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A CASE STUDY ON MANUFACTURING WASTE REDUCTION THROUGH JUST IN TIME

MOHD ROZAIMI BIN ARSHAD

A project report partial fulfillment of the requirements for the award of the degree of

Bachelor of Mechanical Engineering

Faculty of Mechanical Engineering

Universiti Malaysia Pahang

NOVEMBER 2007

"I hereby declare that I have read this thesis and in my opinion this thesis sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Manufacturing Engineering."

Signature : ....

Name of Supervisor : NORAINI BINTI MOHD RAZALI

Date : 21/11/2007

I declare that this thesis entitled "A Case Study on Manufacturing Waste Reduction through Just in Time (JIT)" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ....

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ABSTRACT

The waste reduction through JIT concept that can reduce cycle time is difficulty to find a good solution. However after make solution of this project and discuss with engineer have many constraint that cannot apply in reduce cycle time. In classify the waste that occur in production line of product 4900-X-319 is successful. This product have about 5 types of waste is defect product, motion, transportation, processing and waiting time. To collect this information some observation has to do and discuss with engineer. The cycle time from this product have to collect using stopwatch. The data have to measure at least 3 times because in engineering the accurate data is important. While collect the data each process of this product has to understand and this will give idea to provide a solution about reducing cycle time. After that make line balancing of 4900-X-319 and the total time to produce this product is 5.33min/piece. To achieve last objective several solution have to discuss with engineer. The result of the solution has be reject because many constraint from factory that can implement in this product. If this solution acceptable the cycle time will reduce about 24s and can reduce operator cost.

ABSTRAK

Untuk mencari penyelesaian yang terbaik bagi mengurangkan pembaziran menggunakan konsep Just in Time(JIT) adalah rumit. Untuk mencapai objektif kedua beberapa penyelesaian telah dicari tetapi jurutera tidak bersetuju untuk digunapakai dalam projek ini. Walaubagaimanapun untuk objektif pertama iaitu mengelaskan pembaziran yang berlaku bagi produk 4900-X-319 telah berjaya dilaksanakan. Dalam menghasilkan product ini terdapat 5 jenis pembaziran yang berlaku iaitu kecacatan product, pergerakan, pengangkutan, proses semula dan masa menunggu. Data yang diterima ketika projek ini datang dari pemerhatian dan perbincangan dengan jurutera kilang. Masa untuk semua proses ini diambil menggunakan jam randik. Setiap data yang diambil perlu diulangi sebanyak 3 kali bagi mendapat data yang lebih tepat. Ketika mengumpul data , proses untuk menghasilkan product ini juga harus difahami supaya ia dapat memberi idea dalam mengurangkan pembaziran. Selepas itu masa keseluruhan untuk menyiapkan 4900-X-319 perlu dicatat iaitu 5.33min/produk. Jika penyelesaian untuk product diterima, masa untuk membuat produk ini akan berkurang sebanyak 24s dan kos bagi operator juga dapat dikurangkan.

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CHAPTER 1

INTRODUCTION

In this chapter the background of the project and the problem statement about the existing product is recognize. Other then those, this chapter also state the objectives and scopes for overall of the project.

1.1 Project Background

JIT (Just in Time) method has been developed at the Toyota Motor Company of Japan by Taiichi Ohno. The basic elements of JIT were developed by Toyota in the 1950's, and became known as the Toyota Production System (TPS). JIT was well established in many Japanese factories by the early 1970's. JIT began to be adopted in the U.S. in the 1980's (General Electric was an early adopter), and the JIT lean concepts are now widely accepted and used.

JIT is a philosophy of continuous and forced problem solving that support lean production where lean production supplies the customer with exactly what the customer wants when the customer wants it, without waste through continuous improvement. It also has been described as manufacturing based on planned elimination of all waste and on continuous improvement of productivity [3].

In JIT waste reduction can be achieved by elimination of unnecessary activity, elimination of poor supplier, reduce inventory cost, reduce set up time, and reduce defective product and improving production layout. JIT implementation will give higher benefits to the company that eventually provides faster delivery, reduce work-in-process and speeds throughput [2].

This project is a case study on manufacturing waste reduction through JIT and will be doing in Pekan Pahang. The factory is specialist in electronic component and had been operation about 20 years ago. This factory is vendor of electronic component and the market is in German. The main product in this factory is installation, industrial application, telecommunication and automotive.

In this factory have several waste that could reduce profit company is waste of waiting time, processing waste, waste of motion and waste from product defect. After study the flow of automotive product 4900-X319 in figure 1 the high waste is in setup time and product defect. To reduce this waste must apply Just in time method and make solution refer to theory and environment of factory.

Figure 1.1: 4900-X319

1.2 Project Objectives

1. To identify and classify waste activities in factory.

2. To reduce waste activities by using Just in Time concept.

1.3 Scopes

1. The project will focus mainly on identifying the waste activities and provides waste reduction solution to the company for greater overall returns and sustain competitive advantage using JIT.

2. This project will be doing in real industry environment at Pekan Pahang and focus only on two type of waste product defect and waiting time.

1.4 Problem Statement

In factory have several type of waste that cause financial loss to company if the waste of product is increases. This situation will give other station problem like delivery the product to port not in schedule then have to order the material more than the company needed and increase labor cost. This project must reduce the waste by using Just in Time method and apply in factory. The solution that is provided cannot change the flow of product or the complicated problem.

1.5 Flow Chart

This flow chart shows the stages of process to complete this project for the first and second semester. All the stages are shown in Figure 2:

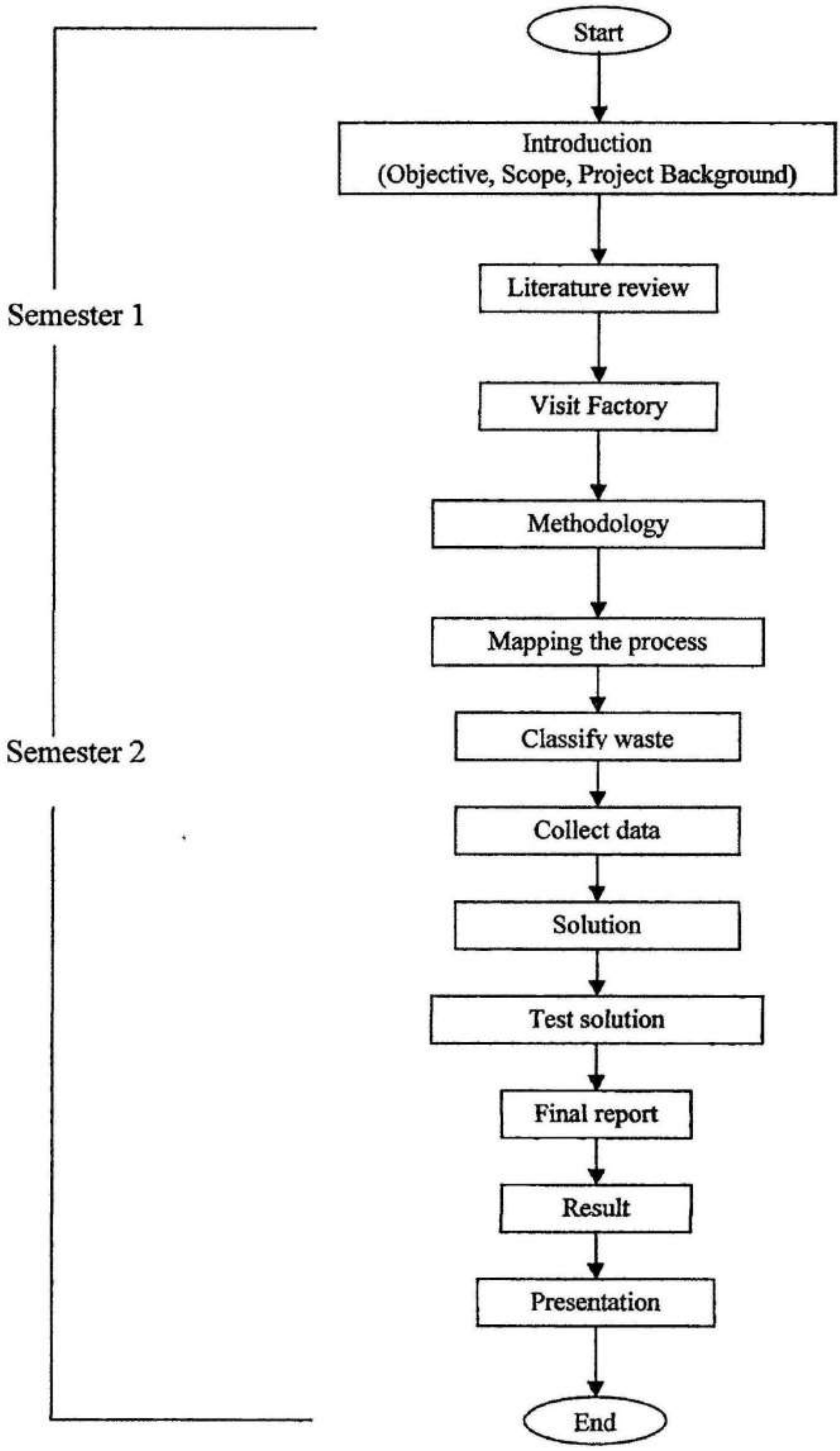

Figure 1.2: Flow chart

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Just-in-time (JIT) manufacturing is a way of managing manufacturing systems that could reduce waste, and lower cost, thus increasing profit. It's most basic explanation and principle JIT is every component in the manufacturing system arriving just in time for it to be used.

Since the products arrive just in time there is no need for stock holding facilities of any kind. The most common industry using JIT manufacturing is the automobile industries. However, many other companies of all sizes and products are currently using and transitioning to just-in-time manufacturing [4].

2.2 History of Just in Time

Just-In-Time is a Japanese manufacturing management method developed in 1970s. It was first adopted by Toyota manufacturing plants by Taiichi Ohno. The main concern at that time was to meet consumer demands. Because of the success of JIT management, Taiichi Ohno was named the Father of JIT [2].

After the first introduction of JIT by Toyota, many companies followed up and around mid 1970s', it gained extended support and widely used by many companies. One motivated reason for developing JIT and some other better production techniques and people had a very strong incentive to develop a good manufacturing technique to help them rebuilding the economy. They also had a strong working ethnic which was concentrated on work rather than leisure, seeded continuous improvement, life commitment to work, group conscious rather than individualism and achieved common goal.

This kind of motivation had driven Japanese economy to succeed. JIT manufacturing can be traced back to the late 1700's. Eli Whitney contributed his concept of interchangeable parts to the idea of JIT manufacturing in 1799. This concept was developed when Whitney took a contract from the United States Army to manufacture 10,000 muskets at the low price of $13.40 each. Over the next several years manufactures overall focused on the development of individual technologies. Through these years few people were concerned with the processes that each product went through during production [6].

Early industrial engineers in 1890 began to be concerned with individual work methods, applying science to management, and all work elements. Frederick Taylor contributed the idea of standardized work. Frank Gilbert conducted a motion study, which led to the development of process charting and organized labor tasks.

