CHAPTER II
BASIC THEORY AND LITERATURE REVIEW

2.1. Literature Review

In the literature review section, will discuss about research carried out primarily for companies that have already considered important Lean concepts which one of them is continuous improvement or often called continuous improvement using Lean technique. The main target is to make the writer able add insight clearer into the topic under study.

2.1.1. Resent Research

The productivity of the construction industry worldwide has been declining over the past 40 years. One approach for improving the situation is using lean construction (Aziz & Hafez, 2013). Lean is one of method that really been used in many industries to reach the goal of the company using the best in every aspect. Lean Manufacturing is a popular term, which is applied widely and brings a lot of benefits. As a result, there is a large number of companies applying lean in manufacturing and achieving success (Nguyen & Do, 2016). Lean will help many industries to setup a good assembly line production that can be reach from the one of lean technique in the production line. There are many kind of assembly line that can be suited in the term of analysis from Lean technique. Lean manufacturing techniques is a set of tools and methods for eliminating wastes in manufacturing operation. Its benefit includes cost reduction, improve output and shorten lead time(Nguyen & Do, 2016). In the company , to put motivation in the worker are really important that will help the company itself to reach the goal easily therefore Motivation for being the best of one's abilities will be investigated as an important driving force in the culture of improvement efforts (Holtskog, 2013). After the motivation to do lean already gain from the worker, need to build a team that will work using lean technique in the company by each of worker will understand their relation by completing the lean training and concepts. A team is formed from functions including production supervisor, product engineer, process engineer, R&D engineer, planning officer, team leader, and lean engineer (Nguyen & Do, 2016).

A survey of over 600 respondents shows that continuous improvement is felt like a natural part of the tasks in the daily work-life (Holtskog, 2013). Which this

method will help in many aspects in the industry which mean continuous improvement will always trying to get the best of each activity in the industry. In case to reach continuous improvement, needed lean technique to support in many problems in the company that need to be improve. A common goal is to establish a continuous improvement process to achieve the same added value with reduced resource utilization (Czumanski & Lödding, 2012). To reduce resource utilization, need to eliminate some waste that can help improve the productivity in the assembly line of production. The continuous improvement in manufacturing using waste elimination has been recognized as one of the most important tasks of socially responsible organizations. The capability to eliminate waste can lead to attaining environmental gains. Waste in any organizations is ranging from non-value adding activities to workplace hazards which can further lead to customers, employees and organizations dissatisfaction as well as environmental destruction (Mostafa & Dumrak, 2015).

Based on the previous researcher, Assembly line balancing is to know how tasks are to be assigned to workstations, so that the predetermined goal is achieved (Kumar & Mahto, 2013). Each of the workstations have different process steps that help the assembly line to finish the product that they want to assembly in that line. The definition of the line balancing itself is really helping to guide and go further. The assembly line balancing is to assign the different tasks to various stations such that the precedence relations are maintained and some measurements of effectiveness are being optimized (Raj, Mathew, Jose, & Sivan, 2016). It contains how many people needed, how many steps needed inside the line and the type of line itself, which the aim and objective are to reduce production cost and improve productivity , to determine number of feasible worker , to identify the location of the bottleneck and way to eliminate them , to determine machinery and equipment according to type of the assembly line in the production , to optimize the production functions by automation , manual or hybrid assembly line , to minimize total amount of idle time and equivalently minimizing the number of operators to increase the assembly speed (Kumar & Mahto, 2013).The model of assembly line is created based on the product that the company or industry will produce, but in this case X Company is using hybrid automation line by consist of operators and machine in the assembly line. In the term of designing assembly line, there are some aspects such as cycle time, lead time, bottleneck, idle time and productivity. Originally, assembly lines were

developed for a cost efficient mass production of standardized products, designed to exploit a high specialization of labor and the associated learning effects (Adeppa, 2015). Each of the aspects are really important in the term of reach the goal of good assembly line design. By the concept that Lean and agile manufacturing is a very fast field and Line balancing in industries is also very important (Kumar & Mahto, 2013). To improve the assembly line, need to using technique such as line balancing technique that will help us to balance the assembly line to improve the productivity by doing continuous improvement as shown as before in the previous research of X HSA assembly on 2305AB Diablo product that come up with the result of reducing 1 HC in the production line using the methodology of line balancing and ECRS technique start from observation and collecting data, layout drawing and identification of each HC, time study and analysis, simulation, implementation plan, final result, until conclusion and recommendation (Jori ,2017). Methodology that have been used in the previous research will be applied to develop some new option in the new product in the production line called Apollo 2306AB hybrid automation line in current research. In which the explanation of making head stack will be explained in the next paragraph.

