ACADEMIC ADVISOR
RECOMMENDATION LETTER

This internship report is prepared and submitted by **Arif Fajar Nugroho** in partial fulfillment of the requirements for the degree of Bachelor Degree in the faculty of Engineering has been reviewed and found to have satisfied the requirements for a report fit to be examined.

Cikarang, Indonesia 16 April 2015

Ir. Andira, MT

COMPANY'S SUPERVISOR
RECOMMENDATION LETTER

ArifFajarNugrohohas performed and completed an internship in **PT SCI,** in partial fulfillment of the requirements for the degree of Bachelor Degree in the Faculty of Engineering. I therefore recommend the report to be examined.

Cikarang, Indonesia, April 16th, 2015

AAB

INTERNSHIP REPORT IN PT SCI, CIKARANG, INDONESIA

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ABSTRACT

Each company have their own production system, whether it is push or pull system. Most company nowadays use pull syste as their production system. Because their production cost become lesser than using push system. But there are still some company that are using push system, and want to change it into pull system, becuase of some consideration. One of the reason is high on WIP and high production lead time. To minimize those several problem there are several can be use. One of it is by using material replenishment system. One of form of material replenishement system is by change the tools for material movement by change it into trolley

Keywords: Push system, Pull system, Work In Process, Production Lead Time, Material Replenishment system, Trolley

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TABLE OF CONTENT

LIST OF FIGURE

LIST OF TABLE

CHAPTER I
INTRODUCTION

1.1. Problem Background

Every company have their own regulation about their production either for the process time, lead time, or setup time, and each regulation have effects for the production itself, either it is good or bad. Good effects occur when the regulation or standard time that have been set is met with the actual condition in that time and it will result in on time production schedule and the delivery to the customer will not be disturbed. On contrary the bad effects will occur when the standard time that have been set before is not met with the actual condition of the company's production and it will result in late production and late delivery to customer.

As the biggest electrical component manufacturer in the world SE International main goal is not only be the best manufacturer in the world but also provide a green energy that will be useful in future state. PT. SCI as one of the branch factory in Indonesia have a commitment to provide the green energy by improving their facility itself and the production itself to have a better quality in their product and also a better energy consumption either during their production or the usage of their product.

Method department as the department that responsible in improving the facility and their production in PT. SCI area. To achieve their goal the company itself faced many problems that needed to be solved either in a short time or in long time period. This problems is not only come from inside the company itself but also from the customers that send them complaint letter about their products. Every problems that come either from the inside or outside the company need to

be followed up and solved immediately so the goal of this company can be achieved.

SE International have a many variety products start from switch, MCCB until power supply and each different type of product manufactured in every branch around the world. PT. SCI itself produced two type of product LV (Low Voltage) and SM6. SM6 is a product that based on standardized specification from SE International, but LV itself is a customized product based on customer specification. Because LV is based on customer specification problem mainly occur on LV production line ,because the part itself is not standardized parts. Customer based specification not only the color of the frame only but it is consist also customized parts and position itself the panel itself. The position of the parts for each project is different therefore the specification of the parts can be different and this customized parts can become a problem that can effect the production lead time of entire process. If the lead time of the product disturbed it can effect entire process because production lead time is time needed for one product from start of the production until it is finish. The standard lead time that have been set by the company is 2 weeks or 14 days, but the actual lead time of the production is around one month until two month.

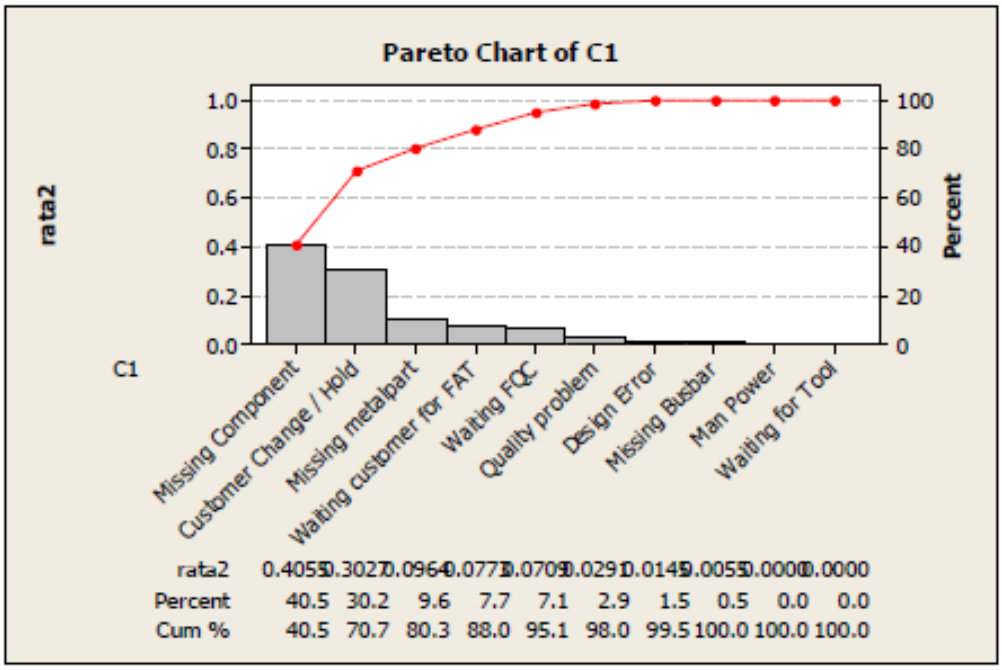


Figure 1.1 Pareto Chart

Based on figure 1.1 above we can know that the main problem that cause the actual production lead time longer than the expected one is because of the missing component and customer modification. Missing components in LV occur almost in the entire process of LV so it can cause longer production lead time. Missing component occur mostly parts inside drawer and panel itself for the metal part for panel frame it have been done by subcontractor.

This study is conducted in LV line area, the reason why this study conducted in this area because the main possibility to become waste due to the availability of the parts is occur in LV area. The goal is to reduce the production lead time by using material replenishment system.

The goal of this study is to give a recommendation in managerial level about what they need to do to improve their production time as well as their efficiency and reducing their production cost.

1.2. Problem Statement

- How to find root cause problem of high production lead time?
- How to reduce the root cause problem?

1.3. Objectives

The key objectives of this study is to eliminate root cause of problem, with this study hopefully this recommendation can be used to be a long term action to improve the efficiency of the company.

1.4. Scope and Limitations

- This study is conducted only in LV line area and for component of drawer and panel not for the metal parts.
- The data that used in this study is come from 2014 data only
- The implementation result of this study is included in this report.

1.5. Research Outline

Chapter I	Introduction This Chapter consists of the background of final project, project identification, objective, and scope of the study.
Chapter II	Literature Study This Chapter delivers the method will be used in this research such as push and pull system, replenishment pull system
Chapter III	Research Methodology This chapter contains steps to reduce production lead time in LV area

Chapter IV	Company Profile and Project
	In this chapter will explain the overall explanation of the company profile included the workflow and also the project to be analyzed is provided.
Chapter V	Data Collection and Analysis
	In this chapter, the data, calculation and data analysis will be provided in order to give solution for the main problem of this research.
Chapter VI	Conclusion and Recommendation
	This chapter will give the conclusion and lesson learned result of this final project, and also recommendation for future research.

CHAPTER II
LITERATURE STUDY

2.1 Push System

Forecasting become one of a company annual activity but there are also company that do not use forecasting to forecast their annual production, in other words this company will produce continuously and not based on customer demands. This situation is so called as push system. Push system is a system that allow manufacturer to moving their material or produce their product by continuously pushing the material even though the subsequent process do not use the same level of material as the preceding process.

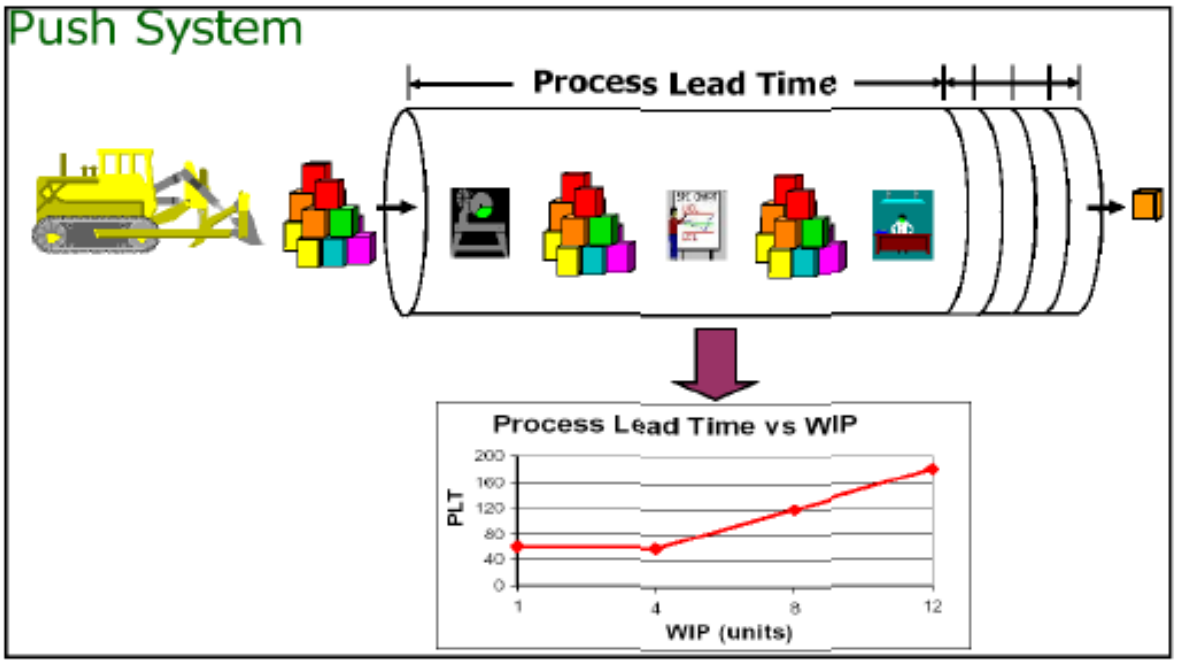


Figure 2.1 Push System

Based on figure 2.1 above we can see a push system process in a company, we can see that the delivery of the material to production line do not concern about the output and the WIP in production area. If during the production process there are some problems occur and decrease the output of the company it will make

production lead time increase and it means the production process will consume a lot of time than the predicted one.

There are weaknesses using push systems:

- By using push system, no matter what the condition of the subsequent process (either machine breakdown, missing component, etc) material from preceding process must be accepted and the process will continuously running.
- If there are any production stage that still processing the material, and the material from preceding process have to be accepted there will be an increasing WIP in that stage.

2.2 Pull System

In manufacturing company they are usually forecasting their future demand from the customer. Usually the forecasting based on the last years demand and sometimes there are some pattern in those demand, therefore they can forecast the future demand. But not every forecasted demand is accurate when the period of forecasted demand has past and it will cost more to the company because what have been prepared to handle the demand that only come from forecast but in reality the forecast is inaccurate.

The excessive cost which company need to prepare will not happen when they implement pull system. Briefly pull system is where company only produce their product based on customer demand. Pull system not only applied in marketing aspect only but also when it comes in production area. Using pull system means the production process is based on actual needs, which means the subsequent process will pull the material from preceding process based on actual needs from subsequent process. In this case the preceding process can not produce and push the material before there are any request from the subsequent process. The

operator who involved in this system become more aware regarding if there are any changes or modification.