In 1914 Henry Ford introduced the idea of the moving assembly line to the world while producing his Model-T Ford; this revolutionized manufacturing. By 1916, Ford began to implement the idea of JIT manufacturing. This reduced the inventory needed from $60 million to $20 million dollars to produce the same number of vehicles.

The present idea of JIT manufacturing can be traced to Toyota motor company in Japan. However, to begin use of JIT manufacturing in Japan, they first researched American production methods focusing on Ford's practices. In Japan JIT manufacturing is referred to as the Toyota Production System [6].

The realization for the new system came after World War II when the Japanese automotive manufactures knew they were far behind the American motor companies. The president of Toyota made a comment about the gap, "Catch up with America in three years, otherwise the automobile industry of Japan will not survive." JIT manufacturing is a result of limited demand, space, and resources in Japan compared to America.

By assessing and solving these problems Toyota was able to increase efficiency and keep up with American auto manufacturing. Ten years after the first introduction of the new production system Toyota successfully implemented this technique across the company. This began started to be implemented into the western world during the late 1970's to early 1980's.

2.3 Seven Types of Waste

Waste elimination is one of the most effective ways to increase profitability in manufacturing and distribution businesses. In order to eliminate waste, it is important to understand exactly what waste is and where it exists in the factory or warehouse. While products differ in each factory, the typical wastes found in manufacturing environments are quite similar. This is a seven type of waste that happens in factory is overproduction, waiting time, transportation, inventory, processing, motion and defect product [5].

2.3.1 Waste from Overproduction

Waste from overproduction is one of the greatest wastes commonly found in manufacturing operations. It is created by producing more products than are required by the market. When the market is strong, this waste may not be very noticeable. However, when demand slackens, the overproduction creates a very serious problem with unsold inventory [6].

Overproduction usually begins by getting ahead of the work required. More raw materials are consumed and wages paid than necessary, resulting in extra inventory. Additional staff, computers, and equipment may be needed to monitor the extra goods.

But as serious as these problems are, even more critical is the confusion about what the priorities are (or should be). Since the overproduction causes the machinery and operators to seem busy, additional equipment may be purchased and labor hired, under the assumption that they are necessary [8].

Since overproduction creates difficulties that often obscure more fundamental problems, it is considered one of the most serious types of waste and should be eliminated as promptly as possible. The elimination lies in the understanding that machines and operators do NOT have to be fully utilized to be cost efficient, as long as market demands are met. Unfortunately this concept is difficult for many people to grasp.

It is helpful for the operator at each stage of production to think of the next stage of the process as his or her "customer". Only the amount required by this customer should be produced, meeting the requirements of high quality, lowest cost and correct timing.

2.3.2 Waste of waiting time

Unlike waste from overproduction, waste from waiting is usually readily identifiable. Idle workers who have completed the required amount of work, or employees who spend much time watching machines but are powerless to prevent problems are two examples of the waste of waiting and are easy to spot.

By completing only the amount of work required, the capacity - both speed and volume - of each work station can be monitored. This will result in using only the machinery and personnel required for the minimum amount of time to meet production demands, thereby reducing waiting time [8].

2.3.3 Transportation waste

The transportation and double or triple handling of raw and finished goods are commonly observed wastes in many factories. Often the culprit of this type of waste is a poorly conceived layout of the factory floor and storage facilities, which can mean long distance transportation and over-handling of materials. This situation is aggravated by such factors as temporary storage, or frequent changes of storage locations.

2.3.4 Inventory waste

Inventory waste is closely connected with waste from overproduction. That is, the overproduction creates excess inventory which requires a list of extras including handling, space, interest charges, people, and paperwork.

It is important to understand that in many operations, inventory covers a myriad of other problems. As levels are reduced, these problems will surface and they must be corrected before inventory levels can be reduced to their optimum levels as poor scheduling, machine breakdown, quality problem, transportation time of raw material, vendor delivery times, line imbalance and lengthy set up time.

2.3.5 Processing Waste

The processing method may be another source of waste. In observing this type of waste, one often finds that maintenance and manufacturability are keys to eliminating it. If fixtures and machinery are well-maintained, they may require less labor on the part of the operator to produce a quality product.

Regular preventative maintenance may also reduce defective pieces produced. When the principles of design for manufacture (DFM) are employed and manufacturability is taken into consideration in product design, processing waste can be reduced or eliminated before production even begins.

2.3.6 Waste of motion

Waste of motion can be defined as whatever time is spent NOT adding value to the product or process. This type of waste is most often revealed in the actions of the factory workers. It is clearly evident in searching for tools, pick and place of tools and parts kept out of immediate reach of the work station. All of these can be eliminated by carefully planned layout and fixture selection.

2.3.7 Waste from product defect

Waste from product defects is not simply those items rejected by quality control before shipment, but actually causes other types of waste throughout the entire manufacturing process. Number of defects and quality problems can be directly linked to the work place state because assembly mistakes due to jammed work table with parts from different models. Next problem is forgotten parts in assembly and scratches on parts by scrap form the work table.

2.4 Solution strategy

People are constantly amazed at how much time is wasted through disorganization and general messiness. Improving elements and eliminating adjustments will require more imagination, time and cost. Even here, the improvements are sometimes astonishingly simple and easy. The solution that can reduce set up time is organize and housekeeping the factory. It often that setup problems are related to poor maintenance such as worn parts, worn tooling, dirt, or damaged threads.

Disorganization and poor housekeeping are also contributors to setup problems. These are easy to fix and should be a first step.

Next solution is examining each internal element and sees if it cannot be done externally. For example, the pre-heating of an injection molding die could be done before it goes into the machine. After that examine every element to see how we can eliminate it, simplify it, reduce the time required or improve it in some other way [9].

In many cases, defective material handling procedures can scrap or damage materials. Defective material handling systems can be improved by performing process failure mode and effects analysis to identify operating procedures required to reduce or eliminate the defects. When designing new material handling systems, perform a design failure mode and effects analysis on the equipment to identify and eliminate sources of damage [8].

As bad as they might be, the previous are insignificant in comparison to a customer discovering your defects for you. Not only are extra warranty and delivery costs involved, but customer dissatisfaction might result in loss of future business and market share.

Eliminate defect waste at the source by establishing a system to identify defects as they occur. Authorize anyone on the plant floor to take corrective action. Without this preventive system in place, other time-saving efforts are futile. There's no advantage to using highly automated machinery to make defective parts faster.

Overproduction generates difficulties that often obscure more fundamental problems. A key element for eliminating overproduction lies in the understanding that machines and operators don't have to be fully utilized to be cost efficient, as long as customer demands are met. This concept is difficult for many plant professionals to grasp. It's helpful for any worker to think of the next downstream operation as the "customer" and produce only the quantity of product the customer actually requires [6].

Extra inventory results when more raw materials are consumed and more wages than necessary are paid. Extra inventory leads to additional material handling, storage space and interest paid on money used to carry the extra inventory. Additional staff, computers and equipment might be needed to monitor the extraneous goods. As serious as these problems are, even more critical is the confusion about what the priorities are, or should be.

When people get distracted, they can't focus on meeting the customer's requirements of high quality, lowest cost and correct timing. Overproduction waste can be reduced significantly or completely eliminated by a material handling system that controls material flow through production to match material supply to customer demand. One effective control is to use the material handling system as a tollgate that won't let anything move until it's pulled by a customer order.

Because of the often substantial cost associated with extra inventory, rigorous measures should be taken to reduce inventory levels. First is disposal of obsolete materials then production only of the number of items required by the subsequent process. Lastly is purchase of required amounts of materials savings achieved through volume discounts must be carefully weighed against inventory and storage costs.

Manufacture of products in required size lots measure set up and changeover costs against inventory carrying costs to achieve the most appropriate size.

Transportation waste can be eliminated by minimizing the distances materials must travel, better process coordination, better transportation methods and general organization of the operation. A material handling system focused on optimum product movement minimizes transportation waste [6].

To achieve optimum product movement, use computer simulation on the plant layout to determine which configuration is most effective. Using the material handling system as a Band-Aid to cover over other problems only adds cost with no value and perpetuates the underlying problems.

Maintenance and manufacturability are keys to eliminating waste from process methods. Well-maintained fixtures and machinery require less operator labor to produce a quality product. Regular preventive maintenance, including total preventive maintenance, also reduces defective pieces produced.

Using the principles of design for manufacturing and taking into account manufacturability during product design reduces or eliminates processing waste before production even begins.

A carefully planned layout and fixture selection can eliminate motion waste. Material handling system changes that improve the material flow through value-added operations are a major opportunity to reduce motion wastes. Implementation of 5S when changing or installing new material handling systems can identify and eliminate or minimize many of the motion wastes. Be sure to include the process engineers in any material handling system design changes [6].

2.5 Element of JIT

The successful of JIT implementation requires five key elements, first is waste reduction this is aimed to eliminate all non-value-added tasks. The main problem with traditional production method is due to the focus on producing large number of items. With level of competitiveness and flexibility requirements, this is no longer an appropriate method to be performed [6].

Second is value adding production oriented this element brings the terminology of "pull-system" which allows customer order to trigger the production process. Pull system requires immediate respond in order to satisfy customer requirement therefore avoiding "the goal of producing large batches". By grouping products based on their production process similarity, manufacturer may also add-value to the products by lessening production complexity, shortening travel and idle time [6].

Third is customer participation in quality improvement in every business, customer will have the final say therefore the success of the business can be determined based on customer satisfaction. This element heavily emphasis the needs of customer involve in product development and delivery. Customer may also be included in development team to direct them to the right manufacturing plan [6].

Fourth empowering employees mean dividing problem solving and decision making responsibilities from management level to its individual team directly related with the task. With careful planning and adequate team work, this element will increase quality, productivity and flexibility of the manufacturing process [6].

Last are specialised suppliers will normally produce a better product since they can concentrate in a particular thing. By outsourcing to those suppliers, a company will be able to put all its time and resources in its core function which in turn will improve the quality of the final products [6].

2.6 The Goal of Just In Time

The first step to eliminating the seven deadly wastes is to identify each one within the operation. After that, measures can be taken to correct the situation and eliminate the problems. The benefit that company gets when using JIT method is increasing the organization's ability to compete with others and remain competitive over the long run. The competitiveness of the firms is increased by the use of JIT manufacturing process as they can develop a more optimal process for their firms [6].

After that increasing efficiency within the production process and efficiency is obtained through the increase of productivity and decrease of cost. Other benefit of is reducing wasted materials, time and effort. For optimal quality and cost relationship, the organization should focus on zero-defect production process. Although it seems to be unrealistic, in the long run, it will eliminate a huge amount of resources.

Finally adopt the work ethnic of Japanese workers for continuous improvement. Commit a long-term continuous improvement throughout the organization. It will help the organization to remain competitive in the long run [6].

JIT can help organization remains competitive by offering consumers higher quality of products than their competitors, it is very important in the survival of the market place. These major objectives are suitable for all organizations. But each organization is unique in some way adjustments of JIT objectives for each form should be made in order to complement the overall production process [6].

