Optimizing Project Management: Integrating Critical Chain Method with Modified Full-Time Equivalent at PT. Indospring Tbk

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Abstract. The Applied Technology Department at PT. Indospring Tbk encounters significant challenges in managing automation projects, such as uneven workload distribution and the absence of standardized tools for project planning and workload analysis. These issues lead to engineer overload, project delays, and reduced productivity. This study aims to tackle these problems by integrating the Critical Chain Project Management (CCPM) method with the Modified Full Time Equivalent (M-FTE) approach. CCPM is used to identify the critical chain and allocate buffers based on allowance values, while M-FTE calculates manpower needs using adjusted standard times. Researchers collected data through observation and processed this data using this integrated approach to develop and simulate three project management alternatives. The simulation results indicate that Alternative 1 (Option 1) and Alternative 1 (Option 2) are the most effective. Option 1, with five engineers, results in a total FTE of 2080 hours (6.6% above the ideal), whereas Option 2, with six engineers, achieves 1733.3 hours (11% below the ideal). These findings provide a practical framework for managerial decision-making that balances labor efficiency, workload distribution, and project timelines.

Keywords: Project Management, Critical Chain Project Management, Workload Analysis, M-FTE

1 Introduction

PT. Indospring Tbk is one of the leading companies in Indonesia's automotive spare parts industry, particularly in the manufacturing of leaf springs, coil springs, and stabilizer bars. To support its operations, PT. Indospring Tbk is structured into several departments, one of which is the Applied Technology Department. The primary role of the Applied Technology Department is to support the improvement of production quality and efficiency by implementing and developing machine automation technologies within the production processes at PT. Indospring Tbk.

The Applied Technology Department undertakes two types of projects across all areas of PT. Indospring Tbk, as follows:

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1. Machine Automation Projects: These projects focus on the implementation of technologies and systems on machines designed to optimize production and operational processes. In the industrial context, automation involves the use of computerized machinery and advanced control systems.
2. Production Line Projects: These projects concentrate on the planning, design, and application of technology to a series of processes or stages used in the production of goods. The main objective of these projects is to create an efficient and effective production system that enhances productivity and reduces operational costs.

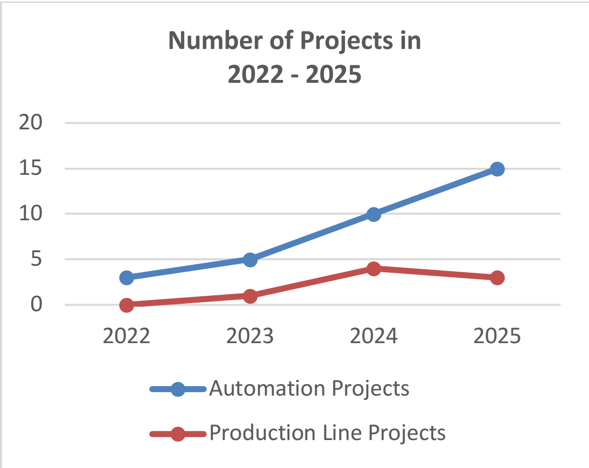


Fig. 1. Number of Project Departments Applied Technology in 2022 - 2025

The number of projects handled by the Applied Technology Department from 2022 to 2025 is shown in Fig. 1.
With the increasing number of tasks assigned annually by management to the Applied Technology Department - both related to machine automation projects and production line projects - several issues and challenges have emerged within the department, including:

1. The increasing workload in the Applied Technology Department, both in machine automation and production line projects, where the department is required by management to complete tasks on time according to the given deadlines while maintaining the highest quality of results.
2. The Applied Technology Department currently lacks standardized quantitative tools to support project management planning that takes into account the results of workload analysis.

In the book "Critical Chain" [3], Critical Chain Project Management (CCPM) is introduced as an innovative approach that addresses the shortcomings of traditional project management methods. In this study, The Critical Chain Project Management (CCPM) method was chosen due to its focus on managing time and resources by utilizing buffers to protect the project schedule, reducing unnecessary safety time, and manage constraints to enhance project efficiency and success.

