

IMPLEMENTATION PROJECT MANAGEMENT CONCEPT FOR INSTALLING DEVICES OF
AUTO PART ASSEMBLY LINE

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ปัจจุบันการบริหารจัดการโครงการเป็นวิธีการที่ใช้ในการตอบสนองเป้าหมายและวัตถุประสงค์ขององค์กร การจัดการโครงการเวลาเป็นส่วนสำคัญในการจัดการโครงการ การบริหารเวลาโครงการที่ดีสามารถเป็นกุญแจสำคัญที่จะได้รับประโยชน์จากการแข่งขันขององค์กร ปัจจุบันองค์กรที่ทำการศึกษามีปัญหาในการควบคุมเวลาของโครงการ วัตถุประสงค์ของงานวิจัยนี้คือการปรับปรุงการบริหารจัดการเวลาของโครงการและส่งมอบโครงการตรงตามเวลาที่กำหนด งานวิจัยนี้ประยุกต์ใช้การบริหารจัดการเวลาตามแนวทางของ Project Management Body of Knowledge (PMBOK) ในโครงการติดตั้งอุปกรณ์สำหรับการประกอบชิ้นส่วนรถยนต์ เครื่องมือและเทคนิคที่ใช้ในการศึกษาครั้งนี้ ได้แก่ วิธีการแบ่งย่อยกิจกรรม (decomposition) วิธีการวาดไดอะแกรมให้กิจกรรมอยู่บนโหนด (precedence diagramming method) วิธีการตัดสินความสัมพันธ์ระหว่างกิจกรรม (dependency determination) วิธีการกำหนด lead time และ lag time วิธีการตัดสินใจของผู้เชี่ยวชาญ (expert judgement) วิธีการประมาณในรูปแบบที่ใกล้เคียงกัน (analogous estimating) วิธีเส้นทางวิกฤติ (critical path method) และการจัดทรัพยากรให้เรียบ (resource leveling) นอกจากนี้โปรแกรม Microsoft Project ถูกใช้ในการพัฒนาแผน จัดทำกำหนดการ และควบคุมกำหนดการของโครงการ กำหนดการของโครงการนำเสนอในรูปแบบของแผนภูมิแกนต์และแผนภูมิขั้น เทคนิค S-curve ถูกนำมาใช้ในการประเมินผลการดำเนินงานโครงการ ผลการศึกษาแสดงให้เห็นว่าการดำเนินการบริหารจัดการโครงการตามแนวทาง PMBOK สามารถปรับปรุงการบริหารจัดการเวลาของโครงการติดตั้งอุปกรณ์ชิ้นส่วนยานยนต์ของโครงการสายการประกอบ

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Nowadays, project management is an approach used to meet the organization goals and objectives. Project time management is an important part of managing a project. Good project time management can be the key to gain a competitive advantage of the organization. Currently, the study's organization have problem in controlling the project time. The objective of this research is to improve project time management and deliver project on time. This research applied project time management follow the project management body of knowledge guideline in installing devices of auto part assembly line project. Tools and techniques used in this study were decomposition, precedence diagramming method (PDM), dependency determination, lead and lag, expert judgement, analogous estimating, reserve analysis, critical path method (CPM), duration compression, and resource levelling. Moreover, Microsoft Project was used to support project plan development and control project schedule. Project schedule was presented in form of Gantt chart and milestone chart. S-curve technique was applied to evaluate the project performance. The result of the study shows that the implementation of project management body of knowledge concept can improve project time management of installing devices of auto part assembly line project.

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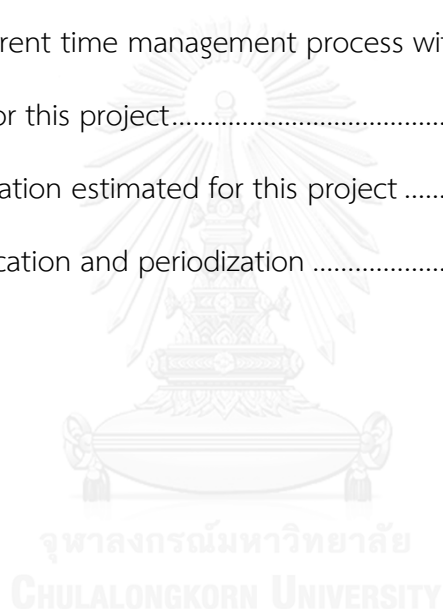
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1 Chapter 1: Introduction

1.1 Introduction

Nowadays, many organizations use project management to bring the change needed to meet goals and objectives of the organization. A project is a temporary endeavor designed to produce a unique product and service with a definite start and finish undertaken to meet unique goals and objectives (Nokes 2004). Every organization initiate projects has to manage, perform and deliver under sophistication of project activities and limitation or certain constrains including time, cost, and quality (Verzuh 2008). According to project management body of knowledge (PMBOK) guideline, project time management is an important part of managing a project. Good project time management can be the key to gain a competitive advantage of the organization. In order to succeed in project time management, it is necessary to understand and implement appropriated project management tools and techniques to guarantee on time completion of the project (PMI 2008).

The focus of this research is on project time management. This chapter provides the research and presents a structure of this thesis about how to apply the project management body of knowledge for effective and efficient implementation of project time management concept in installing devices of auto part assembly line project. The research starts with background of the company to give the thesis a

context. Next, company's historical data is used to analyze and identify problems with project management that the company currently have. Current project management process is analyzed by using project management body of knowledge (PMBOK) as a guideline and applying Fishbone analysis to identify root cause of the problems. Then, the project management body of knowledge (PMBOK) concept is applied to the research and used as a tool that helps to develop a project time management plan in the organization. After that, improvement plan is implemented and a result is analyzed to ensure that the improvement process is effective for a company. This research is applicable for any project based company in order to increase competitiveness, effectiveness, and customer satisfaction.

1.2 Background

1.2.1 Company background

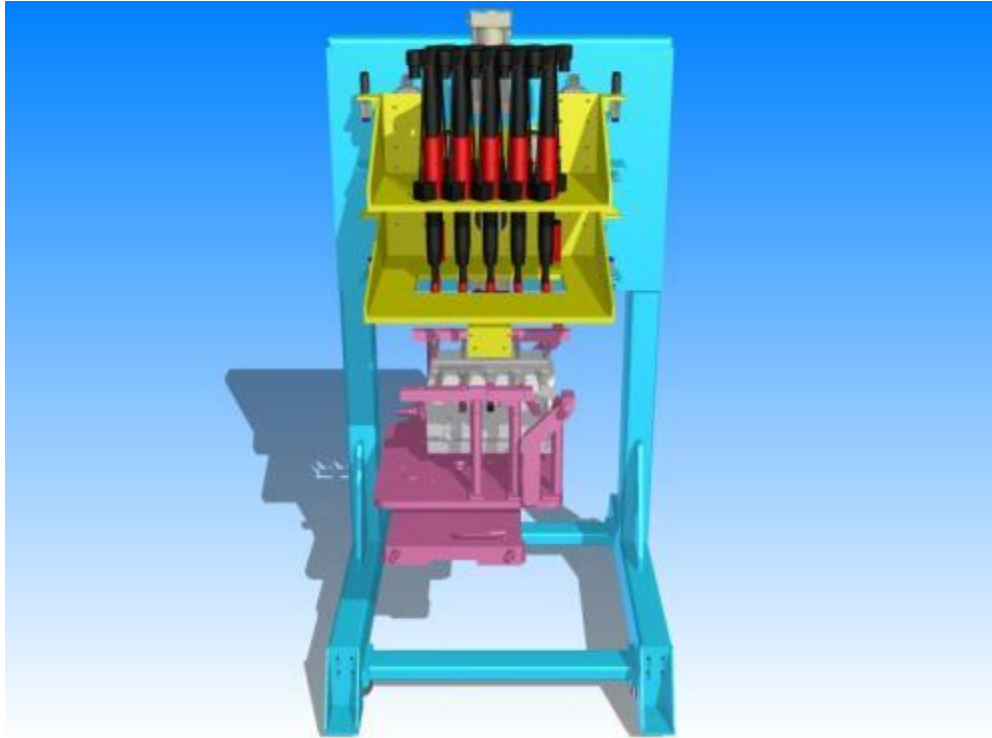
The research company is a family business that was established in 1980. The business started with general trading by importing and selling many different engineering products. Apart from this, the company have workshop for machining mechanical and electrical parts. Furthermore, the company also has factory for producing the coated abrasive paper, flap disc, flap wheel and conversion the coated abrasive products made-to-order. There are approximately two hundred employees working in the company. Main customers for this business are car and furniture

manufacturer. For instance, car manufacturer use these products for polishing and rubbing work and furniture manufacturer use these products to complete the wooden work.

In the area of trading, the company is representative of well-known products from Europe and America. There are various types of air tool products that the company provides for the customer such as drill, screwdriver, nut runner, sander, grinder, and etc. These products are developed with high quality which has the ability to be used in the business that requires high efficiency products such as electronic and car manufacturer. For instance, electronic manufacturer used these products for tightening electronic parts and car manufacturer used these products for assembling car parts. With a good quality of products and services that satisfy customers, the company has an opportunity to expand to project business which involved in building the assembly line for car manufacturer.

In 2010, the company started to focus more on car manufacturing and began to bid for the project that required tightening tools, and torque control unit in the process. Most projects are related to constructing an assembly line that required designing work, procurement, installation and testing, and commissioning. Design work consists of hardware design such as conveyor, fixing tools, frame, etc. and software design such as PLC control system. Design work is shown in Figure 1. Purchasing and logistic department is responsible to contract with the suppliers, and

procure material for the project. Installation, testing and commissioning are performed to successfully complete the project. Onsite installation work is shown in Figure 2.



จุฬาลงกรณ์มหาวิทยาลัย

Figure 1: Design work in previous project

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Figure 2: Onsite installation work in previous project

1.2.2 Company Structure

Currently, there are seven departments including sales and marketing, finance and accounting, business development and R&D, human resource, project administration and project planning, procurement and logistic, and engineering. Managing director supervise the works in the company through the manager of each department and report back to the president. Project manager is responsible for managing and controlling main functions in the project including project administration and project planning, procurement and logistic, and engineering. Remaining functions are supportive functions which are not involved directly to the project business. Figure 3 shows the organizational structure of the company.

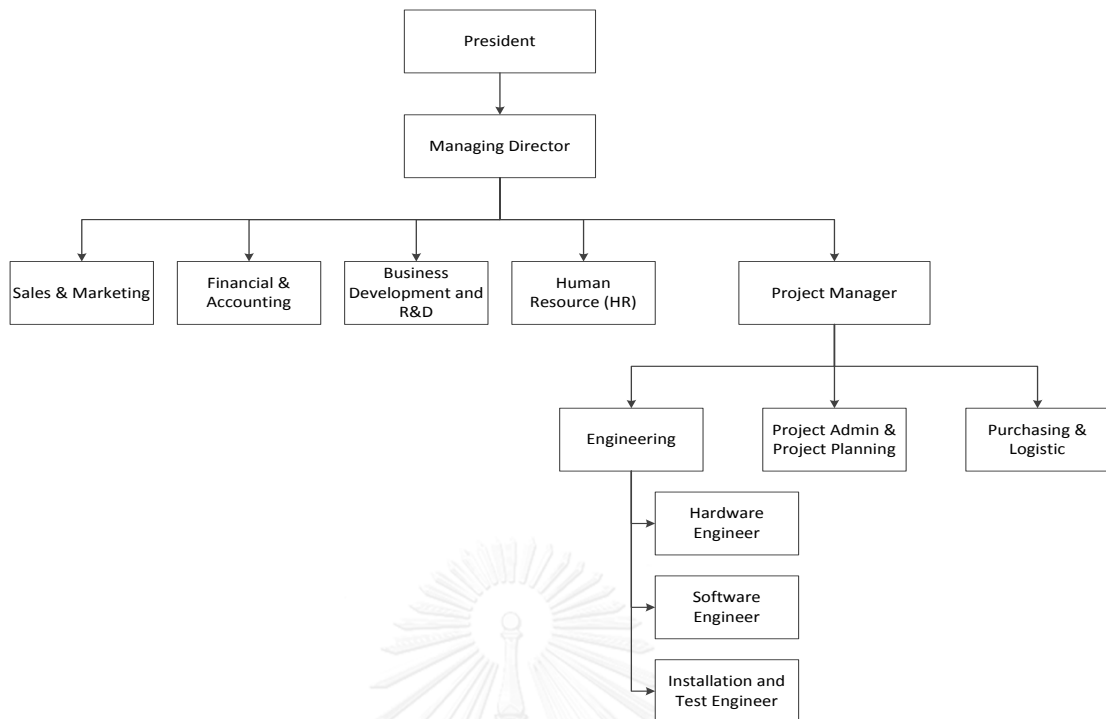


Figure 3: Company's organization chart

1.3 Statement of problem

After collecting data from company's records and interviewing the managing director and manager, it was found that the company have problem with project time management because the company kept failing to deliver project on time which resulted in loss of profit and reputation. According to data from company's record, there were six projects that the company performed in the last four year. The data shown five out of six projects were failed to deliver on time that mean the company only have 17% ability to manage project on time which is very low. Project performed in the last four years are shown in Table 1.

Table 1: Project performed in last four years

No.	Project Name	Year	Project Duration	Actual Time Spent	Status	Success / Failed Rate
1	Platedrive tightening	2011	4 months	5 months	Delayed	83%
2	Connrod tightening	2012	4 months	5 months	Delayed	
3	Cylinder tightening	2012	5 months	7 months	Delayed	
4	B-Cap tightening	2013	5 months	6 months	Delayed	
5	Electric Nutrunner	2013	6 months	8 months	Delayed	
6	U-Bolt tightening	2014	4 months	4 months	On Time	17%

In 2011, first project was performed. The target of this project was to design layout and install Platedrive tightening machine to assembly line within four months. Microsoft Excel was introduced to project team to carry out works required in this project. Since the company did not have much experience in project management and this is the first project so they were failed to deliver this project on time. The completion date of this project was delayed by one month which impacts the company's reputation and result in penalties.

In 2012, there were two projects performed. With more experience and lesson learned from previous project, the company introduced new processes of work started from planning, executing, controlling, and closing. These processes are explained more detail in section 3.1.1. The aim of these new processes was to improve project performance and be able to deliver project on time. However, these

two projects were failed to complete within deadline due to uncertainties occurred to project schedule. These uncertainties were unable to visualize ahead of time and did not manage well by the project team.

In 2013, company focused more on managing uncertainties by encouraging employees to create mitigation action plan to handle uncertainties known from previous project. This mitigation action plan was carried out by project team to reduce or avoid uncertainties that occurred in the project. The result in this period showed that the company failed to deliver project on time because project schedule was not controlled properly. At this stage, company's reputation and customer's trust was lost.

In 2014, company decided to outsource some work to supplier who has more experience in the area of particular work. For this project, hardware design and installation works were outsourced to the supplier. This enables hardware works to complete earlier than expected. Nonetheless, this outsourcing strategy allows the company to deliver project on time but failed to meet the profit margin since the company have to spent more money on supplier to complete the project.

After interviewing project manager and staffs who involved in the project, it was found that the company has various types of problems that lead to delay in project completion. There are two main problems that staffs experienced in the pass

including unrealistic plan created during schedule development, and unable to track project progress which result in lost control of project schedule. In addition, there are small delays from late delivery of material which created by supplier. However, this problem is not the main issue since the company have a good relationship with suppliers and all suppliers are located locally in which the company can easily monitored. From this, it can be conclude that the company cannot identify root cause of problem and create inappropriate improvement plan. As a result, problem with project time management is still remain in the organization.

1.4 Research objective

The key objective of this thesis is to develop a plan and process to improve project time management by applying the project management body of knowledge concept that can help project managers succeed in the execution of the projects.

1.5 Scope of research

This thesis work is focused mainly on the improvement of time management in project that affects the success or failure of project management in project based business. Analysis of current process, tools, and techniques used in managing time and comparison with PMBOK guideline will be conducted. Appropriated tools and techniques will be analyzed and applied in the project.

1.6 Expected benefits

- To improve project time control in the company
- To gain knowledge of project time management for company's employees
- To reduce unnecessary cost and penalty from delay
- To increase customer satisfaction and confidence
- To use the result of this research as a guideline to manage future projects



2 Chapter 2: Literature review

2.1 Project Management Body of Knowledge (PMBOK)

Project management body of knowledge (PMBOK) is a standard and guideline for project management profession. It describes standard methods, processes, and practices for managing individual projects. According to PMBOK, to be successful in project management, appropriated skills, knowledge, tools, and techniques should be applied. Project management processes can be organized into five groups including initiating, planning, executing, monitoring and controlling, and closing. Initiating process group consists of processes performed to formally allow project to be started. Planning process group describes objectives and develops the path of action to obtain those objectives. Executing process group contains processes performed to accomplish work identified in the project plan. Monitoring and controlling process group identify variances from plan and initiate the corresponding changes by regularly observing project execution to allow project manager to take corrective action. Closing process group formally terminates all activities in the project and delivers the final product or closes the cancelled projects. These process groups are connected with each other which explain how project tasks will be accomplished to achieve project objectives (Heldman 2013). Linkage between these process groups is shown in Figure 4.

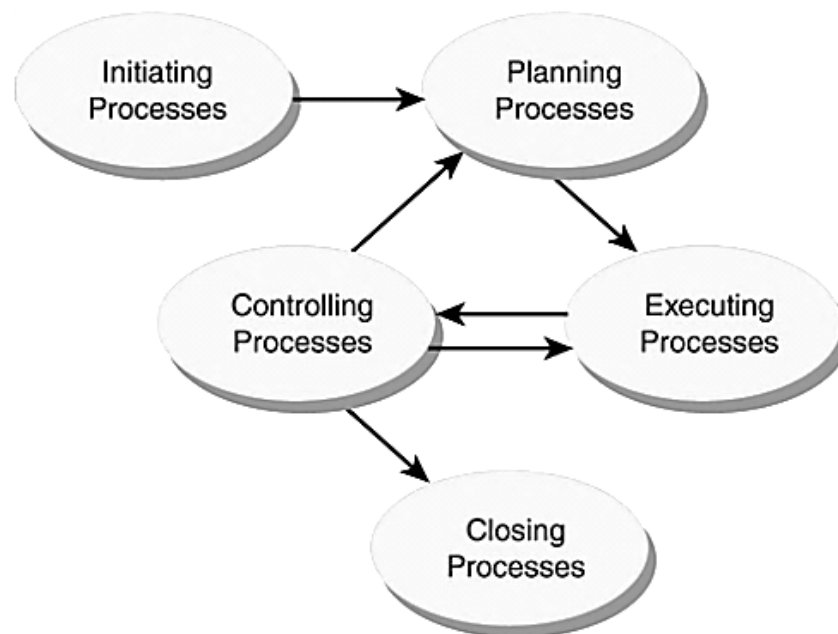


Figure 4: Five project management process group (from PMBOK)

2.2 PMBOK - Time Management

There are some studies investigated the reasons why projects fail. Time is one of the lists of factors believed to contribute to the project management successful (Gallagher 1995). Time is consider as limited resource because once time has been spent, there is no recovery. Moreover, time is also one of the criteria for measuring successful in project management, referred to The Iron Triangle, (Oisen 1971). Moreover, (Egan 1998) recommended that significant time reduction utilized in projects can reduce project cost up to 40%. PMBOK introduced project time management processes to manage the project on time. There are five processes in this knowledge area including define activity, sequence activity, estimate activity duration, develop schedule, and control schedule.

2.2.1 Activity Definition

Activity definition is the process to define and document specific actions needed to produce the project deliverables. The purpose of this process is to break down work packages into activities which provide a basic for the rest of the time management process. The inputs of this process are scope baseline which consists of the approved project scope statement, work breakdown structure (WBS), assumptions and constraints. Moreover, historical information such as plan from previous similar project, lesson learned and etc. should be considered in defining project activities. Tools and techniques used at this stage are decomposition and templates. Decomposition involves subdividing work packages into schedule activities. Templates from similar previous projects can be used to fast track the identification of all activities' in this process. Outputs of this process are, activity list which consist of all activities needed to be performed in the project. In order to develop a realistic and feasible schedule, sufficient information in this process is essential. Another output is milestone list which is a key activity point that corresponding with completion of a project deliverable. Table 2 shows the inputs required, tools and techniques used, and outputs expected in this process.

Table 2: Inputs, tools & techniques, and outputs of activity definition process

Inputs	Tools & Techniques	Outputs
<ul style="list-style-type: none"> - Work breakdown structure - Scope statement - Historical information - Constrains - Assumptions 	<ul style="list-style-type: none"> - Decomposition - Templates 	<ul style="list-style-type: none"> - Activity list - Milestone list - Work breakdown structure updates

2.2.2 Activity Sequencing

Sequence activity is the process to define relationships between project activities to improve the efficiency of the project schedule. To define the logical sequence of work, predecessor and successor must be allocated to each activity. Inputs for this process are activity list, product description, and dependencies. Activity list is the main input to this process which consists of all known activities to be included within the plan. Project scope statement allows project to sequence activities into the most appropriate order. Three types of dependencies consist of mandatory, discretionary, and external. The natural sequence of how work is done defined as mandatory dependencies. Discretionary dependencies are the preferred sequence of activities by project management team. External dependencies contain connections among project and non-project activities. Tools and techniques used in this process are precedence diagramming method (PDM), dependency determination, leads and lags, and network templates.

Precedence Diagramming Method (PDM) is a method of constructing a project network diagram by place the activity on the node and use arrow between the nodes to show the sequence between each activity (Battaglin 1964). Figure 5 shown example of network diagram by using precedence diagramming method.

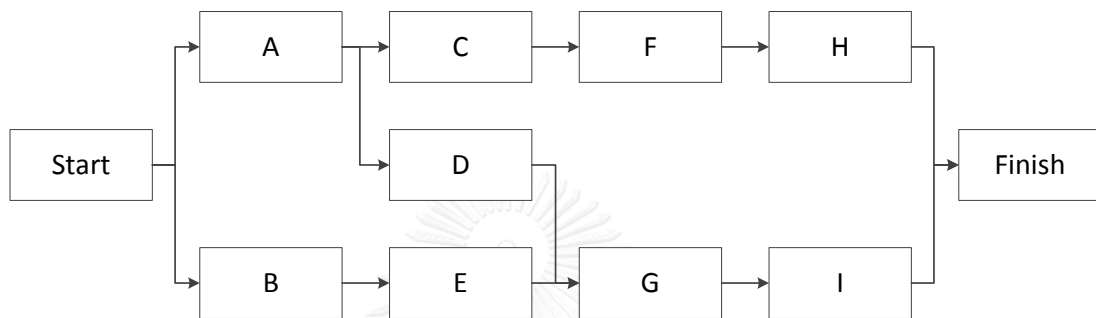


Figure 5: Network diagram by apply precedence diagramming method

There are four types of dependencies to create a precedence diagram including “finish to start” (FS), “start to start” (SS), “finish to finish” (FF), and “start to finish” (SF). “Finish to Start” dependency means successor activity cannot be started before predecessor activity has completed. This is the most common type of dependency used in the project. “Start to Start” means the predecessor activity must start before the successor activity start. “Finish to Finish” means the predecessor activity must complete before the successor activity complete. “Start to Finish” means the successor activity must start before the predecessor activity finish. This type of dependency is rarely used. Each type of relationship is demonstrated in Figure 6.