Producing the head stack will go through some process with each machine included in the production line. At first stage, loading operator will load APFA to shuttle and assemble HGA to the APFA, then move shuttle to unload stage in order to swage ball and unload HSA from shuttle, then load HSA to flow fixture. At the next stage, operator has to bond electrical circuit after that HSA on flow fixture will be transferred to coat stage in order to coat pad with epoxy glue and unload HSA from flow fixture. Then products are transferred to the downstream processes, which are visual mechanical inspection (VMI) and quasi static test (QST). (Srithip, Suthummanon, & Sirivongpaisal, 2017). One method to do help improve the continuous improvement in the line balancing assembly is doing simulation using ECRS technique or concept. Eliminate, combine, re-arrange, simplify the process steps in the assembly line will help to reach maximum productivity with lowest cycle time in the production with the best steps that has been change. Results from simulation and actual data analyzed using ECRS concept were used to propose improvement solutions to reduce the total time of the target process. Three procedures were evaluated via simulation tests (Narayanan, Raj, Ananth, Aravindh, & Karthik, 2016).

2.1.1. Current Research

X is manufacturing for that produce normally in the term of electronic devices. Most of the production will produce in assembly line of production in the clean room to maintain from the contamination outside. X Thailand is one location of WD Company that will produce some of HDD parts such as Slider Fabrication, HGA (Head Gimbal Assembly), HSA (Head Stack Assembly) and finished at HDD products. HSA will be produce in the clean room using hybrid assembly production line in term product of Apollo. Hybrid assembly line is one of assembly line that contains of man and machine working together, which means included in hybrid automation line. The main target of analyzing HSA Apollo hybrid automation line is to do continuous improvement using Lean technique by analyzing waste and utilization that can be improve in the production line. Method to approach the goal to improve productivity in the Apollo hybrid automation start from video recording, clocking until simulation of the data. ECRS technique is one of very helpful technique that will help assembly line to reach the goal to improve in term of lean technique. Eliminate, combine, re-arrange, simplify some of the process steps in the assembly line will improve the productivity of the assembly line which means can reduce waste such as maximum number of operators, reducing the process steps that unnecessary, increase the cycle time to produce more products and etc. To get the best option available in the assembly line, after using method approach need to be analyzed using simulation on the running assembly line, that will help to get the maximum productivity or utilization available in the production line by showing many option and chosen the best one.

2.2. Basic Theory

Some of theoretical based will be discussed in this sub-chapter. Those theoretical based that used in the framework that help to finish this final project.

2.2.1. Lean Principles

The concept of lean production / lean principle was first applied by Toyota Kaizen implementation or continuous improvement. On the concept of Kaizen, there are three kinds of waste categories: Young, Muri, and Mura. Lean principle is part of the Young. Wastes contained in this Young categorized into seven kinds of waste that is:

a. Motion

This waste is related to actual movements no need to do. Examples of waste in this case are operators who had to walk many times to pick up the equipment because of it anxiety in reading instructions.

b. Overproduction

The most easily encountered case is the amount of production that is exceeds the terms or performs the production before that needed. Losses resulting from this type of waste can be direct related to financial affairs for example is the rising cost save the company.

c. Conveyance

Waste can happen if there are too much moving goods, for example too often out or enter the warehouse or transfer the actual item is not a value adding process can occur in a production process.

d. Inventory

In this case, the waste in question is the raw maintenance activity materials, processed products, and excess products.

e. Processing

It means doing more work than what should be done or can be said to do a process that does not need to be done.

f. Waiting

This type of waste is one of the most frequent waste in a job that is usually already utilizing technology which is automated. In waiting for the production process, operators often waiting for the process to complete without doing valuable activity added.

g. Correction

The last waste is correction or more often called as rework. Rework means reworking a product already done because there is damage or the results are not in accordance with specification.