Efficient workload planning through the optimization of engineer capacity is necessary to improve productivity [2]. A commonly used method for objectively calculating and analyzing workload is the Full-Time Equivalent (FTE) method. This method is used to help determine the effective and efficient number of personnel required for a given task based on the workload received [1]. In this study, the Full-Time Equivalent (FTE) method was selected because it enables a quantitative assessment of workforce requirements. This is crucial to avoid both overstaffing and understaffing, which can negatively impact team productivity.

Based on the background described above, a study was conducted to achieve optimal productivity and performance in the Applied Technology Department by planning project management through the integration of the Critical Chain Project Management (CCPM) method with workload analysis using the Modified Full-Time Equivalent (M-FTE) method. The purpose of this integration is to assess the extent to which it can improve workload allocation efficiency, reduce the risk of overload, and support timely project completion. The results of this study are expected to provide guidance for the Applied Technology Department in designing project management planning that is not only effective but also considers the well-being of the engineers.

The purpose of this research is as follows:

1. To develop a more effective and efficient project management model for the Applied Technology Department through the integration of Critical Chain Project Management (CCPM) and Modified Full Time Equivalent (M-FTE) methods as an integrated approach to create a responsive project management system and improve workload allocation efficiency, reduce overload risk and ensure timely project completion.
2. To identify the optimal level of engineer needs using the Modified Full Time Equivalent (M-FTE) method, so as to estimate the proper resource allocation based on the workload analysis faced by the Applied Technology Department.

The expected benefits of this research can be divided into several aspects, namely:

1. Practical benefits for the company: This research can assist PT. Indospring Tbk, particularly the Applied Technology Department, in improving the efficiency and effectiveness of project management. With more structured methods such as Critical Chain Project Management (CCPM) and Modified Full Time Equivalent (M-FTE), the company can optimize resource and time allocation, reduce the risk of overload, and achieve project completion according to target. This will have a positive impact on the company's productivity and competitiveness in the market.
2. Benefits for engineers: The implementation of methods that consider physical workload, such as the Modified Full Time Equivalent (M-FTE), is expected to create a healthier and more balanced work environment. With workload allocated according to capacity, engineers can work more optimally.
3. Benefits for scientific development: This research can serve as an additional reference in the field of project management, particularly regarding the integration of

Critical Chain Project Management (CCPM) and Modified Full Time Equivalent (M-FTE) methods in real case studies.
4. Benefits for other automotive manufacturing companies: The results of this research can also be adapted by other companies operating in the automotive manufacturing sector. This approach can be applied to address workload and project management issues, thereby improving production and project management efficiency across the relevant industry.

The Scopes and assumptions of this research are as follows:

1. There are no changes in job roles and job descriptions during the course of this research.
2. There are no policy changes by company management during the course of this research.

2 Research Methods

This phase begins with data collection through direct field studies and observations of the mechanical design engineer team in the Applied Technology Department to gather the necessary data. The data required for this research consists of both primary and secondary data. Primary data includes Key Performance Indicator (KPI) activity data, the Department Job List for 2025, and estimated time for KPI task completion, which is analyzed based on historical project data from the past three years and determined according to task complexity levels. This is because historical data shows that the estimated completion time provided to engineers is highly susceptible to bias and cannot be considered an accurate reference. Secondary data includes the company's general profile, the general profile of the Applied Technology Department, and a summary of the number of engineers in the mechanical design engineering section of the Applied Technology Department.

Data processing begins with determining the complexity level of tasks in the Department Task List for 2025, as provided by management. This aims to differentiate the characteristics of one task from another.

