	Activities(fax)	Nt	Activities(EDI)	Nt
14	Correct data in computer and confirm picking	27.51	Correct data in Computer and confirm picking	27.51
15	Generate load and invoice	30.36	Generate load and invoice	30.36
16	Feed load paper to printer	18.40	Feed load paper to printer	18.40
17	Printing	30.34	Printing	30.34
18	Load paper out from printer	21.79	Load paper out from printer	21.79
19	Feed invoice paper to printer	18.40	Feed invoice paper to printer	18.40
20	Printing	18.99	Printing	18.99
21	Invoice paper out from printer	20.75	Invoice paper out from printer	20.75
22	Copy load and invoice	1.86	Copy load and invoice	1.86
23	Check and prepare document for driver	33.09	Check and prepare document to driver	33.09

In Table 3.15 although 'process receive order by EDI' has the number element more than Fax but it takes less time than 'process receive order by EDI'. The process can be improved as follows:

(1) 'Process Receive order by EDI' takes 4.72 seconds but 'receive order by fax' take 24.07 seconds. Combined element 1 and 2 of EDI takes only 4.72+1.72=6.44 seconds that is less than process receive order by fax= 24.04. So switch for 'process receive order by fax' to 'receive order by EDI'. It reduces time of element 1 and 2 of processes of receive order by fax 24.07-6.44=17.63 seconds.

(2) Element 6 of process receive order by fax is Key data of PO to computer that takes 57.99 seconds but compared with element 7 of EDI is to down load data from EDI to order entry in 8.33 seconds. The 'process receive order by EDI' take less than 'process receive order by fax' =49.66 second. Both element activities (Key data of PO to computer and down load data from EDI) are of the same objectives that is to input order to the system.

So it is necessary to improve this process by changing 'receive order by fax' to by 'EDI' because from switching to EDI system is faster and more convenient than Fax system . EDI system data is kept in to the computer system so data is brought to generate report for conclusion result , service level, etc. it is easier than fax system . The time reduced by switching process is 17.63 seconds + 49.66 seconds = 67.29 seconds or 1 minutes and 7 seconds. The work is done for one purchase order.

Secondly after switching the process receive order by fax to 'receive order by EDI', improve 'process receive order by EDI'. For 'process receive order by EDI' means it has data in the system already. So it is necessary to improve this process.

(1) By applying software to switch from manual work to computer calculation and computer check can reduce time because computer is an automatic accurate system. In this case, there is no time lost in computer calculation and checking. The element can switch from manual work to computer.

(a) Element 3 Check receive data and delivery (4.93 seconds)

(b) Element 4 Check the correction price (11.61 seconds)

(c) Element 5 Calculation promotion (50.79 seconds)

(d) Element 6 Check stock floor and date code (29.92 seconds)

The total reduced time from switching the manual working system to computer system is 4.93+11.61+50.79+29.92= 97.25 seconds per purchase order.

(2) Increase the number of machines (printer). Now there is only one printer for this process. So increasing the number of printers from one printer to two printers by parallel working process printing by Element 16 feed paper to printer, Element17 printing,18 paper out from printer of 'process receive order by EDI' can do parallel work with Element 19 to feed invoice paper to printer,20 printing,21 invoice paper our from printer. This can reduce working time because We can print invoice and loading at the same time. The result is shown in Table 3. 16. The element 16,17,18 take more time than element 19,20,21.In this case we use the longest working time and element 16,17,18 waiting element 19,20,21 before doing other elements.

Table 3.16. Parallel System to Reduce Time.

Element	Activities(EDI)	Nt	Element	Activities(EDI)	Nt
16	Feed loading paper to printer	18.40	19	Feed invoice paper to printer	18.40
17	Printing	30.34	20	Printing	18.99
18	Load paper out from printer	21.79	21	Invoice paper out from printer	20.75
	Total	70.53		Total	58.14

In Table 3.16. it can be seen that the time is reduced from 70.53+58.14=128.67 seconds to 70.53 seconds because when the element 16) feeds loading paper to printer, 17) Printing, 18) Loading paper out from the printer. These processes are done parallel with Element 19 feeding invoice paper to printer,20 printing,21 invoice paper out from printer. This can reduce time 128.67-70.53 =58.04 seconds per purchase order.