CHAPTER 3

METHODOLGY

3.1 Introduction

Waste is anything that does not add value. Product being stored, inspected, or delayed, products waiting and defective products do not add value; they are 100% waste. Moreover, any activity that does not add value to a product from the customer perspective is waste. JIT provides faster delivery, reduces work-in-process and speeds throughput, all of which reduce waste. Additionally, because JIT reduces work-in-process, it provides little room for errors, putting added emphasis on quality production. These waste reduction efforts release inventory assets for other, more productive purposes. JIT forces waste out of the system [2].

3.2 Variability reduction

To achieve just-in-time material movement managers reduce variability caused by both internal and external factors. Variability is any deviation from the optimum process that delivers perfect product on time. Inventory hides variability a polite word for problems.

Most variability is caused by tolerating waste or by poor management. Variability occurs because employees and suppliers produce units that do not conform to standards or not the proper quantity. Then production personnel try to produce before drawings or specifications are complete and customer demands are unknown.

Variability can often go unseen when inventory exists. This is why JIT is so effective. The JIT philosophy of continuous improvement removes variability. The removal of variability allows us to move good materials just-in-time for use. JIT reduces material throughout the supply chain [2].

The concept behind JIT is that of a pull system that pulls a unit to where it is needed. A pull system uses signals to request production and delivery from stations upstream to the station that has production capacity available. The pull concept is used both within the immediate process and with suppliers. By pulling material through the system in every small lot just as it is needed, the continuous improvement is emphasized. Removing the cushion of inventory also reduces both investments in inventory and manufacturing cycle time [2].

Manufacturing cycle time is the time between the arrival of raw material and the shipping of finished products. For example, at Northern Telecom, a phone-system manufacturer, materials are pulled directly from qualified suppliers to the assembly line. This effort reduced Northern receiving segment of manufacturing cycle time from 3 weeks to just 4 hours, the incoming inspection staff from 47 to 24 and problem on the shop floor caused by defective material by 97% [2].

Many firms still move material through their facilities in a push fashion. A push system dumps orders on the next downstream workstation regardless of timeliness and resource availability. Push systems are the systems are the antithesis [2].

3.3 Selection of product

This factory produce electronic component has various type of product and the market is in German. To select the product have to consider the product always running by factory this is because for research and if the product is seldom running this might be difficult to collect data.

3.4 Work Measurement

Work measurement is concerned with the determination of the amount of time required to perform a unit of work. For many years, its principal use was wage-incentive purposes however, present day industry finds many uses for work measurement, and it has become one of management most important tools. Increasingly, it has been used to measure indirect labor and office work [4].

Work measurement is used to determine the amount of time required by a qualified worker, using a standard method and working at a standard work pace, to perform a specified task. The time required for this task is commonly referred to as the standard or allowed time [4].

3.5 Uses of Work Measurement Data

Analysis of the many manufacturing and control functions required in the fabrications of a product will disclose that most they depend upon time. These time values may be derived from past experience, worker estimates, or from a system of work measurement. Without using some unit of time, it would be virtually impossible to plan and schedule production, to make cost estimates on new work, to balance production lines, or to control labor costs [4].

If standard or allowed times are to be used, they should, for greatest accuracy, to be obtained by a formal system of work measurement. Standard times may be used for any of the following purposes planning the flow of production through the plant, making cost estimates on new products or new models, providing a basis for cost determination and providing basis for wage-incentive plans.

3.6 Work Measurement Equipment

The stopwatch is the most common tools for collect the cycle time of product. Although used less frequently today, it is still in common use for measuring certain jobs.

Figure 1 shows decimal-minute stopwatch of the type that has been used extensively in industry. This watch has sweep hand that makes one revolution per minute: therefore, each division on the large dial represents one-hundredth of a minute.

The miniaturization of electronic circuits has led to the development of a number of digital timing devices. One of these is a battery-operated digital stopwatch of the type illustrated in figure 4. This stopwatch is easy to read and can be used in the same manner as the spring-driven stopwatch shown in figure 3.

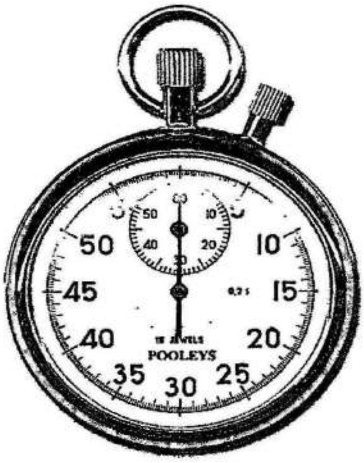

Figure 3.1: Stopwatch

Figure 3.2: Digital watch

3.7 Work Measurement by Stopwatch or other Timing Devices

In his section the common procedure used in setting a time standard using a stopwatch or one of the other timing devices. Most of discussion will concentrate on the use of the stopwatch, since its usage in industry has been widespread over the years. However, it should be readily apparent that essentially the same procedure will prevail no matter which of the various timing devices is being used.

The steps usually performed in the making of a stopwatch time study are as follows break the job down into elements and record these elements in details on the observation sheet. Next is determined and record the times for each of the elements.

3.8 Determine the Time

The next step is to determine the time for each element. The two most commonly used methods of timing with the stopwatch are unknown as continuous and snapback, or repetitive, timing. In continuous timing, the analyst starts the watch at the beginning of the first element and allows it to run for the durations of the study. At the end of each element, the watch reading is recoded in the proper place on the observation sheet. At the conclusion of the study, the time for each element is determined by subtracting the time at the beginning of the element from the time to end.

In repetitive timing, the watch is started at the beginning of each element, and at the end of the element, and at the end of the element it is read zero, and the time is recorded on the observation sheet. This process is repeated for each element for as many cycles as desired in the study.

Each of the methods described above has obvious advantages over the other and in the hands of experienced work measurement analysts probably results in about the same degree of accuracy. However, the continuous method is generally considered best because it includes the overall time for the study and eliminates the possibility of leaving out delays and the necessity for snapping the watch back to zero.

3.9 Administration of Work Measurement

In this age where more and more functional authority is being delegated to the operating level, many people are of the opinion that work crews should be responsible for the time values that affect their performances. This would tend to place great emphasis on the use of historical data and each employee recording the time to do his work. This could lead to question about the job methods used and the work space.

Obviously, variability in the accuracy of the time values may be anticipated and would tend to produce different results than through a formal system of work measurement. However, it is possible that the benefits derived from improved employee motivation and job satisfaction will more than offset any ill effects.

One of the major problems encountered in administering time standard is that of maintaining accurate standards. The work measurement department must provide a continuous check on the job method, material and tools to make sure there have been no changes that will affect the time values. This can be accomplishing only by continuous review of job methods with complete cooperation of the supervisors.

3.10 Manufacturing Process

This is a detailed explanation in manufacturing 4900-X-319 that gets from observation and discussion with engineer VAC.

Stage 1 (Block A)

1. Winding = 5

   Number = 1

   Diameter= 1.8mm

   Wire = 2LW/80

   Color = Brown

1.1 Put the wire from the coil to the straightening machine and lead it to the winding machine.

a) 1 layer on spindle

b) From left to right

c) Cut the wire to a length of 20mm 30s/piece

2. Test with pin alignment only passed wound. 6s/piece

Attention

3. Use cotton gloves for assembly don't pollute the cure surface with eccobond adhesive, resin or something else. Remove the packing material of he core apply the glove eccobond 2332-17 to the core according sheet K6+ K7. Put the coil into core, the coil has to fit loose into the core with straightened leads. Put the second core half on the first core, press together. 12s/piece

Attention

3.1 Don t stores the parts more than 3 hours before the hardening process will be started. Put the core in the glue device.

4. Push the core to the right side of the mould. Harden core into oven

- Waiting time to reach 120^{0}C (15 min -30 min)
- Curing time120^{0}C (30 min – 40 min) 24s/piece

5. Marking use tamporint machine before send the product to Block B for labor to know what product their doing. 3.6s/piece

5.1 Load component onto potting tray 2.22s/piece

Stage 2 (Block B)

1. Preheat the components at least 2 hours with 120 degree C.

2. Unload component from the oven and potting KZ 183 according setting potting dosage: 0.66 ML Potting level: (0 to 3mm) winding can partially visible to technical instruction. 6.54s/piece

2.1 It s not allowed to pollute the adhered surfaces with resin! Bonding problems with semicosil would appear! Don t stores the part more than 3 hours before the hardening process will be started.

3. Put the component into curing tool. The printing sides in front (visible) fix connection the oven waiting time to reach 150 degree (60min+30min) (due to temp drop while opening oven door)

- Curing time: (40 min+ 30min) 150 degree

- Cooling time: (20min) 24s/piece

3.1 Take out the component of the curing tool and set it to. The transport tray 12/178

2.22s/piece

Stage 3 (Block A)

1. Precut wire end to 7mm +/- 0, 5mm with the aid of A cutting machine W4900-R11301-01 cutting plate + distance plate. 9s/piece

2. Remove the wire insulation enamel insulation acc. Data sheet don t store the part more than 4 hours before the tinning process will be start to avoid oxidation. 35.6s/piece

3. Solder with AHAP solder machine ACC F60092-F0004-B010, but solder temperature 350 Degree (Two components simultaneously) with about 1mm/sec. 4.2s/piece

4. Cut the pins with the special cutting machine.

- Pin length 5, 0 +/- 0, 3
- With aid of a cutting plate W4900-R113-01 cutting plate. 9s/piece

5. Final hardening of components (resin and painting) at least 12 hours (over night with 110 ^{0}C) 4.44s/piece

6. Inductance test failure code 951

L01=2, 800 BIS 4, 025 Micro- H

F=10 KHz IAC,

EFF=10 Milli-A 100% Test Machine W4900-V603-01 Adapter 3s/piece

7. Inductance test with Bias failure code 921

Milli –OHM (AQL 1/S4 C=0) 3s/piece

8. FQL: M3200

Core offset inspections with inspection with offset J/G 100% Test 9s/piece

9. Visual and Mechanical Inspection failure 12s/piece

10. Measurement of the thickness of the tin layer. 120s/piece

11. Packing

- Marking side above (visible) packing without cardboard between the PS-Trays only completely Filled cartons with 288pcs are allowed to ship. 0.3s/piece

Total set up time: 320.12s/pcs = 5.33min/piece

3.11 Mapping

Maps and flowcharts help work visible. Increased visibility improves communication and understanding, and provides a common frame or reference for those involved with the work process. This is a current mapping of 4900-X319 product.