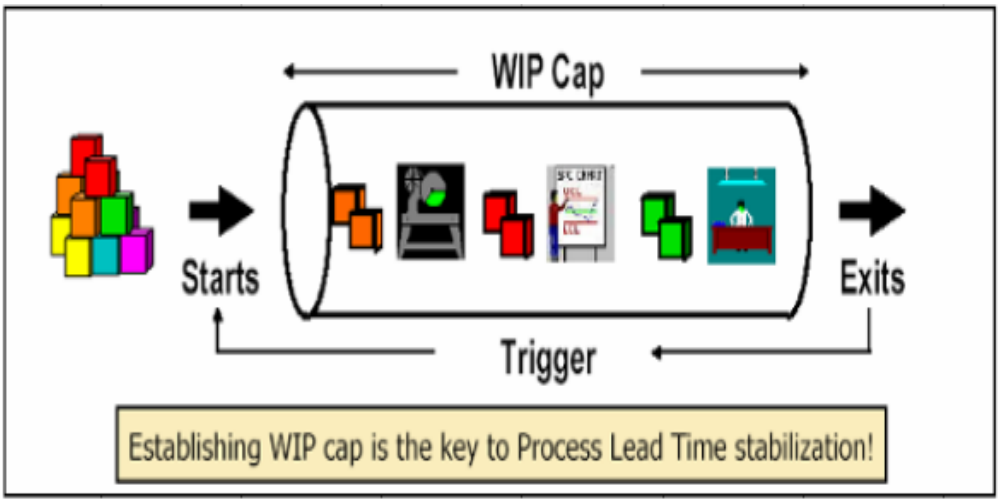


Figure 2.2 Pull System

As we can see in figure 2.2 above pull systems only triggered when there are needs in subsequent process and they will ask the material to deliver it to them from preceding process, and pull system concern about the output of the process so we can say that because the amount of the input and output of the process is same so there will be no increasing in WIP.

2.3 Replenishment pull system

Replenishment system with pull system basis allow company to use buffer in the entire production process. By using buffer, company allowed to pre-produce their product based on actual demand from the customer, usually the pre-produce product will be halfway finished products. This system make sure that buffer and trigger replenishment is prepared based on actual demand from customer or process this is usually called as “kanban”. The objective of using this system is to reduce the possibility of missing consumable component which are needed for a process.

To implement this system buffer will be placed between the production process therefore it can reduce setup time. For buffer replenishment will be based on actual material needs.

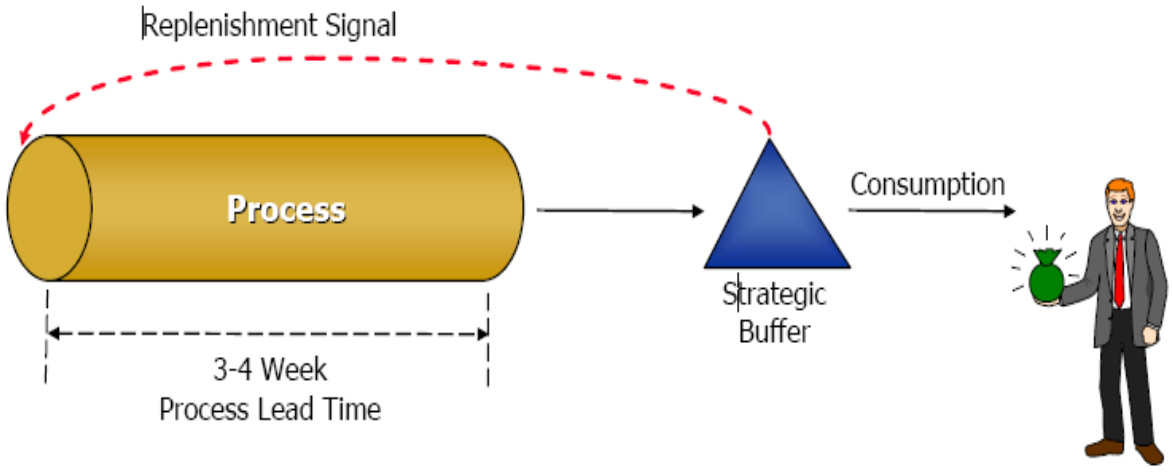


Figure 2.3 Replenishment Pull System

As we can see on figure 2.3 above it is an example of replenishment pull system. The strategic buffer will be placed between production process and to trigger this buffer demand from those process will be asked to an agent that have been placed in those position, so when actual demand received replenishment can be run into the process. The amount of buffer is based on parameter and variability of production process. This condition applied to avoid the lack of buffer which can disturb the flow of the production process.

2.3.1 Advantages of Replenishment Pull System

There are several advantages using replenishment pull system, there are:

- Productivity, by implementing this system it will eliminate the possibility of missing component, so it can optimize the resources and improve the efficiency.
- Inventory cost, replenishment pull system organize the inventory through buffer, buffer itself can be set based on the actual demand either from the

customer or subsequent process, so it will not cost a lot of inventory cost because it will not cost a lot of storage.

- On time delivery, means that the delivery of material is based on the actual demand so it will cost less compare to the delivery that not based on actual demand.

2.4 Material Handling

Material handling is the field concerned with solving the pragmatic problems involving the movement, storage in manufacturing plant or warehouse, control and protection of materials, goods and products throughout the process of cleaning, preparations, manufacturing, distribution, consumption, and disposal of all related materials, goods and their packaging. Condition which involving in material handling are good condition for the location, suitable place, right position, right time, proper order, inexpensive cost, right method.

Good and efficient material handling should be able give company advantages, this advantages give company less outcome and better efficiency, there are:

- More inexpensive handling cost.

  The reason why good material handling system will give company less handling cost is because this system will make the flow of distribution easier, this situation will lead material movement even faster. Because the material movement is faster than before implementation this will lead to fewer operator therefore the cost that needed to pay operator is less than before implementation.

- Reduction of idle time

  To make the material movement faster company should optimize the usage of the tools that will be use in material handling system. When the optimization is on the way then idle time of operator and machine will be reduced

- Enhance the safety

  Implementing material handling system also means that the safety of operator will be increase, because the tools that will be use in this system their safety factors already inspected and approved. And also by implementing proper material handling will reduce fatigue of workers, because by implementing proper material handling company will use proper tools also to support their material movement. Using proper tools for material movement will make operator work a lot easier by make their work easier it will also reduce their fatigue. The example of proper tools is using trolley and skate trolley to support material movement.

Implementing proper material handling should consider a lot of factor regarding the condition of company. The condition regarding material movement in company should be well inspected and analyzed. In implementing material handling there are some aspects need to be consider such as:

- Product design

  Product that produce by company need to be well designed, because if the product is too big and there are spaces to use one of material handling tools then implementing the system will become waste.

- Plant layout

  Designing layout is one of the hardest part when a corporation want to start build the company, because there are some aspects need to be consider, one of the aspect is closeness or relationship between each department. The stronger the relationship between department then designer need to put them really close, the reason why they need to be close at each other is because the frequency of movement between department will be really high therefore if they put too far the time to move will be longer and it will become waste. The same condition also applied in material handling plant layout and material handling should be walking in coherence because let say if the warehouse and production line is too far then it will lead to longer material handling time and

production time because the material movement is not fast enough. Therefore to implement material handling the layout itself need to properly designed to prevent inefficient flow of material movement.

- Production planning

  The flow of production process also need to be properly considered, because if not material handling system itself can not be implemented, because the material movement will not be able run properly because the flow is not properly designed

- Packaging

  Packaging area should not too far with finishing quality control area because if too far material handling time will be longer and the delivery will not be on time. And also the packaging of the product itself should be based on standardized procedure.

2.4.1 Material handling principles

To implementing material handling there are some main principles that need to be considered, there are:

- Planning principle

  All material handling should be the result of deliberate plan.

- Standardize plan

  Material handling methods, equipment, controls and software should be standardized.

- Work principle

  Material handling work should be minimized without sacrificing productivity or the level of service required of the operations

- Ergonomic principle

  Human capabilities and limitations must be recognized and respected

- Unit Load principle

  Unit load shall be appropriately sized and configured

- Space utilization principle

  Effective and efficient use must be made of all available space
- System principle

  Material movement and storage activities should be fully integrated.
- Automation principle

  Material handling operations should be mechanized and/or automated where feasible to improve operational efficiency, increase responsiveness, improve consistency , and predictability
- Environmental principles

  Environmental impact and energy consumption should be considered as criteria when designing or selecting alternative equipment and material handling systems.
- Life cycle cost principle

  A through economic analysis should account for the entire life cycle of all material handling equipment and resulting systems.

2.4.2 Material handling tools

Material handling tools is tools that relate to the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal. Material handling tools is used to increase output, control costs, and maximize productivity. This is because material handling tools also give a big contribution to material movement in production floor, by using the tools and suitable layout the material movement will be fast enough and problem that occur during material movement will be minimized.

As stated before material handling tools can be used as cost control by minimizing several waste. To eliminating those waste it is obvious we need to improve the efficiency of the production itself. For example, using a lot of operator in production line result in very high labor cost, and it will result in

ineffective and inefficient of tools usage because operator is too busy to perform material handling activity. To prevent this happen we can use inexperience operator to perform material handling activity by using tools that the company provide to help another operator to perform material handling, in other words we use more experience operator to operate the material handling tools. Material handling tools that we will elaborate is trolley and skate trolley.

2.4.2.1 Trolley

Trolley is a tools that used to transport materials which will be use in production process such as, component, consumable, and busbar. There are several trolley based on the material will be transported, such as trolley component and trolley metal part.

Figure 2.4 Trolley

Benefit of using trolley are:

- Trolley will be grouped as material that will be transported so, another material will not mixed up with other material.
- More practical, lightweight material and easy to operate
- Able to transport material in large number
- Consume less cost, because if trolley is broken it can be fixed because the spare part is easy to find
- Design is based on needs

2.4.2.2 Skate trolley

Skate trolley is a tools that almost similar with skateboard only consist of wheels and board but it is metal based board. The function is to transport a finish good product in this case is panel itself. And also it can be use as transportation tools for panel from other process to another process until it become finish goods.

Figure 2.5 Skate Trolley

The advantages of using skate trolley are:

- Minimizing the usage of crain, forklift, and handlift during moving panel from one process to another process because of safety issues
- Reduce the material movement time, even more because limited amount of forklift and crain itself
- Reduce scratch on production floor.

2.5 Lead Time

In production process before they make their product they will set their production process first. It is because if they do not set it first they can not explain to their customer how long would it take for their product to make it the hand of customers. Moreover their expense will become higher if they do not set their production time compare to the one that have been set. Production time or we usually call it production lead time is the latency between the initiation and execution of a process. In the other words lead time is a time that needed for product starting they are ordered by customers until customers receive their products.

Lead time have a huge effect on the expense and operational condition of each company either it is low or high lead time. Low lead time means that expense that company need to spend is quiet small their production process have been set to optimal state, but high lead time make expense that company need to spend is a lot higher than the low one and the production process have not been set to optimal state. There are several reasons that can cause high lead time such as high work in process. The relation between lead time and WIP is because if WIP is higher there are some product or material are waiting to be process and it will become idle if the materials is not processed as soon as possible, and if this

condition happen a lot of idle materials production process is obstructed and lead time can be longer as expected.

There are five type of lead time in manufacturing environment:

- Order Lead Time: Time from customer order received to customer order delivered
- Order Handling Time: Time from customer order received to sales order created
- Manufacturing Lead Time: Time from sales order created to production finished (ready to delivered)
- Production Lead Time: Time from start of physical production of first/part to production finished (ready for delivery)
- Delivery Lead Time: Time from production finished to customer order delivered.