2.1 Critical Chain Project Management (CCPM)

Critical Chain Project Management (CCPM) is a project management approach developed by Eliyahu M. Goldratt in 1997. This approach focuses on managing uncertainty and resource constraints within a project. In CCPM, the use of time buffers is key to protecting the project from uncertainty and ensuring timely completion. According to [6], the use of these buffers helps reduce pressure on the project team and increases flexibility in planning and execution. As stated in [6], CCPM includes several key elements that distinguish it from other project management methods:

1. Critical Chain: In CCPM, the critical chain refers to the sequence of tasks that has the greatest impact on the overall project duration. Unlike in the Critical Path

Method (CPM), the critical chain can change as the project progresses, and project managers must continuously update their understanding of the critical chain.
2. Buffers: CCPM utilizes three types of buffers: Project Buffer, Feeding Buffer, and Resource Buffer. These buffers are designed to protect the project from variability and ensure that critical activities can be completed on time.
3. Resource Management: A primary focus of CCPM is the management of resources required to complete activities on the critical chain. Efficient utilization of resources helps reduce waiting times and enhances productivity.

The following are the steps of the Critical Chain Project Management (CCPM) method applied in this study:

- Development of the Work Breakdown Structure (WBS)
- Identification of the critical chain
- Determination of project buffers using allowance values
- Project scheduling using the Critical Chain Project Management (CCPM) method

2.2 Modified Full-Time Equivalent (M-FTE)

One of the methods that can be used to measure workload is the Full Time Equivalent (FTE) method [5]. The FTE method simplifies workload measurement by converting workload hours into the number of people required to complete a specific task. This approach focuses on the time needed to complete a task or job, which is then converted into an FTE index value.

The allowance value used to determine the buffer becomes a factor incorporated into the Full-Time Equivalent (FTE) calculation. This allowance, once quantified, is added to the estimated task completion time to obtain a standard or ideal time that accounts for disruptions and rest requirements. In this way, time planning becomes more realistic, as it includes a time buffer to address unavoidable delays or interruptions. The inclusion of this additional factor in the FTE calculation leads to the method being referred to as the Modified Full-Time Equivalent (M-FTE) method.

Next, the standard or conventional stage of the Full Time Equivalent (FTE) method will be carried out, which involves calculating the FTE index for each employee by first dividing the workload hours by the company's FTE. Workload hours are obtained from the total number of working hours borne by each employee in a given project or task. The company's FTE is calculated by subtracting the total number of calendar days (365 days) by non-working days (weekends, national holidays, leave, training, etc.), and then multiplying the result by the number of working hours per day (8 hours).

The formula used to calculate the FTE index for each employee is as follows:

$$\text{FTE of Employee} = \frac{Workload\ Hours}{Company's\ FTE} \quad (1)$$

Where:

$$\text{Workload Hours} = \text{period x frequency x quantity x process time} \quad (2)$$

$$\text{Company's FTE} = (365 - \text{off days}) \times \text{working hours per day} \quad (3)$$

The result of employee FTE calculation can be categorized into three types which are called as FTE index. According to the workload analysis guidelines from KEP/75/M.PAN/7/2004 [4], each category has the following range of values:

The FTE index classification used in this study is summarized in Table 1.

Table 1. FTE Index

Index	Definition
FTE = 0 – 0.99	Underload
FTE = 1 – 1.28	Normal
FTE > 1.28	Overload

3 Results and Discussion

This chapter will focus on data processing according to the conditions of the observed object, namely the "Mechanical Design Engineer" section of the Applied Technology Department at PT. Indospring, Tbk.

3.1 Overview of the Research Object

The Applied Technology Department was established by PT. Indospring Tbk in February 2022. The primary responsibility of this department is to develop and implement automation and machinery systems in the production process at PT. Indospring Tbk to enhance the quality and efficiency of production. The organizational structure of the Applied Technology Department is shown in Fig. 2, which serves to clarify responsibilities, explain the position and coordination of each department member, outline the hierarchical relationships, provide clear task descriptions, and support the achievement of the department's objectives.