2.2.2. Clean Room

Based on the ISO 14644-1, clean room which the concentration of airborne particles in controlled, and which is constructed and used in a manner to minimize the introduce, generation, and retention of particle and microbes inside the room and which other relevant parameters, e.g. temperature, humidity, and pressure, are controlled as necessary.

People in the clean room really need taking care of the contamination such as microorganism like viruses, bacteria, fungus and for particles such as clothing fibers, equipment, paint and etc. Therefore, people in the clean room really need to use some equipment to protect the air flow in the clean room. The equipment such as hair cover, face mask, shoe covers, and jumpsuits.

2.2.3. Assembly Line

Assembly line is a sequential work flow production system which are still typical in the mass production of standard products. In mixed model assembly line system, it can produce the production sequentially by mixing more than one product on the same line. Different range of products are produced on the same line are quiets similar to the main product. In this case will assembly head stack that started from raw material Head Gimbal Assembly that already become finish goods, will be bring by kitting to hybrid line and then after assembled in production line it will become finish good as head stack assembly and will be pack to the next department of HDD.

There are many types of assembly line systems, some common variations include the classic, automated, intermittent and lean manufacturing models. These assembly line systems are often used for making different types of products. Assembly lines have some shared characteristics. Figure 1 summarizes the kinds of assembly systems. There are many different types of assembly line systems some common variations include the classic automated intermittent and lean manufacturing models. These assembly line systems are often used for making different types of products. Assembly lines have some shared characteristics.

a. Single model assembly line.

   Single model assembly line is a type of assembly line in which assemblers work on the same product.

b. Mixed Model assembly line.

   In mixed-model production is the practice of assembling several distinct models of a product on the same assembly line without changeovers and then sequencing those models in a way that smoothness the demand for upstream components. Setup times between models could be reduced sufficiently enough to be ignored, so that intermixed model sequences can be assembled on the same line. In spite of the tremendous efforts to make production

systems more versatile, this usually requires very homogeneous production processes. The objective is to smooth demand on upstream work centers, manufacturing cells or suppliers and thereby reduce inventory, eliminate changeovers, improve Kanban operation. It also eliminates difficult assembly line changeovers. The Mixed-Model Assembly Line (MMAL) is a more complex to balance in which several types of the products are assembled simultaneously on the line which considering to the shape of line.

c. Multi Model Assembly lines.

   Multi-product production supports process manufacturers where multiple or single components are run through a processing line which delivers multiple end items or finished products, including waste or by-products. Serial/Lot control for components and end items is available, as is a variety of costing and yield methods.

d. Paced and unpaced assembly lines.

   In paced assembly systems a fixed time value restricts the work content of stations (SALB further assumes that the cycle time of all stations is equal to the same value). Assembly lines with this attribute are called paced, as all stations can begin with their operations at the same point in time and also pass on work pieces at the same rate. In unpaced lines, work pieces do not need to wait until a predetermined time span is elapsed, but are rather transferred when the required operations are finished. This type of line control is often implemented if stochastic variations influence processing times.

Assembly lines for single and multiple products. Assembly line balancing (ALB) relates to a finite set of work elements or tasks, each having an operation processing time and a set of precedence relations, which specify the permissible orderings of the tasks. One of the problems in organizing mass production is how to group work tasks to be performed on workstations so as to achieve the desired level of performance. Line balancing is an attempt to allocate equal amounts of work to the various workstations along the line. The fundamental line balancing problem is how to assign a set of tasks to an ordered set of workstations, such that the precedence relations are satisfied and some measure of performance is optimized. The aim of assembly line balancing problems (ALBPs) is to assign activities to stations with respect to the precedence relationships and other constraints while some measurements of performance are optimized.