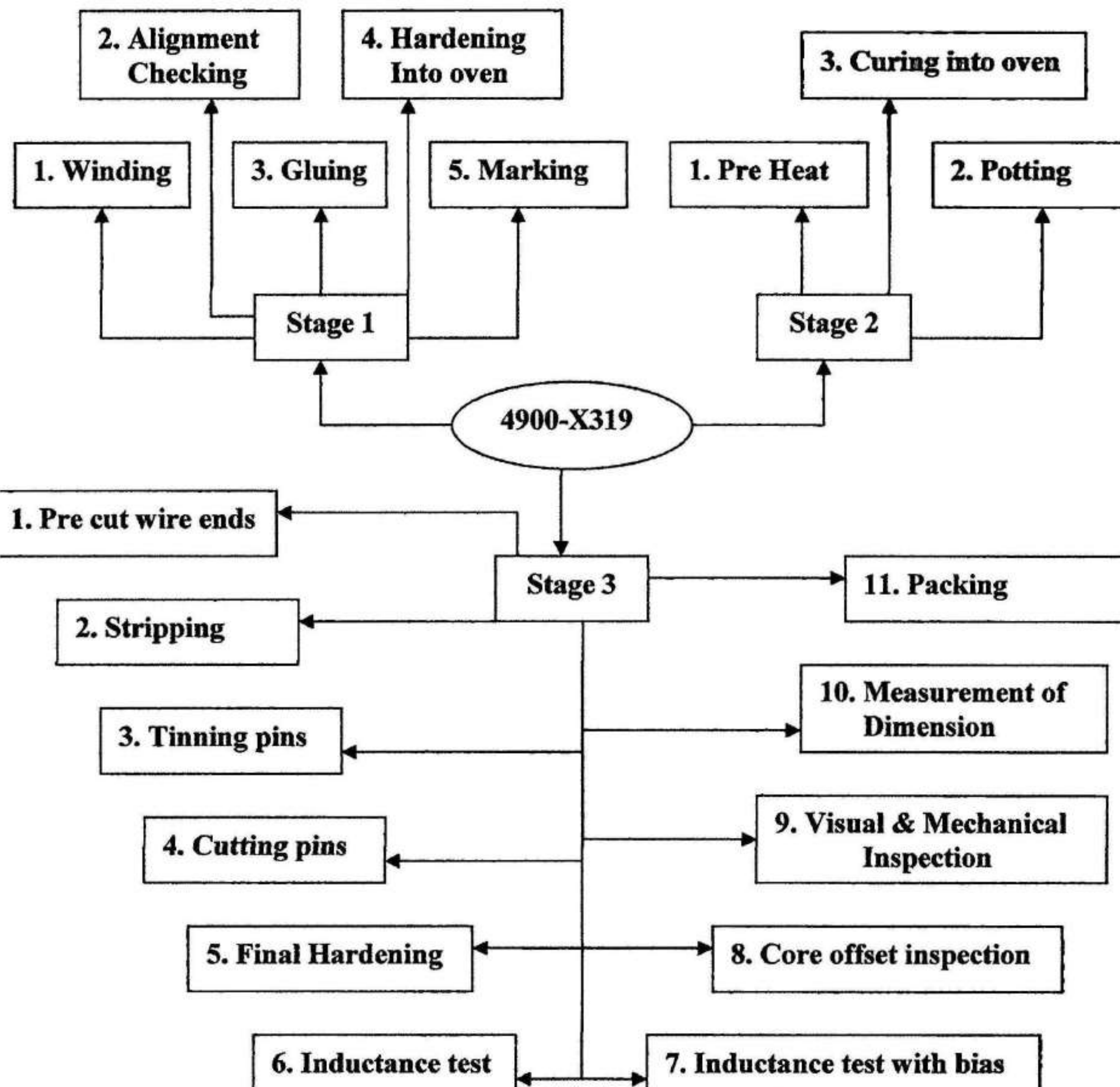

Figure 3.3: Mapping of 4900-X319

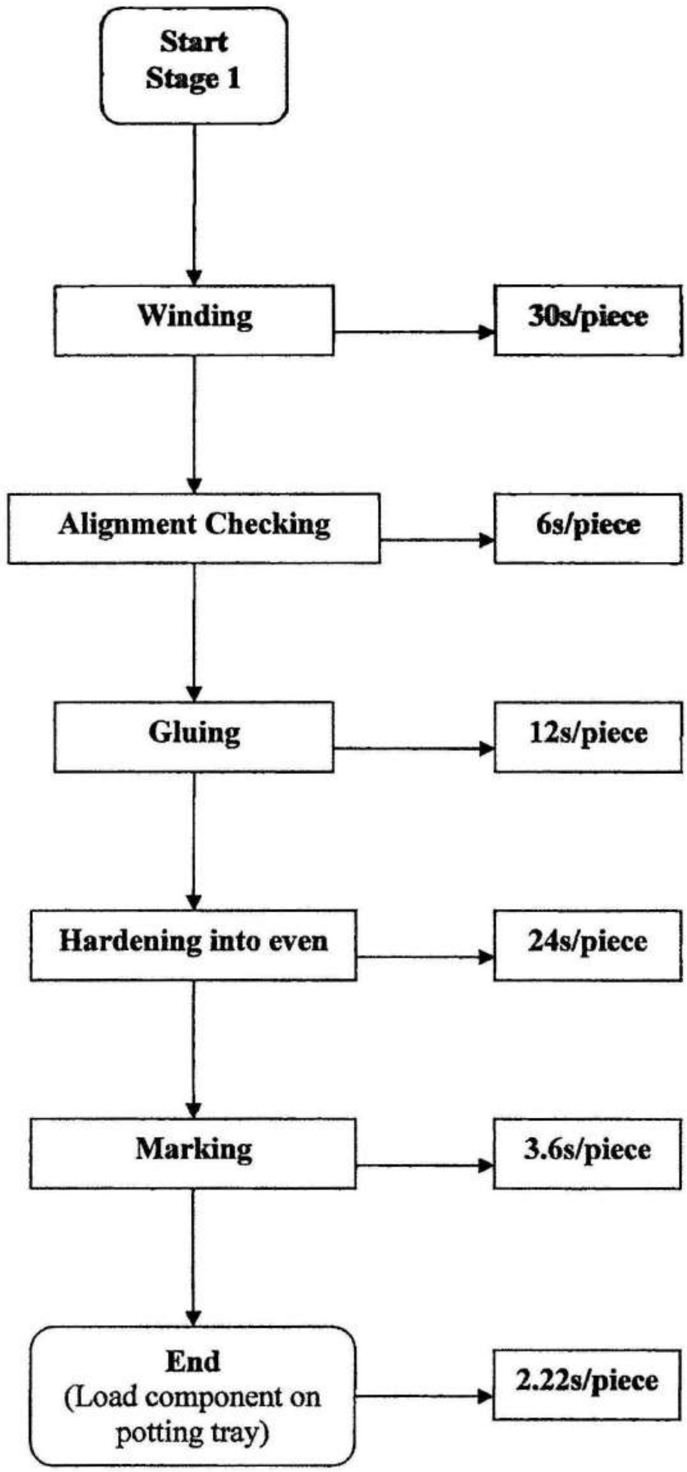

Figure 3.4: Stage 1

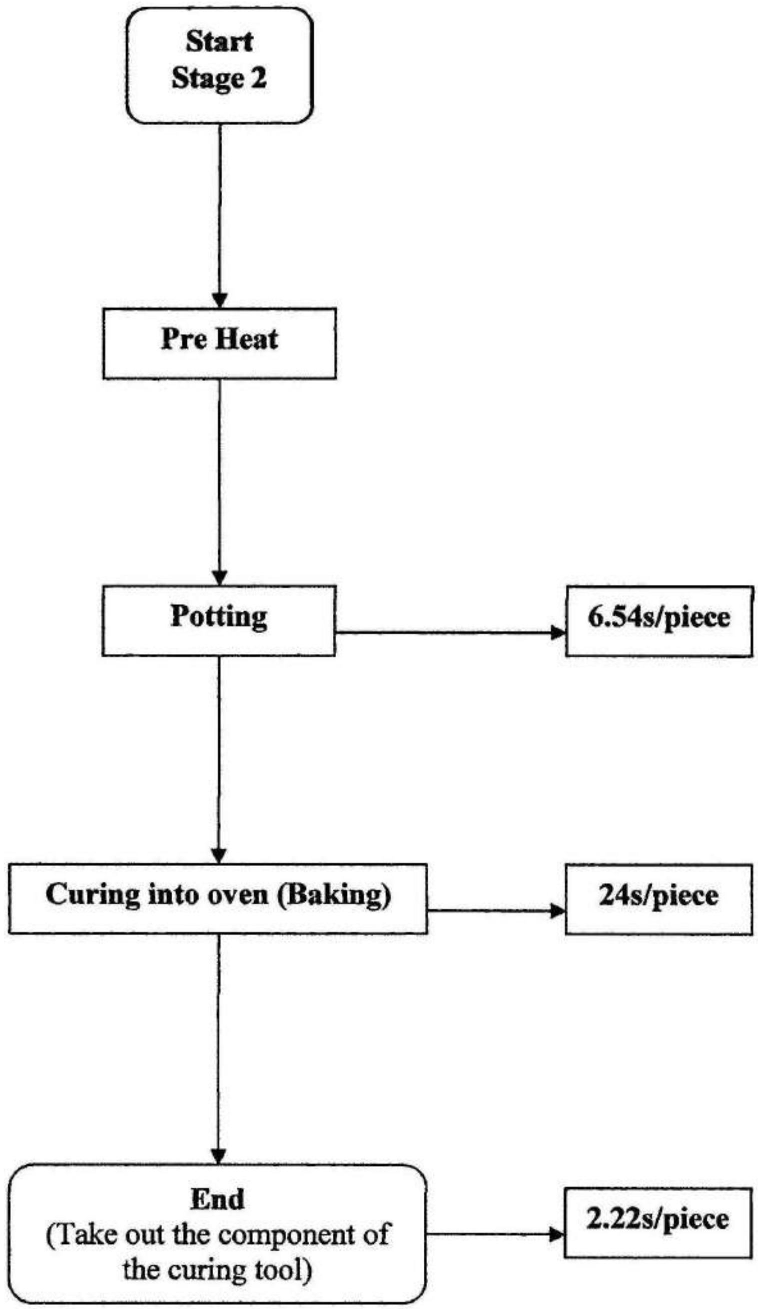

Figure 3.5: Stage 2

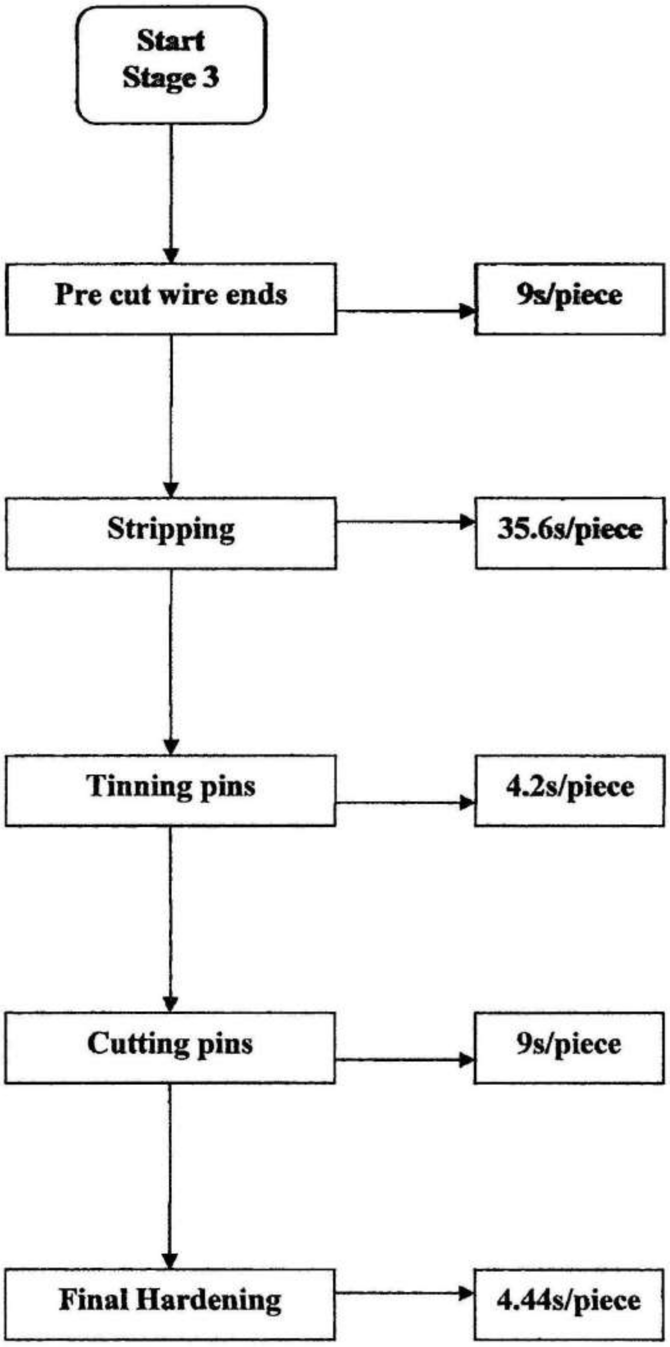

Figure 3.6: Stage 3

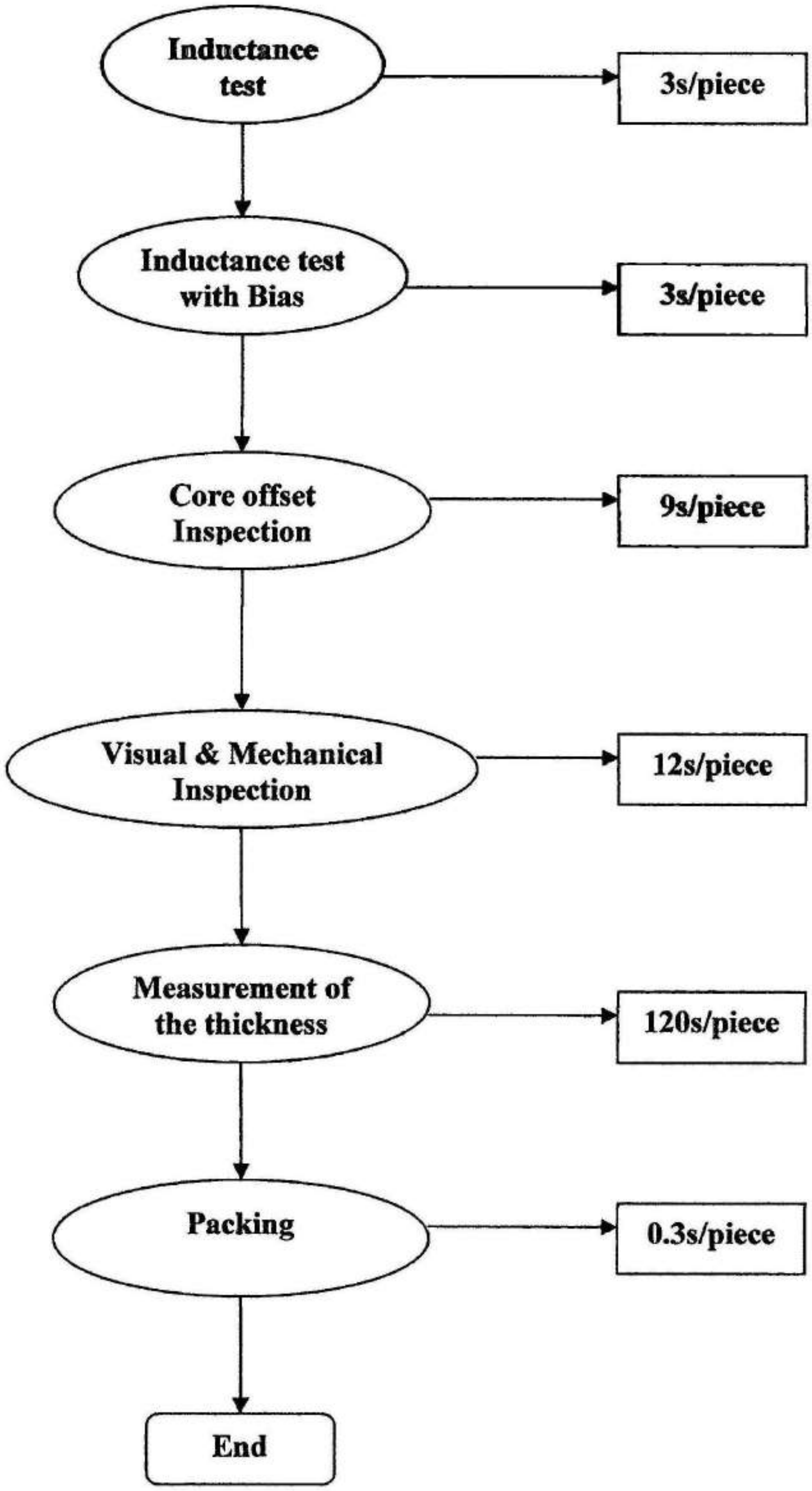

Figure 3.7: Inspection

Cycle time: 5.33min/piece

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

Each of the seven deadly wastes must understand to recognize where it exists in operations. The best ideas usually come from production and maintenance workers. These groups should be rewarded for their ideas and initiatives to improve operations. Most companies' electronics waste 5% to 10% of their resources, and even the very best companies probably have as much as 3% waste. Every layout should develop continuous improvement systems that reduce cost and improve operational effectiveness.

4.2 Classify Waste

In this factory have many types of waste that contribute to financial loss. To identify the waste some observation had be done before classify the waste. First step is study a layout and take a cycle time of product. Then make discussion with engineer about waste that happens in factory especially 4900-X319 products. Finally make list of waste and classify based on seven types of waste.

4.2.1 Overproduction

Overproduction is the result of producing more product than the market requires and represents one of the greatest wastes in manufacturing operations. When the market is strong, this waste might not be noticeable, but, when demand drops, overproduction produces serious problems with unsold inventory and wasted by-products. Wasted by products include material handling, storage space, inventory interest charges, machinery and equipment, defects, overhead, workers and paperwork.

a) In process to produce 4900-X319 products there are many factors that make overproduction occur for instant to meet customer demand. Usually this product produced within 103% this is because 3% more is made for backup stock to prevent rejected part cause by starches and assembly mistake. This situation happen because worker lack of skill and not careful in material handling.