2.6 Cycle Time

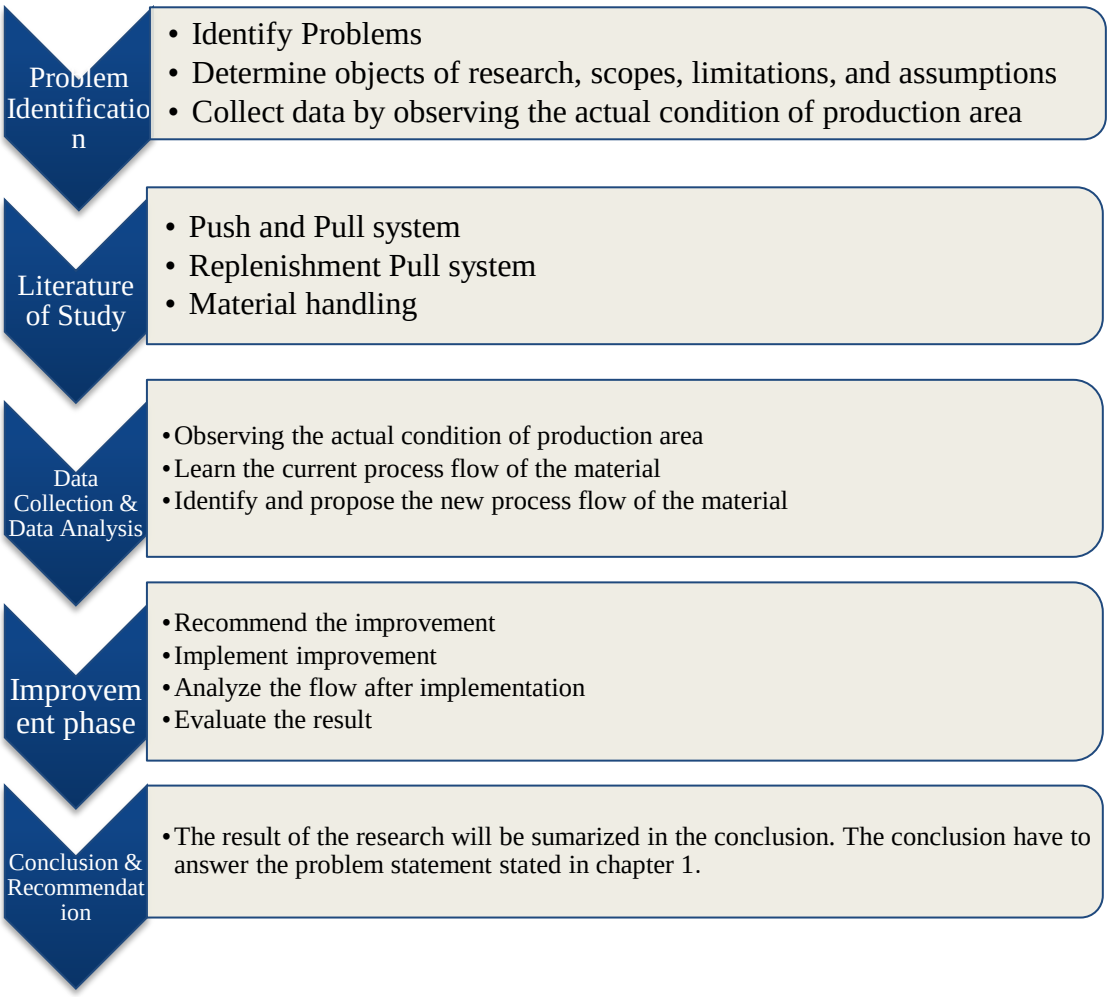
Every process in production area have their own repeated process. Even though it is repeated process the duration is not always same because of several factors. If we do not now the time of each process we can not set the standard time of each process. The measurement of each process is called cycle time. Cycle time is the total time from the beginning to the end of process. In the other words cycle time is a period of time for each process from the beginning until finish. For example material movement in production area is facilitated by trolley, by using trolley there are several process that need to be done there are loading, trolley, and unloading. Each process have their own cycle time depends on how many and how heavy the material to be load and unload, and also the distance of delivery process can determine the period of cycle.

CHAPTER III

RESEARCH METHODOLOGY

This chapter will explain briefly how to conduct the research, start from problem identification, data collection, data analysis until conclusion and recommendation.

3.1 Research Flow



3.2 Problem Identification

The first step is problem identification, the problem occur in PT. SCI. the problem occur in LV line which have a problem with their production lead time, therefore this study will try to reduce the production lead time. Second is set the scope and limitation of this study, by setting the scope and limitation this study will not gone to far outside the context. Third is collecting the data, collecting the data in this study is by observing the current situation of production area in PT. SCI especially in LV line area.

3.3 Literature Study

Second step is Literature Study, in this step method or theory from expert that we considered suitable in this project will be explained furthermore. The theory will be a guidelines for finishing this project. Some literature that will be use is push and pull system, it will help to classify what type of manufacturing method will be use for the product, pull replenishment system, by using this method hopefully it can reduce the production lead time, and last is material handling. The usage of this literature is to use a proper way to deliver the material and setting up the material so it can also be use as a method to reduce the PLT

3.4 Data Collection & Analysis

For this research there are several data that needed to be collected and analyzed. First is by observing the actual condition of production area, by conducting an observation we can determine what is wrong with current condition also we can determine cause and effect of the increasing PLT. After conduct observation next step is to learn the current material flow, by learn current material flow we can identify the cause of the problem also solve the current problem. After we are able to identify the cause next step is propose the new material flow, by proposing the new material flow hopefully it can reduce PLT.

3.5 Improvement phase

After the analysis is done next step is improvement step. The result of data analysis will become recommendation that can be a suggestion to company to implement it. By implementing it for a limited time the result will be shown after the trial period is over and the result will be shown either it is effective or ineffective for company.

3.6 Conclusion and Recommendation

For conclusion itself we can take from the result of the implementation of this method in trial period that will be determine by the company itself. And for the recommendation will consist of recommendation for the company where this research is conducted.

CHAPTER IV
COMPANY PROFILE

4.1 Brief History

In 1836, two brothers named Adolph and Eugene Schneider discovered the Creusot mines, forges and foundries gaining a big opportunity during French industrial revolutionaries. Their main product was not electricity management, there were steel, heavy industry, railroads and ship building. Until 1870 Schneider was become the leading manufacturer in steel industries, but due to the collapsed of Second Empires and in the edge of World War I led by Eugene son Henri Schneider, the company became a manufacturer in weapon and canon industry. During post war Schneider began their expansion to Germany and Eastern Europe by gain partnership with Skoda. But in the edge of World War II Germany power threated Schneider into a very difficult position.

After World War II Schneider was not a weapon manufacturer again, under new chief executive Charles Schneider, company new direction was to help rebuild country and civilian needs. New slogan of the company was “expand, modernize, and rationalize”. Under this slogan the company was in big success until in 1959 Schneider was announced as “leading the national economy”. The sudden death of Charles brought the company into a denial state due to their main product such as steel and shipbuilding, until Empain family took over the company. But this took over was not helping the company directly, until Merlin-Gerlin gradually joined forces with Empain-Schneider, and Jeumont Schneider offered promising prospect to the company which is make Modicon became one of the part of Schneider.

In 1981, Didier Pineau Valencienne took over the company and began to rationalizing the Company and did a negotiations with French government to find the solutions for the decline segments. And after consolidating their financial base and by bringing the new shareholders and simplify the organizational structure, in the late of 1980s the company was redeploy to public. And by several acquisitions the new strategic by refocusing on electricity was completed in 1996, and by ten years later the company that looked headed for bankruptcy transformed itself into a world class manufacturer of equipment of Electrical equipment, Automation and Control.

Until this days Schneider factory have been open their branch all over the world with over 1000 employee. And one of their factory in Indonesia is PT. SCI in Cikarang was established in 2001 and focused only in two products which are LV and SM6 with more than 2500 employees.

4.2 Organizational Structure.

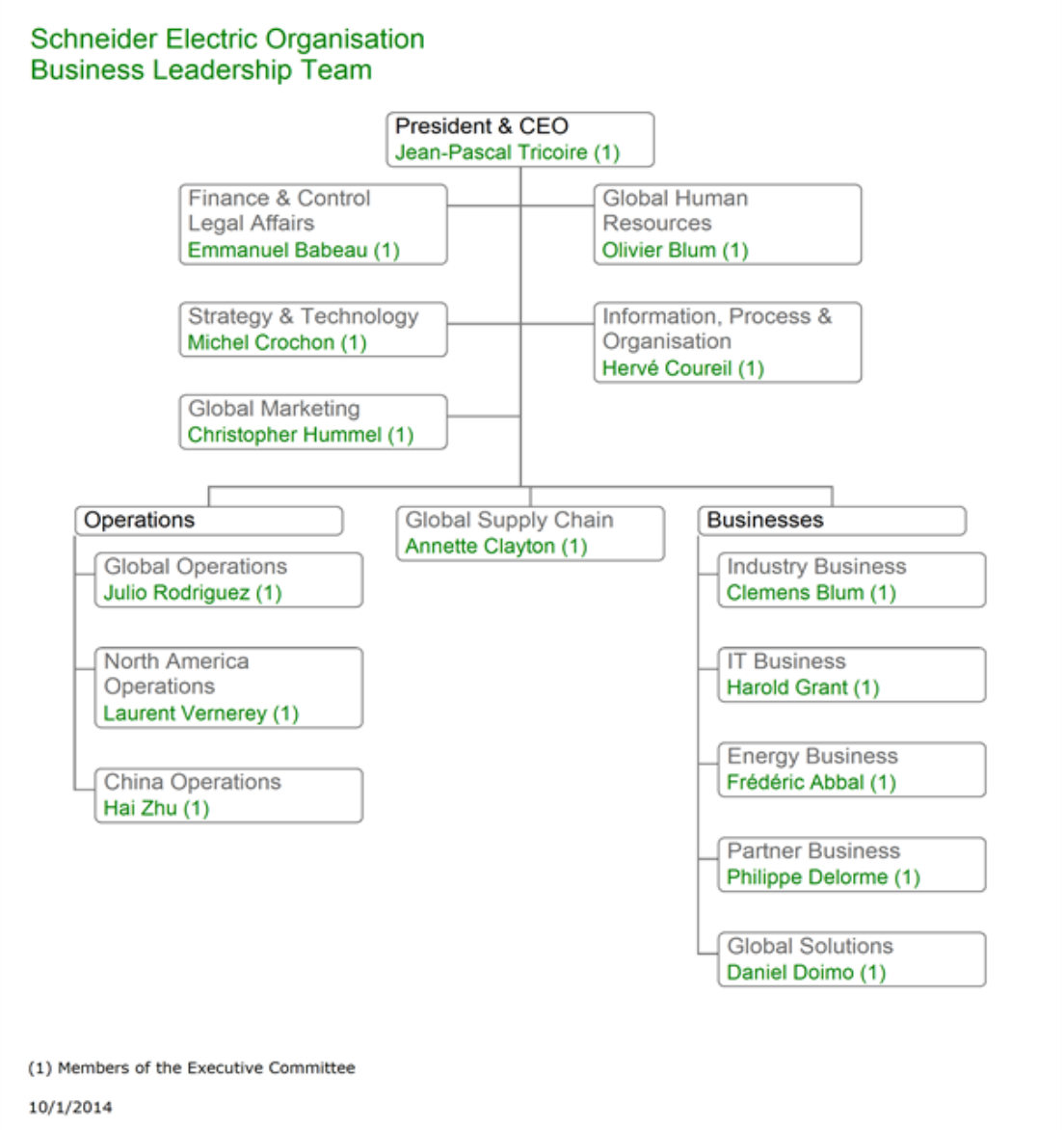


Figure 4.1 X Inc. International Organizational Chart

4.3 Method Department

Method department is one of department in PT. SCI under the supervision of Industrial Engineering division. Method department was developed to make sure that all process in production line run same as the protocol and to do improvements which is needed by the company since problems always occur in company.