This improvement can reduce time = 97.25+58.04=155.65 seconds. The new process flow chart is shown in Figure 3.6 and Table 3.17 shows normal time of the process(improving). Receive order fax process can be switched to 'receive order by EDI' process, new processes from process receive order by EDI is shown in Figure 3.6.The element of 16 ,17,18 can work parallel with 19,20,21 and eliminate manual element(activity).

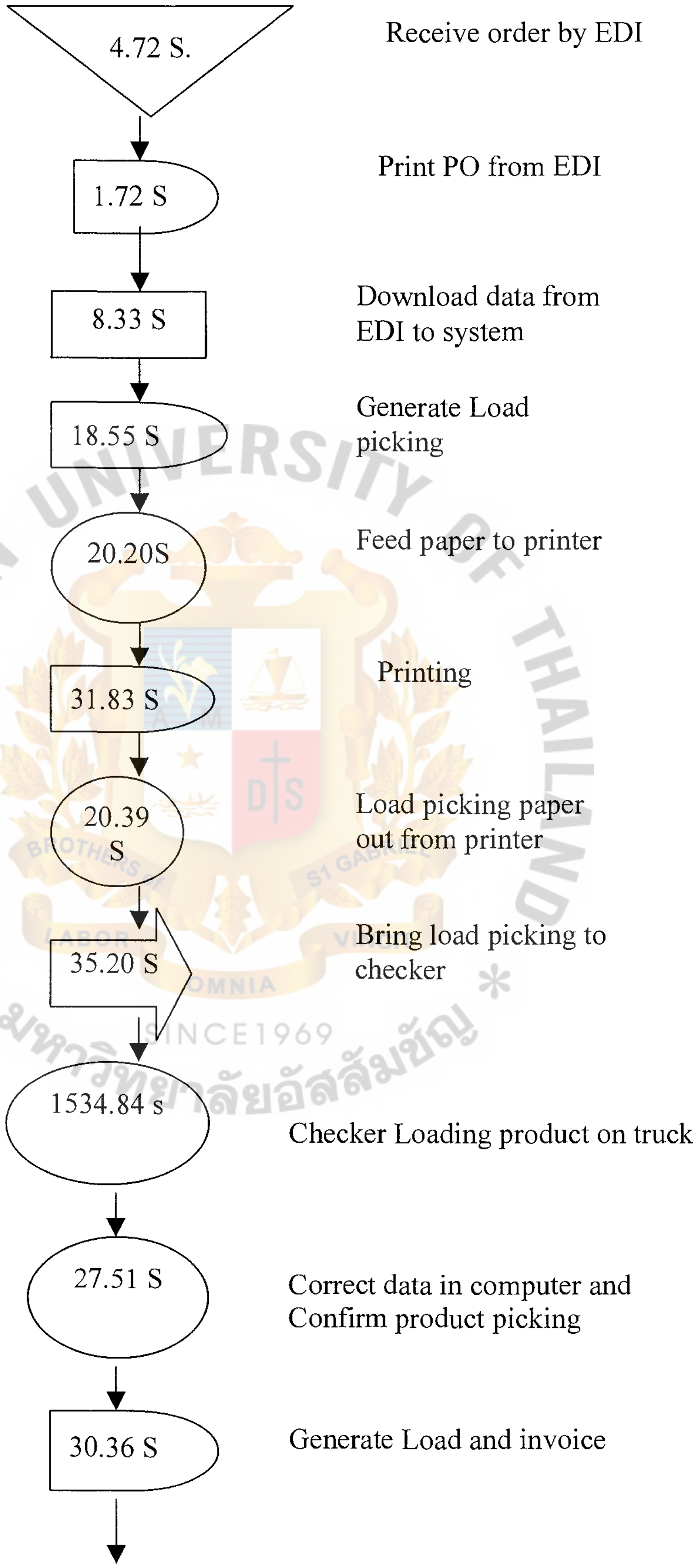


Figure 3.6. The Process Chart Improvement of Receive Order by EDI.