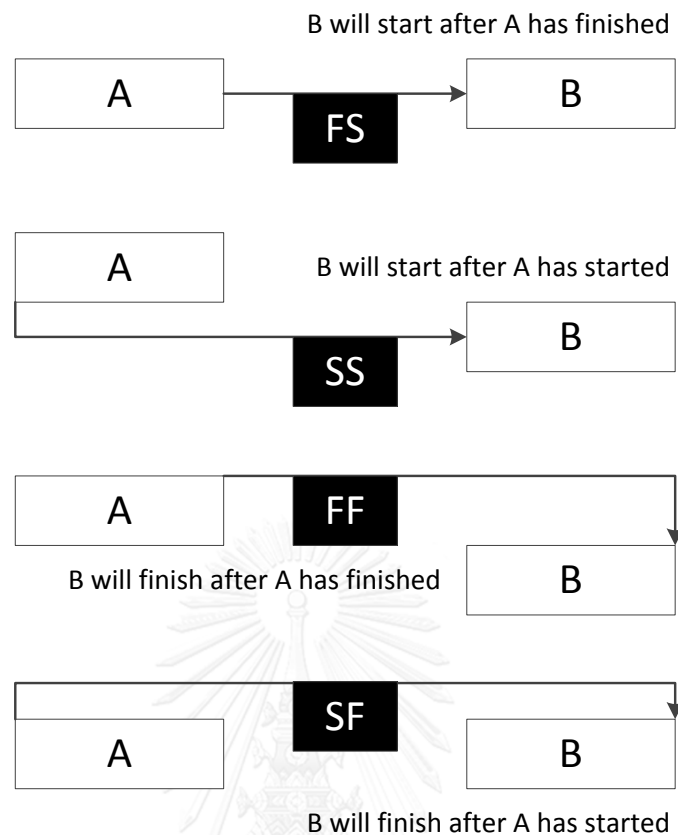


Figure 6: Four types of relationship

PDM technique provides managers with a powerful tool for scheduling and controlling their projects. However, type dependencies must be determined since some activity relationships within sequence activities are logically mandatory, some may be logically discretionary, and some are depend on external factors. Leads and lags are used in addition to the above sequence activities task relationships. Leads are the acceleration of a successor activity which only used in “finish to start” (FS) relationship. This allows the successor activity to begin in parallel with the first activity even though finish-to-start relationship is assigned. Lag represent period of

time that must pass before the successor activity can start which can be used in all types of relationship. Network templates are useful tools to accelerate the preparation of project network diagram.

Outputs of this process are project network diagram and updated activity list.

A project network diagram is a diagram presentation of project activities and their logical relationships. However, preparation of project network diagram may require activity to be redefined in order to produce the realistic logical relationships. Table 3 represents the inputs required, tools and techniques used, and outputs expected from this process.

Table 3: Inputs, tools & techniques, and outputs of activity sequencing process

Inputs	Tools & Techniques	Outputs
<ul style="list-style-type: none"> - Activity list - Project scope statement - Mandatory dependencies - Discretionary dependencies - External dependencies 	<ul style="list-style-type: none"> - Precedence Diagramming Method - Dependency determination - Leads and lags - Network templates 	<ul style="list-style-type: none"> - Project network diagram - Activity list updates

2.2.3 Activity Duration Estimating

Estimate activity duration is the estimation process that identifies number of work period required to complete individual activities. The duration of each activity is depending on the amount of work in the activity, amount of resources allocated to the task, those resource availability and etc. Inputs to this process are activity list,

resource requirements, resource capabilities, and historical information. Activity list is the main input to ensure that the duration is estimated to every identified activity in the project. Resource requirements can be non-human for instance facilities, materials, tools and equipment or human. More resource assigned may benefit in less duration needed to perform the activity. However, activity duration can be influenced by resource capability (Bowers 1995). For instance, employee with high experience can complete an activity sooner than the one with less experience. Historical information from previous similar estimate activity durations are used as guideline for this process.

Tools and techniques are expert judgment, analogous estimating, and simulation. Using resource that has performed similar activities is a great way to attain realistic and practicable estimates because experience, knowledge, and skills can improve the accuracy of the estimation. Analogous or top-down estimating technique used historical information from a previous project to estimate the duration of a future task. Reserve analysis or contingency is an approach to identify any risks that may occur when perform a particular activity. Activity duration estimates and activity list updates are produced at the end of this process. Activity duration estimates are measurable assessments of the time required to complete an activity. Activity list may need to be update due to assumptions made during

development of activity duration estimate. Activity duration estimating process's inputs, tools and techniques, and outputs is shown in Table 4.

Table 4: Inputs, tools & techniques, and outputs of duration estimating process

Inputs	Tools & Techniques	Outputs
<ul style="list-style-type: none"> - Activity list - Resource requirements - Resource capabilities - Historical information 	<ul style="list-style-type: none"> - Expert Judgement - Analogous estimating - Reserve analysis 	<ul style="list-style-type: none"> - Activity duration estimates - Activity list updates

2.2.4 Schedule Development

Schedule development is the process to finalize the project schedule by reviewing activity list, sequences, durations, and constrains. Planned start and finish dates for each activity are determined in this process. There are five inputs in this process including activity list, project network diagram, activity duration estimates, resource requirements, project scope statement, and calendar. These inputs are created in previous process. In this process, critical path method, duration compression, resource levelling heuristics and project management software are used as tools and techniques.

Critical path method is one of the mathematical analysis techniques that involve calculating early and late start and finish dates for all activities in the project. Forward and backward pass technique is applied to identify time availability for

delaying the activity without effect to the project completion date. Critical path contains with activities that have zero day in float which means that the delay from any activity in this path will delay the project completion date. Critical path method has become one of the most useful tools applied in the planning and control of the realization of complex projects (Kelley 1961). The critical path method provides useful information such as the critical path, free float, and total float that can be used for project scheduling to develop an efficient plan and helping managers to ensure the completion date of project. Activity-on-node diagram showing critical path schedule, along with earliest start/finish, latest start/finish, and total float of activities as demonstrated in Figure 7.

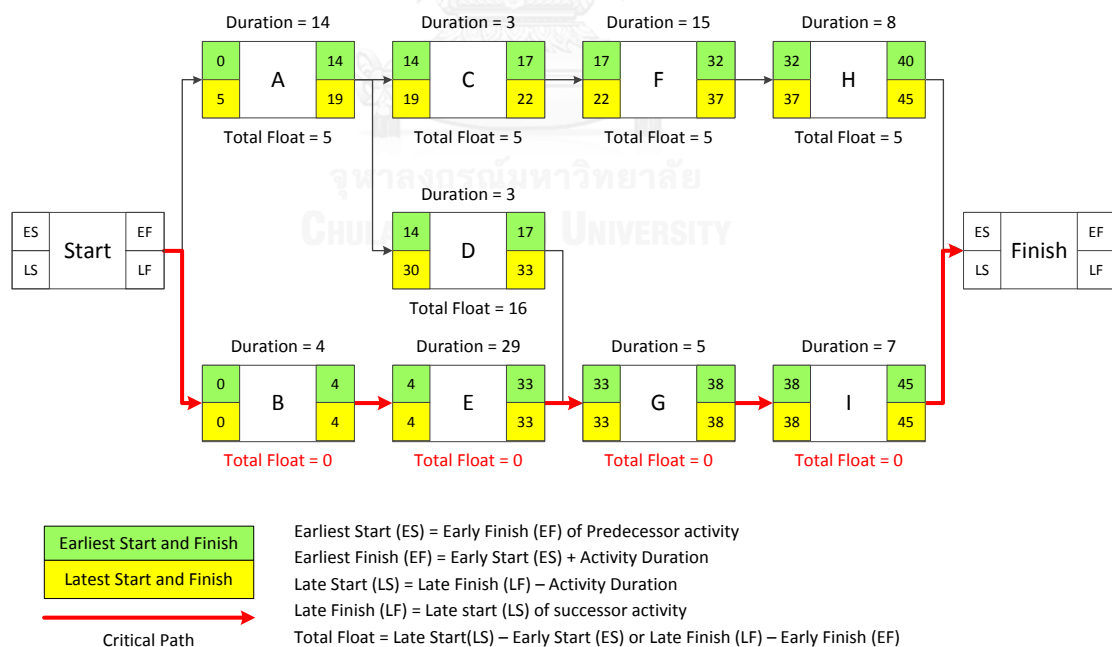


Figure 7: Critical path calculation

Duration compression consists of two techniques include crashing and fast tracking which used to shorten the project schedule without the scope changing. Crashing technique can be used by assign more resources to perform key activities so that the work can be finish sooner. This technique is best apply to activities in the critical path since reducing the duration of non-critical activities will not effect on the project completion date. Fast tracking is done by changing the sequence and relationships of the activities. This technique can be used by consider which activities can be done in parallel rather than in series. “Start to Start” (SS) relationship as well as lead and lag technique can be applied to fast tracking the activities.

Resource levelling can be used to ensure that required resource and work during certain time period are optimized. Furthermore, resources should be allocated to critical path activities first (Leu, Yang et al. 2000). As said in (Neumann and Zimmermann 2000) study, Resource levelling, resource constrained project scheduling where some degree of the variation of resource utilization is to be minimized becomes more and more important. The reasons that project need to do resource levelling are first to meet the limit of resources and second, to avoid the daily fluctuation in resource demands. The third is to maintain flow of application for resources. Long term overloading may cause project failure. (Li 2009) stated that optimization of resources is important issue of project planning because in some period resources are not available as required which cause the project plan to be

modified. Therefore, resource planning or levelling results in “resources limited and time least” which help the planning to be more realistic.

Project management software is widely used to help plan, organize, and manage project schedule (Harold 2013). Project schedule that created by these program can be present in form of project network diagram, Gantt chart or also known as bar chart, milestone chart, and etc. These project schedule formats can be applied to track planned dates against actual dates and to forecast the effects of schedule changes. According to survey conducted by (Liberatore, Pollack-Johnson et al. 2001), et al. shows that project management software was used by professional project managers for 83%, 58% for planning and 44% for controlling the project. It was derived in this survey that the most popular software packages used in construction projects are Primavera and Microsoft Project. From the research of small project, approximately four month duration, comparison of regularly used program Microsoft project and Primavera, the result shown that both are equally good. However, the result would be different when apply these software to larger and more complex projects.

At the end of this process, project schedule is finalized and approved by the user, sponsor, customer, or operational managers. The approved schedule is called project baseline which can be display in form of project network diagram, Gantt chart, milestone chart, and time scale network diagram. Project network diagram is

discussed in sequence activities process. Gantt chart displays each activity in bar format whose length represents the duration. Each activity is also listed against a suitable time line on the horizontal axis. Since Gantt chart format provided timeline that is easy to understand so it is often used for communication and reporting aspects within the project. Schedule management plan defines how the project will manage changes to the schedule. Resource requirement could be updated according to approved schedule. The inputs, tools and techniques, and outputs of schedule development process is displays in Table 5

Table 5: Inputs, tools & techniques, and outputs of plan development process

Inputs	Tools & Techniques	Outputs
<ul style="list-style-type: none"> - Activity list - Project network diagram - Activity duration estimates - Resource requirements - Project scope statement 	<ul style="list-style-type: none"> - Critical Path Method - Duration compression - Resource leveling heuristics - Software support 	<ul style="list-style-type: none"> - Project baseline - Project network diagram - Gantt chart - Schedule management plan - Resource requirement

2.2.5 Schedule Control

Schedule control involve in monitoring status of activities in the project to determine the current situation of the project schedule, identify the variance from the project baseline, and manage changes to the project baseline. Inputs of this process are project schedule, performance reports, change request, and schedule management plan. Project schedule is the major input to the control schedule

process since it contains the most updated schedule which is being used to compare planned progress with actual progress. Project management plan is the document that defines how the control schedule will be managed. Project schedule and schedule management plan are discussed in section 2.2.4. Performance reports provide information on how the work is being performed and progress on activities that are currently on going. The report can be in form of Gantt chart, S-curve, milestone chart, and etc.

Tools and techniques used in this process are performance reviews, performance measurement, schedule compression, and project management software. Performance reviews are meeting arranged to assess how the project is progressing against the schedule. Performance measurement such as variance analysis, trend analysis, and earned value analysis help project to assess the magnitude of any variation that occurred. These analyses are used to determine whether corrective or preventative actions are required. Project management software can be used to track planned versus actual dates as discussed in section 2.2.4.

Outputs from this process are work performance measurements and project management plan updates. Work performance measurement is normally showing both schedule variance and schedule performance by using earned value data or S-curve. Schedule updates are any modification to the schedule that reflects the

situation. Corrective action is the plan to bring the schedule back to align with project plan. Any lesson learned from the project is created and used as historical information for future reference. Table 6 illustrates the inputs, tools and techniques, and outputs expected from schedule control process.

Table 6: Inputs, tools & techniques, and outputs of schedule control process

Inputs	Tools & Techniques	Outputs
<ul style="list-style-type: none"> - Project schedule - Performance reports - Change requests - Management plan 	<ul style="list-style-type: none"> - Project review - Performance measurement - Software support 	<ul style="list-style-type: none"> - Work performance measurements - Project management plan updates - Corrective action



3 Chapter 3: Research Method

This thesis is aimed at improving project time management by applying tools and techniques from project management body of knowledge (PMBOK) guideline. The method is divided into six processes including data collection, define and analyze problem, develop improvement plan, implementation, result analysis and discussion, conclusion and recommendation. The process begins with gathering information by reviewing historical project data, review current project management process, and interview staff who involve in the project. Next process is to define and analyze problem by benchmark current project management process with PMBOK guideline. Third process is reviewing relevant literatures to develop improvement plan and implement suitable tools and techniques needed during planning, executing and controlling process. After implement the solution, next process is performance measurement and result analysis. The result is then concluded and followed by discussion.

3.1 Data collection

Data collection is a dynamic part of this research. It is a process of gathering information that allows the research to evaluate outcomes. An official data collection process is necessary to make sure that data collected are defined accurately. An accurate data collection is crucial to maintain the integrity of research.

For this research the data collection is done by review company's historical data and interviewing project manager and team members. The data is then plotted in the graph and used for analysis and making the valuable information to answer the questions. Figure 8 shows company's historical project data.

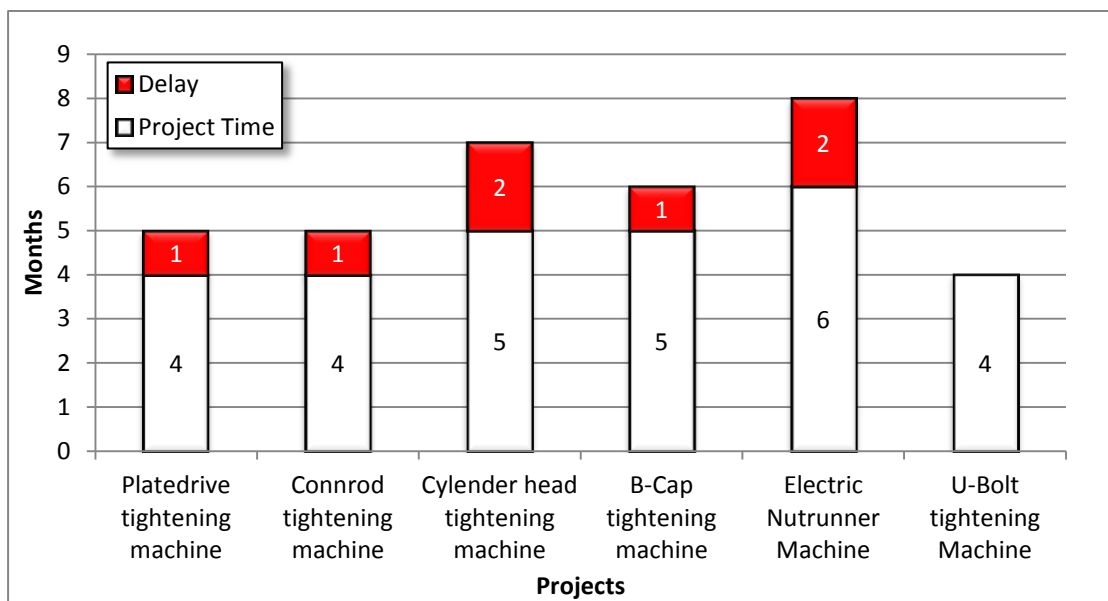


Figure 8: Delayed projects in last four years

3.2 Define and analyze problem

According to section 3.1, it can be seen that the company have problem with project time management since they failed to deliver five out of six projects on time.

A project management process is the process of planning, monitoring and controlling the performance of a project. To define the problem, current process is reviewed then compared with process identified in PMBOK guideline. After problem is defined, fishbone analysis method is used to perform root cause analysis.

3.2.1 Current project management processes

Currently, project in the organization is divided into six project phases including start-up phase, design phase, procurement phase, installation phase, test and trial run phase, and closure phase. These project phases are grouped in to three process groups including planning, executing and controlling, and closing process.

Figure 9 shows the major scheme phases and processes

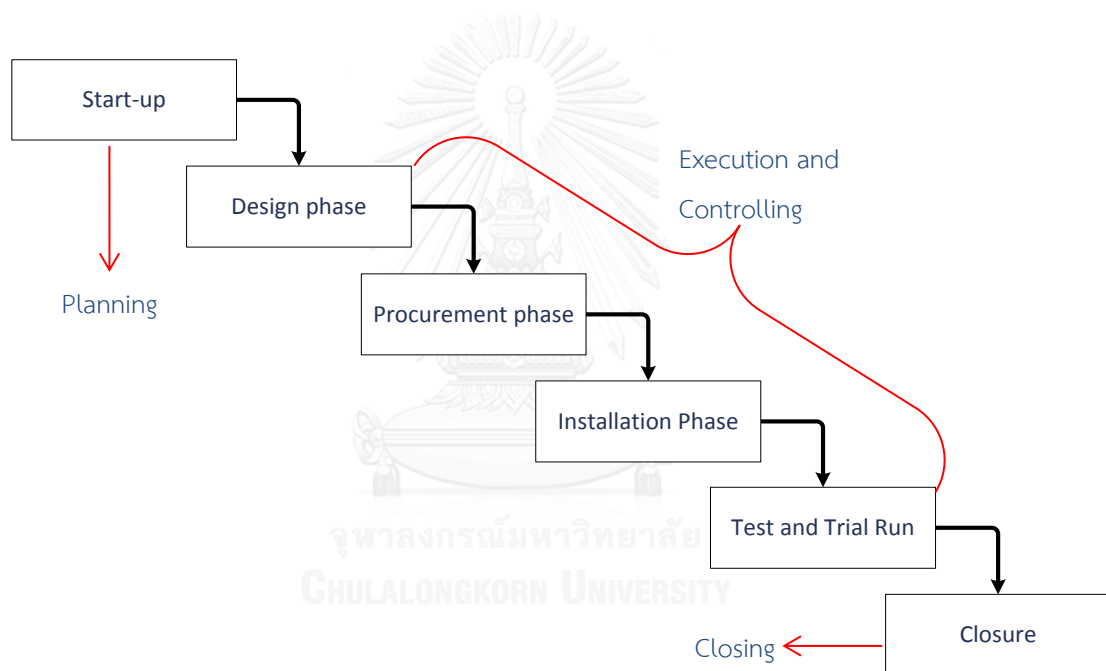


Figure 9: Current project phases and processes

Planning:

During planning process, meetings were organized to discuss with project team about list of activities needed in the project, sequence of work, and duration required for each activity. Historical information is considered in defining project

activities which was done by select previous similar project and identifies what activities were actually required and how long does it take to complete. Drafted plan was created and meetings were set to review, comment, and update before finalize the plan. At the end of this process, final project plan is harmonized to the project team. Microsoft excel program is used to form a project schedule as shown in Appendix 1 and Figure 10 shows current process flow during planning period.

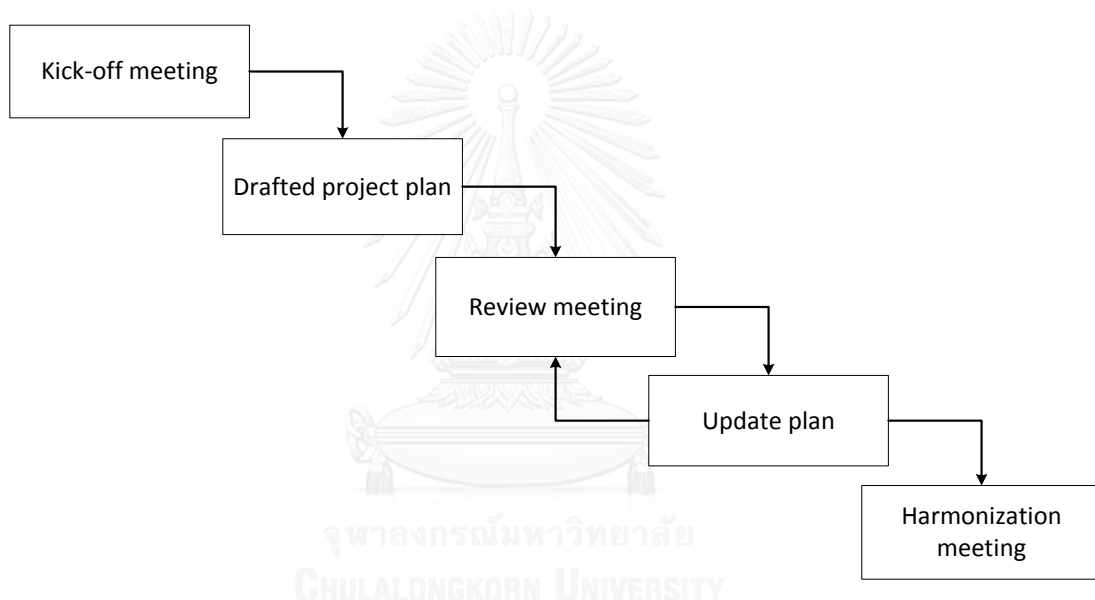


Figure 10: Process flow during planning period

Executing and controlling:

In executing and controlling process resources used project plan to realize starting and finishing date of their activities. Each team is required to report their progress in the weekly meeting to ensure that project objectives are met. If there are problems which cause delays in project plan, mitigation plan is created additionally

to monitor the problem closely. Microsoft excel program is used to create and monitor this plan. Information that required in the mitigation plan is consisting of problem, solution, target starting, target finishing, and responsible person. Appendix 2 shows example of mitigation plan and Figure 11 shows current process flow during executing and controlling period.