The main duty of Method department are:

- Ensuring the flow of production process is not disturbed by any kind of problems
- Inventing a new improvement so the process flow can run smoother.
- Make work instruction for both trainee operator or senior operator.
- Providing any new layout if the company need to expand the facility or make changing in current layout.
- Make contact with supplier in order to provide best part but still have to spend less cost.

4.3.1 Organizational Chart

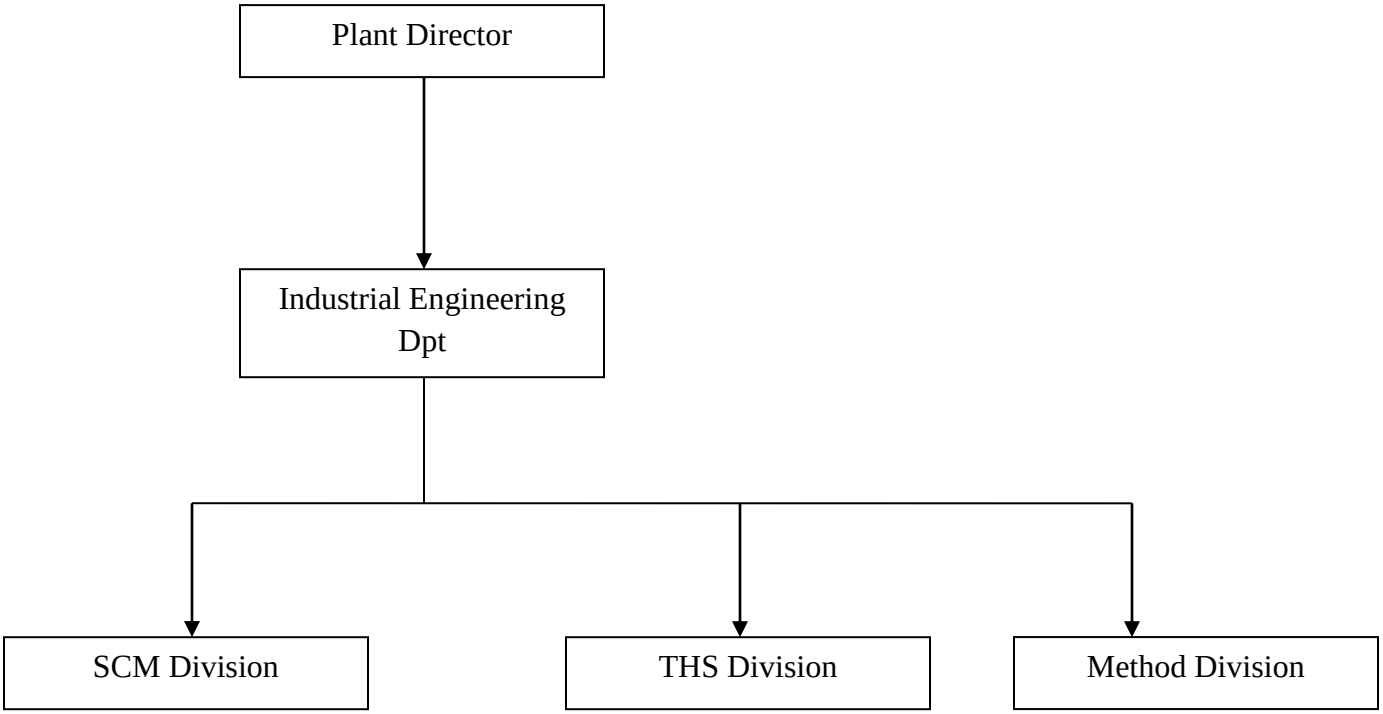


Figure 4.2 PT SCI IE Dpt Organizational Chart

CHAPTER V

DATA ANALYSIS

PT. SCI for their production process use many supplier for their material either it is from local supplier or foreign supplier. Material which they use from local supplier are for frame panel, MCCB, MCB, trolley spare part. For frame panel the material come from subcontractor but also this contractor make the frame panel for this company so what PT SCI receive is the frame panel that has been built. For MCCB, MCB the supplier itself come from the same company but different location which is in Cibitung. Material which they use from foreign company usually more sophisticated material or essence material.

5.1 Panel production process

Generally, the production process of panel in LV line have several steps that need to be completed to obtain a finish goods. The steps are, frame assembly, busbar assembly, install component, wiring, drawer assembly, FQC (Final Quality Control), finishing, FAT, and packaging. For frame assembly PT SCI already use subcontractor so in PT SCI production line itself only received frame that has been built. For busbar assembly there are two kind of busbar which are busbar standard and busbar standard. The fabrication of busbar itself still in PT SCI but the installation of busbar standard especially already in subcontractor, and for busbar non standard still in PT SCI. and for drawer assembly itself it is also already done by subcontractor. So in this chapter the production process directly start from Install component and wiring

5.1.1 Install component and wiring

Because three previous steps is done by subcontractor which are frame assembly, busbar assembly, and drawer assembly. We directly go to drawer assembly

process. In install component and wiring can be classified as two process in panel and drawer also. The first step in install component both on panel and drawer will be installation of component on both products, next step is wiring on both products. The only differences is the station and time to finish the process. Both panel and drawer when component installation on the way placed in two separate line. For drawer will be placed in line that have ten workstations and for panel will be placed in several cluster and each cluster can processed until 4 panels. Roughly both panel and drawer from install component and wiring will finished in one day if the product is standard products. but if the complexity that customer asked is higher the process time for both panel and drawer will be different. If the complexity is high for drawer it will take one until two days and for panel from one until 4 days if there are no problems occur.

5.1.2 Busbar non standard assembly process

Busbar non standard assembly process will be processed until all the wiring process in panel is finished. Busbar non standard assembly itself consist of two process preparation of busbar non standard which busbar non standard assembly based on customer specification and installation on panel both process will be done in one days by expert operator.

5.1.3 Drawer installation on panel

Drawer installation on both type of LV panel which are okken and blokset is pretty easy the concept of drawer itself is like a drawer on wardrobe or table we just need to put the drawer on available spot on panel.

5.1.4 FQC Process

Next step is FQC process panel that already processed will be placed on this station the test is about the panel works or not and if it is works it is based on customer specification or not.

5.1.5 Finishing process

In this process all operator from wiring, quality will be placed in this station to inspect one more the panel. The inspection will be physical inspection. The goal of this process is to check if there are still any missing parts in panel. If there are then this operators job is to complete the missing parts before panels go to next station. The time that usually take in this process is took very long time because usually the part that are missing still not available in short time so, and based on my observation the operator that have to finish the finishing process is still lacking.

5.1.6 FAT process

People who are involved in this process not only from inside PT SCI itself but also PT SCI invite their customer to do the final check of the products. Customer and alongside quality operator will check if their product meet customer specification or not. If not the repairing process will be run directly until it is met with customer specification. That is why in this process it took long time also because customer also check the document of their products also.

5.1.7 Packaging process

.Panel that already passed finishing process and FAT process will be stamped by green label (QC Pass) as a sign that the panel is already complete both inspection and production process. After panel stamped by green label next step is panel will be delivered to packaging area. In this area the packaging will be distinguished by the destination of panel itself. For abroad destination panel will be packed by both plastic wraping and wood wraping to make sure panel is not broken until it reach the customer abroad. For domestic destination panel will be packed only by plastic wraping. The packaging process is done by subcontractor but still in PT SCI area. For each process of panel is equipped by auto control form this form will give hint to both operator in every process and customer when their product arrive for the condition of panel. And repairing process also include in those auto control form.

5.2 Current Problem

According to pareto chart stated before and it was 2014 data, stated that the high number of PLT is caused by missing component. When missing component occur panel production will be obstructed, and when the production is obstructed panel will be in state of idle waiting for the component that was missed and this situation will lead to increasing in WIP.

5.2.1 Cause and effect analysis

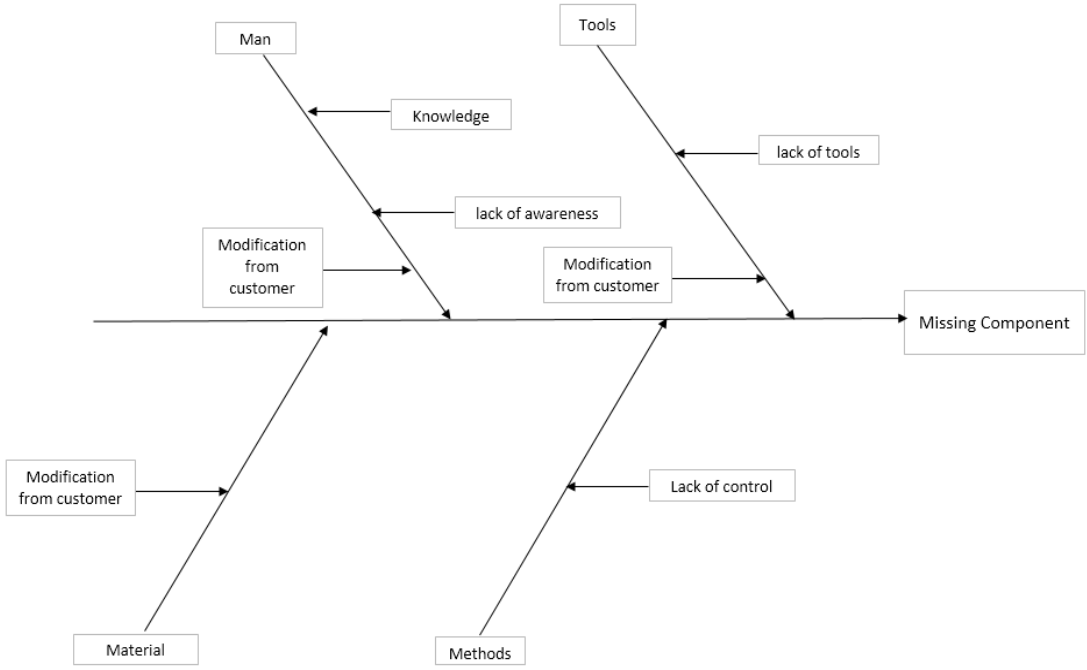


Figure 5.2.1 Fish Bone Diagram

To determine what the cause of increasing in PLT in LV line PT SCI we need to run the cause and effect analysis before hand. Our main problem is missing component but there are also causes that caused missing component that need to be analyzed. As we see in fish bone diagram above there are 4 main problems that cause missing component which are man, tools, methods and environment.

First problem is man or the operator, in one of the branch we can see the cause why man aspect effect the missing component problem in LV area. First is because of the knowledge, operator knowledge for material handling and bill of material become one of the cause of missing component if operators do not have any sufficient knowledge about those two knowledge then missing component will be inevitable. Second is lack of awareness, lack awareness can become a problem for our main problem. Lack of awareness can be cause by fatigue if fatigue affect operator their focus will be split and if their focus have been split several problem can be occur like forget to write in BOM or make an error in making of kitting list. Last is modification from customer, PT SCI's product is based on customer specification it is common in the middle of production customer asked for another modification. New modification lead to an error in BOM.

Second problem is materials. Material can be one of problem that can cause missing component, it is because modification from customer. Modification from customer that have been stated before can lead to several problem on of it is material. The new material required for new modification sometimes unavailable in warehouse or the number that operator need do not meet customer requirement so they need to ask their supplier to send the material and delivery time of new material is not in range between one until two days it is more than that so panels that was in production process now in idle waiting for the new part to come.

Third problem is tools. As we see in diagram above there are two problems that can cause main problems. First is lack of tools. The lack of tools that happen in PT SCI is the usage of pallet for material movement there are no trolley to their material movement. The usage of pallet hold up the material movement and in result lead to increasing in WIP. Second problems is modification from customer. Modification from customer can lead to three problems man, material, and tools. The first two have been stated before and the last is effect tools. Using a new

material for new modify panel sometimes lead to inappropriate tools to install the new material. So operator who lack a proper tools need to find it by themselves and borrow it from another operator this activity resulting in increasing idle time of panel production because of finding proper tools and waiting tools which is borrowed.