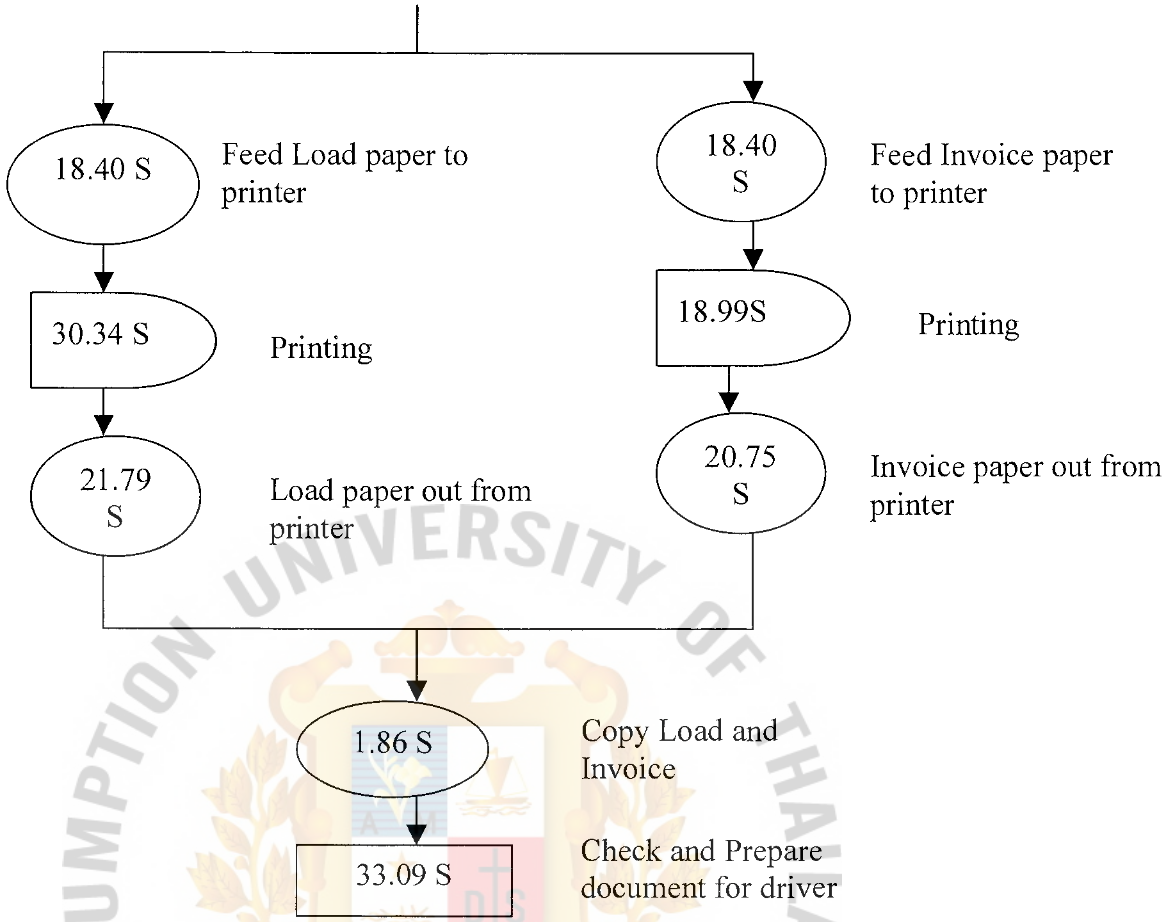


Figure 3.6. The Process Chart Improvement of Receive Order by EDI. (continued)

Table 3. 17. Normal Time from Improving Process.

Element	Activities(EDI)	Nt
1	Receive order by EDI	4.72
2	Print to from EDI	1.72
3	Down load data from EDI to Order entry	8.33
4	Generate load picking	18.55
5	Feed load picking paper to printer	20.20
6	Printing	31.83
7	Load picking paper out from printer	20.39
8	Bring load picking to checker	35.20
9	Checker loading product on truck	1534.84
10	Correct data in computer and confirm picking	27.51
11	Generate load and invoice	30.36
12	Feed load, invoice paper to printer	18.40
13	Printing	30.34
14	Load paper and invoice out from printer	21.79
15	Copy load and invoice	1.86
16	Check and prepare document for driver	33.09
	Total	1839.13

Calculate standard time for improving process: Allowance factor=0.4

=(1839.13(1+0.4))

=2574.78 seconds

From table 3.11 'receive order by EDI' system standard time =2792.33 seconds and receive order by fax =2897.02 seconds. So improving process can reduce time from 'receive order by fax' =2897.02-2574.78=322 seconds or 5 minute 22 seconds per purchase order. When compared with 'receive order by EDI', improving process reduces time = 2792.33-2574.78=217.55 seconds or 3 minutes per purchase order.