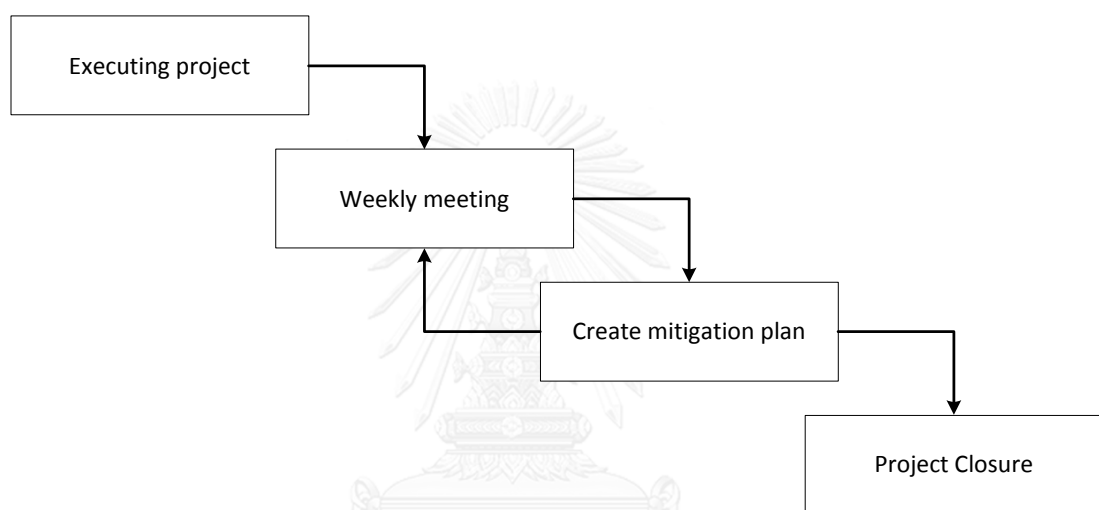


Figure 11: Process flow during executing and controlling period

Closing:

Project closure process is performed after achieving all defined project objectives and the project's product is formally accepted by customer. The organization begins project closure process with wrapping up administrative documentation by completing of remaining tasks in the project schedule. Prepare final project status report and ready for internal closure audit. After audit, all open items need to be completed before summarize closure documents to the customer.

Last step is to archive project files in hard copy and soft copy for future reference.

Figure 12 shows current process flow during closing period.

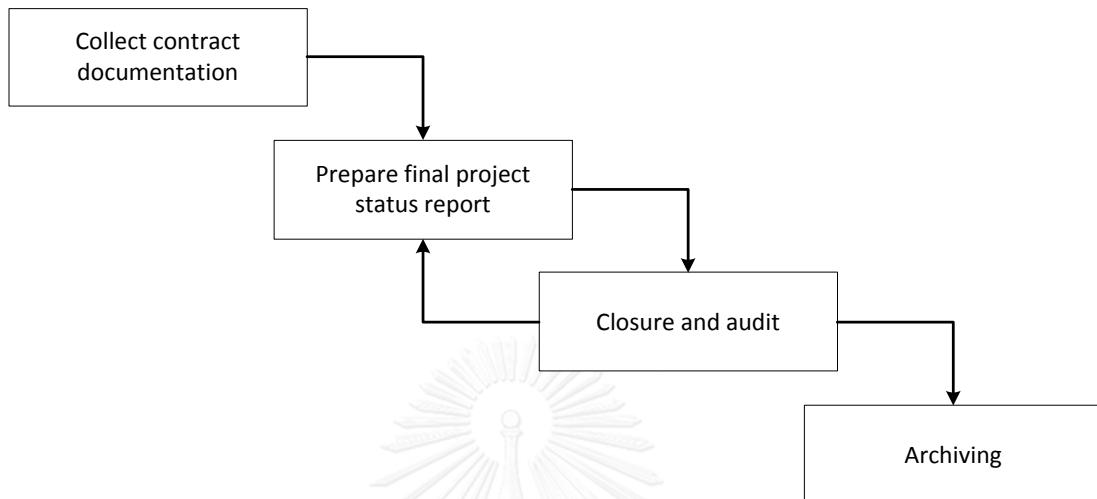


Figure 12: Process flow during closing period

3.2.2 Compare current project management process with PMBOK

This section is to compare current process with process in PMBOK guideline. According to PMBOK guideline, project time management is another key aspect of managing a project. The main purpose of this knowledge area is to ensure timely completion of the project. Time management is divided into five major processes including define activities, sequence activities, estimate activities duration, develop schedule, and control schedule to provide better management control. To analyze problem with current time management, PMBOK guideline is used to check against current process as shown in Table 7.

Table 7: Compare current time management process with PMBOK

Phase	Process	Tools and Techniques	
		PMBOK	Currently Use
Planning	Activity Definition	1. Decomposition 2. Template 3. Communication	1. Yes 2. Yes 3. Yes
	Activity Sequencing	1. Precedence Diagramming Method 2. Network Template 3. Communication	1. No 2. No 3. No
	Activity Duration Estimating	1. Expert Judgment 2. Top down Estimating 3. Communication	1. No 2. Yes 3. Yes
	Schedule Development	1. Critical Path Method 2. Project Management Software 3. Communication	1. No 2. No 3. Yes
Execution and Controlling	Schedule Control	1. Performance Measurement 2. Additional Planning 3. Project Management Software 4. Communication	1. No 2. Yes 3. No 4. Yes

During activity definition the company has process to define activities required in the project. In this process, meeting was set to communicate among team members to clarify sufficiency of these activities. In activity sequencing process, company did not apply appropriate tools and techniques to perform project networking such as precedence diagramming method or arrow diagramming method. During activity duration estimating process, the company has process to estimate

duration of each activity in the project. However, the outcome of this process is not very accurate due to duration of some activities were under estimated and some were over estimated. The means the company lack of staffs that can provide accurate information regarding activity duration. At the end of planning process, critical path was not performed and appropriate project management software was not used to form a project plan. During schedule control process, the company did not have process to measure project performance since there is no baseline to measure against. Additional plan was created but this plan was not distributed among team members so each team carry different version of project plan. Project management software was not used to help manage and control deviations that occurred to project.

Currently the organization used Microsoft excel program to develop project plan and control the project. This program is not appropriate because it cannot perform key functions such as calculate for float, identify critical path, project network diagram, and form a project schedule in Gantt chart format. These functions are crucial and very useful for managing and controlling project. As a result, the organization failed to create a realistic plan and unable to control schedule.

Unrealistic plan due to:

- No project network diagram to display the activities in the logical relationships.
- No resource to provide realistic estimation of activity duration.
- No critical path to show the longest path and critical activities of the project.
- No project management software to assist the schedule development

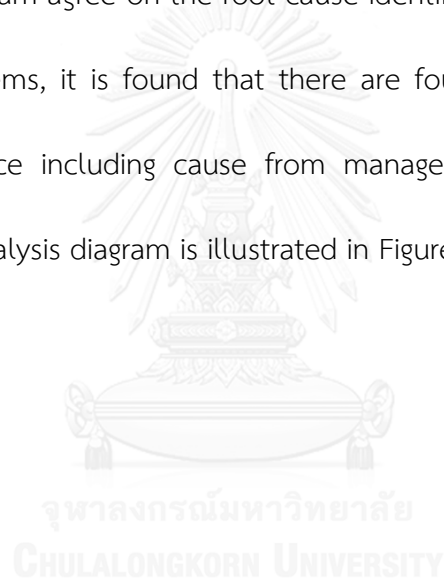
Unable to control schedule due to:

- No Gantt chart to show start and finish date of each activity
- No milestone chart to display major deliverables of the project.
- No performance measurement to assess the variations between plan and actual.
- No project management software to support the schedule control

3.2.3 Fishbone analysis

Fishbone analysis is a method that used to identify root cause of problem. To identify source of variation, causes are grouped into major categories. Five why technique was used to help identify the underlying source of problem. There are five

steps to perform root cause analysis. First step is to assemble a team of people who have experience about the area of problem. Second step, people in the team are brainstorming to list all possible problems. Third step, members in a team have to ask why the problems identified in second step could occur then note down the answer underneath the problem description. Forth step is to repeat the third step until the root causes of problems are likely to be identified. Last step is to make sure that members in a team agree on the root cause identified in step four. After identify root cause of problems, it is found that there are four main causes that affected company performance including cause from management, method, people, and process. Fishbone analysis diagram is illustrated in Figure 13.



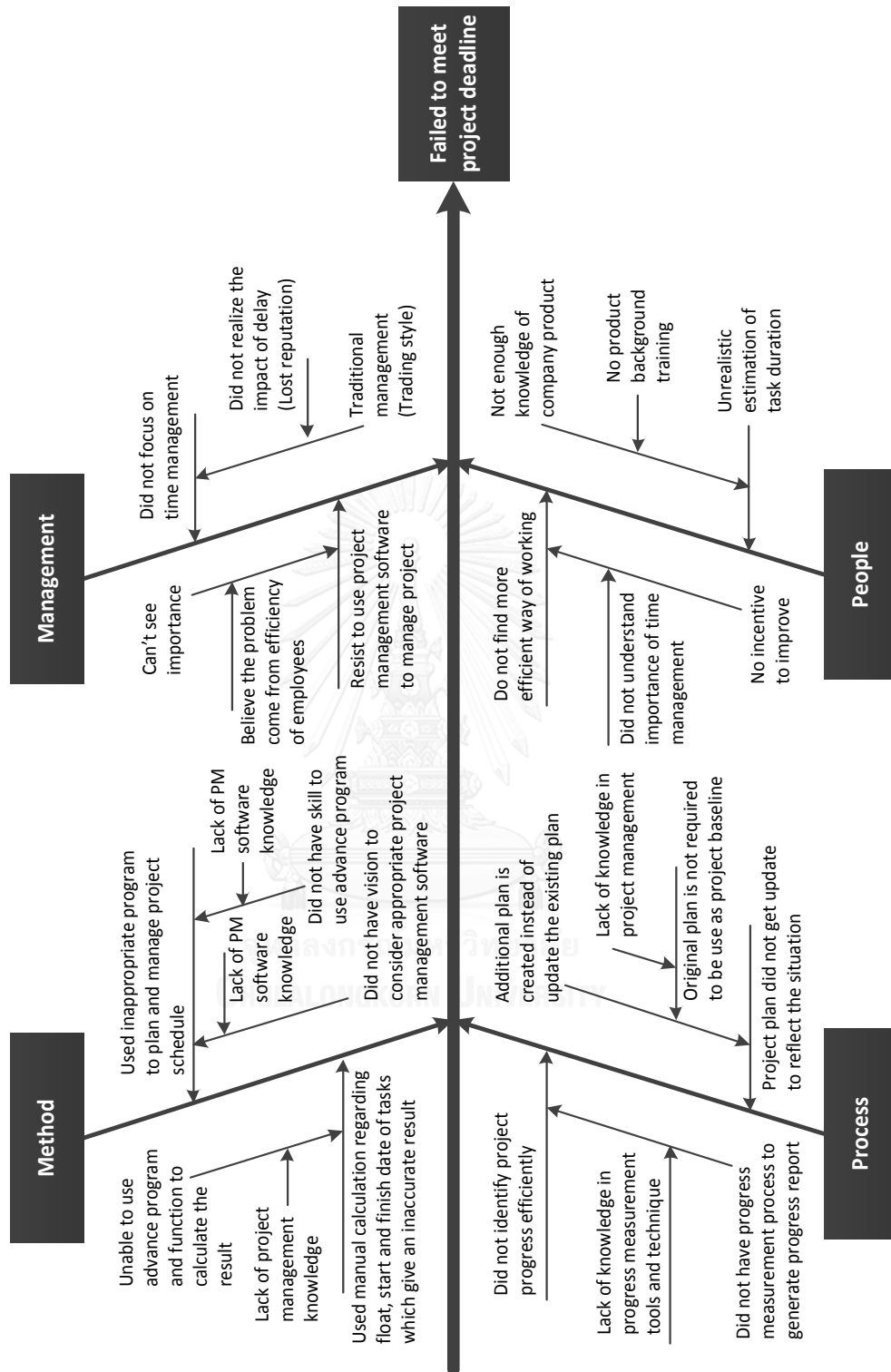


Figure 13: Fishbone analysis diagram

Management:

Problem in management area is that the company manage project in trading style which is focus more on selling products than managing project. The company did not realize the effect from failing to meet project deadline. Top management level resists to use proper project management software such as Microsoft project to plan and manage schedule because they believe that the problem came from efficiency of employee not the software. Therefore, the company cannot see the benefit from apply project management tools, techniques, and software to improve the project performance.

Method:

Problem with method is the program, Microsoft excels, that the organization currently uses to plan and manage schedule. This program cannot perform many functions such as assign relationship in each task to perform project network diagram, and automatically calculate for critical path. Presently, the organization adjust project plan manually which is time consumed. Moreover, current method created errors and inaccurate information to the project. This inaccurate information leads the project to the wrong direction and result in failure.

People:

Problem with people is the capability of estimating task duration that required in the project. Because employees do not fully understand the sophistication of products, which result in underestimate of work duration and lead in failure to achieve project completion date. In performing project, employees do not understand the importance of project time management and believed that it is not their job to manage project time so they have no incentive to find more efficient way of working. The root cause of this problem is the organizational culture which needs to be improved.

Process:

There are two problems in process area consist of process of update project plan, and process of measurement of project performance. The organization handle all changes to project plan by creation an additional plan to monitor which means that the project does not use an original plan as project baseline. Project baseline can be used to measure against progress to reveal the project status. There are no tools and techniques application in the current process to measure project performance which is the key point to control the project.

In conclusion, the problem that the company has is to create a realistic schedule and control schedule. The reason is because employees are lack of

knowledge in project management, and did not have enough understanding about project products. The company also did not apply appropriate tools and techniques to manage the project. As a result most project in the company were failed to meet with project deadline.

3.3 Improvement plan

This section demonstrates the improvement plan for this research. There are four processes in developing the plan consist of summarize problems, identify area of improvement, review relevant literatures, and create improvement plan and process.

Summarize problems:

First process is to summarize problems that occurred in current process. This process is done by using information identified in section 3.2. In section 3.2, it is found that root cause of problems are from four factors including lack of project management knowledge, inappropriate method, inefficient process, and staffs have insufficient skill. These factors created problems in unrealistic plan and unable to control project schedule which lead to failure to meet with project deadline. The cause and effect relationship of this information is shown in Figure 14.

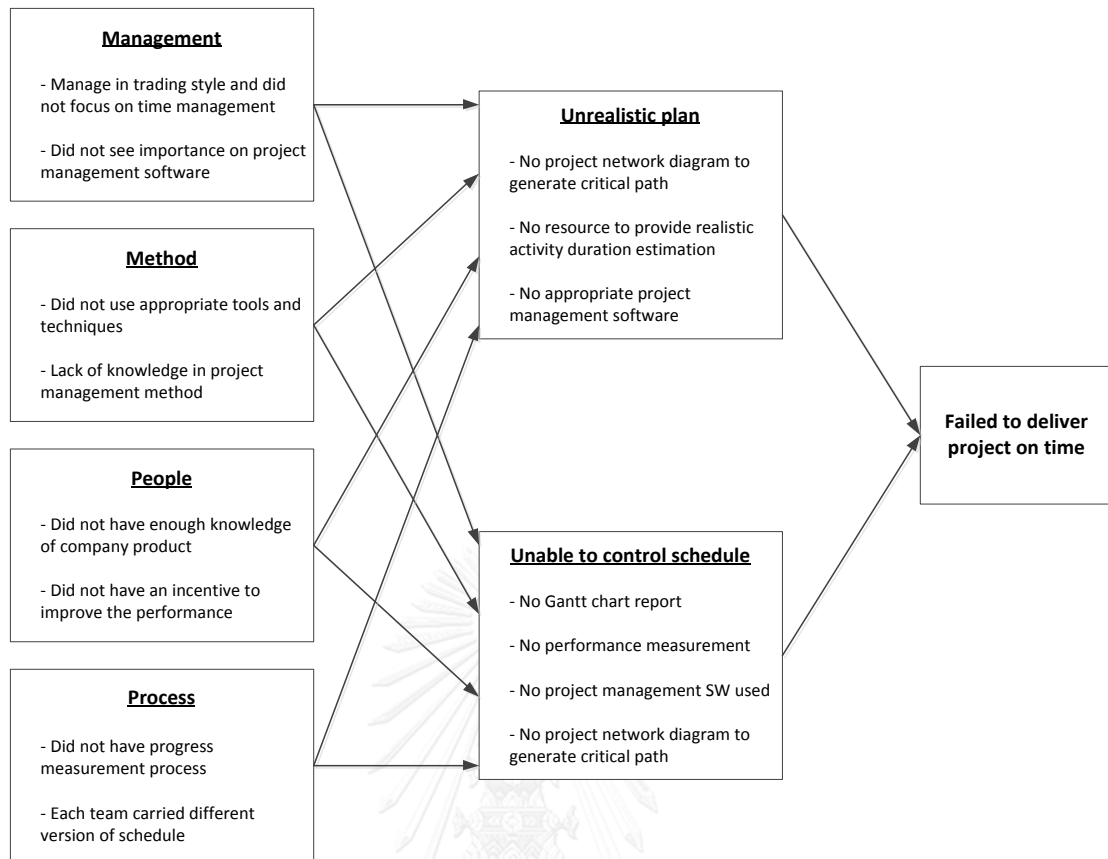


Figure 14: Summary of problems in current process.

Identify area of improvement:

According to the PMBOK guideline, project time management deals with the ability to plan and capability to complete the project on time. After analyzed the problems in section 3.2, it is found that the problem that company objects is project time management. The key factors including management, method, process and people could be improved by apply appropriate project time management method to create project plan and control. Employee should be train in area of company products and time management so that they can work more efficiently. Project

management software should be introduced to handle project more accurately. The organization culture needs to be improved for mind setting of employees' attitude, behavior, belief and value. Moreover, the PMBOK time management approach, training, and project management software should be implemented to improve project time management in the organization.

Review relevant literatures:

According to PMBOK, project time management is based mainly on planning, and then it's all control and execution. There are five processes including activity definition, activity sequencing, activity duration estimating, schedule development, and schedule control. These processes are located under planning, executing, and controlling as shown in section 3.2.2. Since the study is focus on project time management so the area of implementation is mainly in these three process groups. The area of implementation for this research is shown in Figure 15.

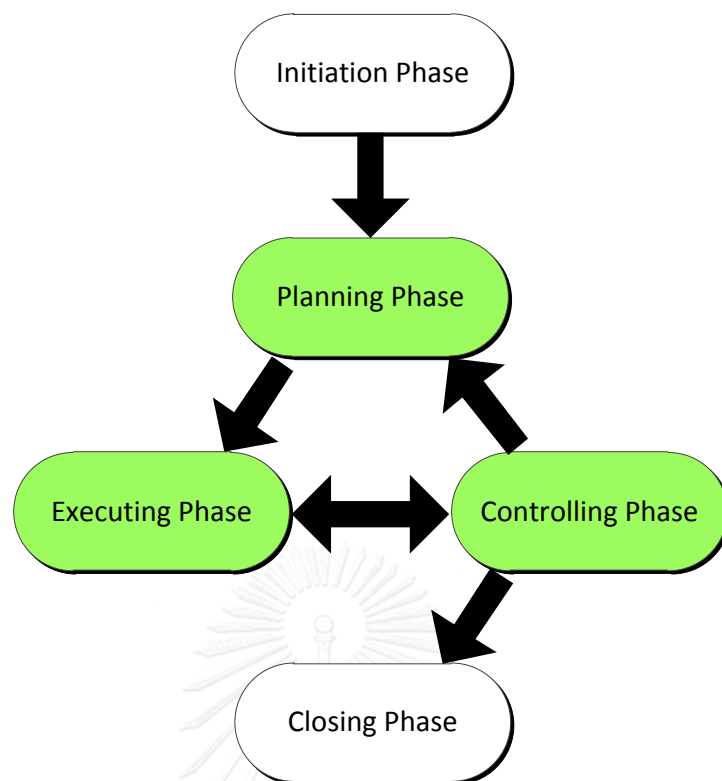


Figure 15: Project processes (adapted from PMBOK)

Today, there are many project management software solutions available in the market. The company may select the software solution based on budget, sophistication of the project, difficulty of using the program, and etc. Microsoft project is the most popular project management software measured by a combination of the total number of customers, users, and social presence (Capterra 2014). This program is used by most company because it is easy to install, easy to use, and easy to integrate with other Microsoft products such as Microsoft Word and Microsoft Excel. Moreover, this program is a desktop application which means user can work on the project schedule even if there is no internet connection. Support and reliability is another concerned by the customers. Microsoft project offers

reliable support because this product is developed by Microsoft Company which is the largest and most reputable software company in the world.

Improvement plan:

The improvement plan for this research is to introduce the PMBOK time management concept to the organization. Top management level need to change managing style from trading to focus more on project time management by follow PMBOK guideline. Current method need to be improved by applying PMBOK tools and techniques to plan, execute, and control project. Microsoft project will be used to support with schedule development and control. Four step of Project Culture Initiative (PCITM) (Stanleigh 2006) will be used to improve the company's culture. Training will be provided to employees in order to gain knowledge and understand more about company's products and project time management. Process need to be clearly identify and agreed by project team so all members can follow the same process effectively. Project performance will be measured by comparing the Project baseline with the actual performance. There will be one project baseline at a time so everyone in the project can follow the same schedule. Project time management tools and techniques will be used during planning, executing, and controlling phase which allows the project to create realistic plan and control schedule effectively. With the ability to create realistic plan and control schedule, the company will be able to deliver project on time. Figure 16 shows improvement plan for this research.