b) Other than that it helps to control the quality of the product to make sure the product produce follow the customer specification. Before go throw packing process some test should be done such as inductance test, inductance test with bias, core offset inspection, visual and mechanical, measurement of dimension and packing. Overproduction is made based on previous year data in figure 10 as guide to match the customer demand.

Table 4.1: The demand and production

Month	Demand	Production	Reject	Overproduction	Product + Inventory
February	2100	2150	30	20	20
March	2200	2250	50	20	2250+20
April	2150	2200	30	40	2200+20
May	2000	2050	40	50	2050+40
June	2200	2210	50	10	2210+50

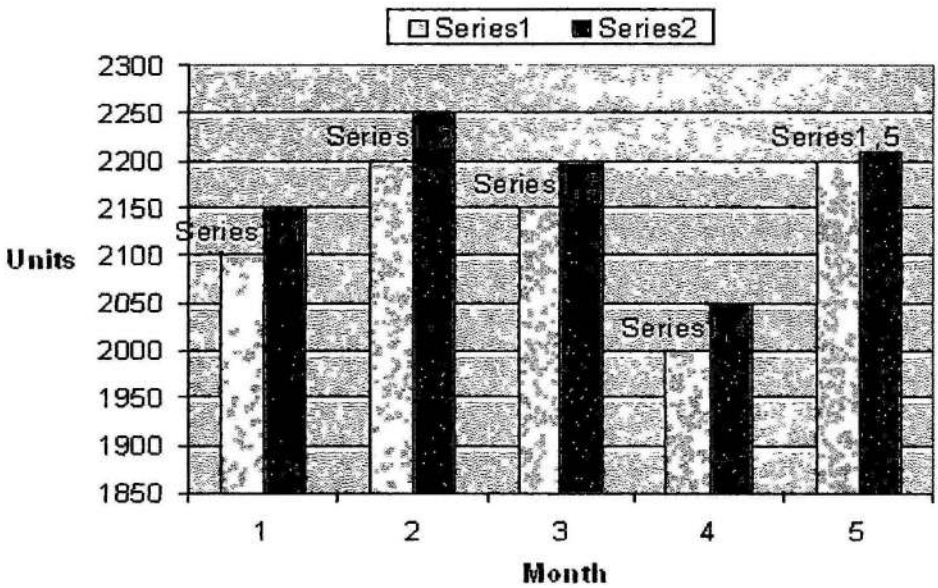

Figure 4.1: Demand Chart

4.2.2 Waiting time

Unlike overproduction, waste from waiting usually is readily identifiable. Idle workers or employees who spend much time watching machines but are powerless to prevent problems are two examples of the waste of waiting. A material handling system that regulates the work flow at an efficient pace (small buffer queues may be necessary) minimizes or eliminates wait time waste.

a) After study and understand the layout of product we found that in stage 1 have waiting time. The problem occur in gluing process because movement of glue machine is slow and cause operator to wait about 4 to 5 second in figure 11 before continue to arrange the product in tray for hardening.

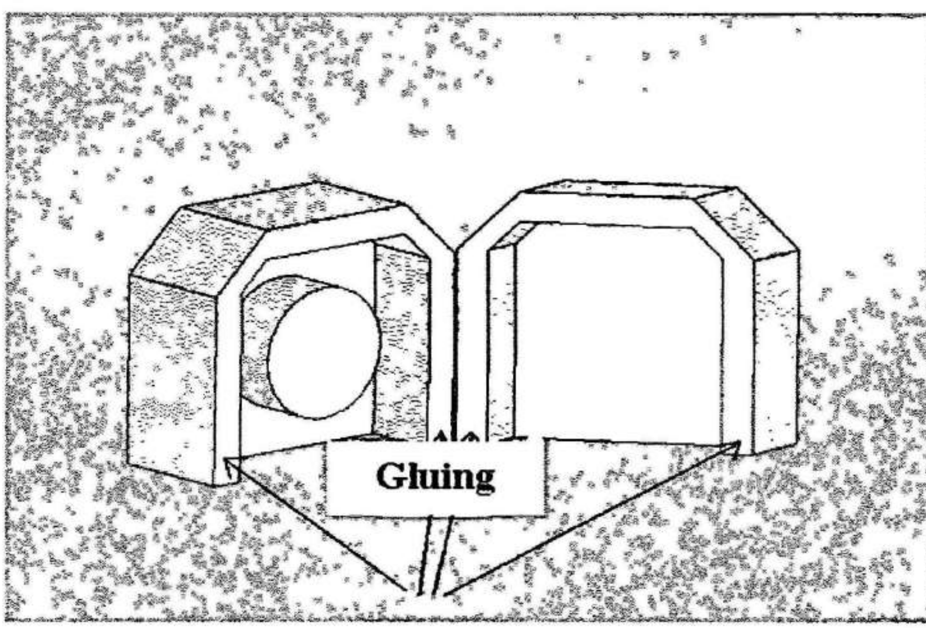

Figure 4.2: Gluing Process

b) Next step is after glue the core this product will be harder into oven and the time needed for reach 120^0c is 20 minute and 35 minute to curing time. The time that needed for oven in figure 12 to reach 120^0c cause waiting time for this product especially in morning because cool environment. This situation weather actually gives effect to oven although the problem is not visible.