Utilization between worker and machine for improving process has idle time as shown in table 3.18 (The result for worker operation 93 % and idle 7 %. The result Printer machine is operation 7% and idle 93%) that can improve the process. Table 3.19 shows improvement of utilization between workers and machines. The worker can use waiting time to do other jobs by rescheduling the job. It is shown in Table 3.19. The result shows workers operation may be possible to 100% and idle 0% but machine operation cannot improve because sequencing is fixed.

Table 3.18. Working Machine Chart.
Job customer service improvement

Element	Operator	Time(seconds)	Machine
1	Idle	4.72	Receive order by EDI
2	Idle	1.72	Printing from EDI
3	Idle	8.33	Down load data from
4	Idle	18.55	Generate load picking
5	Feed picking paper to	20.2	Idle
6	Idle	31.83	Printing
7	Picking paper out from printer	20.39	Idle
8	Bring load picking to checker	35.2	Idle
9	Checker loading product on truck	1534.84	Idle
10	Correct data in computer and confirm picking	27.51	Idle
11	Idle	30.36	Generate load and
12	Feed load,invoice paper to printer	18.4	Idle
13	Idle	30.34	Printing
14	Load,Invoice paper out from printer	21.79	Idle
15	Copy load and invoice	1.86	Idle
16	Check and prepare document to driver	33.09	Idle
	Total	1839.13	

Summary				
	Operation time	%	Printer Machine time	%
work	1713.28	93%	125.85	7%
Idle	125.85	7%	1713.28	93%
	1839.13	100%	1839.13	100%

Table 3.19. Working Machine Chart Improvement.
Job customer service improvement

Element	Operator	Time(seconds)	Machine
1	Recommend do other task	4.72	Receive order by EDI
2	Recommend do other task	1.72	Printing from EDI
3	Recommend do other task	8.33	Down load data from EDI
4	Recommend do other task	18.55	Generate load picking
5	Feed picking paper to printer	20.2	Idle
6	Recommend do other task	31.83	Printing
7	Picking paper out from	20.39	Idle
8	Bring load picking to checker	35.2	Idle
9	Checker loading product on truck	1534.84	Idle
10	Correct data in computer and confirm picking	27.51	Idle
11	Recommend do other task	30.36	Generate load and invoice
12	Feed load,invoice paper to printer	18.4	Idle
13	Recommend do other task	30.34	Printing
14	Load,Invoice paper out from printer	21.79	Idle
15	Copy load and invoice	1.86	Idle
16	Check and prepare document for driver	33.09	Idle
	Total	1839.13	

Summary				
	Operation time	%	Printer Machine time	%
work	1839.13	100%	125.85	7%
Idle	0	0%	1713.28	93%
	1839.13	100%	1839.13	100%

IV. CONCLUSIONS AND RECOMMENDATIONS

From the analysis of normal time and standard time for processing customer service of Thai Pure Drinks Ltd., the result is reducing time and increasing efficiency of workers.

4.1 Conclusions

(1) Almost all work is done manually. For example, check receive date and delivery date, check the correction about price, calculation promotion and check stock floor. These tasks take too much time in process. Manual work can cause mistakes. Especially in calculation of promotion from mechanic takes about 1 min per PO to calculate.

(2) Allowance factors are high because machines (Printer or system in computer) often break down and cause delay. Waiting time occurs due to printer break-down or system failure. So it cannot finish job and workers have to work overtime.

(3) There are 4 process that process in customer service. Process 3 is 'Process cancel PO received by fax' and Process 4 is cancel PO received by EDI. The standard time of 'process cancel PO received by fax' is 445.13 seconds or 6 minutes 25 seconds and 'process cancel PO received by EDI' is 418.051 seconds or 5 minutes 58 seconds. The result shows this process does not take too much time and cause delays. (The average for these process are 6 PO per day or 5% of total PO per day)

(4) In Table 3.2 , the average work for one day is work done by Fax PO are 32 PO per day. The standard time for 'Process Receive order by fax' is 2897 seconds or 48 minutes 17 seconds. The working time for one day is 92704

seconds or 26 hours per day. Now there are 10 workers so 26/10=2 hrs 36 minutes per person.

(5) In Table 3.2, the average work for one day is done by 81 PO. The standard time for 'Process Receive order by EDI' is 2792 second or 46 minutes 32 seconds. The working time for one day is 226152 seconds or 63 hours per day. Now 10 workers are working so 63/10= 6 hrs 18 minutes per person. So the total time use for EDI and fax PO = 8 hours 54 minutes.