The first one is technical measurements such as cycle time, balance delay or total idle time, and minimizing the number of workstations. The second one is economic measurements like profit maximization and cost minimization. In general, assembly line balancing problem occur when an assembly line has to be designed or redesigned. The assembly line problem was first introduced by Henry Ford in 1915, the father of modern assembly lines used in mass production.

The aim of this work is to minimizing workloads and workers on the assembly line while meeting a required / maximum output. The aims and objectives of the present study are as follows:

a. To reduce production cost and improve productivity.
b. To determine number of feasible workstation.
c. To identify the location of bottleneck and eliminate them.
d. To determine machinery and equipment according to assembly mechanism.
e. To equally distribute the workloads among workmen to the assembly line.
f. To optimize the production functions through construction of mix form of automation assembly and manual assembly.
g. To minimize the total amount of idle time and equivalently minimizing the number of operators to do a given amount of work at a given assembly line speed.

Assembly line based on the method separated into assembly line by human and assembly line by machines. Which make it into 3 types of assembly line, which are manual assembly line, semi-automation assembly line and automation assembly line.

a. Manual assembly line

   Assembly line which each of the process manually done by human or operators in the assembly line, there are no machines in the term of manual assembly line.

b. Semi-automation assembly line

   This line is composed of operators and machines in the same time of process, which machine will be operated by man to get into maximum productivity of assembly line.

c. Automation assembly line

   The last type of assembly line is automatic assembly line, which in the assembly line there are no human or operators. This line only consists of

highly automatic machines that integrates each other which needed a lot of investment or cost in the term of making it.

2.2.4. ECRS Technique

Design of working method is one of things that can be done in the term of make good working system. Design of working method usually the first beginning of steps by a company that plan to produce a new product or add another service facility on the consumer. In the term of re-designing to reach some productivity improvement must follow some steps such as:

a. Main purpose of re-designing
b. Analyses the problem
c. Gather the data or information based on the current state
d. Identify the saving potential that could possibly do.

Re-designing the working method could possibly do using method approach that available. There are 4 solutions that available to reach this goal:

a. Eliminate

   Eliminate is one of the method that should be priorities before changing the 3 others working method. There are few things that should be considering using this approach:

   i. Choose Determine operations or activities at most cost / time high to give priority to the improvement of the giving the greatest impact in the course of a system.
   ii. Identify the main causes of problems and contributions from operations / activity to the running of the system. If it does not exist contribution to the system can then be eliminated. But if the moment the identification process was not found to be a significant problem then it is important to consider and consider the explanation from step three.
   iii. In this step the thing that should be the main focus is what is will occur when the operation is not completed or not running properly. It is clearly related to the possible impacts and how much it relates to other parts of the system.

   After paying attention to considerations that need to be done in the process elimination then elimination can be done in accordance with the results of the analysis (elimination whole process or partial). Elimination is a must be

prioritized because in the elimination means there is no need additional costs are in repair and operators or workers do not need to practice with new method of improvement.

b. Combine (combining an operation or an element)

The second approach can be done in order to improve the method work is by merging process. Merging operations can useful for reducing waste such as frequency of use material handling height, accumulated delays resulting from too much operation, low efficiency due to too much unnecessary movements, and much more.

c. Rearrange (sort or change the order of operations or elements)

Rearrange is one thing which can be done for optimization. Rearrange can be used to facilitate a worker in doing his job. Examples of applications of rearrange include:

i. Rearrange layout to reduce waste of activity running caused by a great distance
ii. The arrangement of books in the library is adjusted in alphabetical order author's name and field of study

Rearrange can contribute to increased machine utilization or operators working efficiency.

d. Simplify (simplify operations or activities that need to be done)

Simplification or simplification that can be done after understanding an overall picture of the activities that need to be done. On stage simplification will be simplified activities with a scope that smaller so that the improvements are more detailed.