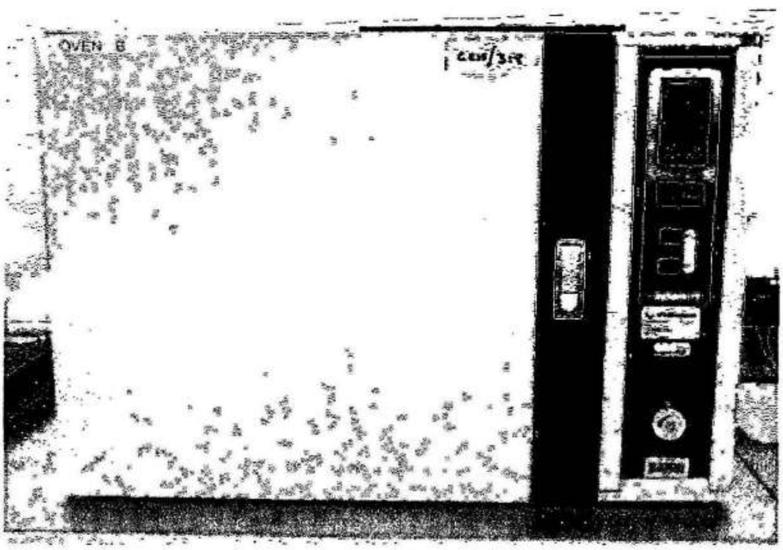

Figure 4.3: Oven

4.2.3 Transportation

Often the root cause of this waste is a poor layout of the factor floor and storage facilities, which can mean long distance transportation and over handling material. Transportation waste can be eliminated by minimizing the distances materials must travel, better process coordination, better transportation methods and general organization of the operation.

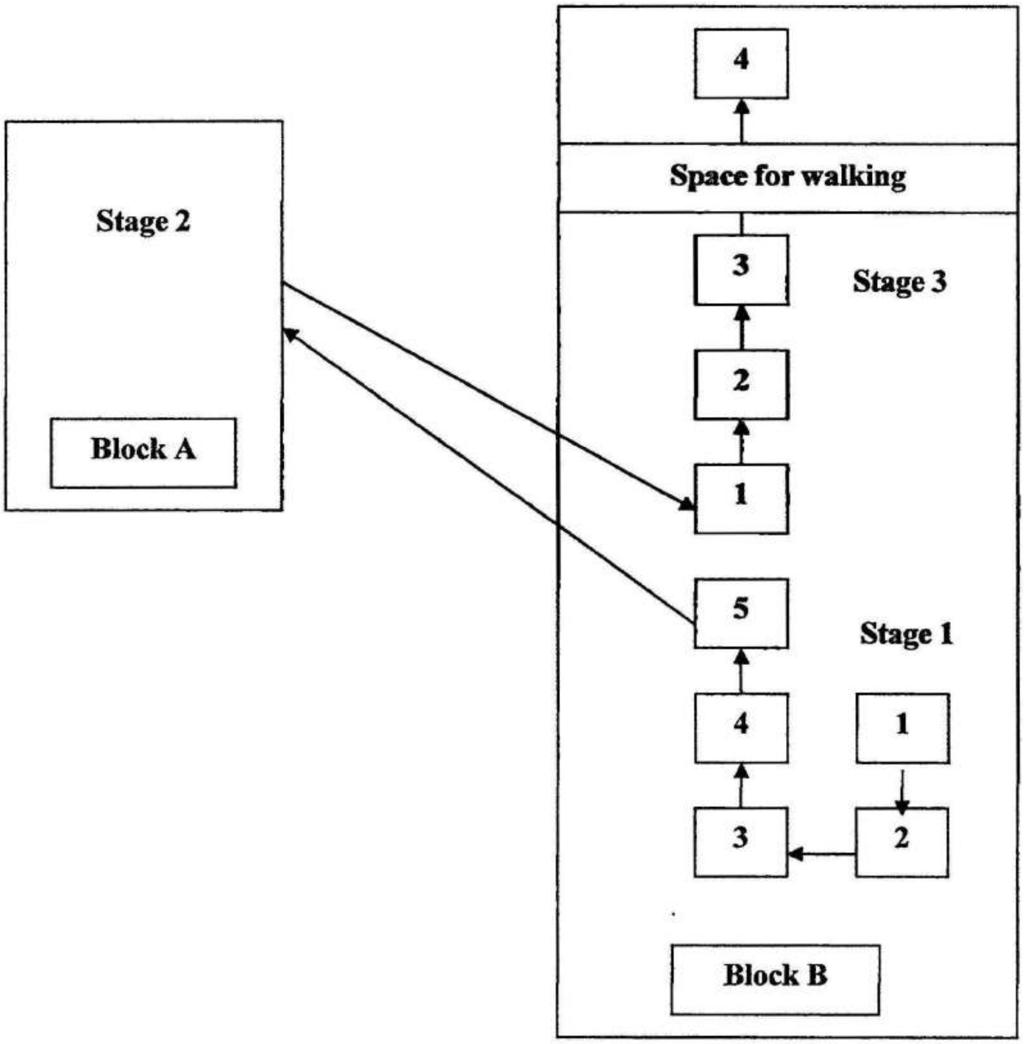

Figure 4.4: Process Layout

a) In this factory have 2 blocks that produce various type of product to delivery at German. Majority of product manufacture in block A and the production based on customer order. Waste transportation that happens in stage 1 is after core hardening this product will be arrange in tray that can reload about 30 cores but one operator can carry

2 tray in one time. To complete the oven capacity is about 16 tray can reload for hardening, the movement of operator that arrange the tray in oven is 8 times from arrange the core in tray and send into the oven.

b) After marking the product in step 5 this core will be send to next block and the distance from block A to block B is 20 meter in figure 13. This different place of process contribute to waste transportation because to carry the material to next block will be use forklift in large quantity or operator in low quantity.

c) In stage 3 the process is cut the pins with the special cutting machine but the arrangement of table from step 3 to step 4 have space for walking area if this space completely remove, the table from step 4 can take walking space area. The material can easy send to another operator without make many move.

4.2.4 Processing

Maintenance and manufacturability are keys to eliminating waste from process methods. Well-maintained fixtures and machinery require less operator labor to produce a quality product. Regular preventive maintenance, including total preventive maintenance, also reduces defective pieces produced. Using the principles of design for manufacturing and taking into account manufacturability during product design reduces or eliminates processing waste before production even begins.

Have certain condition product can be repair, first the condition of pins bend and not accurate because careless of operator that drop the product to floor. Next is pin not fully strip because operator not expert or lake of skills. If product surface is dirty or soil rework process has to be done to make sure the quality in standard.

The method to test the product is in random from one production. The process is put fluid that called semicosil to core and then let the fluid dry. After that this semicosil will try to clean and if semicosil fall out this product consider reject.

4.2.5 Motion

Waste motion is defined as time spent not adding value to the product or process. Motion waste is most often discovered in the actions of workers as they search for tools, how they pick and place tools and parts that are kept out of immediate reach of the workstation, and the time spent walking among machines if they are responsible for several workstations.

The materials that deliver to factory will send to inventory before manufacture. First step in produce 4900-X-319 is the material will be check in Block B by one operator. This twice checking have be done although the vender check the quality before send to our factory. This waste of motion will increase labor cost or salary operator.

4.2.6 Inventory

Inventory waste is closely connected with overproduction. Excess inventory requires extra handling, storage space, interest charges, people and paperwork. It's essential to dispose of obsolete materials and produce only the number of items the next process requires. Purchase only the required amounts of materials, but be sure to weigh carefully any savings achieved through volume discounts against inventory and storage costs.

Waste for inventory not very high because extra product is about 30 to 40unit per month. Beside that this product size not big because this company only produce electric and electronic component. The inventory type is raw material inventory that can be used to decouple supplier from the production process. Inventory advantage is reduced and optimizes inventory and safety stock levels or obtains lower raw material prices through creative supplier networking. To make sure the raw material not be stolen or damage several operator will check the material everyday like in figure 14.

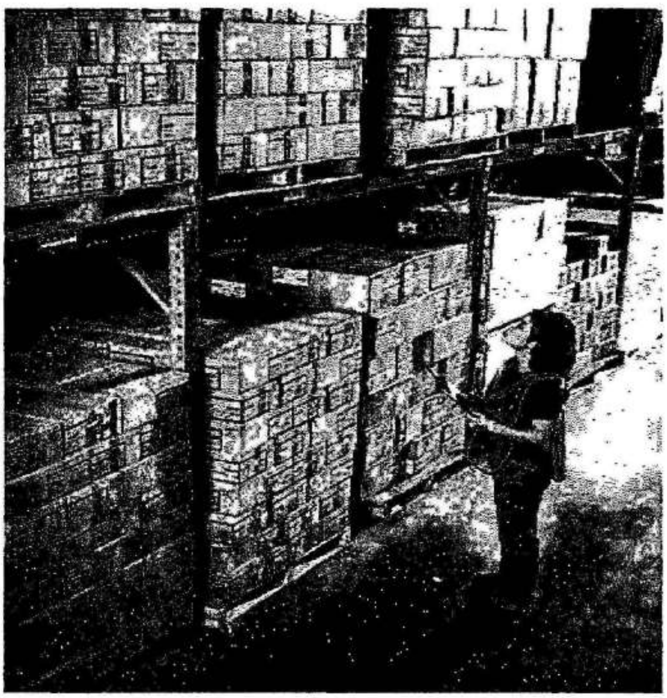

Figure 4.5: Inventory

4.2.7 Product defect

Product defect wastes aren't simply those items quality control rejects before shipment. Instead, product defect waste actually causes other types of waste throughout the manufacturing process. These other wastes include wait time that increases costs and lead times for subsequent processes, rework that increases labor costs to make parts usable, additional labor required for disassembly and reassembly, additional materials needed for replacement parts, the extra labor involved in sorting defective from acceptable parts, and scrapping defective pieces, which wastes both materials and work already performed.