(6) In Table 3.18, the worker works 93% and idle time is 7% but machine work 7 % and idle time was 93% This result shows workers can improve from 93% to 100% whiles machines are working, the worker can do other job. But the machine can not improve utilization because the sequence of machine is fixed for work.. Table 3.19 shows results by improving working machine chart.

(7) For process 1 receive order by fax Sample size result =1 because element 12 (Loading product on truck) takes time more than other elements . It affects T (Total job cycle time) that result to n (Number of cycle). For process 3 'receive order by EDI'. it is the same reason to get n=1. This result is from element 13. (loading products on trucks)

(8) Improve process can be done by 3 step 1)improve fax system to EDI system reduce 67.29 seconds or 1 minutes 7 seconds per PO compared with input average PO 113 per day. This can reduce working time = 113*67 seconds =7,571 seconds or 126 minute or 2 hour 6 minute per day . For 2) improve by (increase the number of printer) workers working parallel jobs with machine. This can reduce 58.04 seconds. So 113*58.04=6558 seconds or 109 minutes or 1 hour 49 minutes. 3) Improving process can eliminate

manual work. This can reduce time of work to 97 seconds per PO Input average PO 113 per day. This can reduce time work per day for receive order by fax = 113*97 seconds 10691 seconds or 182 minutes or 3 hours 2 minutes. So final improves 1 PO can reduce 2897.02-2574.78 =322 seconds or 5 minutes 22 seconds for process receive order by fax. In the part of process receive order by EDI can reduce 2792.33-2574.78=217seconds or 3 minutes.

(9) In Table 3.2, the average work for one day (Fax+Edi) is done by 113 PO. The standard time for Process Improving final is 2574 second or 42 minutes 54 seconds. The working time for one day is 290862 seconds or 81 hours per day. Now 10 workers are working so 81/10=8 hrs 6 minutes per person. So the process improving can reduce time 48 minutes per person per day.

So customer service has 4 processes. 1) Cancel PO received by fax 2) Cancel PO received by EDI. Both processes do not take time so it is not necessary to improve. "The process receive order by Fax is improved by switching to it receive order by EDI process". It can reduce 67.29 seconds. When 'receive order by fax' is switched to EDI system , the next step to improve is to switch manual system to computer system and parallel working system , which can reduce 155.65 seconds. According to Table 3.18 the idle time of printer is still high. So improvement is to help reduce time of working. The standard time after improving the system final is 2574.78 seconds. When compared with 'process receive order by fax', the standard time is 2897.02. The improvement can reduce 2897.02-2574.78= 322.24 seconds per PO and when compared with 'process receive order by EDI', the standard time is 2792.336 seconds. The improvement can reduce 2792.33-2574.78=217.55 seconds per PO.

4.2 Recommendations

(1) Preventive Maintenance for breaking down of printer, computer and system. The break down can stop and interrupt the work. So the preventive maintenance can reduce time for working. Printers or computers should be checked every 2 months.

(2) Plan to prepare for picking products 2 days ahead. Now the customer service prepares documents and picking products before delivering to them customer 1 day ahead. So the workers prepare products or if the work is not finished, they have to work overtime to finish the work. If they prepare 2 days before, the load may be reduced.

(3) The programs and MIS support can eliminate and reduce manual work, which takes time, such as checking receive date and delivery date, checking the correction about price, calculation of promotion and checking stock floor. Use computer to check and do calculation. The computer helps decision plan for working. Now the inventory transaction did not update real time. Software ERP is used in the company JDE model does not support function calculation of warehouse system. If the program can develop software in control inventory transaction, the manager can plan work more efficiently.

(4) Increase the number of printers. Although the company has to buy printers it can gain more benefits than cost because 1)it reduces OT pay for workers. 2) when printers break down , the workers can continue their work by using other printers. It did not lose time for working but it improves service level. When the printer breaks down, the products cannot be delivered to customers because there are no invoice and loading for picking products.

Then the workers have to write invoice and loading lists. This process takes time and errors will occur.

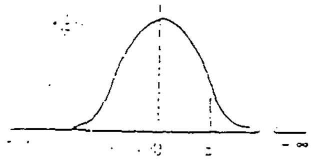
4.3 Future Research

(1) Separate the process of picking products to study it alone because this affects the number of cycle of other element (activities). By studying the improved delivering product process ,inventory management will improve its work.