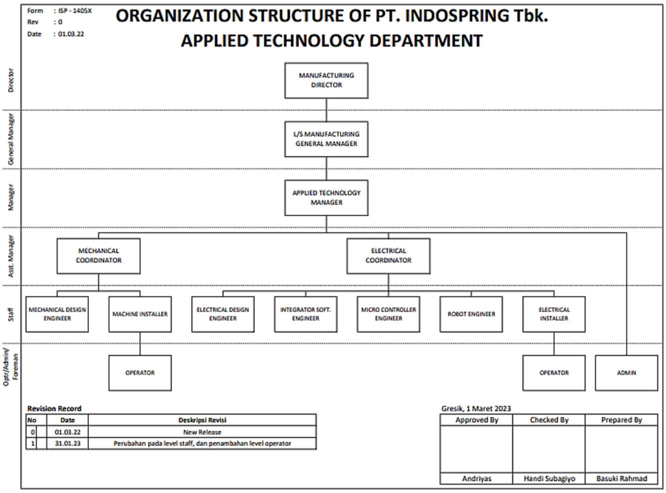


Fig. 2. Organization Structure of the Applied Technology Department

The Applied Technology Manager supervises two assistant managers, namely the Mechanical Coordinator and the Electrical Coordinator. The Mechanical Coordinator oversees two staff sections, namely the Mechanical Design Engineer and the Machine Installer. The object of observation in this study is the "Mechanical Design Engineer" section, which has several main tasks, including the following:

- Machine design and development
- Machine performance analysis and simulation
- Documentation and standardization
- Testing and validation of machine design
- Collaboration with other teams and departments
- Continuous improvement and research development

The engineers in the Mechanical Design Engineer section, which are the subject of this study, consist of a total of 3 (three) engineers. A summary of the data for the engineers in the Mechanical Design Engineer section is shown in Table 2 below.

Table 2. Summary of Engineer Data for the Mechanical Design Engineer Section as of January 2025

No.	Name	Position	Age (Years)	Experience (Month)
1	ARM	Mechanical Design Engineer	22	26
2	AAP	Mechanical Design Engineer	27	29
3	AH	Jr. Mechanical Design Engineer	27	3

There are 2 Key Performance Indicators (KPI) in the Mechanical Design Engineer section of the Applied Technology Department, namely:

- Engineering Work Package (EWP)
- Design conformity

The detailed KPI activities for the Engineering Work Package are listed in Table 3.

Table 3. List of KPI Activities for Engineering Work Package in the Mechanical Design Engineer Section (1)

Phase: Project Scoping
Product and System Design (PSD) Meeting
Site Visit / Genba
Develop PSD form and approval.
Develop conceptual design (design brief)
Develop Work Breakdown Structure (WBS)
Develop project schedule

The continuation of the KPI activity list for the Engineering Work Package is provided in Table 4.

Table 4. List of KPI Activities for Engineering Work Package in the Mechanical Design Engineer Section (2)

Phase: Design Concept
Site Visit/Genba
Technology studies and benchmarking
Develop of initial design concept.
Technical feasibility evaluation
Economic feasibility evaluation
Review and feedback
Concept Finalization
Phase: Design Model
Data and reference preparation
Technical calculation and analysis
Creation of 3D CAD models
Interference and conformity analysis
Geometry and Material Optimization
FEA simulation and initial validation
Making technical drawing
Making Bill of Material (BOM)
Technical drawing and BOM review and revision
Finalization of model and documentation

Follow up standard part procurement - before PO issues.
Create a pneumatic system diagram.
Create a hydraulic system diagram.
Complement deficiencies

The KPI activities related to design conformity are summarized in Table 5.