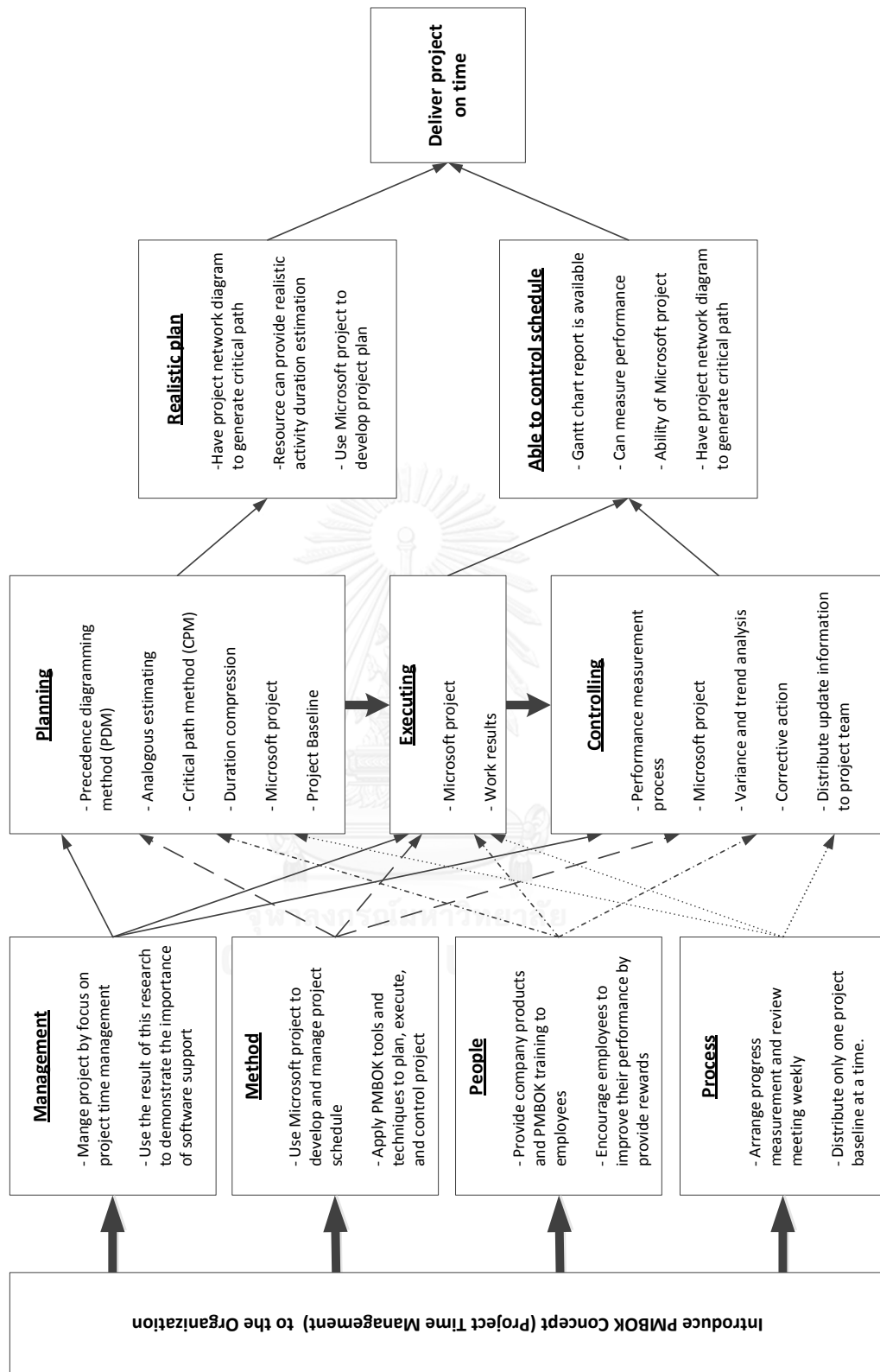


Figure 16: Improvement plan for this research

Improvement process:

Improvement process is set to ensure the success of the project. These processes are linked with project phases as shown in Figure 17. The process start by identify change that will occur to the project. Next, project charter is created to gives the project manager the information and authorization to direct the project. Once project charter is created, training are arranged to prepare staffs that will be involved in the project. Besides training, management of change (MOC) document is prepared to ensure that project have a systematic approach to helping the individuals impacted by the change to be successful. Moreover, MOC document encouraged project to address resistance and develop the required knowledge and ability to implement the change. After MOC document is created, project manager and project engineering will evaluate and review the document before submit for approval. Once MOC is approved and employees are trained, kick off meeting is arranged to provide team members with project information and requirement. At the end of initiating phase, project team members should have ideas on what they have to deliver to the project and how can they achieve the project objective.

In planning phase, project management team used Microsoft project program to structure project schedule. First activity in this phase is to create work breakdown structure (WBS) and input list of activities defined by project team. Next, activities are put in sequence and relationship between activities is assigned to form a network

diagram. Activity duration is estimated to clarify start and finish date of each activity. At this stage, project is able to identify critical path. Since this path is critical for the project so risk that could occur to this path is identified. At the end of planning phase, project critical path and risks are identified and reviewed by team members. Further development is needed if the schedule is rejected by some member. Once everyone agreed with the schedule, harmonization meeting is set to harmonize project baseline to the project team members. During project execution, project team members used project baseline to carry out works needed to be performing in each period. At the end of each week, team members report their weekly progress to project management team which will be used during controlling phase.

In controlling phase, project management team used weekly progress report to update schedule in Microsoft project. Project status reports such as S-Curve, critical path, and etc. are created to summarize situation of the project. Weekly meeting is set to review project performance and update project status to team members. If project status is in line with project baseline, team members can use the same baseline to perform their activities in the next period. However, recovery plan is created when project status is not in line with project baseline. Team members used this plan to carry out their work and feed back to project management team weekly. This process is continued until all activities required in the project have been performed. The project is entered to closing phase after the requirement is fulfilled.

Since the objective of this thesis is to improve project time management so the success will be measured on the accuracy of work performed during planning, executing, and controlling phase.



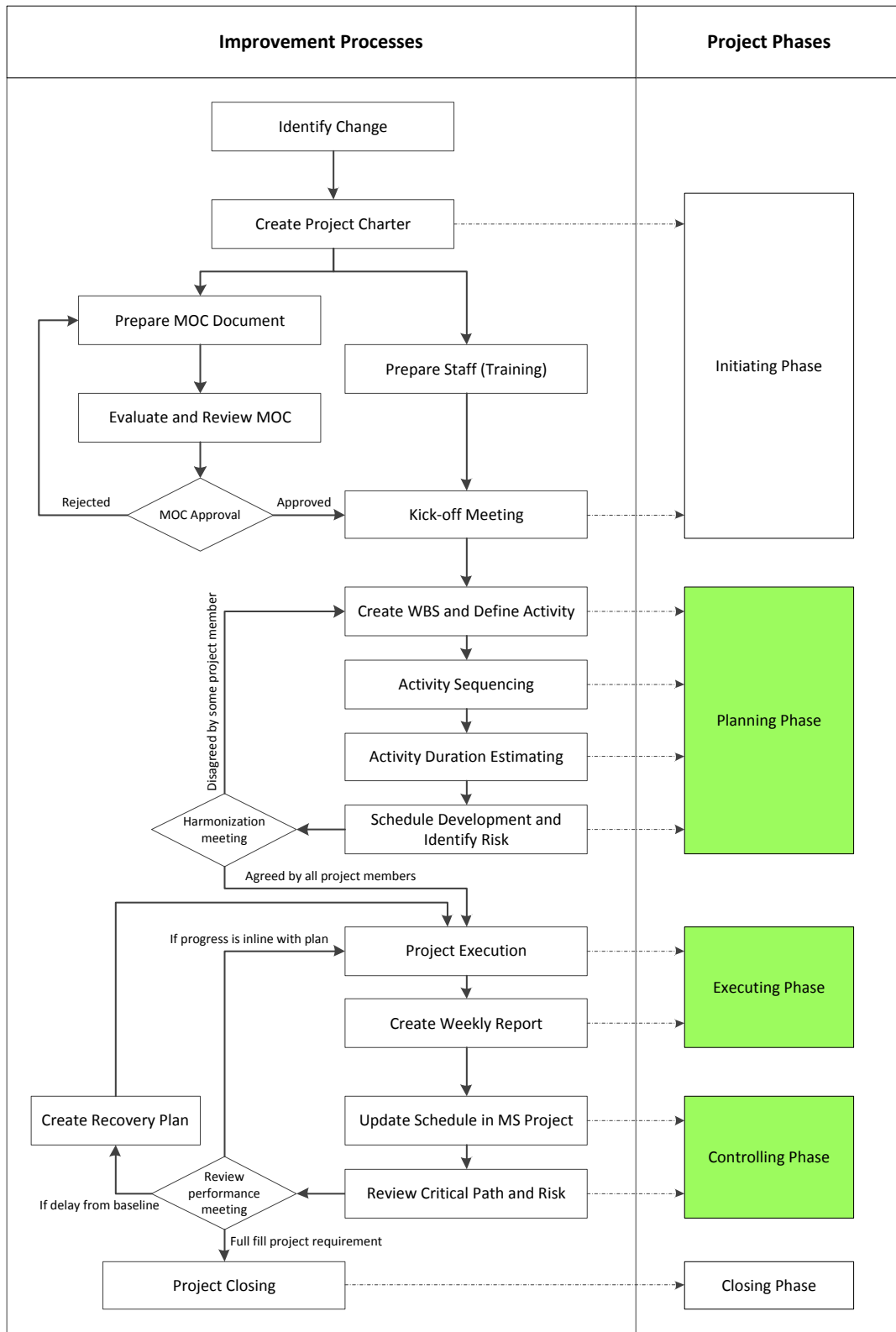


Figure 17: Improvement process for this research

4 Chapter 4: Implementation

After improvement plan is created, the company implemented the plan to the selected project. The selected project for this research is U-Bolt tightening machine 2014. The duration of this project is four months start from 27th October 2014 to 28th February 2015. This research also conducted for four months from beginning until end of the project by applying project time management following the PMBOK guideline. Microsoft project software is used to support the calculations of mathematical analysis which allow rapid consideration of many schedule alternatives. The objectives for this project is to create a realistic plan, improve schedule control, and deliver project on time.

4.1 Initiating phase:

Initiation phase is the first process in a project including project charter which is an official authorization document to provide a project manager with the information to direct the project. Project charter is a document that is developed for a formal statement of the scope, objectives, deliverables, and participants in a project including role and responsibility of members. It is also involve in high level planning that allow the project to assess whether project constrains are feasible. In this research, Project charter is used to guide the project members by communicate

the key information to ensure everyone understand where the project's heading from the beginning.

In this document, there are five project objectives. First objective is to improve employees' skill and knowledge in project management and company product. Second is to successfully implement project management concept and Microsoft project software to track and report on the impact of the schedule. Third is to ensure employees understand the importance of project time control. Fourth employees must understand and comply with policies, processes and procedures. Last objective is to deliver project on time. There are two assumptions made for this project. First assumption is all materials will be supply by local supplier only. This means project can assume short lead time for material delivery. Second is there will be support from supplier and customer. Project scope is also defined in this document to identify the limits and deliverables of the project. Scope of this project is to design production layout, supply material required for installation work, and install hardware and software products.

Furthermore, major milestones of the project are listed and used to measure success of the project. Project need to achieve these milestones in order to avoid penalty. There are three milestones in this project including design approval, document approval, and commissioning or project completion. For design approval, project need to submit conceptual design within fifteen days after project start. To

achieve second milestone, project need to submit installation plan, test procedure, and specification thirty days after project start. Last milestone is to complete the project by complete installation work, pass trial operation test, and handover the project. Success measurement is listed to identify target that project are trying to achieve as a result. For this project, the success is measured from the deviation between actual progress and project baseline. The ability to track, identify delays and create an effective recovery plan. Last success measurement is on project completion date. Moreover, high level project risks and strategies to mitigate them are identified.

Lastly, project team members' roles and responsibilities are described. In this project, project team members consist of sponsor who provides overall direction on the project, project manager who lead the planning and development of the project, and team member in each function who works toward the deliverables of the project. There are six functions in the project including project engineer who look after overall engineering performance, hardware engineer take care of hardware design, software engineer responsible for software development, purchasing is in-charge in procure material and ensure the delivery date, installation engineer involve in installation work including test and commissioning, and quality control engineer is there to make sure project is full fill customer requirement. Project charter of this project is shown in Figure 18 and 19.

PROJECT CHARTER

Project Title:	U-Bolt Tightening Machine 2014		
Project Start Date:	27-Oct-14	Completion Date:	28-Feb-15
Prepared Date:	17-Sep-14	Version:	0.1

Project Objectives:
Explain the specific objectives of the project.

- Improve employees' skill and knowledge in project management and company product
- Implement project management concept and software to track and report on the impact of the schedule
- Ensure employees are aware and understand the importance of project time control
- Ensure employees understand and comply with policies, processes and procedures
- Deliver project on time

Assumptions:
List and describe the assumptions made in the decision to charter this project.

- All materials will supply by local supplier
- Have communications support from supplier and customer

Project Scope:
Describe the scope of the project. Identifies the limits of the project and defines the deliverables.

- Design production line layout
- Supply materials required for installation
- Install conveyor
- Install rack and PLC cabinet
- Install U-Both Tightening Machine

Project Milestones:
List the major milestones and deliverables of the project.

Milestones	Deliverables	Date
Design approval	Conceptual design submission	19-Nov-14
Document approval	Installation plan, test procedure and specification	12-Dec-14
Project completion	Product installed and in operation	28-Feb-15

Success Measurements:
Identify metric and target you are trying to achieve as a result of this project.

- Start and finish date of each activity is in line with project baseline
- Review and track weekly progress to create an effective recovery plan
- Deliver project on time

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Figure 18: Project charter


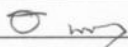
Roles and Responsibilities:
Describe the roles and responsibilities of project team members.

Sponsor: Provides overall direction on the project. Responsibilities include: approve the project charter and plan; secure resources for the project; confirm the project's goals and objectives; keep abreast of major project activities; make decisions on escalated issues; and assist in the resolution of roadblocks.	
Name	Mr. Banlue Krue-Chotekul
Project Manager: Leads in the planning and development of the project; manages the project to scope. Responsibilities include: develop the project plan; identify project deliverables; direct the project team members; scope control and change management; report and forecast project status; resolve conflicts within the project or between cross-functional teams; and communicate project status to stakeholders.	
Name	Mr. Thanasak Namthong
Team Member: Works toward the deliverables of the project. Responsibilities include: understand the work to be completed; complete research, data gathering, analysis, and documentation as outlined in the project plan; inform the project manager of issues; and proactively communicate status.	
Name	Function
Mr. Natsaran Krue-Chotikul	Project Engineer
Mr. Kitphong Chuakhao	Hardware Engineer
Mr. Kuerkool Charoenchindarat	Software Engineer
Mrs. Jantana Potiwarakorn	Purchasing
Mr. Somboon Wibulwerattana	Installation Engineer
Mr. Prachuab Chanchian	Quality Control Engineer

Project Risks:
Identify the high-level project risks and the strategies to mitigate them.

Risk	Mitigation Strategy
Employees will not cooperate	Employee engagement
Long holiday during new year may delay some work	Provide overtime to compensate with time lost
Less project margin due to more overtime and additional resource used in the project	Consider resource capacity in the planning phase

Signatures:
The signatures of the people below document approval of the formal Project Charter. The project manager is authorized by this charter to proceed with the project as outlined in the charter.

Project Sponsors:		18 SEP. 14
Project Manager:		18 Sep 2014

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Figure 19: Project charter (continued)

After project charter is created, management of change (MOC) document issued to identify what need to be change, the impact from this change, and what need to be preparing to handle this change. This document helps people in the organization to understand the elements of change and reduce resistance to change which allows the organization to manage change easier and more efficient (Prosci). In the document, type of change and description of purposed change is identified. The company introduced fifteen questions in the MOC check list. These questions are designed to ensure the organization is ready to implement the change. Project manager and project engineer is assigned to review and evaluate these questions before submit to approver. MOC document for this project is shown in Figure 20 and 21. After all fifteen questions are full filled and approved, change relating new project management process and new software support tool is implemented to this project.

Management of Change

Change Title:	U-Bolt Tightening Machine 2014		
Change Date:	27-Oct-14	Ref:	BB.PK.MOC.02.2014
Prepared By:	Patipat Kruechotikul	Date:	22-Sep-14
Type of Change:	<input checked="" type="checkbox"/> Process	<input checked="" type="checkbox"/> Equipment	<input type="checkbox"/> Facility <input type="checkbox"/> Procedural

Description of proposed change:

Current project management process cannot control project completion date. No proper process to plan and control project. Project time management follow PMBOK guideline will be implemented to improve project performance during planning, executing, and controlling. Microsoft project will be used to support with planning, executing, and controlling activities.

Management of change check list:

Topic	Circle Answer	
	YES	NO
Have systematic approach been considered for managing change on this project?	YES	NO
Are resources dedicated to this change sufficient?	YES	NO
Have affected personnel been explained why and how this change should be effectively managed?	YES	NO
Have this change been integrated to project management process?	YES	NO
Have assessments been in place to evaluate change and organizational readiness?	YES	NO
Have the audiences needed to communicate with throughout this change been identified?	YES	NO
Have the most effective way of communication been identified?	YES	NO
Have tools been in place to enable two-way communication?	YES	NO
Have supervisors or supporters been prepared and announced to affected personnel?	YES	NO
Have training been provided to supervisors or supporters to help them become effective coaches?	YES	NO
Have resistances been identified and investigated?	YES	NO

Page 1 of 2

Figure 20: Management of change checklist

Have the mitigation actions been created to prevent and deal with resistance when it does occur?	<input checked="" type="radio"/> YES	NO
Do you have systems in place to track the adoption and compliance of the new solution?	<input checked="" type="radio"/> YES	NO
Have a channel to collect feedback from those who are affected by this change?	<input checked="" type="radio"/> YES	NO
Have mechanisms been created for analyzing gaps and resistance?	<input checked="" type="radio"/> YES	NO

Evaluation Group

Project Manager: Thanasak Namthong Signature: [Signature] Date: 23 Sep 2014

Project Engineer: Natsaran Kuechoitikul Signature: [Signature] Date: 23.9.2014

Authorization for Startup:

Initiator: Patipat Kuechoitikul Signature: [Signature] Date: 24 SEP 14

Approver: MR. BANLUE KURRCHOTAKUL Signature: [Signature] Date: 14 SEP 14

Figure 21: Management of change checklist (continued)

In parallel with preparation of MOC document, general management and project management training is provided by guest speaker who is successful in this business area. The aim of this training is for project managers to acquire leadership and people management skill. These skills are essential for project manager in order to enable people in the project to deliver their optimum performance. Project management training is provided for project planner to obtain ability to run a project according to the standards published in the Project Management Institute's Project Management Body of Knowledge (PMBOK). Moreover, Microsoft project training is provided by external company. This training provide project planner with the knowledge and skills to plan and manage projects using Microsoft project.

Since project management concept is new for everyone in the organization so people may not have enough understanding on the project schedule area such as project baseline, bar chart, critical path, and etc. Project schedule training is provided by project planner to provide project schedule knowledge to team members. The purpose of this training is to ensure that every one understand how to use project schedule to carry out their work. They also need to understand the importance of project baseline, and the effect when the activity is not complete as planned. Company's product training is also provided by internal resource to gain company's product knowledge to other team member. The product knowledge allows project members to execute the project efficiently.

Company culture is one of the areas that are improved by implement PCI™. Human resource department is the leader of this activity. The committees are volunteers from every department and seminar training is set to perform team building, ice breaking, and introducing reward system to reset employees' attitude, behavior, and ensure they understand the company value.

Once Project charter is created and employees are trained, kick off meeting is arranged to provide project information to the project team such as project time frame, key milestone, project organization, project budget, and etc. At the end of this phase, project team members used project information along with knowledge gained from training to prepare their work for the next phase.

4.2 Planning phase:

The planning phase carries out detailed planning for the whole project during the start-up period. This phase contains the performance to establish the best of alternative ways of action to obtain project objectives. The intent for this phase is to develop a realistic schedule to be used as baseline for the project. To develop a realistic schedule, the project needs to ensure to have the right people, resources, methodologies, and supporting tools in place for each planning phase. There are four processes in planning phase including activity definition, activity sequencing, activity duration estimating, and schedule development.

Activity Definition:

In this process, work breakdown structure is the primary input. The creation of WBS for this project is done by used a template from project that has similar project life cycles and deliverables required from each phase. WBS for this project contain with four areas of work including management, engineering, purchasing, and installation test and commissioning. Management area is broken down in to project management and project engineering. Interface and client training scope is under project engineer since project engineer look after overall engineering activities. Under engineering, works are split into hardware engineer and software engineer. Scope of hardware and software engineer is then divided into design and test. There are two teams under purchasing which is procurement and logistic. In area of installation test and commissioning, scope split into two areas as shown in Figure 22.

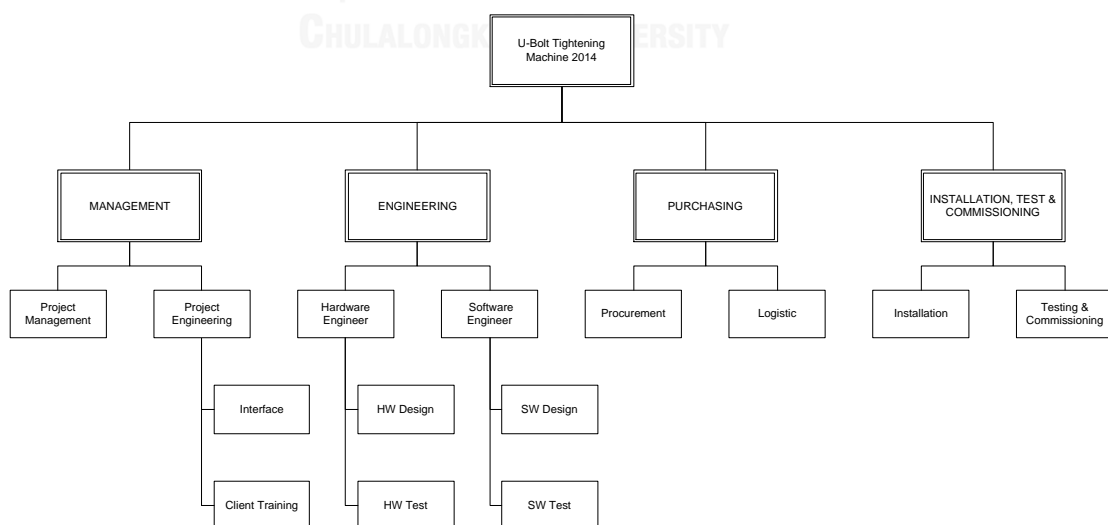


Figure 22: Project work breakdown structure

After the WBS is created, meeting is set for project members to identify the specific actions required in the project. Each team is responsible for defining their activities by taking into account of historical information, constraints, and assumptions. This project used decomposition technique to subdividing project element into smaller and more manageable components for better management control. The objective of this meeting is to produce the deliverables and sub-deliverables identified in the work breakdown structure. The outputs from this process are activity list, and WBS updates. Activity list and WBS of this project is shown in Table 8.



Table 8: Activity list for this project

WBS Level 1	WBS Level 2	WBS Level 3
Project Name	Responsible Team	Activity List
1. U-Bolt tightening machine 2014 project	1.1 Management	1.1.1 Project mobilization and start up
		1.1.2 Interface meeting
		1.1.3 Project management plan
		1.1.4 Harmonization meeting
	1.2 Engineering	1.2.1 Machine study
		1.2.2 Design concept
		1.2.3 Operation design
		1.2.4 Assembly design
		1.2.5 Design document (Design and test spec.)
		1.2.6 Design review
		1.2.7 Approval from customer
		1.2.8 Detailed design of Rack
		1.2.9 Detailed machine interface design
		1.2.10 Software development
		1.2.11 Updating design and application manual
		1.2.12 Safety for generic application document
		1.2.13 Hardware design analysis machine interface
		1.2.14 Prototype design and approval
		1.2.15 Test spec and document
		1.2.16 Final design approval for installation and test
1.3 Procurement	1.3.1 STD purchasing	
	1.3.2 Material parts purchasing	
	1.3.3 Production	
	1.3.4 Painting & treatments	
	1.3.5 Inspection & QC parts	
	1.3.6 Packing	
	1.3.7 Transportation	
1.4 Installation	1.4.1 Conveyor installation	
	1.4.2 Machine setting	
	1.4.3 Rack installation	
	1.4.4 Program & setting	
	1.4.5 Install inspection	
	1.4.6 Follow up on commend	
	1.4.7 Final assembly & Wiring	
1.5 Testing and Trial Running	1.5.1 Power supply to machine	
	1.5.2 Manual mode & automatic mode test	
	1.5.3 Production test run	
	1.5.4 Retest machine pull automatic	
	1.5.5 Final machine acceptance	
	1.5.6 Machine start up	

Activity Sequencing:

Now that the activity list has been created, next step is to arrange these activities in a logical sequence. Activity sequencing is a process for project manager and the project team to identify and document dependencies between activities. Microsoft project is used to perform activities sequencing which help the project to develop accurate and realistic schedule. During activity sequencing, dependencies and milestones are considered. There are three types of dependencies including mandatory, discretionary, and external. Mandatory dependencies are the natural sequence of activities. For instance, installation activity must be performed before test and commissioning. Discretionary dependencies are the preferred sequence of activities based on experience. External dependencies are dependencies outside of the project's control such as production and delivery of equipment from supplier. Moreover, project key milestones are considered and evaluated at the stage to ensure all work required to achieve these milestones are included.