In the production line of head stack assembly line, this method is believed really efficient because it will help the hybrid line to minimizing the cycle time to achieve the new cycle time target. The method to eliminate, combine, rearrange and simplify are really significant in this project otherwise to improve steps that needed to produce goods of X Company especially in every assembly line. After get the new result of the implementation need to also consider about the efficiency and cost in the term of implementation plan in the next targeted cycle time needed. Also, it needs to be considering about every aspects and steps in the assembly line that will change in the term of ECRS technique. ECRS was one

basic effective tool that can be used in manufacturing efficiency improvement. Thus, ECRS was applied for the bottleneck improvement in this study.

2.2.5. Simulation

Simulation is a useful tool to study the behaviors of any process. To evaluate the operation procedure, a suitable simulation tool can provide the best way to evaluate a process. They can show how the real process is affected by changes in policy. Moreover, the simulation can be used to monitor the effective factors in the system without testing in the real situation. The steps of simulation study were presented as Figure 1. The first step is to formulate a problem and plan the study. Then, the model was built using simulation language and this step can parallel work with input data collection. Next step is to verify both model structure and input data. After the model was verified, the model is used for pilot runs and statistical data can be collected at this step.

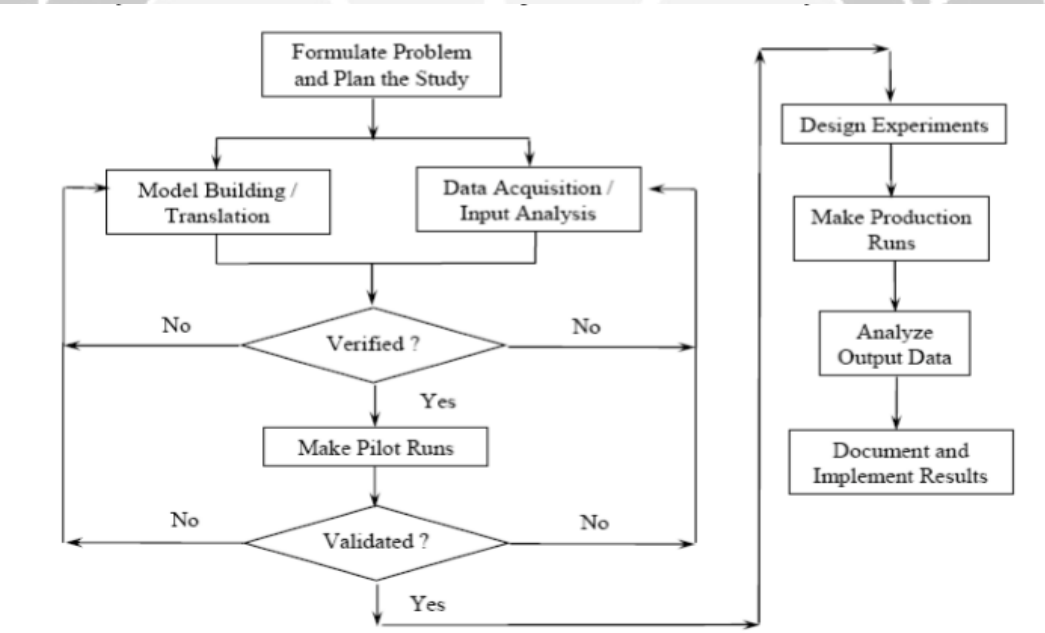

Figure 2.1. Step of simulation study (Banks et al., 2004)

The data collected from pilot runs were used in validation step to see how reality that the model can represent. If the model was confirmed that it can correctly represent the real situation, designing experiments can be conducted including setting of alternatives, run length, number of runs, initial condition and warm-up period. Then, production runs were carried out and results from production runs were analyzed and answer to the objective of the study.

2.2.6. Line Balancing Technique

Line Balancing means balancing the production line, or any assembly line. The main objective of line balancing is to distribute the task evenly over the work station so that idle time of man of machine can be minimized. Lime balancing aims at grouping the facilities or workers in an efficient pattern in order to obtain an optimum or most efficient balance of the capacities and flows of the production or assembly processes. Assembly Line Balancing (ALB) is the term commonly used to refer to the decision process of assigning tasks to workstations in a serial production system. The task consists of elemental operations required to convert raw material in to finished goods. Line Balancing is a classic Operations Research optimization technique which has significant industrial importance in lean system. The concept of mass production essentially involves the Line Balancing in assembly of identical or interchangeable parts or components into the final product in various stages at different workstations. With the improvement in knowledge, the refinement in the application of line balancing procedure is also a must. Task allocation of each worker was achieved by assembly line balancing to increase an assembly efficiency and productivity.