Last problem is method. There are not much problem that can cause method to cause missing problem because method that have been use in PT SCI already tested and approved. But there is one weakness in method which is lack of control by supervisor or team leader. Lack of control make operator feel loose in other word they feel no one see them if they not do their works or not do their works properly. For example if someone in production line asking for material to warehouse and in warehouse one of the operator that was asked and do not feel being watched and feel lazy to find it they will just say that material is not available in warehouse. Or because of lack of control operator can be mistaken input material to kitting list and BOM.

All of the problem that have been stated before lead to one main problem which is missing component. Missing component can lead to obstruction in production process which is a lot of WIP because panels is idle. Production will continue until component that missing arrive in PT SCI. until the arrival period come panels will become idle. If the idle time is increasing it also occur in WIP and if WIP continuously increasing PLT will become longer and it will affect in longer delivery time to customer.

5.2.2 Solution for current problem

As we know our current problem is missing component in LV area. Missing component can cause to the increasing number of PLT and WIP in those area. Therefore make a kitting list or material list during supply material can minimize the probability of missing component. Data about component recorded by

warehouse operator during kitting proses. Each trolley contain different needs and material type. Component on each panel depends on projects and complexity of panel itself from customer specification. To minimize missing component and fulfill the needs of component on each panel then we try to implement material replenishment system.

Material supply system with material replenishment concept chosen because if there are any missing component can be discovered directly and an action can directly execute to fulfill the needs of component that was missing before. There are two base concept about material replenishment which are pull system and push system, this is the explanation.

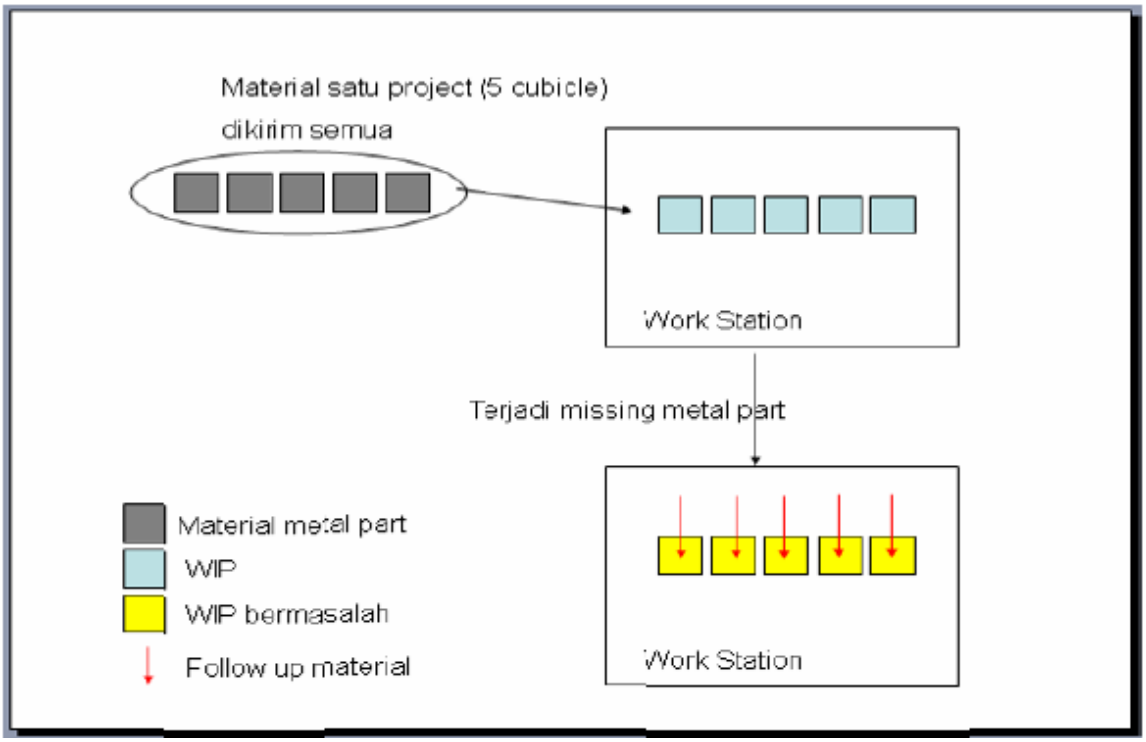


Figure 5.2.2 Material Replenishment Push System

In figure 5.2.2 above is a flow of material replenishment push system base concept. Material supply accommodate all entire material needs in one project, and in one project there are not only one panel but a lot of panel and the production process need to be done together. This current system cause the increasing of WIP in production line, because if there are any missing part current process will be stop and wait until material which is missing available. The example of this system is the usage of pallet, using pallet can also lead to the increasing of WIP because when operator need to find the missing part they all do it by themselves. Pallet usage not only lead to the increasing number of WIP but also can lead to messy production line.

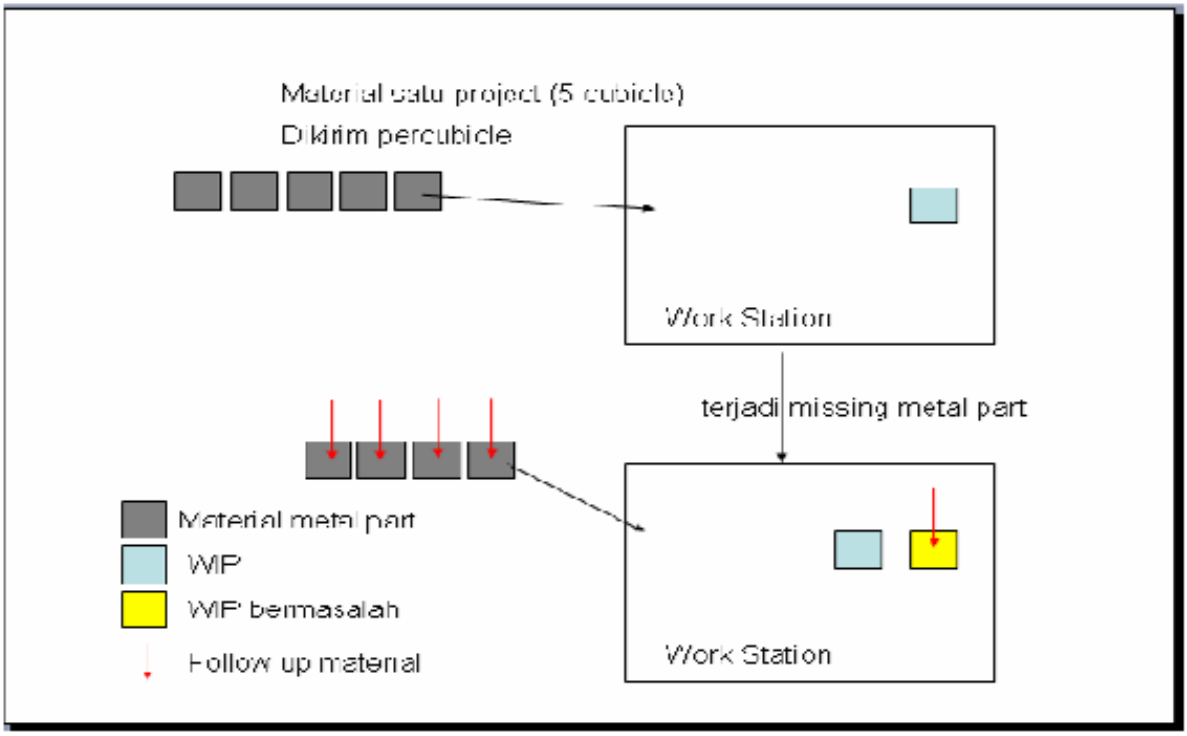


Figure 5.2.3 Material Replenishment Pull System

Compare to previous picture, in figure 5.2.3 described material replenishment pull system base concept. Material supply with pull system concept accommodate material needs for each panel. This system is very effective to discover the

missing component. If missing component occur it can discovered directly can take an action directly which is to fulfill the material needs for each panel in one project. In this system idle time is really short or even there is no idle time. Because while waiting for the missing material, production process will still running until the missing material available.

5.3 Material Replenishment Implementation

To implementing material replenishment system, we need to know the delivery flow of the component in production process first. When component arrive in PT SCI warehouse need to be in kitting process for recording their information. After kitting process has been done then component will be send to staging area and for busbar material will be sent busbar fabrication first then when finish it will send also in staging area. Delivery process of component from staging area into, wiring, busbar non standard, FQC, FAT, and Finishing is done by one operator so called as *water spider*. Delivery process also involving feeder, team leader and warehouse operator. In this picture below it will show the distribution flow process of component

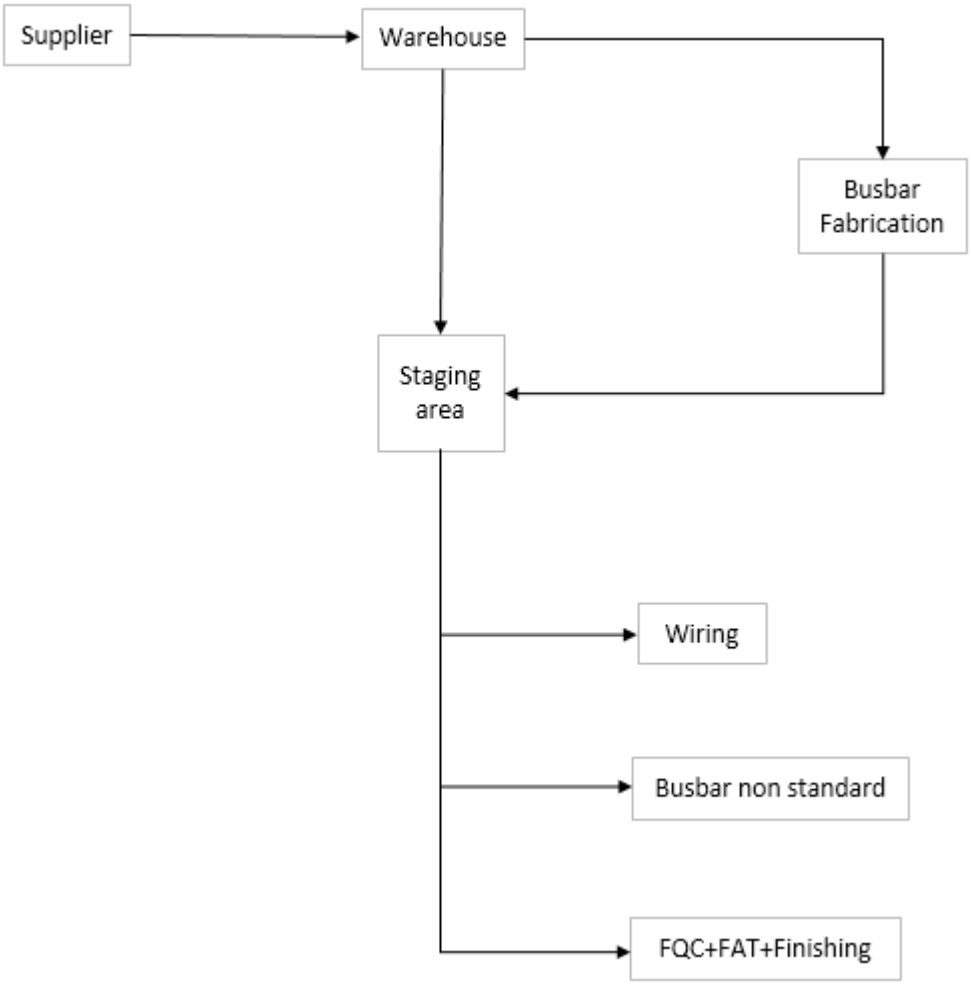


Figure 5.3 LV FLow

5.3.1. Material Replenishment preparations

Implementing material replenishment system we need to do some preparation before. The preparation need to be supported with proper facility so this process can running optimally. First step is to analyze the facility that will be use as supporting factor in material replenishment. In LV area previous process still using pallet for material supply. Using pallet for material supply is not effective enough because during the usage of pallet there are a lot of panel in WIP production area. This condition happen because material supply by pallet is used for each project. Using pallet also lead to missing component because material

supply previously only for each project but not for each panel. To minimizing the probability of missing component trolley usage is recommended as a proper facility for material replenishment.