The technique used in this process is precedence diagramming method (PDM) or also known as activity-on-node (AON). The project used this technique to identify how the work will progress from start to completion. The aimed of PDM is to construct a project schedule network diagram which can be done by using boxes to represent activities and connects them with arrows that show the dependencies. There are four types of activity relationship including FS, FF, SS, and SF. However, SS,

FF, and SF relationships can produce unexpected result when applied in Microsoft project. So FS relationship is the only type of relationship used for this project. At the end of this process, project schedule network diagram is created as shown in Figure 23.

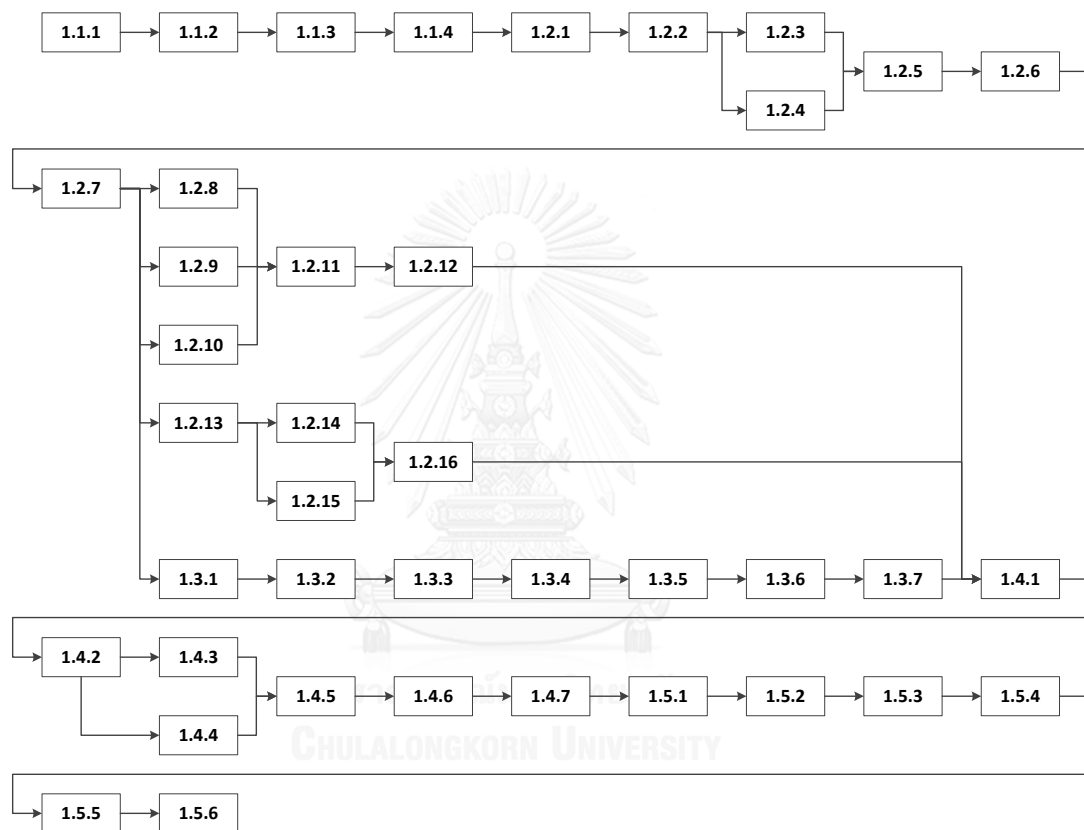


Figure 23: Project network diagram

Activity Duration Estimating:

Activity duration estimating is required for every activity in the project. The purpose of this process is to determine the project timetable by assigned the amount of time needed to perform each activity. Accurate estimates are necessary

since it can predict project completion date. To create accurate estimates, several inputs have been considered in this project. First concern is about resource requirement since number of resources assigned to the activity can reduce activity duration. For instance, conceptual design normally required one month to complete with one person assigned but this task need to be completed within fifteen days to achieve project. Therefore, two people are assigned to this activity to reduce the duration to fifteen days and meet with project milestone. However, some activities have fix duration and not effected by amount of people assigned such as software testing activity. Second concern is about resource capability. Since some activities are complex and critical so it is important to assign resource who has sufficient capability. This allows project to complete these activities faster and more accurate.

For this project, historical information and expert judgment is incorporated to predicate accurate estimates. The estimation of resource and duration is done by staff who familiar with specific activity. The technique used in this process is called analogous estimating or also known as top-down estimating. This technique is used to generate reliable estimates by using the duration spent in previous project which has similar activities and adjust to the current project. Nonetheless, senior staffs have to study the similarities and differences between these two projects and adjust any features that may result in differences in duration. After the duration of each activity is estimated, the planning team is in charge of update the activity duration in

Microsoft project to form a project schedule. Activity duration estimating of this project is shown in Table 9.

Table 9: Activities duration estimated for this project

WBS	Previous Resource Used		Previous Duration Used		Current Resource Estimate		Duration Estimate	
1.1.1	1	resource	1	days	1	resource	1	days
1.1.2	1	resource	2	days	1	resource	2	days
1.1.3	1	resource	2	days	1	resource	2	days
1.1.4	1	resource	1	days	1	resource	1	days
1.2.1	1	resource	3	days	1	resource	3	days
1.2.2	2	resource	4	days	3	resource	3	days
1.2.3	2	resource	4	days	3	resource	3	days
1.2.4	2	resource	4	days	3	resource	3	days
1.2.5	1	resource	3	days	1	resource	3	days
1.2.6	1	resource	2	days	1	resource	2	days
1.2.7	1	resource	5	days	1	resource	5	days
1.2.8	2	resource	7	days	3	resource	5	days
1.2.9	2	resource	6	days	3	resource	5	days
1.2.10	2	resource	8	days	3	resource	6	days
1.2.11	1	resource	3	days	1	resource	3	days
1.2.12	1	resource	3	days	1	resource	3	days
1.2.13	2	resource	4	days	3	resource	3	days
1.2.14	1	resource	3	days	1	resource	3	days
1.2.15	1	resource	3	days	1	resource	3	days
1.2.16	1	resource	2	days	1	resource	2	days
1.3.1	1	resource	3	days	1	resource	3	days
1.3.2	1	resource	2	days	1	resource	2	days
1.3.3	External	resource	15	days	External	resource	15	days
1.3.4	External	resource	3	days	External	resource	3	days
1.3.5	External	resource	2	days	External	resource	2	days
1.3.6	External	resource	2	days	External	resource	2	days
1.3.7	External	resource	10	days	External	resource	10	days
1.4.1	2	resource	7	days	3	resource	5	days
1.4.2	2	resource	7	days	3	resource	5	days
1.4.3	2	resource	8	days	3	resource	6	days
1.4.4	2	resource	6	days	3	resource	5	days
1.4.5	1	resource	1	days	1	resource	1	days
1.4.6	1	resource	2	days	1	resource	2	days
1.4.7	1	resource	2	days	1	resource	2	days
1.5.1	External	resource	1	days	External	resource	1	days
1.5.2	2	resource	2	days	2	resource	1	days
1.5.3	1	resource	1	days	1	resource	1	days
1.5.4	2	resource	2	days	3	resource	2	days
1.5.5	1	resource	1	days	1	resource	1	days
1.5.6	1	resource	1	days	1	resource	1	days

Schedule Development:

After the estimates for the activities are completed, schedule development is performed. The objective of this process is to define start and finish dates for project activities. There are several types of inputs to create a project schedule including project network diagram, activity duration estimates, resource requirements, project calendars, constraints, and assumptions. Project network diagram is re-evaluated in this process to ensure that the decisions and logic made earlier are feasible and fit within the project completion. Estimate of activity duration is reviewed to determine duration of each activity and the whole project. Furthermore, resource requirement and effort is reviewed to avoid counterproductive from having too many resources in one activity. Five working day calendar and holidays are considered during schedule creation which allows project management team to realistically predict when a project begins and end. Project constrain is re-evaluated to make sure everyone understand why the constraint has been imposed. The biggest constraint in this project is project deadline. All assumptions made in previous process are reviewed to make sure that they are still valid.

Tools and techniques used in schedule development are critical path method (CPM), duration compression, and project management software. Critical path method (CPM) is the mathematical analysis technique that calculates early and late start and finish date of each activity. This project used forward and backward

pass to expose which activities are considered critical. The longest path in the project called critical path where delayed from activities in this path will affect project completion date. For this project, CPM is calculated manually to expand staffs' knowledge as shown in Figure 24.

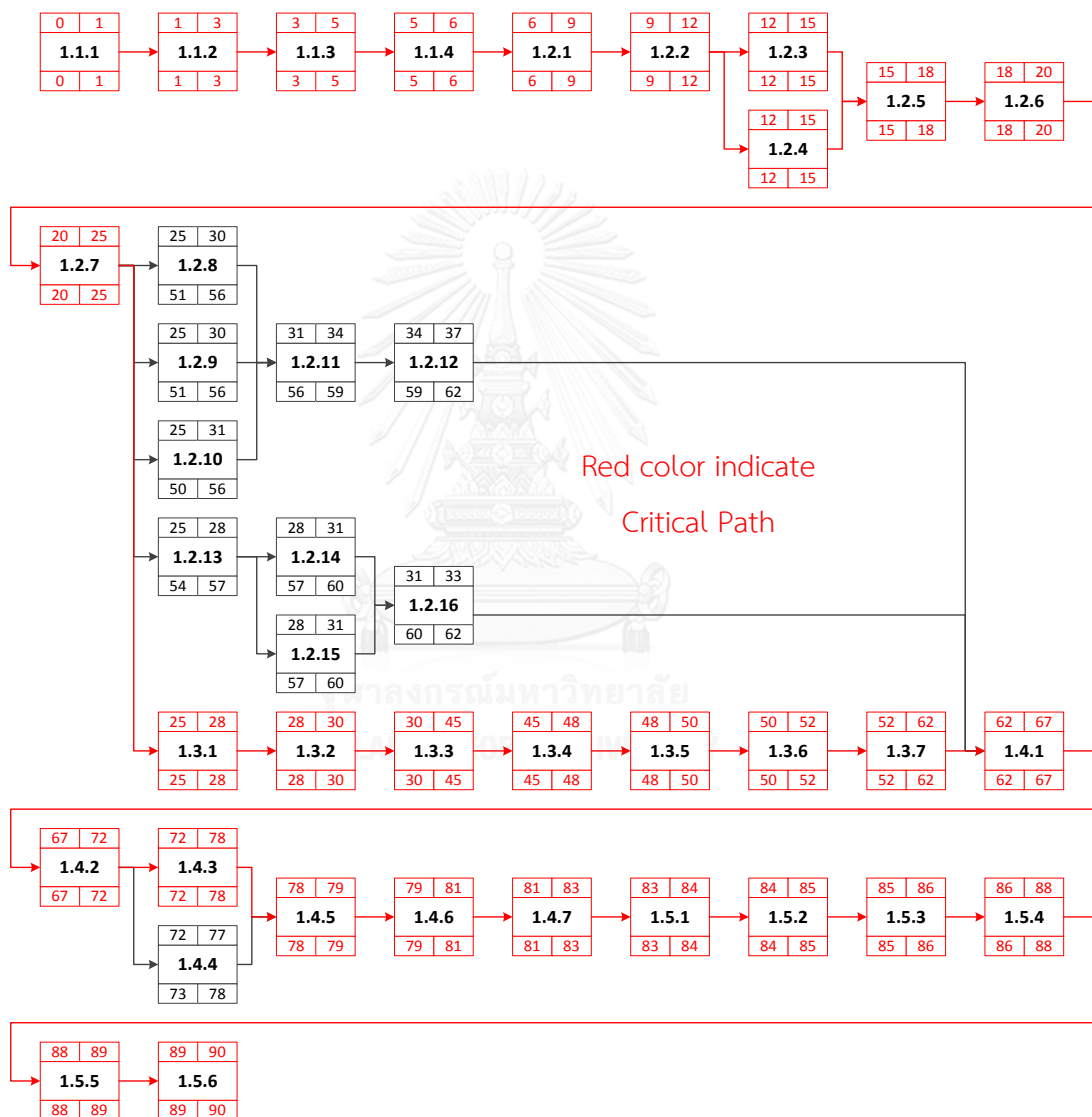


Figure 24: Identify project critical path by manual calculation

However, manual calculation will take some time to complete and there is high chance for miscalculation. To avoid this issue, Microsoft project is used to support the CPM calculation to produce a quicker and more accurate result that can determine the flexibility of activities (Hawkins 2007). Figure 25 shows the CPM calculation via Microsoft project.

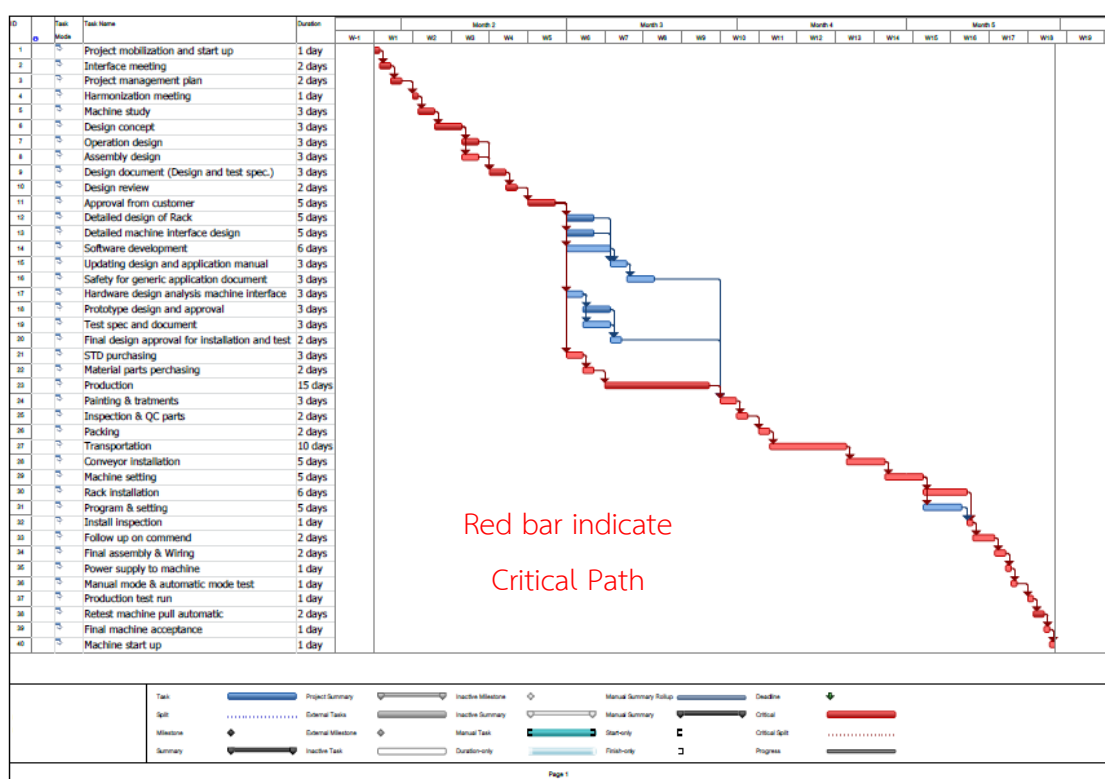


Figure 25: Identify project critical path by Microsoft project

From Figure 25, it can be seen that most activities in this project are in the critical path. Since delays from these activities can delay the project's completion so the focus of this project is on activities in the critical path. Risk management plan is created to reduce risk that may occur to these activities. The plan consists of three

parts including risk identification, risk evaluation, and risk control. During risk identification, project members are brainstorming to identify risks that likely to affect the project. Moreover, cause and impact of risk are indicated. Risk evaluation is performed by evaluate risks in term of the probability and impact. Criteria are set to identify level of probability and impact to project. At this stage, project management team plots each risk in the risk assessment matrix form to prioritize risks in the project. This project introduced four level of urgency including extreme, high, moderate, and low. Risks that are under extreme level have the highest priority which will be closely monitor during project execution and controlling. Second priority goes to risks under high level and last priority goes to moderate and low level. Risk assessment matrix and criteria is shown in Figure 26.

		Impact				
		Insignificant (Easily mitigated)	Minor (Delays up to 10% of schedule)	Moderate (Delays up to 30% of schedule)	Major (Delays up to 50% of schedule)	Catastrophic (Project abandoned)
Probability	Almost certain (>90% chance)	High	High	Extreme	Extreme	Extreme
	Likely (50% - 90%)	Moderate	High	High	Extreme	Extreme
	Moderate (20% - 49%)	Low	Moderate	High	Extreme	Extreme
	Unlikely (5% - 19% chance)	Low	Low	Moderate	High	Extreme
	Rare (<5% chance)	Low	Low	Moderate	High	High

Figure 26: Risk assessment matrix

Once risks are prioritized, mitigation action is created to decrease probability of risk and reduce impact to the project. Based on the evaluation, material delivery from supplier is the highest risk for this project. There is high chance for supplier to deliver material later than the date predicted in the beginning due to unexpected factors during production such as machine breakdown, power outage, and etc. Since these factors are beyond control of project so mitigation plan is created and carefully managed. The mitigation plan for this risk is to follow up closely with supplier until all materials are delivered. However, mitigation action for remaining risks are also created and monitored base on the level of urgency as shown in Table 10.

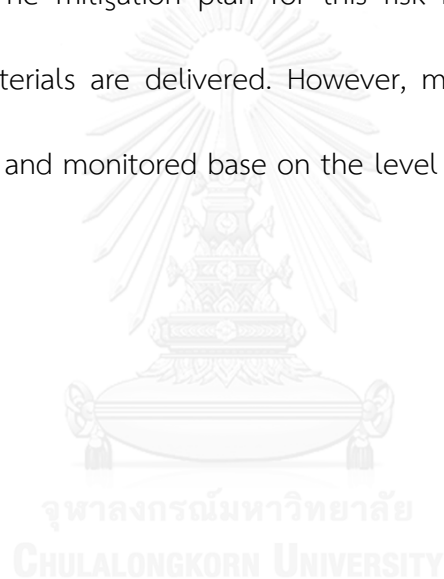


Table 10: Risk identification and periodization

No.	Risk condition	Cause by	Impact	Propability	Impact	Result	Mitigation Action Description
R001	There may be damaged incident while transit delivery	Poor Handling from supplier	Damaged Materials and delayed	20%	2	Moderate	Coordinate closely with supplier to prevent damage while transit the materials
R002	The material might get delay delivery	Suppliers production	Delay installation work	60%	4	Extreme	Logisitcs follow up closely for the delivery date with supplier
R003	Additional test may be required	Unclear test requirement	Software modification	10%	1	Low	Ask customer for clear statement
R004	More design documents are required or updated	Customer requirement	More time spent to complete the requirement	10%	1	Low	Ask customer for requirement since the beginning and reuse the existing document
R005	Some safety system not active	Failures in interface components not detected	More time to complete software development	10%	2	Low	Ensure procedures for testing is in place.
R006	Position of tool fixing is too high or low when install in the rack	Installation and space requirmeent is not yet confirmed by customer	Delays due to change of design	30%	2	Moderate	Define installation requirements as soon as possible
R007	Software is not released and successfully integrated in the system in time for tests	New development	Delayed start of tests and delayed approvals	20%	3	High	Assign more staffs with high experienced
R008	The operation mode will not be accepted by end-customer	Customer prefers other definitions	Delays in revised application manual	10%	1	Low	Include detailed explanation of operation contact functionality in system description.

Since one person cannot perform more than one activity at the same time so resource levelling method is used to smooth the schedule when resources are over-allocated. This method is performed automatically in Microsoft project which allows project to determine start and finish date of each activity realistically. However,

resource levelling increased time to complete activities that have resources over-allocated which affected to project completion date.

Duration compression is the method to bring the project back on track by applying crashing or/and fast tracking technique. The project used crashing technique to get the work done faster by giving overtime, adding more resource, and motivating team members with rewards. Since the schedule compression process often results in increased cost so the project aimed to apply this technique to activities in the critical path which allows the project to obtain the greatest amount of compression for the least amount of cost. After apply this technique, the duration of other paths is reviewed by project management team to ensure they are not become equal to or more than the duration of the critical path. Fast tracking technique involve in reviewing the critical path to find out which sequential activities can be performed parallel or partially parallel to each other. This technique is very risky because the project has to perform many activities in parallel and sometime have to manage more than one critical path. In this research, fast tracking technique is not applied to reduced risk that may occur to the project.

At the end of this process, working schedule is created and presented to project team members in form of Gantt chart. This schedule is created in Microsoft project where critical path, start and finish dates of each activity are calculated automatically. Harmonization meeting is set to ensure that everyone agreed with the

schedule created in this phase. Once project schedule is agreed by project members, it is used as project baseline which progress will be measured on a weekly basis.

Project schedule for this project is shown in Figure 27.