In many cases, defective material handling procedures can scrap or damage materials. Defective material handling systems can be improved by performing process failure mode and effects analysis to identify operating procedures required to reduce or eliminate the defects. When designing new material handling systems, perform a design failure mode and effects analysis on the equipment to identify and eliminate sources of damage.

a) In 7 types of waste at this factory the highest waste come from product defect because factory produce electronics component that easy to get damaged or reject when machine or operator not carefully in handling the component. Example the product consider reject if process assembly between two core not in right sequence similar to figure 5. Other than that careless by operator like not wearing glove can cause product starched.

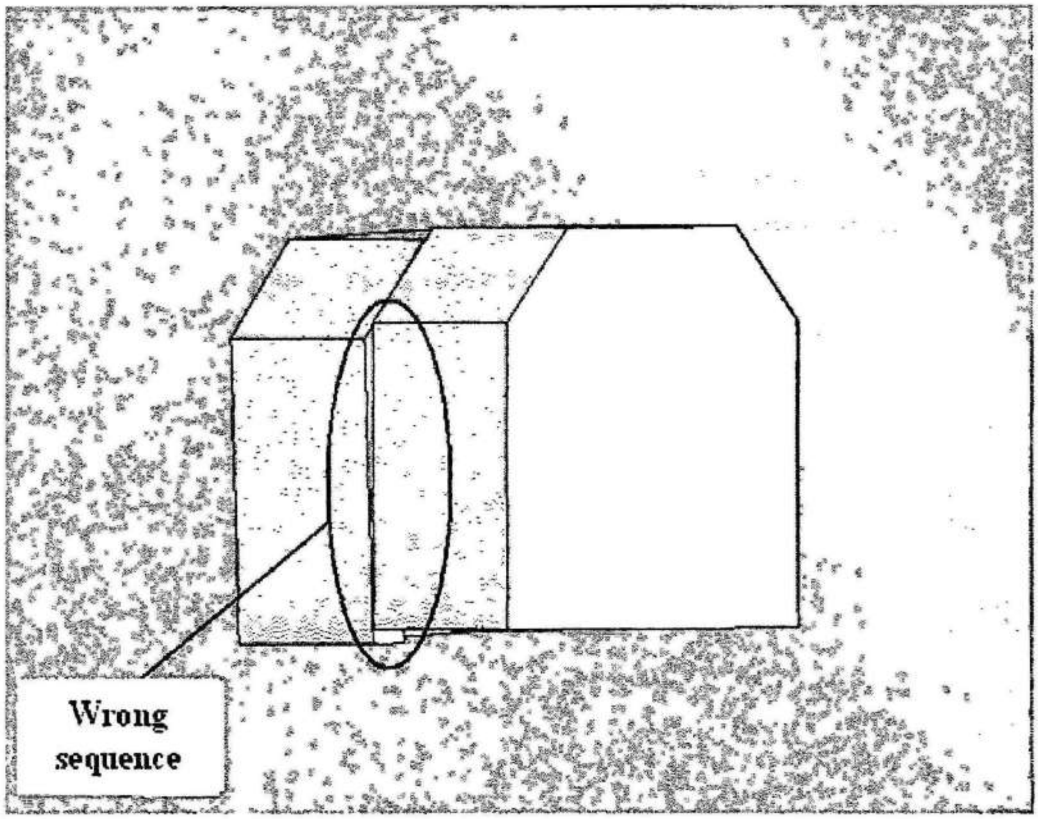

Figure 4.6: Wrong Sequence

b) Other reason that product defect is dirty that stick at core when product expose to air that has dust after hardening or potting process.

All of the above are serious, but pale in comparison to the results customer discover defect. Not only are extra warranty and delivery costs incurred, but customer dissatisfaction may results in loss of future business and market share.

4.3 Waste

The ultimate objective of this project is to find which area has waste and provide a solution to reduce cycle time of the product. To manufacture 4900-X-319 have 4 waste area that can improve the layout or the problem.

4.3.1 Waste

1. In gluing process left core and right core will stick together using glue device. Before doing this operation 5 core will be arranged in special tray and the machine will running about 10 to 12 second to finish the process. When machine running the operator has to wait and this waiting time will increase production cost.

2. After core harder into oven operator will separate the product and this core have to cool using fan. The wasting time happen when operator from marking have to separate the core after cooling. The operator movements from his chair to separate the product take about 6 to 10s.

3. To produce this product has several steps that have to follow and this step involves two blocks that produce waste transportation (see Figure 16). For finishing this product 80% is make in block B and another 20% in block A. The distance from different block is about 15m and waste time is about 100s.

4. For the last of waste that occur in this production line is come from extra space. The space for walking area between two process wire cut and inspection cause waiting time

to operator for send the material to inspection area (see Figure 16). The distance from table cutting pins to inspection is 2.5m and waiting time about 7 to 10s.

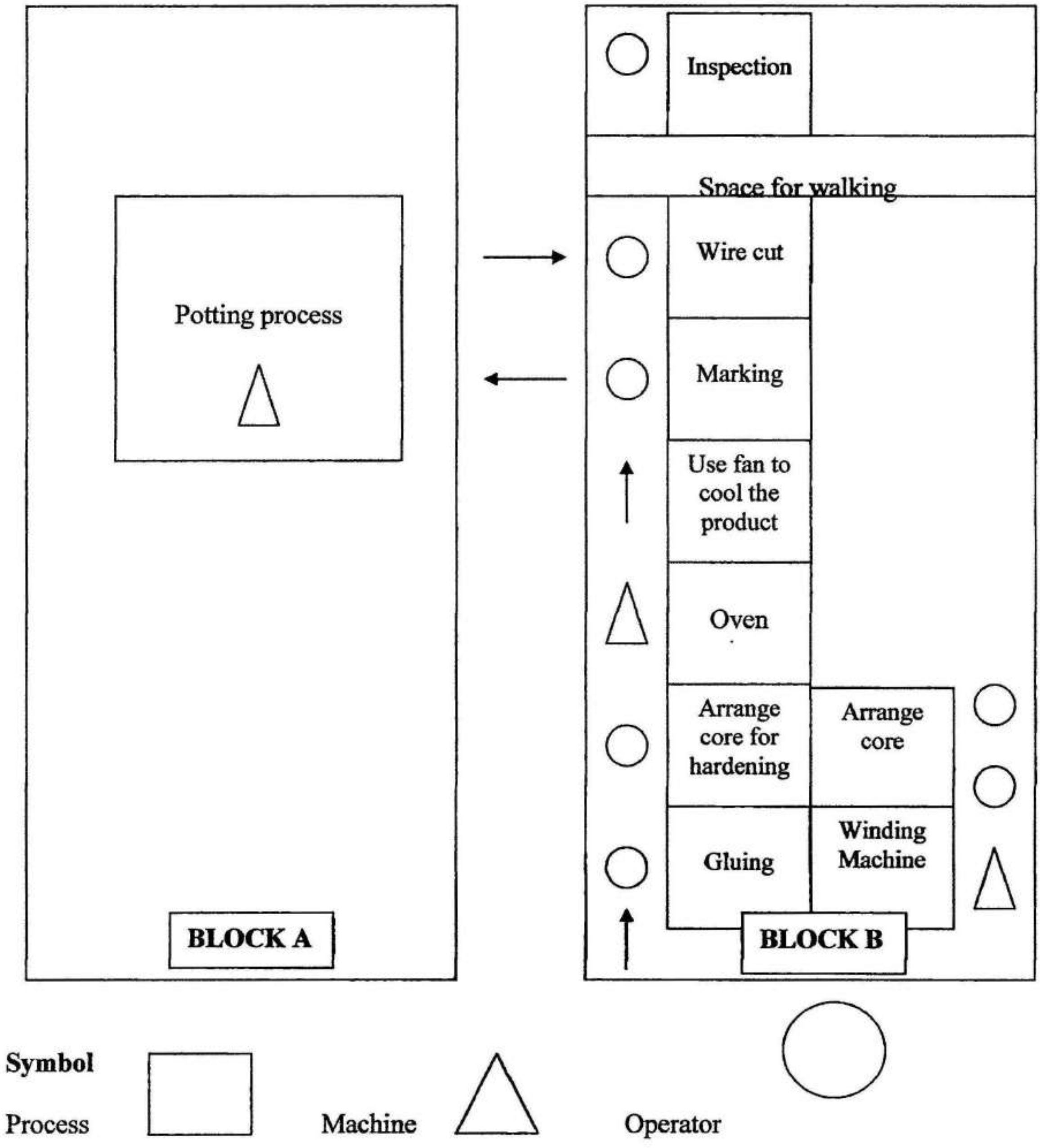

Figure 4.7: Process Layout

4.3.2 Solution

1 a) Change program of the machine for increasing the speed to put the glue at core and this method will reduce waiting time from 12s to 6s.

b) In gluing process, only one machine that be use to glue the core if the machine breakdown the production will stop. To avoid this problem my suggestion is buy one machine and this 2 machine will be operated by one operator. After that chair of operator have to change from fixed position to flexible position because distance between two machines is 1.2m. After apply new machine waste from waiting also can be reduce, because after put 5 core to first machine the operator have to arrange another 5 core to put in second machine. This is an assumption of the table that can increase productivity and reduce waiting time.

Table 4.2: One Machine

Time	Condition	Total core
0s	Put the tray at glue machine	
12s	Wait the gluing process finish	5 piece
14s	Put the tray at glue machine	
26s	Wait the gluing process finish	5 piece
28s	Put the tray at glue machine	
40s	Wait the gluing process finish	5 piece
	Total	15 piece

Table 4.3: Two Machines

Time	Condition	Total core
0s	Put the tray at glue machine A	
4s	Put the tray at glue machine B	
12s	Machine A finish	5 piece
14s	Put the tray at glue machine A	
16s	Machine B finish	5 piece
18s	Put the tray at glue machine B	
26s	Machine A finish	5 piece
28s	Put the tray at glue machine A	
30s	Machine B finish	5 piece
32s	Put the tray at glue machine B	
40s	Machine A finish	5 piece
	Total	25 piece

2. In this problem process layout is important as a guide for rearrange the operator position. To reduce waiting time 2 operators from first process have to separate and help operator from marking process or hire another one operator. This solution can achieve if this operator active because after operator prepare the product for marking process this operator can continue her job arrange the core in tray. That means these operators have to do 2 jobs but to prepare the core for marking not every time because operator have to wait core cool first.

3. In production process one of the solutions to reduce a cycle time is combine the all process in one block or area. Movement from different block can contribute to defect product because failure in handling material by operator. If the process can be combine

in one block the positive impact is the supervisor can guide or watch how the operator work and the important thing is can reduce cycle time because not have waste transportation from block B to block A.

4. In this problem we can eliminate the waste of extra space by setup a new position of the table inspection and combine with table wire cut (see Figure 17). After apply this solution the material or product can deliver by window between two operators or more. If this solution can implement the extra space and movement can be eliminate.