Previous production process the transportation tools is still using hand pallet. To implementing material replenishment previous facility need to be replace because hand pallet can not transporting material for one panel. Therefore in this system hand pallet can not be use anymore. There are some consideration for using trolley as tools for material supply of component, there are:

- Material movement for trolley relatively light and easy
- Trolley is relatively cheap
- Using trolley can accommodate entire material for one panel
- Distribution process by trolley to production area can use man power
- Trolley do not need specific way in production area
- The usage of trolley make production line neater.

The main material to build trolley is pvc pipe. Reason of using pipe as main material is because pipe is cheaper than using steel. And by using pipe trolley can be more flexible because the model of trolley can be modified by adding some joint. Pipe also relatively strong material it has been proved that for 100 cm of pipe it can withstand until 100 kg mass of component. Based on several consideration that has been stated before, using pipe as main material is already decided.

Provision process of trolley involving team leader, feeder, field operator, warehouse operator and LV method engineer. Data that need to be gather for provision process are finding the right material, and the dimension for each material. The data that have been gathered will become a reference to designing trolley. Trolley design will be designed by LV method engineer as the one who responsible for improvement in PT SCI especially in LV line area. The design that has been created will be discussed with team leader, feeder, warehouse

operator and field operator. If the design is approved then the it will be given to third party as trolley supplier.

5.3.1.1. Trolley Component

Trolley component is one of type of trolley that use for accommodate component movement. Trolley component accommodate component which are have a high complexity and flexibility based on customer specification. It is because during production process customer sometimes ask for new modification.

Table 5.3.1.1 Material Dimension

Type	Dimension (mm)		
	Length	Wide	Height
Long shaft	450	50	100
Contactor	400	200	300
NS	400	250	250
MCCB	200	200	100
MCB	200	100	150
Others	200	50	100

Figure 5.3.1.1 show us the dimension of components that will be used in panel LV. Based on consideration of material type and the dimension of LV component, therefore the design of trolley component made into have a lot of spaces and divided into three divider. This decision taken because PT SCI want to make a flexible trolley that can accommodate almost any type of component. Because this trolley hopefully can be use for any type of panel with various complexity of component. Based on this consideration, the design of trolley will become in this picture below. After the design is finished, method department as the one who responsible for the design will send their design to third party as the supplier of trolley.

Trolley component need to accommodate any type of component which is needed by operator to finish their jobs which is assembly panel. This components will be placed in trolley component based on notes in trigger card.

Loading process of component into trolley start with big component first like contactor, long shaft then it will follow with smaller components like MCCB, MCB, etc. There are no specific regulation how to put the component because the trolley itself is flexible trolley because for each panel contain various type of component. One thing that need to be reminded that main component can be accommodated into trolley.

Figure 5.3.1.2 Trolley Component

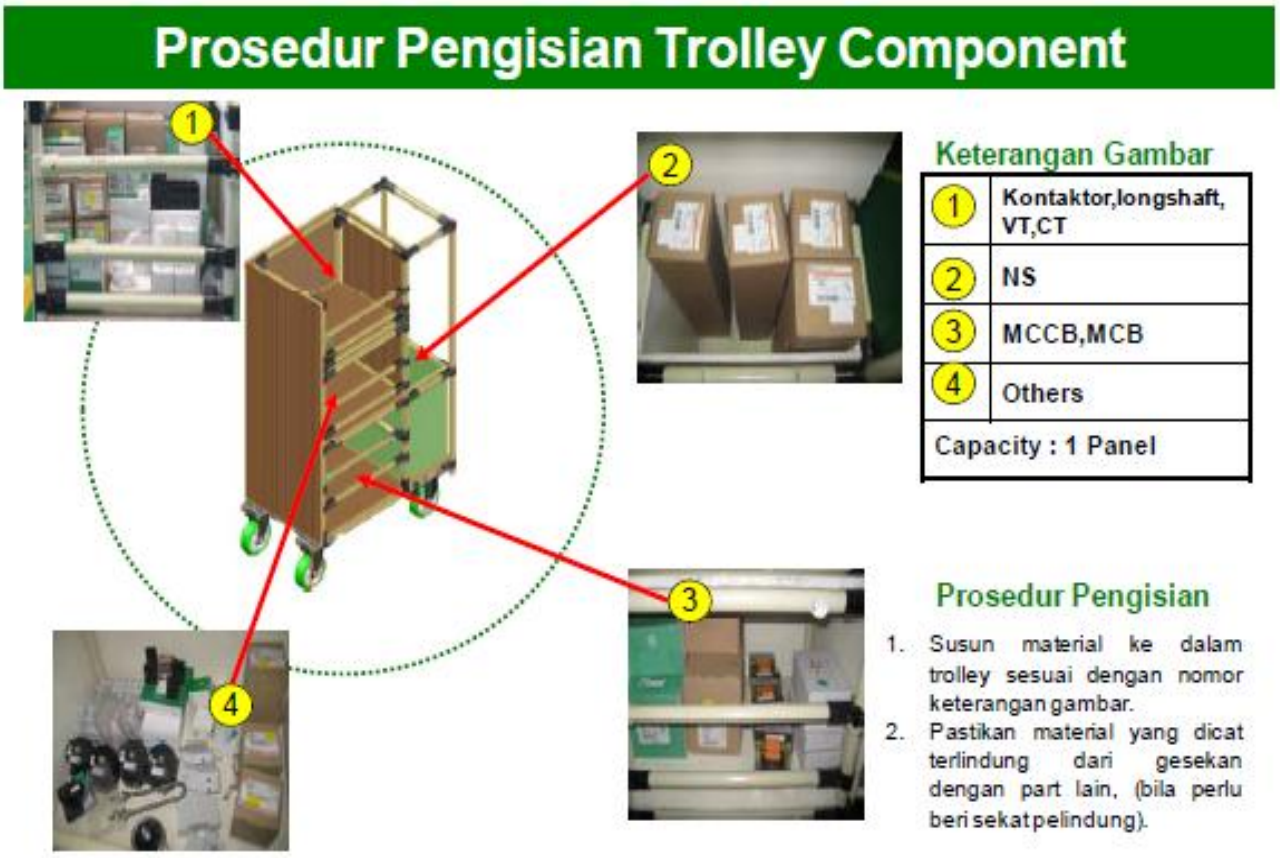


Figure 5.3.1.3 Trolley Loading Procedure

5.3.2. Component Provision Process

To implement this system we need to know the provision proses and the delivery process flow of material to production area. Material that are needed for production process will be placed on warehouse area. Material that will be move out from warehouse to production line need to follow the system that have been established. The system consist of several process that need to be run in order material can arrive into production line. As for example the initial process is order material from production line into warehouse up until the signing of kitting list form between production department and warehouse department. The procedure already written in QI and QP (*Quality, Safety Health and Environmental Instruction & Procedure*), and also SPS (Schneider Production System). There

are a book contain instruction and procedure that have been established by SCI International. The complete flow is shown in figure below

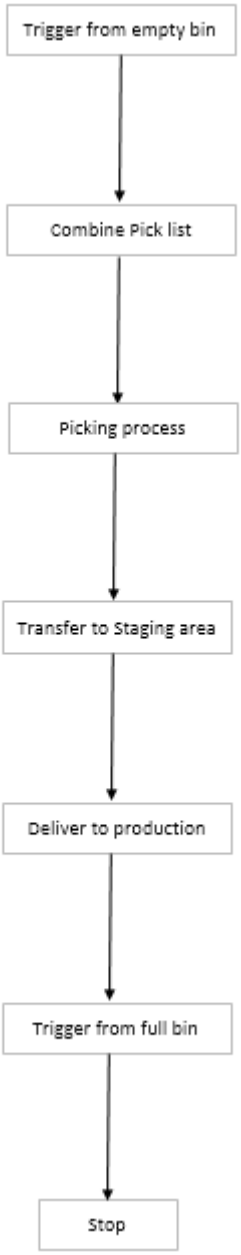


Figure 5.3.2 Component Provision Process

As we see in flow above the start of material delivery will be triggered by empty bin in production area, when the bin is empty operator will immediately request

for material order to warehouse operator by using trigger card. The list of material will be collected and combine. After that the warehouse operator will be pick the requested material and put it into staging area for later to put into trolley. Then trolley and the operator from warehouse will deliver them to production area where the material is requested. After the bin is full then the delivery process is finished. But this process of course will run continuously as long the material that are requested available.

5.3.3. Storage process for component

After component that have been ordered to supplier arrive in PT SCI, material will be sent into warehouse for further use. The procedure for storage process for component is the component will be ordered in large number. The reason is component will be use for safety stock to prevent the missing component in production area. Component will deliver into production area when there are any request for order material from production area.

5.3.4. The after effect of trolley implementation

Before using trolley for material movement PT SCI use pallet to transport their component from warehouse into production area. using pallet increase the WIP because to cover components for one project they only use one pallet. The effect of using pallet also make production area messy because the material placement by panel require big space.

By implementing material replenishment by using trolley make material movement more effective and efficient. All component that are needed for production placed in one trolley, because most of the component still sealed in their boxes so the risk of getting scratch is almost none. By using trolley we can also minimize the WIP because each trolley only accommodate components for one panel. Also by using trolley production area will look neater because trolley only need small spaces compare to pallet.

Trolley Component	
Before Implementation	After Implementation
	

Figure 5.3.3 Before and After Implementation

In figure 5.3.3 we see the comparison before and after implementation of trolley. The usage of one pallet for one project like we see in picture above is not really efficient and effective because one pallet only can accommodate small number of component compare with one trolley for one panel it is really effective and efficient as we see one trolley can accommodate large number of component and as we see in these picture above pallet need to be placed in big spaces it will lead to messy environment and reduce the production capacity and increase WIP also. But for trolley it do not require big spaces and also it can increase production capacity and reduce WIP.

5.3.5. Trigger Card

Trigger card have a function as a tool for material supply to production area. Means that when operator in production area run out of component they will ask team leader to fill the trigger card and the trigger card will sent to warehouse operator to further process. Trigger card contain panel project and material supply

code. Trigger card also have function to match the panel project and material supply code with kitting list in warehouse. To use trigger card there are several people that need to be involved like team leader, planner and feeder in production area.