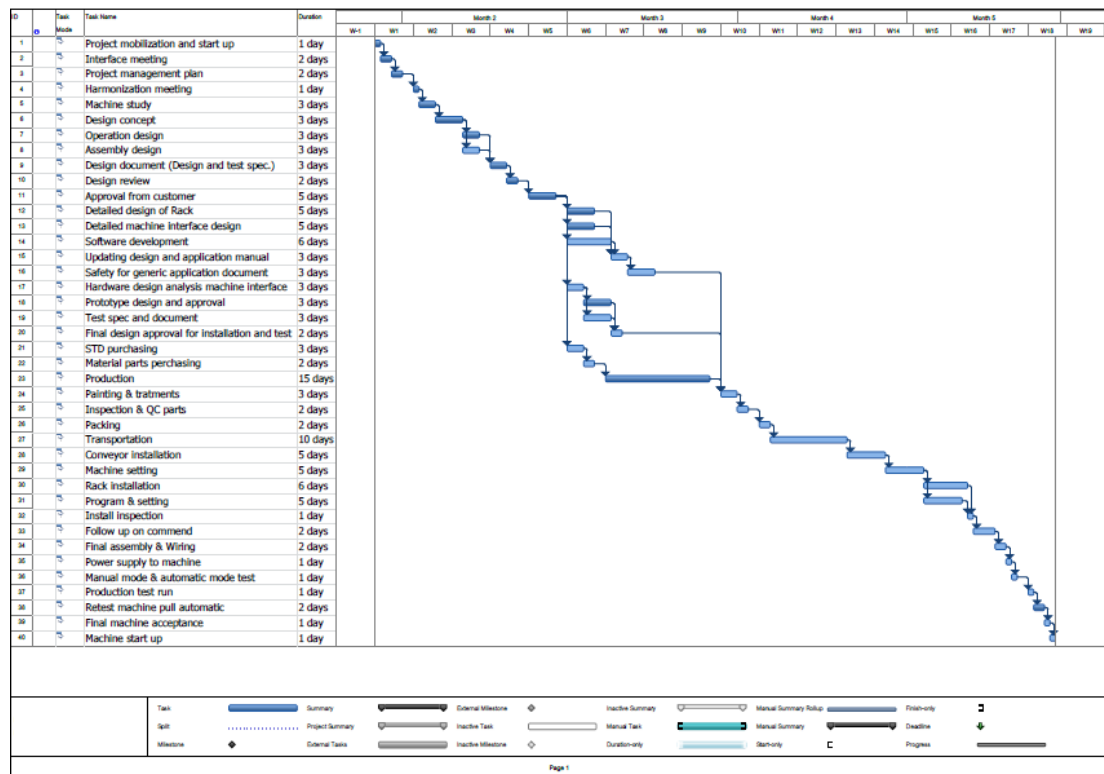


Figure 27: Project schedule of this project

4.3 Execution phase:

The core process of execution phase is project plan execution. The objective of this process is to achieve the project deliverables as defined in the plan. In this process, project team members used project baseline to carry out their works. The project baseline is also used by project management team to track progress against actual performance in order to determine project status. To ensure successful of

project execution, techniques for displaying project schedule are applied. Gantt chart schedule format is used to track progress of activities in the project. In the Gantt chart, each activity is presented by a bar of a time line where the left edge of the bar indicated start date and the right edge of the bar indicated finish date. This allows project members to clearly see when activity should be started and completed. Moreover, Project Gantt chart is also used by project management team to track progress of project.

Milestone chart is used to identify start and completion of major deliverables. In the chart, only key project milestones are displayed. The focus of these milestones gives project management team a framework for planning and tracking project activities. There are two types of milestones including internal milestone and customer milestone. In the graph, diamond shape represented internal milestones and triangle represented customer milestones. Milestone chart for this project is shown in Figure 28.

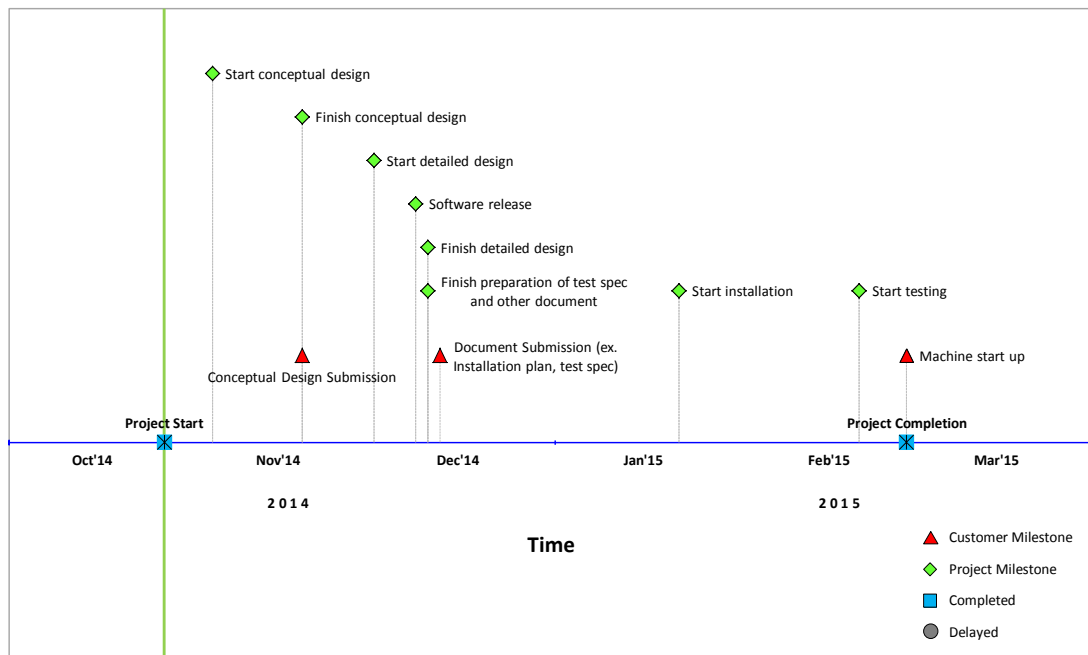


Figure 28: Project milestone chart

Monitoring process is generated to define the process used for preparing, updating, analyzing, and reporting the schedule. It is an internal process created for project core team especially work package leaders who are responsible for updating the progress. Work progress is generated every Wednesday by work package leaders and report to project management team. Project management team then used this information to update progress in Microsoft project and prepare report for schedule review meeting. Schedule review meeting is arranged every Thursday for project team to update the situation of the project. Report used in the meeting consists of project Gantt chart, project milestone chart, critical path, S-Curve, and risk review. At the end of the meeting, mitigation action and recovery plan is created to ensure the completion date of project. On Friday, project management team distributed project

status as discussed in the meeting to all members in the project. Project team members used this information to carry out their work. Moreover, report is submitted to customer and project status is presented to senior management of the company by project manager. Monitoring process for this project is presented in Figure 29.

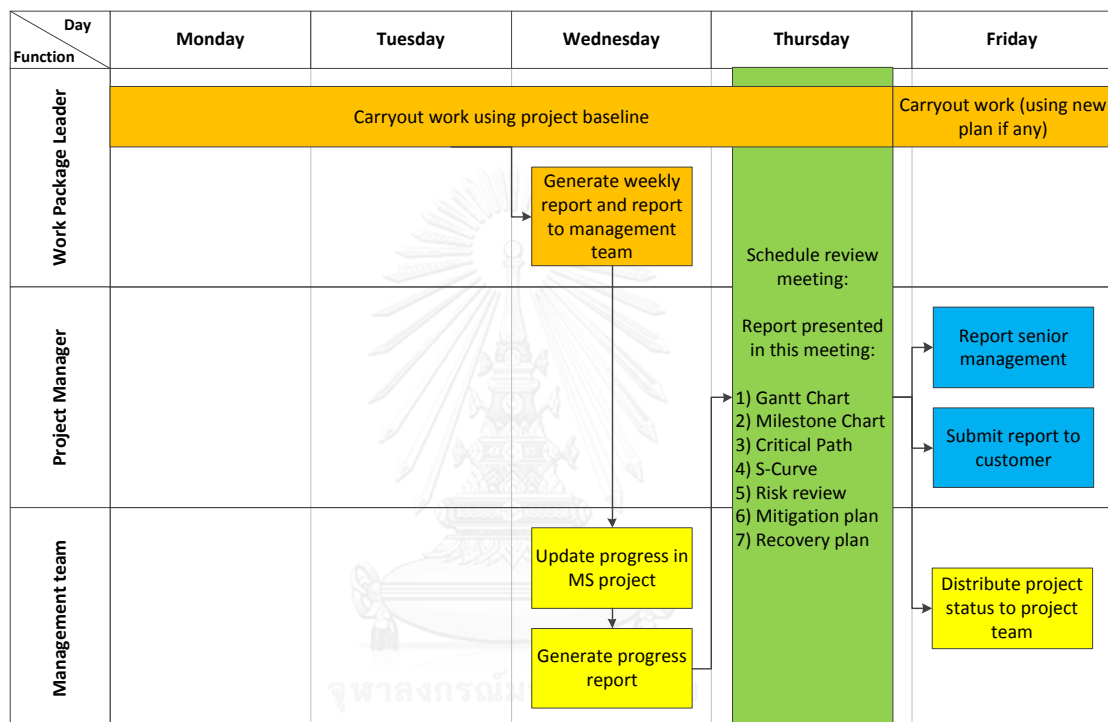


Figure 29: Monitoring process of this project

4.4 Controlling phase:

In controlling phase, project performance is measured weekly to identify variances from the project baseline. These variances are fed in to the control processes of project time management area. The objective of this phase is to monitor and control the project baseline by focuses on tracking, reviewing, and

managing the project performance and progress. According to the PMBOK guideline, controlling phase consist of two processes that related in project time management area including performance reporting and schedule control.

Performance reporting

Performance reporting process involves in collecting and distributing information for instance status, progress, forecast, and variance of the project. After received work results from staffs, project management team used these work results to update the project schedule in Microsoft project and assess project performance by measured against project baseline. At this stage, project management teams prepare reports for weekly schedule review meeting. There are four reports used in this project including updated schedule in Gantt chart format, critical path, milestone chart, and S-Curve.

Microsoft project is used to generate the report in form of Gantt chart or bar charts which allows project team to identify where the project now stands, what the project team has accomplished, and what is coming up next. Critical path is also reviewed to alert the project team to foresee problems that may occur in the future. Critical path is calculated automatically in Microsoft project. Gantt chart and critical report for this project is shown in Figure 30.

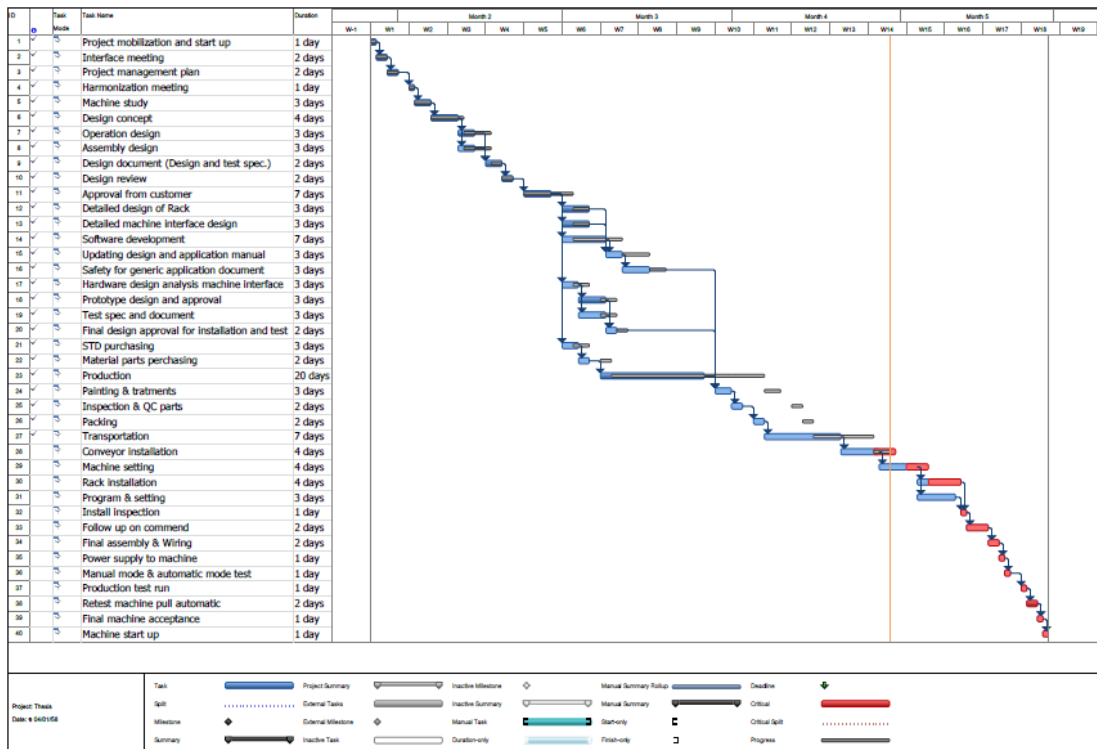


Figure 30: Gantt chart and critical path report format

Another type of report is in form of milestone chart. Milestone chart is similar to a Gantt chart, but with less detail regarding individual activities. Each week, project management team used information from updated schedule to update project milestone chart. In the chart, there are four types of milestone including customer milestone, project milestone, completed milestone, and delayed milestone. Customer milestones are milestones required by customer which cannot be delay. Project milestones are a list of key deliverables which selected by project manager. Completed milestones are assigned in the chart when project achieve that specific milestone. When the delay occur to baseline, delayed milestone represent original

date of that milestone which allows project members to see how many days the milestone has been delayed. Project milestone chart is shown in Figure 31.

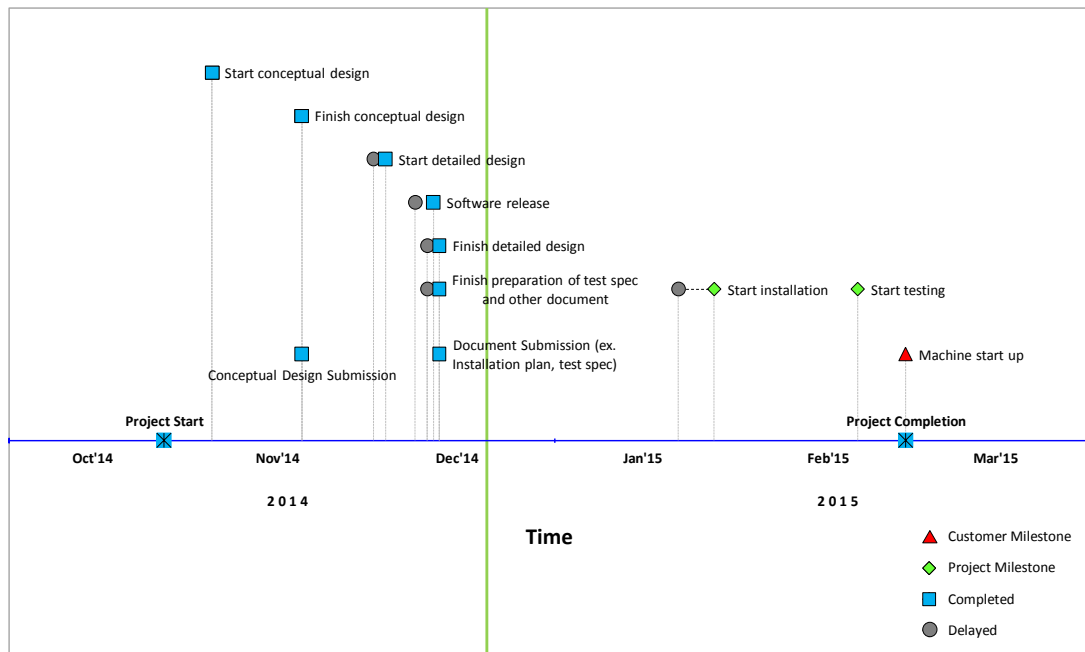


Figure 31: Milestone chart report format

S-Curve is an important report generated by project management team which allows progress of a project to be tracked visually over time and form a historical record of what has happened to date. For this project, S-curve consists four elements including activity planned to be complete each week, actual completion, cumulative plan, and cumulative actual as shown in Figure 32. In this report, red bar indicated amount of activity planned to be complete each week where blue bar indicated actual amount of activity completed each week. Cumulative plan is presented in red line which is used as baseline to measure against cumulative actual

which is show in blue line. The project aimed to align these two lines as much as possible to assure the completion date. This report allows project manager to quickly identify whether the performance is improving or declining.

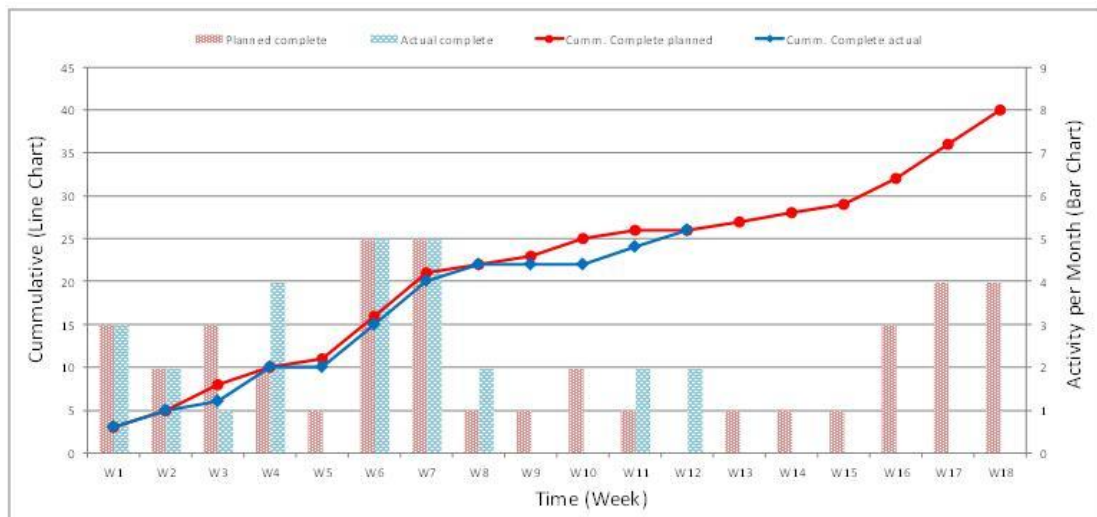
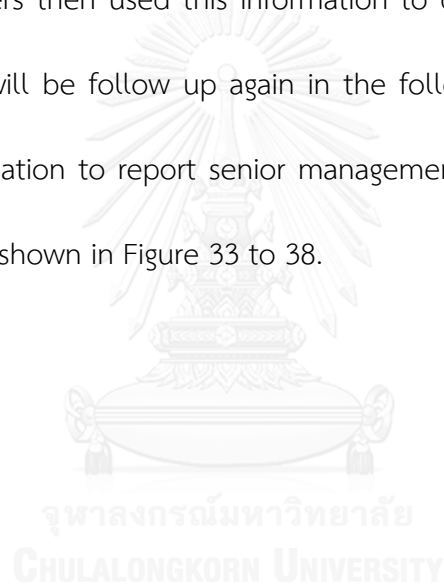


Figure 32: S-curve report

Schedule control

Schedule control is the process of managing and controlling changes to the project schedule. The focuses of this process is on control changes by monitor the project activities against the project baseline and also monitor project critical path. The project baseline and critical path can be affected from uncertainties created by internal and external party. Microsoft project is used to track these changes and forecast the effects of changes made to schedule. At this stage, schedule performance review meeting is set to update project status to project members. All reports created in previous stage are used in the meeting to evaluate the magnitude

of any variation. If there are variances between actual and baseline, fast tracking technique is used to create recovery plan and mitigation actions which allow project to bring schedule back into alignment with the original dates and goals for the project completion date. Moreover, project risks are reviewed and updated by project core team. At the end of this process, all updates discussed in the meeting are summarized in the minute of meeting and distributed to project members. Project team members then used this information to direct their remaining work in which the progress will be follow up again in the following week. Project manager also used this information to report senior management and customer. Example of minute of meeting is shown in Figure 33 to 38.