Line Balancing is leveling the workload across all processes in a cell or value stream to remove bottlenecks and excess capacity. A constraint slows the process down and results if waiting for downstream operations and excess capacity results in waiting and absorption of fixed cost.

2.2.7. Cycle Time Study

Cycle time is one of the important data for the line balancing at any production line. The time required to finish one product, or the total time takes before the product leaves the workstation and move to the next workstation is called cycle time.

Cycle Time, C = (Effective time available per period / production volume)

Cycle time that calculated that will really affect the production line when product some goods that really matter. In this X Co. production process are really need to calculate the cycle time study to do continues improvement by always minimizing the cycle time of production so can produces more goods by considering the calculation of payback period and benefit that the company can get. The main target of cycle time is to eliminate the work that unnecessary or even combining one to another job can get the better result without adding more useless

components to the line of production. In the case of hybrid line there are two aspect that will affect to the production line, first from machine and from the man. Need to considering both aspects are really critical in the term of improvement cycle time continuously. Each of the aspect need to be improved one by one following each other so can get the maximum lowest cycle time that available to achieve.

2.2.8. Allowance Factor

Allowance factor are really important factor in the industrial ergonomics. To help some workers to do their jobs in good performance we need to calculate the allowance factor for the workers. In this case some data will be needed such as how many work days, how many work hours in 1 day, how many time for total nonproduction hours, how much station cleaning time, how much jumpsuit/communication time, and will get the result of effective working hours. After all of the data have been collected we can calculate the allowance factor using the table of evaluation from two factors from the **Figure 2.4. Fatigue Allowance** and worker allowance itself.

TOOLING	w/ Stagger break	
ASSEMBLY	**WDM**	**comment**
Work Days	1	
Work Hours	24	
Total nonproduction hrs	1.27	
Break1	-	stagger break
Break2	-	stagger break
Station cleaning	0.93	3 times per shift @ 9.33mins
Jumpsuit/ communication	0.33	10 min./shift
Glove Cleaning	-	n/a
Effective c/r working hours	**22.73**	

Figure 2.2. Working hours

Total work time	720	min/shift
Break time 1	50	min/shift
Break time 2	30	min/shift
Work time Remain	640	min/shift

Figure 2.3. Work time

ตารางที่ 1.1 EVALUATION STANDARD FOR FATGIUE ALLOWANCE

Effort		Posture		Special Clothing&Protections	
Little effort within the work area of arms	1.0	Easy posture in the sitting position	1.0	Working with no inconvenient colothing or protection	**0**
Efforts classified between 1. End 3.	1.5	Working, moveing end raising under the nomal condition	1.3	Having on mask , rubber gloves , lone boots from time to time	0.2
Handling 0.5 to 2 kg. For move than 50% or 2 to 10 kg. For 10 to 25% within the wider area	2.0	Items between 2. And 4.	1.7	Wearing boots or rubber gloves for more than 75 %	0.6
Handling 2 to 10 kg. For 50 % or more or 10 to 30 kg. For 10 % to 28%	2.5	Working in the uncomfortable posture for 25% or less	2.0	Wearing a mask for move than 75% of a day	0.75
Handling 10 to 30 kg. For 50% or more	3.0	Uncomfortable posture for more than 75 & of a day	**2.5**		
Eye Fatigue		**MonotonousFeeling**		**Sesponsibility and Attention**	
Not fixing eyes on minute things	0.0	Works interesting and not recurring	0.0	No responsibility and attention is required	0.0
Little tired through gazng miuute things	0.3	General factory works wish a little monotony	0.3	Ordinary responsibility for safety of products and selfand other workers	0.2
Eyes become tired through lone use	0.8	Monotonous works but some rests ar taken	0.8	Higher responsibility as for above , or works with materials of high value	0.4
Eyes become tired through lone longer use with minute things	1.3	Continuous and highly monotonous works	1.4	Specially dangerous works, including responsible works of high danger to the workers ' life	0.7
Precise operation through & microscope	3.0				
Surroundings		**Noise**			
Clean and air conditioned place	0	No noise	0		
Ordinay condition of a factory with no air conditioning and some smoke and dust	0.2	Noisy as in the ordinary factories	0.2		
Much dust and smoke , but workers can get but of the place	0.3	Noisy place but workers can get out of the place from time to time	0.3		
Uncomfortable place where much dust and smoke are always present	0.5	Workers must work in continuous noise	0.5		