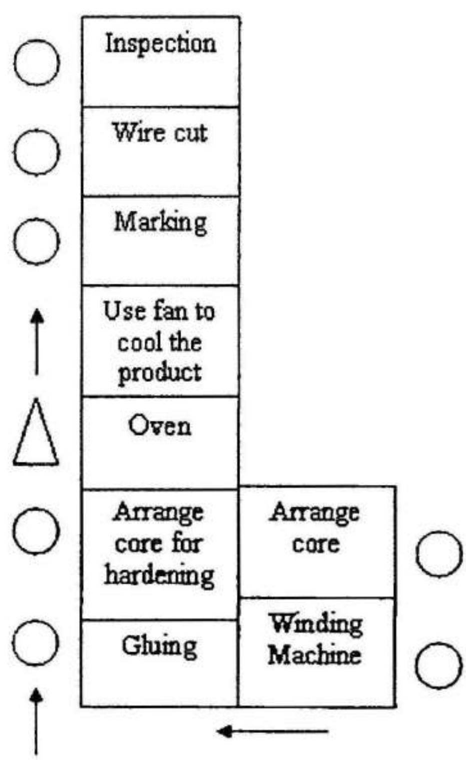

Figure 4.8: New Process Layout

4.3.3 Discussion

1 a) If speed machine increase product defect will occur. This problem happens because material that stick together with core will trickle around the product and this is example of product defect in Figure 18.

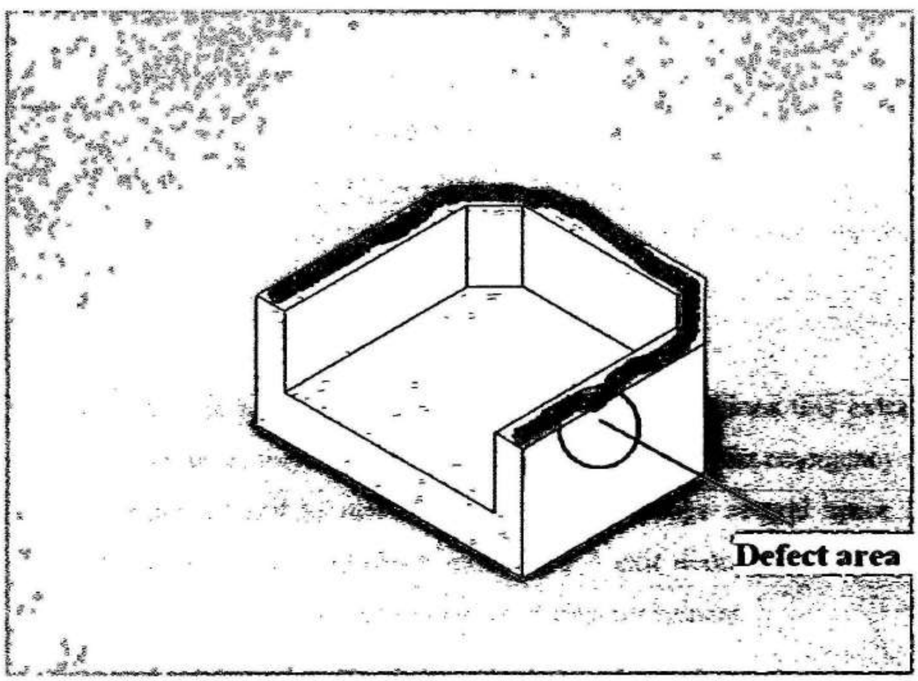

Figure 4.9: Defect Area

1 b) In this factory each machine must be checked by technician twice per week to maintain the machine from breakdown. Technicians have to follow the schedule and always observe the machine to avoid production down. The solution of buying another one machine not suitable because customer order not only in this product and after 2 to 3 year this product will change so the manufacturing also follows the alteration as well.

2. After core cool by fan has one operator will prepare the product for marking process but this operator actually done two work, first is prepare the product to marking and second is send the product to next block for potting process so when this operator not around, this operator at next block. For arrange the core in tray have 2 operators because this is new operator and senior operator will teach how to do a basic thing.

3. In this factory have various type of product from automotive, installation, industrial application and telecommunication. For this product only one process make in another block. This because from 70% product in this factory that be made in block A and other 30% product is manufacture in block B so if the potting and material machine change the place to block B the cycle time for other 70% product will increase and add extra cost. Be sides that space in block A is large than block B and comfortable for worker.

4. To eliminate extra spaces is good solution but several situations this extra spaces actually is important to factory. In this block the extra spaces is for emergency passage this spaces is important and to make the emergency passage several space have to reserve. Based on fire safety this block must have 3 exit doors and this emergency passage cannot have anything that can hinder the human movement.

4.3.4 Result

This is a result of the production cost 4900-X-319 based on cost of operator if the solution implement.

Table 4.4: Working Hours

Working time	Hours
8.30-12.30pm	14400s
12.30-1.00pm	Break time
1.00-4.30pm	11880s
	Total: 26280s

Salary operator per hour RM2

Cycle time: 5.33min/piece:319.8s/piece

Current operator cost: Total time one day/ Cycle time

$$: \frac{26280s}{319.8s/piece}$$

: 82.17 ≈ 82 piece per day

Operator cost to produce 82 piece is (10 operator x 8hour x RM2 = RM160)

After implement solution reduce cycle time 24s

$$: \frac{26280}{(319.8-24s/piece)}$$

: 88.84 ≈ 89 piece per day

Operator cost to produce 89 piece is (10 operator x 8hour x RM2 = RM160)

The results is production are increase when cycle time is reducing because in factory time is money and if engineer can give good solution the factory can gain more profit.

CHAPTER 5

CONCLUSION AND RECOMENDATION

In this chapter overall project is conclude and some recommendation recognize. These recommendation based on the project and it use for the study or future development of this project.

5.1 Conclusion

This JIT (Just in Time) concept is applied in reducing the cycle time in factory. All important information or data from literature review and production process in factory was taking as an influence and guideline to classify waste and make solution to reduce cycle time. First step to eliminate the waste, understands the production flow because this basics knowledge can give idea and point to develop a solution and reduce waste. Each process in this flow is explained by engineer and supervisor in that factory. Actually in factory have 7 waste that occur in that production flow so to achieve the objective several research and discussion have to be do based 4900-X-319 product. All waste must be listed first and then classify by type so arrangement of the waste is easy to understand. After that to achieve second objective is to make solution or improvement of the problem. Solution that be made must be discuss with engineer if the solution can implement to this problem. If this solution has been accepted by engineer the production cost will reduce and the productivity will increase.

5.2 Recommendation

For research in the future in purpose to get a better result, this research can expand in various types. For the future study in this project, some recommendation had identified. The recommendation to get a better solution for reducing cycle time on this product is as below:

- Make survey and research from operator and production management
- Next study about changing shifting times from one shift to two shift.

Through these recommendations, the new solution can reduce cycle time based in JIT concept.

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APPENDIX A

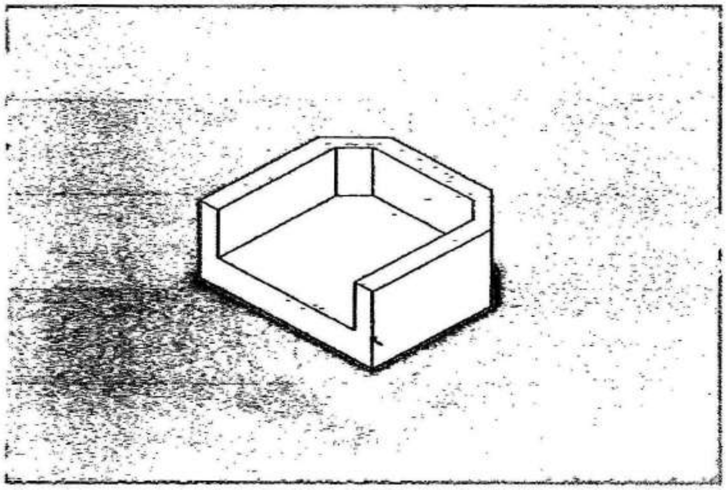

Figure A 1: Core 1

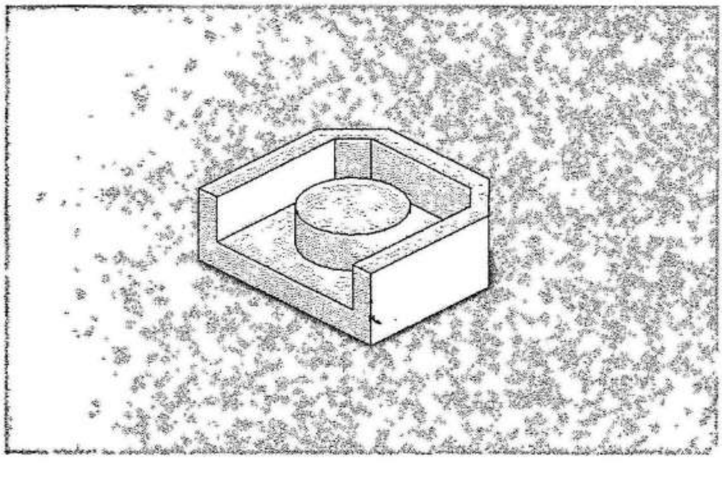

Figure A 2: Core 2

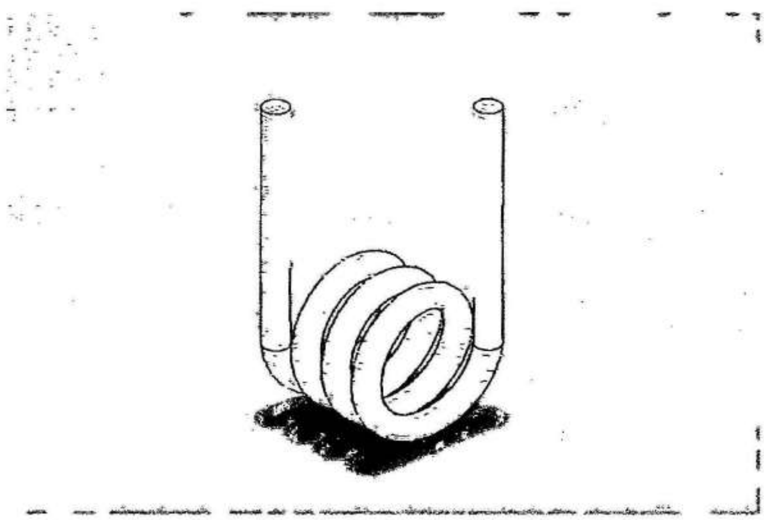

Figure A 3: Wire

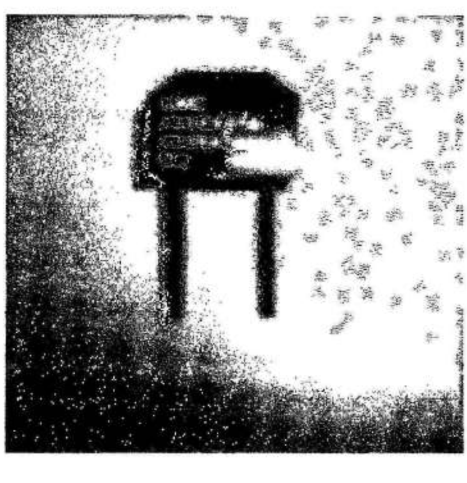

Figure A 4: 4900-X-319