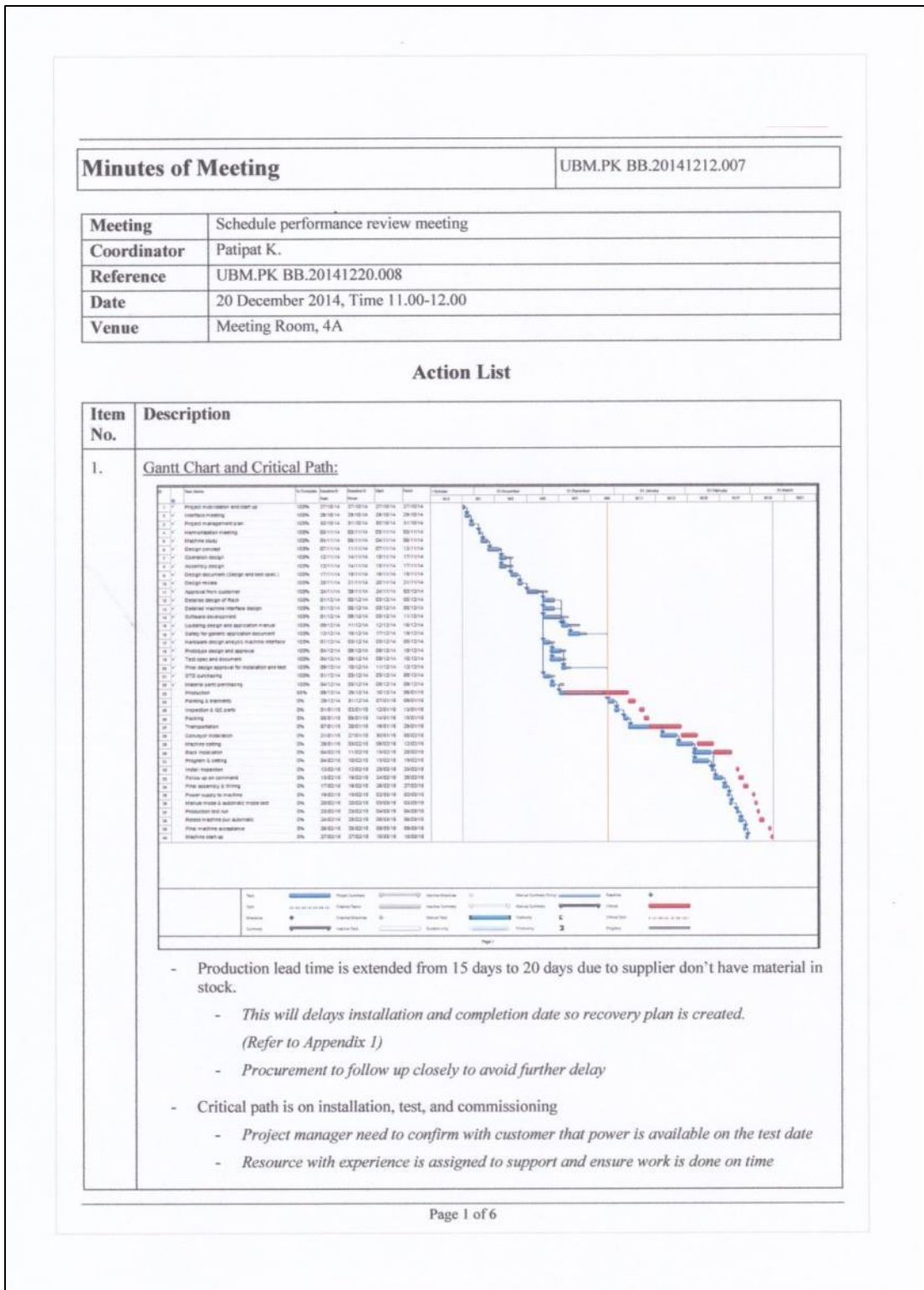


Figure 33: Minute of meeting of this project

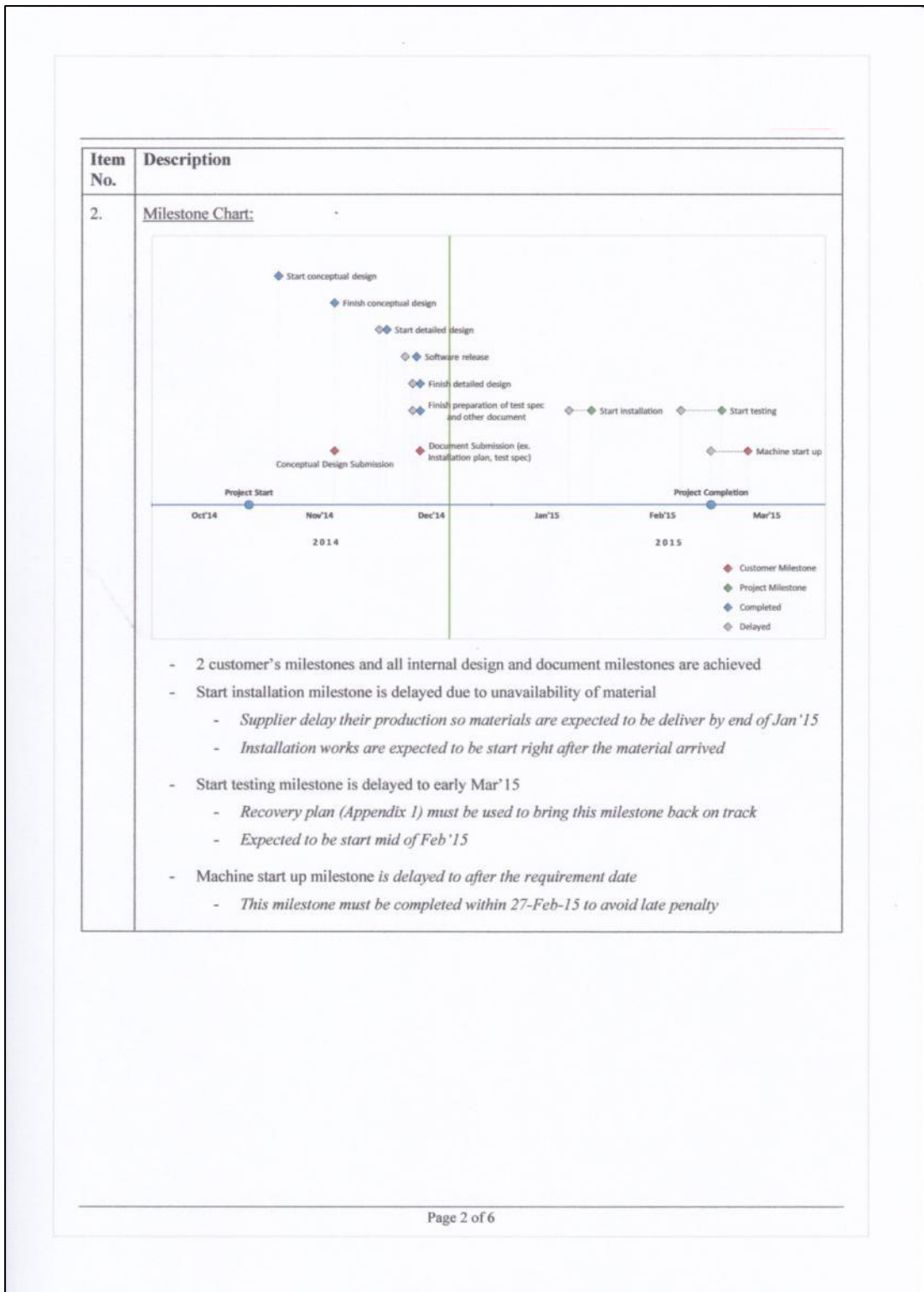


Figure 34: Minute of meeting of this project (continued)

Item No.	Description							
3.	<u>Risks:</u>							
	No.	Risk condition	Cause by	Impact	Propability	Impact	Result	Mitigation Action Description
	R001	There may be damaged incident while transit delivery	Poor Handling from supplier	Damaged Materials and delayed	20%	2	Moderate	Coordinate closely with supplier to prevent damage while transit the materials
	R002	The material might get delay delivery	Suppliers production	Delay installation work	60%	4	Extreme	Logistics follow up closely for the delivery date with supplier
	R003	Additional test may be required	Unclear test requirement	Software modification	10%	1	Closed	Ask customer for clear statement
	R004	More design documents are required or updated	Customer requirement	More time spent to complete the requirement	10%	1	Closed	Ask customer for requirement since the beginning and reuse the existing document
	R005	Some safety system not active	Failures in interface components not detected	More time to complete software development	10%	2	Low	Ensure procedures for testing is in place.
	R006	Position of tool fixing is too high or low when install in the rack	Installation and space requirement is not yet confirmed by customer	Delays due to change of design	10%	2	Low	Define installation requirements as soon as possible
	R007	Software is not released and successfully integrated in the system in time for tests	New development	Delayed start of tests and delayed approvals	10%	3	Moderate	Assign more staffs with high experienced
	R008	The operation mode will not be accepted by end-customer	Customer prefers other definitions	Delays in revised application manual	10%	1	Low	Include detailed explanation of operation contact functionality in system description.
	<ul style="list-style-type: none"> - R003 and R004 are closed <ul style="list-style-type: none"> - We received test requirement and design document requirement from customer - R001 and R002 <ul style="list-style-type: none"> - Procurement must coordinate closely with supplier to reduce these risks - These risks will be closely monitor until all materials are delivered - R005 <ul style="list-style-type: none"> - Software is tested in the office and waiting for test on site - This risk is active until software test on site is passed - R006 <ul style="list-style-type: none"> - Installation and space requirement is received from customer - Risk's probability is reduced from 30% to 10% , Moderate to low (less critical) - This risk will be closed once actual installation is performed with no problem - R007 <ul style="list-style-type: none"> - Software is released and wait to perform integration test on site - Risk's probability is reduced from 20% to 10% , High to Moderate (less critical) - This risk will be closed once software is successfully integrated in the system - R008 <ul style="list-style-type: none"> - Closely monitor with customer 							
Page 3 of 6								

Figure 35: Minute of meeting of this project (continued)

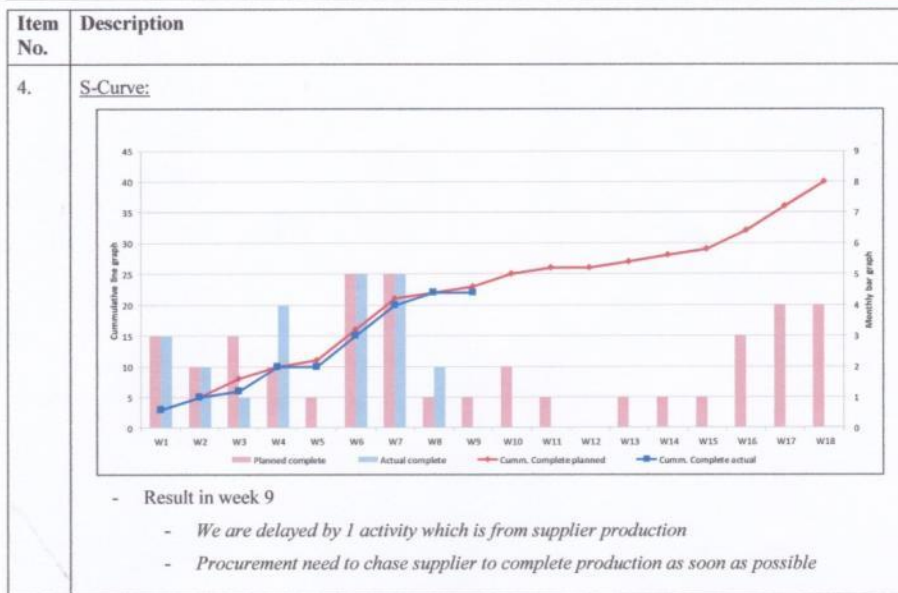


Figure 36: Minute of meeting of this project (continued)

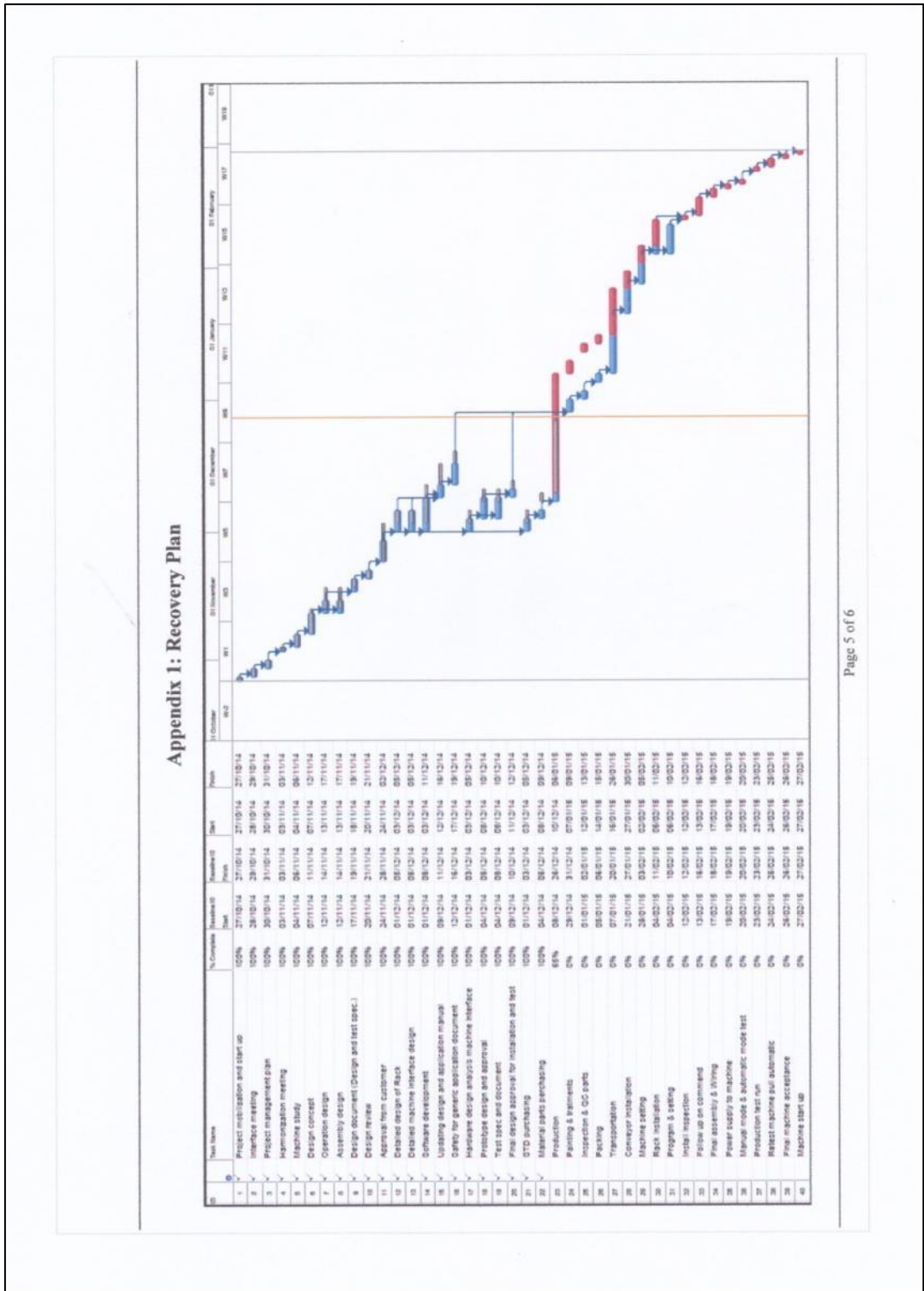


Figure 37: Minute of meeting of this project (continued)

Appendix 2: Mitigation Action

WBS	Project Name	Original Duration	Revised Duration	Reason for revision / Corrective action
1.1.1	Project mobilization and start up	1	1	
1.1.2	Interface meeting	2	2	
1.1.3	Project management plan	2	2	
1.1.4	Harmonization meeting	1	1	
1.2.1	Machine study	3	3	
1.2.2	Design concept	3	4	Information pending by customer
1.2.3	Operation design	3	3	
1.2.4	Assembly design	3	3	
1.2.5	Design document (Design and test spec.)	3	2	Provided over time to complete this activity sooner
1.2.6	Design review	2	2	
1.2.7	Approval from customer	5	7	Customer requested more info which extended the duration
1.2.8	Detailed design of Rack	5	3	Added more resource to reduced the duration
1.2.9	Detailed machine interface design	5	3	Added more resource to reduced the duration
1.2.10	Software development	6	7	Unexpected error
1.2.11	Updating design and application manual	3	3	
1.2.12	Safety for generic application document	3	3	
1.2.13	Hardware design analysis machine interface	3	3	
1.2.14	Prototype design and approval	3	3	
1.2.15	Test spec and document	3	3	
1.2.16	Final design approval for installation and test	2	2	
1.3.1	STD purchasing	3	3	
1.3.2	Material parts purchasing	2	2	
1.3.3	Production	15	20	Take longer time than expected supplier (Ran out of stock)
1.3.4	Painting & treatments	3	3	
1.3.5	Inspection & QC parts	2	2	Procurement to chase supplier to speed up these process
1.3.6	Packing	2	2	
1.3.7	Transportation	10	7	- Delivery lead time provided by supplier is unrealistic - Since they are local supplier so the lead time should be 1 week - Procurement to follow with supplier closely about delivery date
1.4.1	Conveyor installation	5	4	
1.4.2	Machine setting	5	4	
1.4.3	Rack installation	6	4	Add experienced staff to supervise and ensure to complete this task within revised duration
1.4.4	Program & setting	5	3	
1.4.5	Install inspection	1	1	
1.4.6	Follow up on commend	2	2	
1.4.7	Final assembly & Wiring	2	2	
1.5.1	Power supply to machine	1	1	
1.5.2	Manual mode & automatic mode test	1	1	Once schedule is back on track, project team must maintain duration of these activity
1.5.3	Production test run	1	1	
1.5.4	Retest machine pull automatic	2	2	
1.5.5	Final machine acceptance	1	1	
1.5.6	Machine start up	1	1	

Figure 38: Minute of meeting of this project (continued)

4.5 Closing phase:

The project close-out and handover are the final phase of the project which marks the end of the project's operation. This phase consists of commissioning processes to guarantee to the owner for checking, inspecting and testing every operational parts of the project. For this project, the results from tests are documented in the signed and approved test records. During commissioning process, test records are reviewed to ensure that there are no errors and deviations in the system. Beside test records, the conditions of the installations are considered satisfactory. Moreover, Training is provided to handover to staff who will carry out normal operations and to ensure that tools and techniques and procedures are effective. At the end of this process, handover form is created to be an evidence of commissioning process. This form consists of checklist that is filled by project team and customer to ensure all requirements are fulfilled and sign off the project. Figure 39 shown handover form of this project.

PROJECT HANDOVER			
Project Title:	U-Bolt Tightening Machine 2014		
Project Manager:	Thanasak Namthong		
Project Start Date:	27-Oct-14	Handover Date:	1-Mar-15
Product/System Delivery:			
B&B Solimec has fully installed U-Bolt tightening machine and system to HATC-M Engine Assembly line which includes Air tightening equipment, torque control unit, detector, sequenser, board Display, conveyor, rack, fixing tool, and operation program.			
Handover Checklist:			
Description	Circle Answer		
As built drawing, Part drawing, Part list, Electric circuit drawing are submitted	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Equipment are installed and tested	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Installation Record/Report are submitted	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Test Record/Report are submitted	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Commissioning Record/Report are submitted <i>Partially</i>	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Operation and maintenance manual for equipment are provided	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Operation and maintenance training is provided	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
As built drawing, Part drawing, Part list, Electric circuit drawing are submitted	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
The contract terms have been satisfied	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
The result of the project is satisfied	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Handover Acknowledge:			
Transfer by: <u><i>Kantak</i></u>	Date: <u>28 Feb 15</u>	Quality: <u><i>[Signature]</i></u>	Date: <u>28/2/2015</u>
Handover by: <u><i>Steele</i></u>	Date: <u>28 FEB 2015</u>	Safety: <u><i>[Signature]</i></u>	Date: <u>28 Feb 15</u>

Figure 39: Handover form and checklist of this project

However, the project is not finished until project closing is performed. According to PMBOK guideline, there are two processes to formally closeout the project including contract closeout and administrative closure.

Contract Closeout

Contract closeout is applied by using contract documentation including requested and approved contract change, invoices and payment records and the result of inspection identified in contract which use for internal audits. In this project, internal audit is arranged to identify successful and failure of activities in a project according to contract document and ensure that all activities is completed before the formal acceptance and closure.

Administrative Closure

Administrative closure is the process consists of verifying and documenting project outcomes to formalize acceptance of the project by customer. The formal written notice is sent to the customer for formal acceptance and closure. Moreover, all of the evidences including signed formal acceptance and contract file are kept as project archives in the company for the future reference. In addition, best practice and lesson learn from this project is documented and keep as a historical data for this project and the future project.

5 Chapter 5: Result analysis and Discussion

In this chapter, result analysis and discussion are presented. Since this research aimed to improve the project time management so the data were collected and processed in responsible for analysis of the project time improvement. The result analysis is divided into four month by using progress tracked in the Microsoft project to discuss the situation and suggest for the improvement. Result from first month is shown in Figure 40.

Result at the end of first month

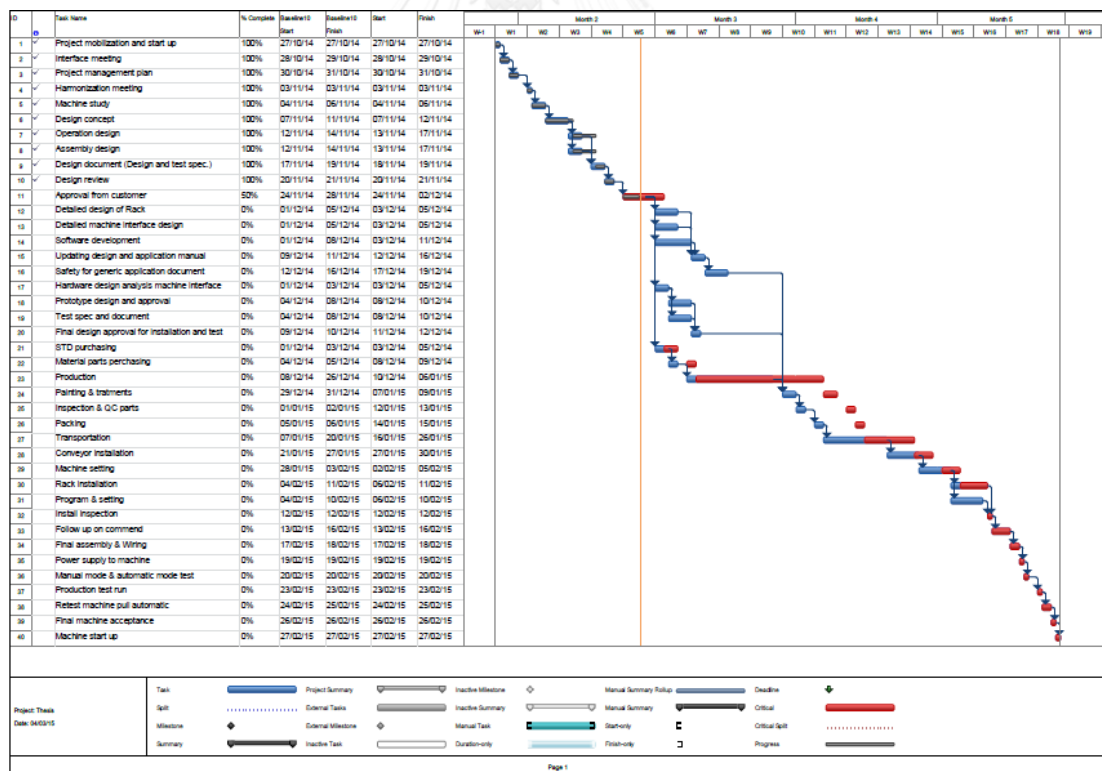


Figure 40: First month result

The result at the end of first month shows that design concept took longer than expected to complete because the project is waiting for some input from customer. The delay of this activity pushed the start date of operation design and assembly design out which means the project is now delay by one day. However, project manager decided to provide overtime for employees to complete the design document sooner which allows project to recover from delay. Last activity in this period is design approval from customer. Since customer requested for more information about the design so the duration for this activity is expected to be longer. At the end of this period, critical path is reviewed and recovery plan is created to bring the schedule back on track. The project realized that critical path came from design approval from customer to purchasing activity. Therefore, the recovery plan is created by preparing all purchasing document for ready to be send to supplier once the design approved from customer. Second month's result is shown in Figure 41.

Result at the end of second month

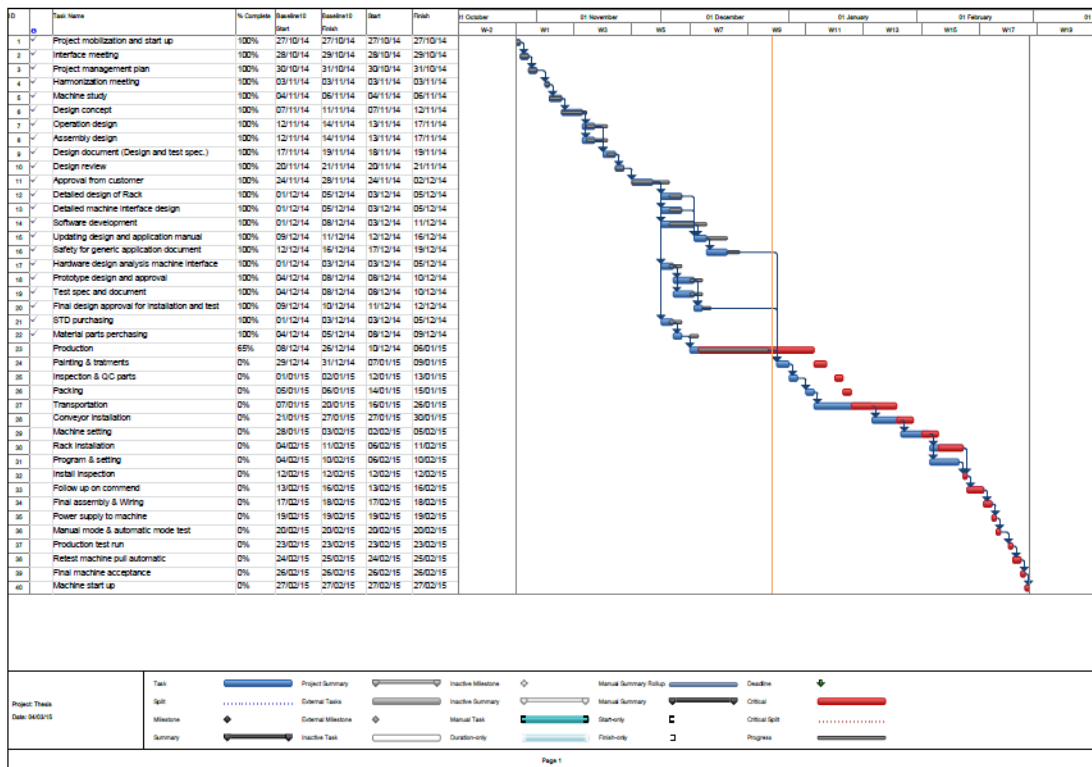


Figure 41: Second month result

Managing the work in this period is more challenge because there are three paths to manage. In this period, activities that project need to focused are customer approval, purchasing, and production. These activities are critical because the delay of these activities will impact the project completion date. The result at the end of this period shows that customer approval is delayed by two days which delay the start date of detailed design works, software development, and standard purchasing. At this stage, project manager focused more on purchasing and production activities. Project cannot do anything to reduce production lead time because this activity is

belongs to the supplier which is considered as a highest risk in the project. However, mitigation plan is created by having buyer cooperation with supplier closely. Third month's result is shown in Figure 42.