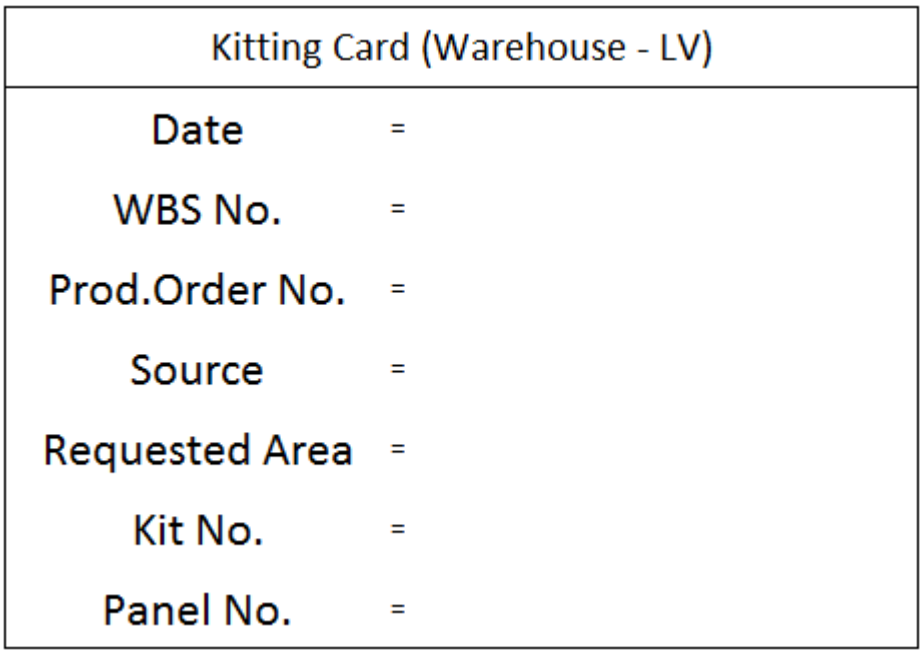


Figure 5.3.4 Trigger Card

5.3.6. LV Material Supply Flow

Component that are PT SCI receive from supplier will be placed in receiving area. receiving department will coordinate the received component to warehouse department. Component will be classified based on the type and function by warehouse operator. After it have been classified that it will be stored in warehouse as stock.

Component that have been recorded in kitting process will be placed in trolley component. Trolley component will be placed in staging area and will be delivered to production area according the schedule. Trolley supply process also will be helped by water spider.

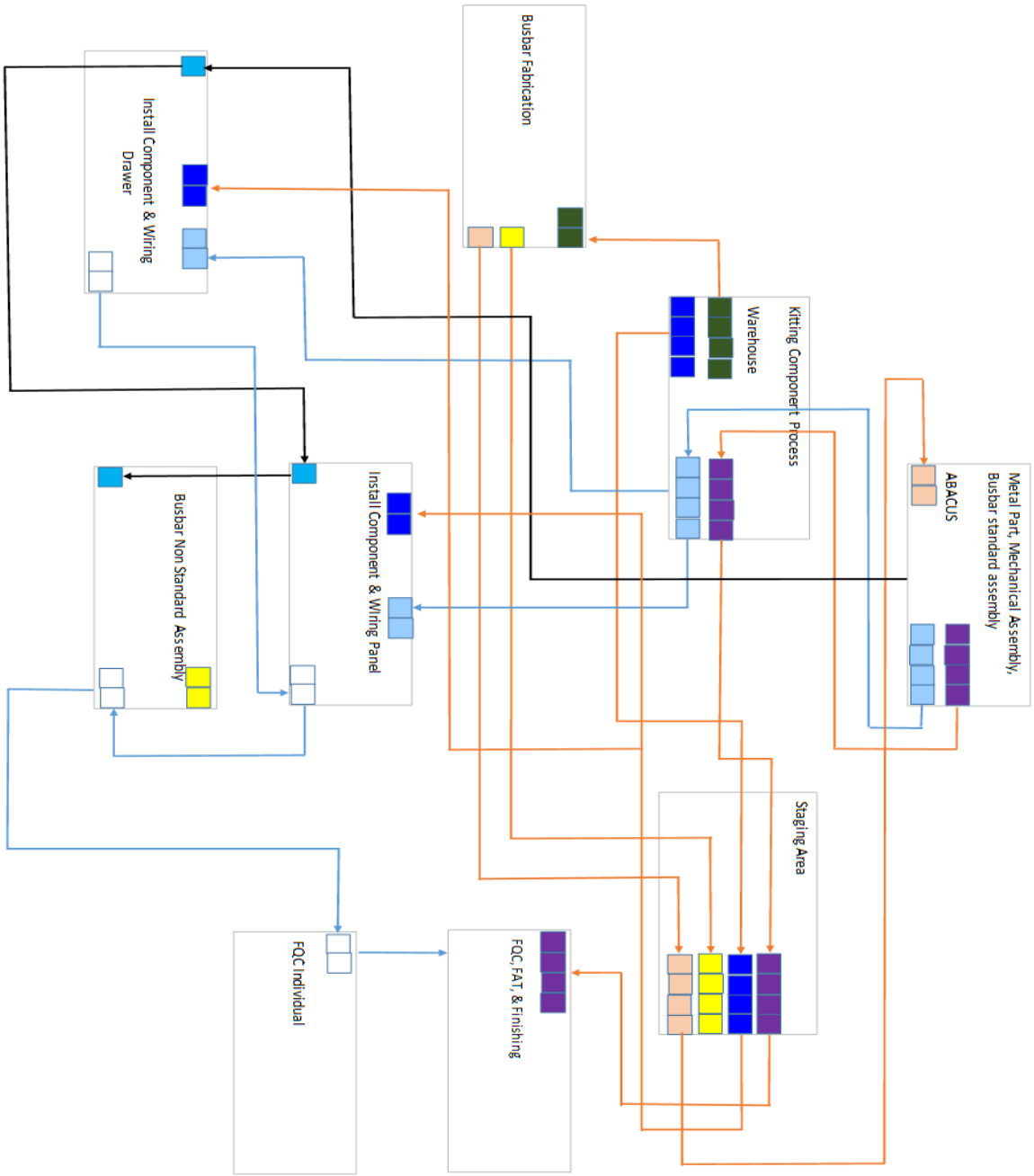


Figure 5.3.5 LV Material Supply Flow

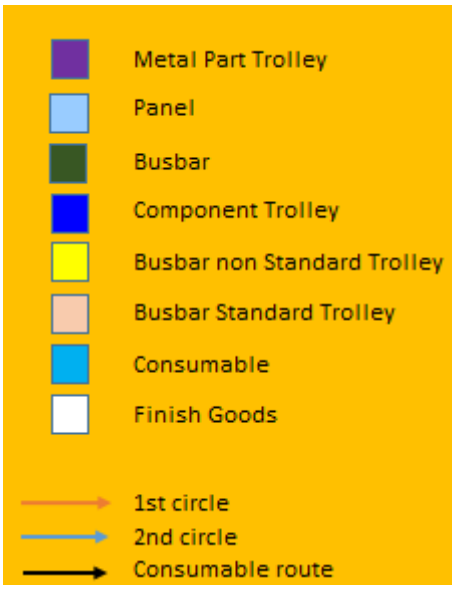


Figure 5.3.6 History

As we see in figure 5.3.5 above it is material supply flow in LV area. ABACUS is subcontractor of PT SCI, they make panel frame, install busbar standard and also assembly drawer. That three material will be received by PT SCI as panel. For further process drawer will be removed to install their own component and wiring. Same as panel, their component will be installed and there will be wiring also. Drawer will be placed in panel again after the installation complete and it will mostly happen when panel still in installation process. The finish good as complete panel will be transferred into FQC individual. In this phase the inspector will be from quality operator. After it pass it will be transferred in FQC, FAT, and finishing area. any additional metal part or component will be transferred in this phase if necessary.

For busbar, PT SCI still fabricate itself. The finish good after fabrication distinguish into two type busbar standard and non standard. For the installation busbar standard will be installed by ABACUS but for non standard will be installed by PT SCI itself. Busbar standard that have been installed will become finish good which is frame panel from ABACUS.

5.3.7. Water Spider Flow

Water spider has a task as the one who responsible for trolley material supply. Water spider have responsibility to transport trolley to certain area that have been determined. There are two type of water spider which are water spider warehouse and water spider production. Water spider warehouse in charge for take empty trolley from staging area and deliver loaded trolley from warehouse to staging area. Water spider warehouse have responsibility to maintain availability for trolley component in staging area.

Water spider production in charge for take trolley from staging area and deliver it to production area. Empty trolley will be deliver back into staging area for refill with new material which is brought by water spider warehouse.

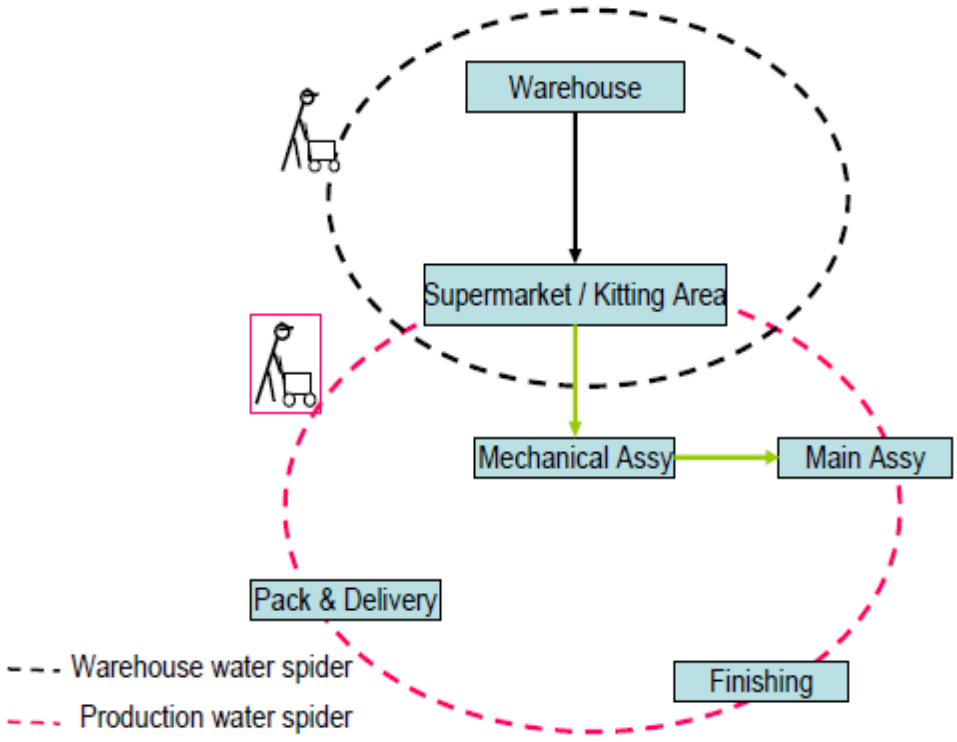


Figure 5.3.7 Water Spider Flow

5.3.8. Trolley flow in LV Staging area

Trolley movement from staging area to production area involve feeder and team leader from each production area. Feeder will check the completeness material together with team leader and warehouse operator. After checking process done trolley will be delivered by water spider production to production area.

Empty trolley will be refilled by new trigger card by planning and team leader. Trolley will be returned to staging area by water spider production. Water spider warehouse will take empty trolley from staging area for refill process containing new component by using kitting process with recorded trigger card.