Figure 2.4. Fatigue Allowance

General Allowance Calculation Sheet

Section: Industrial Engineering - HSA Factory: B3		Process			Date : 29 Nov 2012 Issued by: Veerapat_R Check by: Sarita_S Approved by: Angkhan_T
Allowance type	**Description**	**T (min/Shift)**	**Contents**		
Workshop Allowance type (A)	Gathering Work Slip Entry Cleaning		A. Work Slip Entry ..... min A. Shop Cleaning ..... min	B. Cleaning hanks: ..... min/once B. Special case	
Personal Need Allowance (B)	= "Jumpsuit wearing"		A. No special cleaning needed ..... min/day B. Special cleaning only hands ..... min/day C. Walking if toilet is distance from working area ..... min/day [90m*m/s] D. White cloth changing 3.55 min/times/shift		
Operational Allowance (C)	Number Reading		Actual Observation		
	Marshalling Product		Actual Observation		
	Handling Material		Actual Observation		
	Tool Arrangement		Actual Observation		
	Machine Preparation		Actual Observation		
	Material Arrangement				
	Obtaining Tools		..... min/once x ..... times/day		
	Reading Drawings		Actual Observation		
	Operational talk		A. Operation ..... min/day B. Head Up ..... min/once x ..... times/day C. Actual Observation		
	Workbench Cleaning = "Station Clean"		Actual Observation (Average 1.81 min x 3 times/shift) - break1, break2, end shift		
	Soldering Iron Preparation		A. Preparation ..... min/day B. Head Up ..... min/once x times/day C. Actual Observation		
	Operation Preparation = "Scan Initial Line"	3.94	Actual Observation (Average 1.31 min x 3 times/shift) - start shift, break1, break2		
	Going to Material Room		Actual Observation		
	Special		Actual Observation		
Fatique (D)	**Type**	**Percent (%)**	**Allow. Type**	**Allow. Time (min)**	**Allow. Reduction** / **Allow. Classification**
	Effort	2.00%	A Total	0.00	0.00
	Posture	1.30%	B Total	0.00	0.00
	Clothing	0.75%	C Total	3.94	3.94
	Eye Fatique	3.00%	D Total	56.64	
	Monotonous Feeling	1.40%	**Total**	**60.58** (3)	**0.00** (4) / **3.94** (1)
	Responsibilily	0.20%			
	Surrounding	0.00%	General Allowance	$\frac{(3)}{(\text{work time}) - (3)} \times 100$	10% (5)
	Noise	0.20%			
	Total	**8.85%** (2)			
	$[(\text{work time}) - (B)] \times (2)$	56.64	Conveyor Allowance	$\frac{(4)}{(\text{work time}) - (3)} \times 100$	0% (6)
			Assignment Allowance	(5) − (6)	**10%**

Figure 2.5. Allowance Calculation

2.2.9. Payback Period

Payback period is one of the important calculation by determining length of time to recover the cost of an investment. It is determinant of whether to undertake the position or project. Shorter the payback period is considered to be better, since the investor`s initial outlay is at risk for a shorter period of time. Payback method is method that can calculate the used to derive the payback period. Payback period also used as amount invested in an asset to be repair by the net cash flow generated by the asset.

Formula for calculating the payback method is divide the cash outlay by the amount of net cash inflow generated by the project of the year