Result at the end of third month

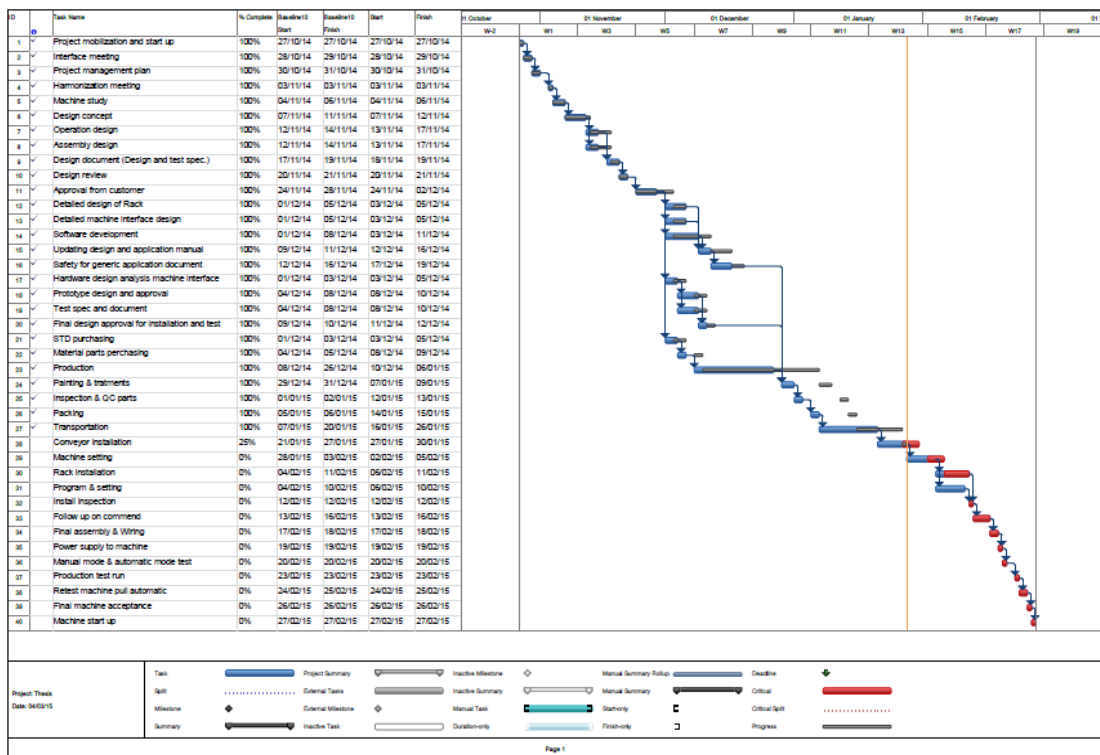


Figure 42: Third month result

In third period, the situation starts to get worst when supplier informed that they are lack of raw material and need to extend the duration of production time from fifteen days to twenty days. This result in the delay of installation work that affect to the completion date. At this stage, project manager arranged meeting with project team members to create a recovery plan by taking into account of risk in the

remaining activities. For activities that have high risk, resources with high experience are allocated additionally. At the end of this period, the start date of installation activity is delayed by six days. However, risks have been considered to create more realistic recovery plan so delays are expected to be recovered within next period.

Fourth month's result is shown in Figure 43.

Result at the end of fourth Month

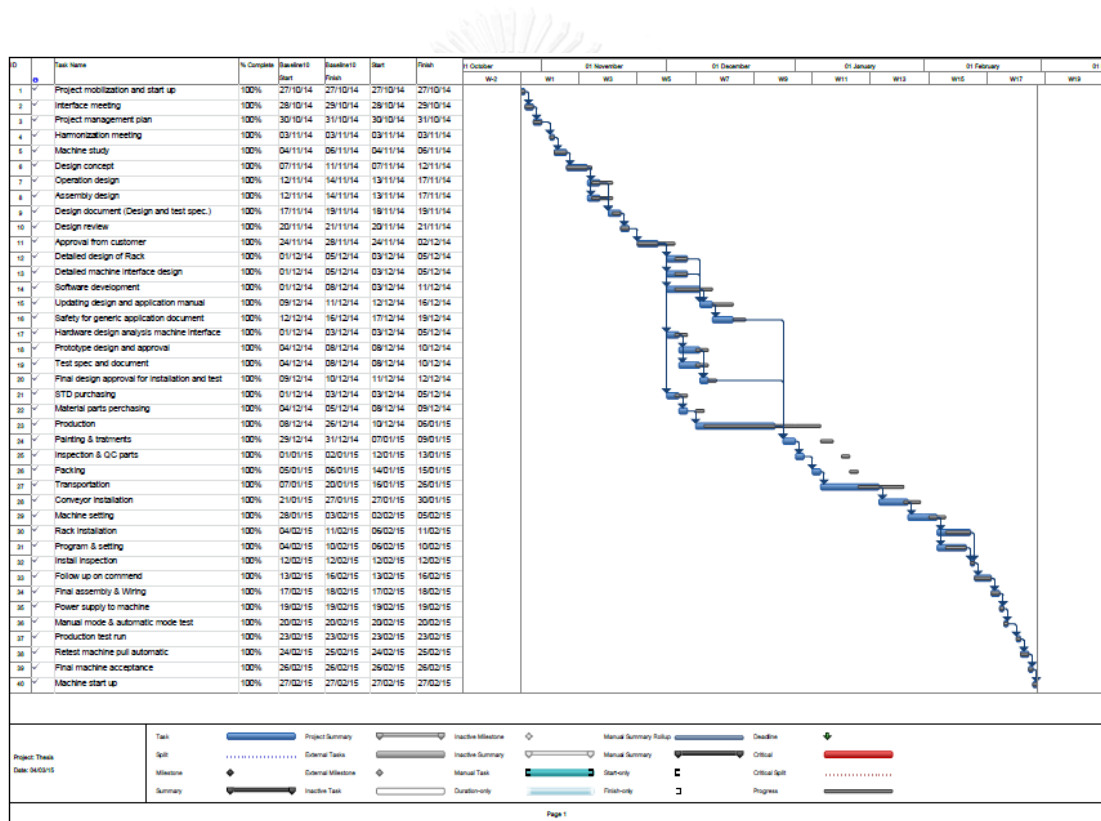


Figure 43: Fourth month result

This period is the last period of the project which contain with remaining works including installation, testing, and machine start up. The result of this period shows that installation team is able to complete their works ahead of time due to

the recovery plan created in previous period. This enables project to fully recover from delays. The result also shows no delay in the inspection and testing activities which allows the project to perform machine start-up on the planned date. At the end of this period, all activities are performed and project is handed over within deadline.



6 Chapter 6: Conclusion and Recommendation

6.1 Conclusion

According to the company record, it shows 83% of time the organization failed to deliver project on time. After observation of the current process by benchmark with PMBOK guideline and apply fish bone analysis to find root cause of this problem, it was found that the organization did not have an ability to create a realistic project plan and unable to control activities in the project. The reason is because people in the organization do not have enough knowledge and experience in project management and applied inappropriate tools and techniques to manage the project. Therefore, the objective of this research is to develop a plan and process to improve project time management by applying PMBOK concept.

This project consists of five phases including initiating, planning, executing, controlling, and closing. During initiating phase, project charter was created and project management concept was introduced to project staffs. Moreover, general management skill such as leadership, negotiation, and problem solving was built to project managers to help them manage project effectively. Kick off meeting was set to provide project team with project detail. In planning phase, WBS was generated and all required activities were listed in Microsoft project program. Precedence diagramming method was used to create network schedule. The duration of each

activity was estimated by team members. Moreover, critical path method was used to visualize the longest path in the project. At the end of planning phase, project baseline was set and presented to the team in form of Gant chart. Project team used this project plan to carry out the work. Project progression was collected at the end of each week to generate the report for analysis. Review performance meeting was set weekly to evaluate the situation of the project and create the recovery plan if needed. After all activities were completed, internal audit was arranged and formal letter was issued to the contract closeout.

The study revealed that project time management by application of PMBOK guidelines can help project members to plan and develop project schedule efficiently that allow project team to forecast and create recovery plan timely. Before project time management is applied, plan and schedule are created in Microsoft Excel and activities are listed without assigning of activities relationship which result in no network diagram and critical path cannot be identified. Without critical path, project cannot prioritize which activities need to be focused at that period. For instance, adding more resources in the activity that is not in critical path do not help project to recover from delay. Moreover, project cannot be controlled previously because there is no controlling process and each project member has different plan to find their own way to work around. The performance of an example of previous project time control is shown in Figure 44.

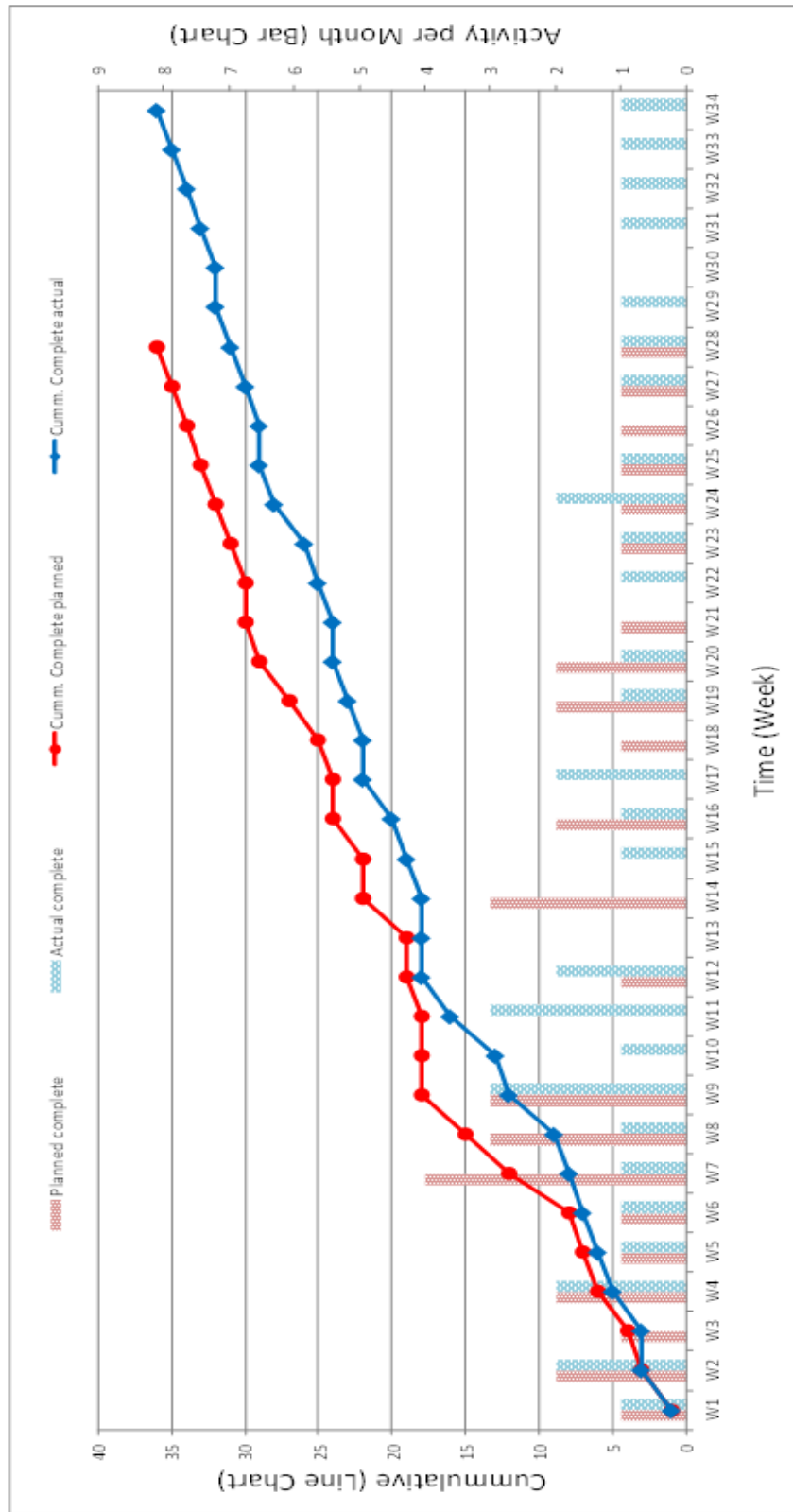


Figure 44: S-curve of previous project

In Figure 44, the graph shows comparison of activities planned to be performed, red bar, each week with actual activities performed, blue bar. The red line is cumulative plan that is used as baseline to compare with cumulative actual, blue line. The result shows that planned and actual activities are not align due to unappropriated tools and techniques used during planning, executing, and controlling phase which result in the late completion of the project.

After implementation, critical path is identified which allow the project to focus on the right activity. Controlling processes is applied to control and manage project performance. Project baseline is used and followed by project team. Weekly meeting is set to update project status to the team in which three reports, grant chart, milestone chart and S-curve, are created which allow project team to realize the project situation. The performance of study project is shown in Figure 45.

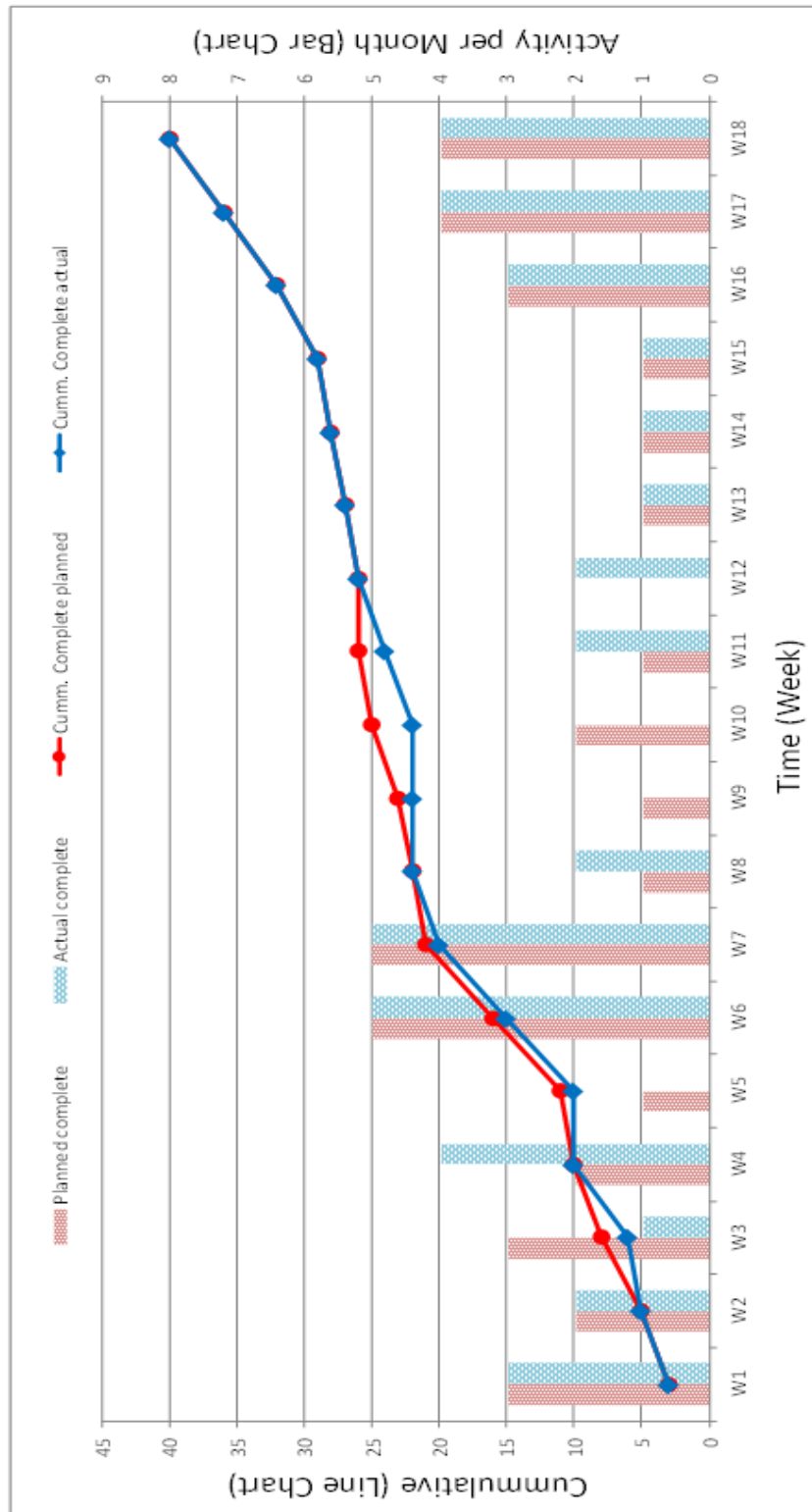


Figure 45: S-curve of studied project

From Figure 45, the result shows that after implementation of project time management follow the PMBOK guideline, project can be caught up every time when delay is occurred which implies the improving of project capability resulting in on time project delivery that affect to the company reputation and no penalty. Therefore, it can be concluded that project time management follow PMBOK concept can improve the process of project time management to the successful of project delivery.

6.2 Obstacle

The obstacle of this study started at the beginning. There are resistance from some employees when changes the way they managing their works. These people gave insufficient cooperation which made difficulty of implementation. However, the organization managed them by encourage them and notice them about disadvantage impact of the current process of work. Moreover, the company provided knowledge of project management to show them how this change support and improve the company. While the project was ongoing, the problem was from external factors such as delay of material delivery by supplier. Since the company did not have control over supplier so delays from late delivery was absorbed by the project. To catch up with the schedule, project had to add more resource to complete the work on time. This resulted in more expense to the project.

6.3 Recommendation

Since this study focused on project time management so there are room for improvement in area of risk, cost, and procurement management. Project risk management could be applying to the whole project to minimize the impact of project threats and seize the opportunities that occur. For example, needed for repair the failures could be prevented if project applies risk management since the beginning. There are ten golden rules of project risk management including make risk management part of the project, identify risks in early stage, communicate about risks, consider both threats and opportunities, clarify ownership issues, prioritize risks, analyze risks, plan and implement risk responses, register project risks, and track risks and associated tasks (Jutte 2014). These rules will guide project on how to implement risk management in the project.

Project cost management can be applying to guarantee that the project is completed within budget. For example, report in the second month shows that more resources were added to recover activities that are not in the critical path. As a result, the money spent on these activities does not help the project to catch up with delay. However, more margins could be earned if the project concerned the resources expense required to complete the activities. According to PMBOK guideline, project cost management consist of four processes including planning cost, estimating cost, determining budget, and controlling cost which are used during the

planning, monitoring and controlling phase. Furthermore, earned value management (EVM) could be used as key technique to bring success in project cost management.

Project procurement management describes the processes to obtain products or services from external source. When dealing with suppliers, it is important to have a legal binding contract that represents an agreement between company and supplier. The result from this study shows that project cannot control supplier because there is no agreement between these two parties. Since the project used in this study is small and not complex so the impact from supplier can be recover easily. However, more problems and risks will arise when working with larger project where there are multiple external sources. As stated in PMBOK guideline, there are six processes in this knowledge area including procurement planning, solicitation planning, source selection, contract administration, and contract closeout. By follow these six processes, project can transfer some risk to the supplier and retain control of any project purchases to the organization.

Lastly, this research can be used as a model to the company that have similar business, project based company. In addition, further study should be done in the areas that have not been observed in this study which is the part of project management successful.

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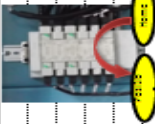
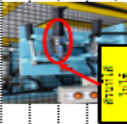


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APPENDIX

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Appendix B: Mitigation plan before implementation

Project status / Follow up						
Product number : APU 888 88 001 Record Data : 24-10-2013						
Item	Problems	Solution	Picture	Start	Target/Finish	Responsible
Planning						
ปัญหา Mechanical						
1	ทาง Honda ต้องการให้ติดตั้ง Solenoid Valve จากเดิมด้านขวามือเป็น Home ด้านซ้ายมือเป็น Positioning ทำงาน	ส่งสายลม และสวิตช์ลม ไปของ Valve (ยกมาติดตั้งไว้จากทาง Honda) เนื่องจากข้อจำกัดของการทำงานตามแบบและรูปแบบ		28-10-2013	29-10-2013	Sompong Sombat
2	ชุด Pokajoke มี Tool Torque ไม่ได้	แก้ไขชุด Pokajoke ใหม่ โดยมีการของเข้ามา Modify ภายในวันที่ 28-29/10/2013		28-10-2013	29-10-2013	Sompong
ปัญหา Electrical						
1	ทาง Honda ต้องการให้ปุ่ม Emergency มี Lamp หรือ ให้แสดง Alarm ที่หน้าจอ Operate	เนื่องจาก Part ชุดที่ทาง Honda ต้องการ ไม่มีติดแล้ว ดังนั้นจะเชื่อมเข้ากับทาง Operate แทน คือเพิ่มหน้า Alarm ของ Emergency		29-10-2013	30-10-2013	Programmer
2	ทาง Honda ต้องการให้ไฟ Warning สีแดง ที่ด้านบนของ Operate ได้แกว In feed	ทาง Desouter จัดหาไฟ Warning ให้ทาง AP ต่อและติดตั้ง		28-10-2013	28-10-2013	Matapong Thaweewut
3	เนื่องจากด้านหน้า Limit check repair ชุด Pokajoke ติดอยู่กับทาง Pallet engine	ย้ายด้านหน้า Limit check repair ชุด Pokajoke	ภาพประกอบข้อที่ 2	28-10-2013	29-10-2013	Sombat
4	มีแรง Torque Wrench แทนที่ตาม วิศวกรต้องการ	เพิ่มสายเข้า Junction Box	ภาพประกอบข้อที่ 6	28-10-2013	29-10-2013	Sombat
						การ Female Connector ทาง Honda support ประมาณ 2 week

VITA

Mr. Patipat Kruechotikul was born in 1987 in Thailand. He earned a Bachelor degree in Electrical Engineer from University of Missouri, USA in 2010. After his graduation, he has begun his career path in automotive industry. In 2012, he has an opportunity to expand his knowledge in railway industry until present. Along with his full-time job in railway industry, he took Master's degree in Engineering Business Management at the Regional Center for Manufacturing Systems Engineering, Chulalongkorn University and University of Warwick.