(2) Study ware house system. Checking shelf life, stock floor, will improve its work and sufficient products enough for customer order by computer calculation can reduce working time and satisfy customers' needs.

APPENDIX A

CUMULATIVE PROBABILITIES OF THE NORMAL DISTRIBUTION



Cumulative Probabilities of the Normal Distribution
(Areas under the standardized normal curve from $-\infty$ to z)

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

APPENDIX B

EXAMPLE OF PURCHASE ORDER BY FAX

FROM : CARREFOUR PETCHKASEM PHONE NO. : 028074753 DEC. 11 2003 11:2

Confirmed Order for Promotion Item
ใบสั่งซื้อ

CenCar Limited Petchkasem คาร์ฟูร์		PAGE หน้า	: 1/1
DEPARTMENT CODE รหัสแผนก	: 10 Beverages	TELEPHONE NO. โทรศัพท์	: 5002162-68
SUPPLIER CODE รหัสผู้ขาย	: 0333	FAX NO แฟกซ์	: 5002172,73
SUPPLIER NAME ชื่อผู้ขาย	: THAI PURE DRINK LIMITED ไทยน้ำทิพย์		
ORDER NO. เลขที่ใบสั่ง	: 10 0333 203 P EXPECTED CANCEL DATE วันคาดเลิก		: 14/11/2003
ORDER DATE วันที่สั่ง	: 10/11/2003		
EXPECTED REC. DATE วันคาดรับ	: 12/11/2003 TIME เวลา : :		

Item Code Sub/Unit	Capacity Barcode	Item Name Sub Code Name		Ordered Qty. Normal (Pack)	Ordered Qty. Free (SKU)	Qty/ Pack	Total Qty.
000000	325 มิลลิลิตร	COKE CAN โค้กกระป๋อง					
001/01	8851050132012	COKE CAN โค้กกระป๋อง	5511	P 8	0	24	192
000002	2 LT	COKE PET โค้กเพ็ท					
001/01	8851050142011		6611	N 49	0	6	294
000013	250 ML	COKE BUDDY 250 ML โค้กบัดดี้ 250 ML					
001/01	8851050122013	COKE BUDDY 250 โค้กบัดดี้ 250	6511	N 2	0	24	48
001000	325 ML	SPRITE CAN สไปรท์กระป๋อง					
001/01	8851050132364			N 1	0	24	24
001002	2 ลิตร	SPRITE PET สไปรท์เพ็ท					
001/01	8851050142363		4691	N 22	0	6	132
002000	325 ML	FANTA ORANGE CAN แฟนต้าน้ำส้ม					
001/01	8851050132166			N 2	0	24	48
002001	2 มิลลิลิตร	FANTA ORANGE PET แฟนต้าน้ำส้มเพ็ท					
001/01	8851050142165	FANTA ORANGE PEแฟนต้าน้ำส้ม		N 21	0	6	126
002002	325 ML	FANTA CREME SODA แฟนต้าน้ำเขียว					
001/01	8851050132180			N 2	0	24	48
002004	325 ML	FANTA STRAWBERRY CAN แฟนต้าน้ำแดงกระป๋อง					
001/01	8851050132173			N 2	0	24	48
002013	1.25 ลิตร	FANTA BLUE PET แฟนต้า บลูแพท					
001/01	8851050144290	FANTA BLUE PET แฟนต้า บลูแพท	5151	P 1	0	12	12
002019	1.25 ลิตร	FANTA ORANGE แฟนต้าน้ำส้ม					
001/01	8851050144109		5111	P 53	0	12	636
051049	1.500 CC	NAMTHIP DRINKING WATER น้ำดื่ม ตราน้ำทิพ					
001/01	8851050143711	NAMTHIP DRINKINNAMTHIPDRINKING	4593	N 44	0	6	264

PROMOTION

ธ.91

SALES CLERK : 88010 Order Pool Clerk Department 10

P.S. (PLEASE BRING ALONG FAX ORDER WHEN DELIVERING GOODS)

APPENDIX C

EXAMPLE OF PURCHASE ORDER BY EDI

Printed 10 November 2003 11:43

ผู้สั่งซื้อ : 101
LOGISTICS SPECIALIST (THAILAND) CO.
70 MOO 6 TUMBOL LAHARN, BANGBUATHONG
NONTHABURI
โทรศัพท์ : โทรสาร :
Dept Code :
Dept Name :
ผู้ผลิต : 80022200
Not found.