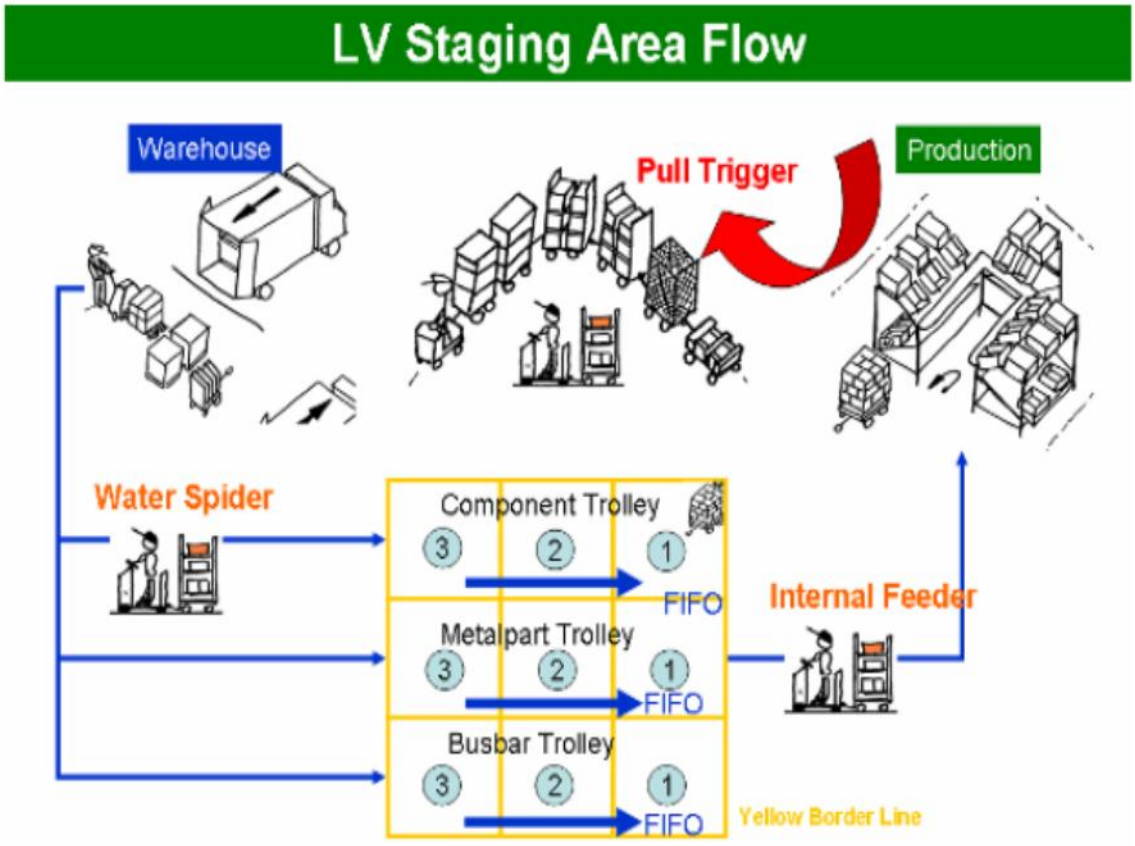


Figure 5.3.8 LV Staging Area Flow

5.3.9. Material Replenishment standard procedure

To achieve our current goal which are minimizing PLT and prevent missing component, material replenishment implementation need to be optimally implemented. To implement new system optimally there are standard procedure that need to be consider. Standard procedure can become references so material supply process can run smoothly.

5.3.9.1. Warehouse procedure to staging area

1. Team leader will write trigger card for daily need and give it to water spider production
2. Water spider will insert trigger card to card pocket in empty trolley
   Type of trigger card : Busbar non standard, component
3. Supply Chain Management will make list of needs for each panel containing, busbar non standard and component based on production schedule
4. Water spider production will take empty trolley from assembly area to staging area and place it into empty trolley area.
5. Water spider warehouse take empty trolley to staging area, and send it warehouse. The delivery period will take two working shift. Warehouse operator will prepare the components based on trigger card.
6. Warehouse operator will prepare the component based on trigger card and will give it check if they are match and send back trolley to kitting process area if component is complete and fully loaded. Warehouse operator should call SCM if the component is not complete and if this happen trolley can not go back to kitting process area
7. Water spider warehouse send fully loaded trolley component that have been through kitting process to staging area.
8. Fully loaded trolley will be placed according the queue line

5.3.9.2. Wiring process

1. Production operator will release trigger card for component

2. Water spider production bring trolley component from staging area to wiring area
3. Water spider production will bring back empty trolley from wiring area into staging area.

5.3.9.3. Busbar Non Standard Process

1. Production operator will release trigger card for busbar non standard.
2. Water spider production bring trolley for busbar non standard from staging area to busbar non standard area.
3. Water spider production will bring back empty trolley from busbar non standard area into staging and put it back to empty trolley area.

5.3.9.4. Finishing Process

1. Water spider production will bring trolley for metal part finishing from staging area into finishing area
2. Water spider production will bring back empty trolley from finishing area into staging area and put it back to empty trolley area. For water spider warehouse to prepare to refill the trolley

5.4 Loading and Unloading time trolley

By using water spider for material movement its means that there are 3 locations where loading and unloading process need to be done, which are warehouse, staging area, and production area. Cycle time of each process on each area need to be measured in order to determine the new production lead time after implementation.

Table 5.4.1 Trolley Cycle Time

	Event Description	Time (min)	Frequency/month	Total Time (min)
January	Loading Warehouse	11.23	155	1740.65
	Unloading Staging	5.36	155	830.8
	Loading Staging	10.54	124	1306.96
	Unloading Production	4.43	124	549.32
Cycle Time (days)				3.07

	Event Description	Time (min)	Frequency/month	Total Time (min)
April	Loading Warehouse	14.76	155	2287.8
	Unloading Staging	7.54	155	1168.7
	Loading Staging	10.47	155	1622.85
	Unloading Production	4.86	155	753.3
Cycle Time (days)				4.05

	Event Description	Time (min)	Frequency/month	Total Time (min)
February	Loading Warehouse	13.44	124	1666.56
	Unloading Staging	4.87	124	603.88
	Loading Staging	11.23	155	1740.65
	Unloading Production	5.43	155	841.65
Cycle Time (days)				3.37

	Event Description	Time (min)	Frequency/month	Total Time (min)
May	Loading Warehouse	9.53	180	1715.4
	Unloading Staging	3.67	180	660.6
	Loading Staging	10.11	180	1819.8
	Unloading Production	5.75	180	1035
Cycle Time (days)				3.63

	Event Description	Time (min)	Frequency/month	Total Time (min)
March	Loading Warehouse	12.54	112	1404.48
	Unloading Staging	5.33	112	596.96
	Loading Staging	10.64	112	1191.68
	Unloading Production	3.56	112	398.72
Cycle Time (days)				2.49

As we can see in figure above is total cycle time for each process on each month. For the sake of study I only use 5 month as the measurement of cycle time after the implementation. The reason why we also calculate cycle time is it can also determine whether the implementation of trolley is effective or not by adding it into new production lead time. As stated before we have three area with two process those figure show the result of cycle time after implementation by using trolley. The measurement we use on first step is using minutes, for operator the time needed to complete loading process on each area is around 5 until 15 minutes in optimal condition no disturbance allowed and for unloading time in same condition take not less than 6 minutes. We use average time for each month because the cycle time for each day is different. For frequency we use cumulative frequency because we need to calculate the lead time for each month. The amount of days for each month is different and we use previous month to calculate the frequency because the production is start from earlier month and what we use is

cumulative frequency. All measurements is in minutes until the total cycle time for each month. After we get total cycle time we need to convert it into days by dividing the cycle time with 1440 minutes the number of minutes in one day.

Table 5.4.2 Total Production Lead Time

	PLT (days)	Cycle Time (days)	Total Time (days)
January	20.2	3.07	23.27
February	21	3.37	24.37
March	21	2.49	23.49
April	25	4.05	29.05
May	23	3.63	26.63

As we can see in figure above is the PLT and Cycle time in 5 months. We got PLT is based on observation during the last 5 months. And as far as I know the new PLT have not been added by cycle time of trolley. To make the new PLT is more valid we need to add cycle time with the PLT and the result is shown in figure above.

5.5 Analysis the Affect after Implementation on Production Lead Time

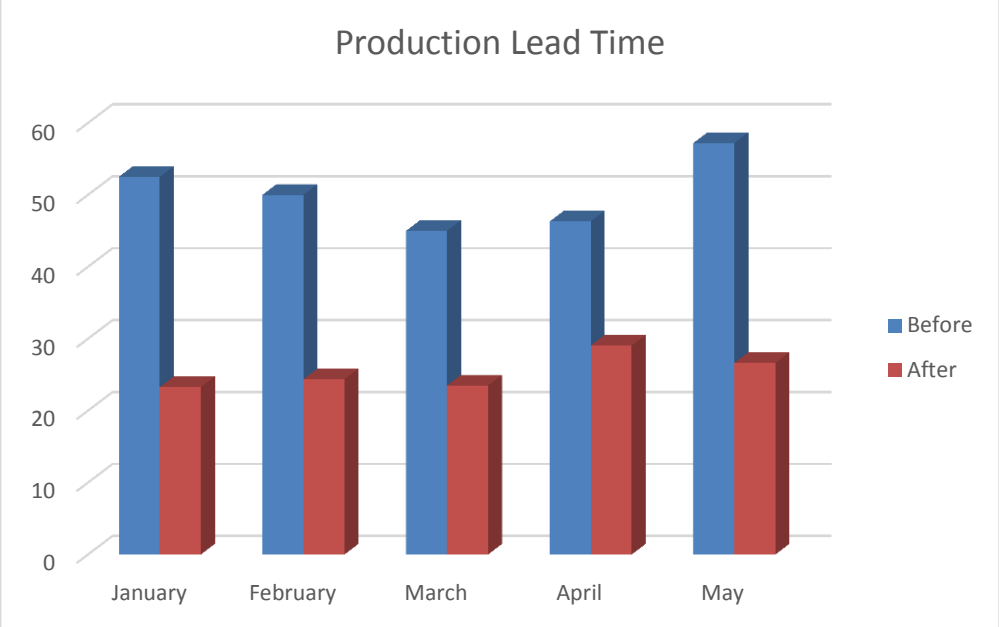
Based on table below we can see the comparison before and after the implementation of PLT. We can see there are any significant changes that happen after the implementation, the amount of PLT have been minimized almost a half of previous PLT. It is a good sign that our implementation is effective but as we can see it is not effective enough it is because the target that already been set by company is not achieved which is 2 weeks of PLT. The reason why it can not achieve target is because missing component always happen but because there are inevitable factor by PT SCI which is modification from customer, and lateness of FAT.

And we can see in table 5.5.2 is the chart of PLT before and after implementation, we can see more clearly the changes that happen after implementation.

Table 5.5.1 Before and After Implementation Result

	PLT	
	Before	**After**
January	52.5	23.27
February	50	24.37
March	45	23.49
April	46.3	29.05
May	57.2	26.63

Table 5.5.2 Before and After Implementation Chart



Average PLT before the implementation period

Average= $\frac{52.5+50+45+46.3+57.2}{5} = 50.2$ days

Average PLT after the implementation period

Average= $\frac{23.27+24.37+23.49+29.05+26.63}{5} = 25.362$ days

Total reduction of PLT before and after implementation

Total PLT = 50.2-25.362 = 24.838 days

CHAPTER VI

Conclusion and Recommendation

Material replenishment implementation proven successful reduce PLT by minimizing the probability of missing material and also it can reduce the waiting time of missing component by providing buffer. Material replenishment implementation fruitfulness proven by reduction of PLT from 50.2 days into 25.362 days by reducing the total PLT by 24.838 days.

Material replenishment implementation have been done nicely. Further improvement should be done by analyzed another factor outside missing component like waiting FAT, FQC, man power, error design, etc. This improvement hopefully make production lead time reach 14 days. Improvement should be implemented to trolley design to make it more practical and economical efficient, so component can be placed in trolley more efficient and effective.

REFERENCES

Gaspersz, Vincent. (2004). Production Planning and Iventory Control. Jakarta: PT Gramedia Pustaka Utama.

Pujawan, I Nyoman. (2009). Ekonomi Teknik. Surabaya: Guna Widya.

Schneider Production System (2008). Material handling. France: Author.

Schneider Electric Production System. (2008). Push System and Pull System. France: Author.

Schneider Electric Production System. (2008). Replenishment Pull System. France: Author.

To Whom It May Concern

Internship acknowledgment
No. 1632/HRS/SITE/II/VII/2015

The undersigned here with acknowledged that:

Name	: Arif Fajar
Institution	: President University
Major	: Industrial Engineering

Has successfully completed the Internship Program in PT Schneider Indonesia - IND Quality division with the period of **December 1st, 2014 - April 10th, 2015.**

During this period of time, he worked under the supervision of Mr. Syafyan Sari our **IQC Supervisor.**

We thank Arif for his contribution to the company and we wish for his success in his future study and career endeavor.

Jakarta, 25th February, 2015

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