โทรศัพท์ : โทรสาร :
หมายเหตุ :

เลขที่ใบสั่งซื้อ : 03459924
วันที่สั่งสินค้า : 10/11/2003
วันที่ส่งสินค้า : 13/11/2003
วันที่ยกเลิกใบสั่งซื้อ
การชำระเงิน : 30 วัน
PO Type : Mail Promotion :
ส่วนลด(%) : 0.00
รหัสภายในผู้ผลิต : 80022200
รหัสสำนักงานใหญ่ :

โปรดส่งสินค้าไปที่ : 101
LOGISTICS SPECIALIST (THAILAND) CO.
70 MOO 6 TUMBOL LAHARN, BANGBUATHONG
NONTHABURI
โทรศัพท์ : โทรสาร :

ลำดับ	รายการ	ขนาดบรรจุ	รหัส(บาร์โค้ด/ ผู้ซื้อ/ ผู้ผลิต)	จำนวน	ราคา	ส่วนลด%	ส่วนลด	จำนวนเงิน
1	โค้ก1.25LTR.	12car	(8851959144015/IN/-)	250				
2	โค้กวานิลลา1.25ลิตร	12car	(8851959144060/IN/-)	50				
3	แฟนต้าน้ำส้ม1.25LTR	12car	(8851959144169/IN/-)	100				
4	สไปรท์1.25LTR.	12car	(8851959144367/IN/-)	100				

รวมเงิน
ส่วนลด
ภาษีมูลค่าเพิ่ม
รวมเงินทั้งสิ้น

APPENDIX D

EXAMPLE OF PICKING LOAD

OASIS II XLCR003 VE R0601901 บริษัท ไทยน้ำทิพย์ จำกัด Printed 11/11/03 13:05:07 PAGE 6

LOAD-ADVICE รส ขนด. ฝาจุก	12/11/03	Load COIL]	LOAD-ADVICE รส ขนด. ฝาจุก	12/11/03	Load COIL]	LOAD-ADVICE รส ขนด. ฝาจุก	12/11/03	Load COIL]	LOAD-ADVICE รส ขนด. ฝาจุก	12/11/03	Load COIL]	LOAD-ADVICE รส ขนด. ฝาจุก	12/11/03	Load COIL]	LOAD-ADVICE รส ขนด. ฝาจุก	12/11/03	Load COIL]
CC 2L	4611	50	CLI124 325	5512	10										IC Colus (TYPE 3)		
TOTAL		56	TOTAL		10												
CC 1.25	5111	270	OOI124 300	6060	1												
CV 1.25	5117	8	OXI124 300	6061	8												
FO 1.25	5121	50	OOI124 300	6062	12												
FU 1.25	5182	13															
SP 1.25	5131	88	TOTAL		21												
TOTAL		429	OO 1L	1560	5												
			OX 1L	1501	6												
			TOTAL		11												

APPENDIX E

EXAMPLE OF INVOICE

บริษัท ไทยน้ำทิพย์ จำกัด
เลขประจำตัวผู้เสียภาษี 3 10101760 1
สำนักงานใหญ่ : เลขที่ 214 หมู่ที่ 5 ถนนวิภาวดีรังสิต
แขวงทุ่งสองห้อง เขตหลักสี่ กรุงเทพมหานคร 10210

สาขาที่ออกใบกำกับภาษี :
โรงงานรังสิต 9 ม.7 ถนนเลียบคลอง 13
ตำบลบึงบา อำเภอธัญบุรี ปทุมธานี 12150
โทรศัพท์ 5692152-58 โทรสาร 5692169
W/H : 60 โรงงานรังสิต

ใบโอนใบกำกับภาษี

(เอกสารออกเป็นชุด) หน้า 1

[ ] ใบขายเชื่อ/สำเนาใบส่งของ

[ ] (สำเนา)ใบลดหนี้/ใบรับคืน วันที่

ชื่อลูกค้า
ที่อยู่

สถานที่ส่งของ
ที่อยู่
รหัส
ผู้ติดต่อ

รหัสเขตการขาย LMK ชื่อสาขา 60 โรงงานรังสิต ครบกำหนดชำระ \DTC.= 113 Dei:

PO number 12.307089 เอกสารเลขที่

ผลิตภัณฑ์	รหัส	ขนาด ลัง : ขวด	จำนวน ลัง : ขวด	ราคา	จำนวนเงิน
***** NOTHING FOLLOWS *****					

มัดจำ / ยืมภาชนะ

A [ ] มัดจำเงินเชื่อ (113)
B [ ] ยืมภาชนะ (212, 213)

คืนภาชนะ

C [ ] คืนมัดจำลดหนี้ (113)
D [ ] คืนภาชนะที่ยืม (212, 213)

ภาชนะ	รหัส	จำนวน ลัง:ขวด	ราคา	จำนวนเงิน
กระบะพลาสติก	8901	1		
=7ONE24กระบะ	8903	5		

คืนกระบะไม้........../ พลาสติก..........

ลงชื่อลูกค้า..........

ลงชื่อพนักงานขับรถ..........

รวมเงินค่าภาชนะ

รวมเงินสุทธิ (.5)

กรณีคืนหรือลดหนี้ให้ใช้ในการอ้างอิง

ใบขายเชื่อ อ้างถึง
เลขที่..........
ลงวันที่..........
เหตุผลที่ขอคืนผลิตภัณฑ์..........
1. มูลค่าผลิตภัณฑ์เดิม..........
2. มูลค่าผลิตภัณฑ์ที่ถูกต้อง..........
3. ภาษีมูลค่าเพิ่มเดิม..........
4. ภาษีมูลค่าเพิ่มที่ถูกต้อง..........

① รวมค่าผลิตภัณฑ์และภาษีมูลค่าเพิ่ม
② ภาษีมูลค่าเพิ่ม 7/107 (.900)
③ ค่าผลิตภัณฑ์สุทธิ (ไม่รวมภาษี)
④ ภาษีสรรพสามิต (อัตราแกลลอนละ 47.15 บาท) จำนวน .... แกลลอน
⑤ รวมเงินทั้งสิ้น 0-0
ตัวอักษร.......... (.5)

พนักงานขาย	ผู้จัดการเขต	ผู้รับของ/ลูกค้า

เลขที่ควบคุมเอกสาร: A 0658264

APPENDIX F

EXAMPLE OF LOAD

IS R52 LCP310 ORIGINAL R9 R0 หน้า 0003

สินค้า 80 รง.รังสิต
ตัวแทน 101 นาง. ธัญญทิพย์ พาณิชย์สปอร์ต
สาย : LL01 LOGISTIC NP

วันที่ส่งของ : 10/11/03
หมายเลขรถ : 001HT
เลขที่เอกสาร : 80000755452

ปริมาณ 1000
เที่ยวที่ 15632
จำนวนเที่ยวของ: 0

ชั้น2 ชั้น3 NO.

ผลิตภัณฑ์	ลัง/ขวด	ปัดเศษ	รหัสผลิตภัณฑ์	LOAD OUT เต็มลัง	LOAD OUT เพิ่ม	LOAD OUT รวม	รหัสผลิตภัณฑ์	LOAD IN จำนวนเต็ม		LOAD IN ขาดแตก
CC 250			6511	1260			6511			
SHS 10oz			3054	112			3054			
PALL PLAS			8901	20			8901			

รวม LOAD OUT (.1)
RET. ลัง12
RET. ลัง24
NON-PET.
กะบะไม้ (8902)
กะบะพลาสติก (8901)

ขนาด	COKE ขวดเปล่า		รวมขวด	FANTA ขวดเปล่า		รวมขวด	SPRITE ขวดเปล่า		รวมขวด	MELLO/PX /ท่อ CO 2 ขวดเปล่า		รวมขวด	อื่นๆ ลัง/กบบ	รวม
0 HL	8151	7151		8152	7152		8153	7153					0012	
0 CC	8201	7201		8202	7202								8024	
02	8251	7251		8252	7252		8253	7253						
02	8301	7301		8302	7302		8303	7303		8304	7304			
1 10	8305	7305												
5 02	8351	7351											8901	
0 CC	8401	7401		8402	7402		8403	7403		7721	7769		8902	

ผู้: ____ พนักงานขาย   ยอด: ____ เช็คเกอร์-1   ยอด: ____ เช็คเกอร์-2

เข้า: ____ พนักงานขาย   เข้า: ____ เช็คเกอร์-1   เข้า: ____ เช็คเกอร์-2

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