Table 5. List of KPI Activities for Design Conformity in the Mechanical Design Engineer Section

Phase: Standard Part Procurement
Follow up standard part procurement - after PO issues.
Phase: Close Out
Prepare a punch list and follow up with the fabrication team.
Prepare markup and as-built drawing.
Prepare the handover document for approval to the customer
Prepare Engineering Work Request (EWR) close-out document.
Coordination meeting, etc. (if any)

3.2 Department Task List 2025

The Department Task List 2025 is a list of projects that must be carried out by a department to achieve the company's objectives for the year 2025. Each project includes improvement activities that must be executed in alignment with Key Performance Indicator (KPI) activities. These KPI activities are performed sequentially through the following phases: project scoping, design concept, design model, standard part procurement, and close-out. The sequential execution of these KPI activities forms a critical chain.

3.3 Determination of Task Complexity Levels

Since each task has different characteristics, the difficulty level and estimated completion time of each task must also be differentiated based on its complexity level. The task complexity levels are divided into 3 (three) categories based on the complexity score, which are:

- Simple: complexity score 4 – 10
- Medium: complexity score 11 – 16
- Complex: complexity score +17

The complexity score is obtained by summing the scores from each of the task complexity categories, which are:

- Technology & innovation
- Design complexity

- Regulatory requirements & safety standards
- Integration with existing system

3.4 Effective Working Time

The determination of effective working days and effective working hours can be seen in Table 6.

In Table 6, the effective working days are obtained by subtracting the number of weekend days (Saturdays and Sundays) in a year, the number of national holidays in a year, the number of annual leave days (which vary for each level of engineer), and the number of training days for engineers in a year, from the total days in a year.

The standard working hours per day are 8 hours, so the company's FTE for one year can be calculated by multiplying the total effective workdays by the standard working hours per day.

Table 6. Effective Working Time in 2025

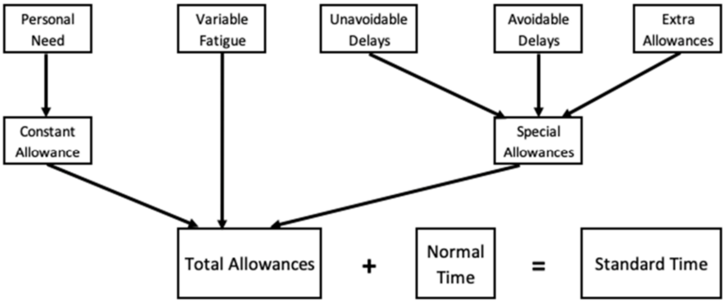
<table>
<tr><th colspan="4">Effective Working Time in 2025</th></tr>
<tr><th></th><th></th><th>Junior Engineer</th><th>Engineer</th></tr>
<tr><td>Total Days</td><td>Days of Calendar</td><td colspan="2">365</td></tr>
<tr><td rowspan="3">Off Days</td><td>Weekend (Saturday and Sunday)</td><td colspan="2">104</td></tr>
<tr><td>National Holiday</td><td colspan="2">17</td></tr>
<tr><td>Annual Leave</td><td>0</td><td>12</td></tr>
<tr><td rowspan="3">Total</td><td>Total Effective Workdays (Total Days - Off Days)</td><td>244</td><td>227</td></tr>
<tr><td>Working Hours per Day</td><td>8</td><td>8</td></tr>
<tr><td>Company's FTE (Hours per Year)</td><td>1952</td><td>1856</td></tr>
</table>

3.5 Estimated Task Completion Time Data

The estimated task completion time data is obtained using the expert judgment method, where the process of determining the estimated completion time is carried out by an expert, namely the Mechanical Coordinator, by observing and analyzing historical project data from the past 3 years and is determined based on the task complexity level.

3.6 Determination of Allowance Values

Based on the ILO (International Labor Organization) table for determining allowance values, several criteria related to each Key Performance Indicator (KPI) activity, as shown in Table 3 and Table 4, were selected. In general, allowance is divided into two categories. The first category is personal allowance, which refers to unavoidable allowances in each activity, such as going to the restroom, discussing with coworkers, and so on. The second category is fatigue allowance, which refers to allowances related to physical factors or working environmental conditions that can cause fatigue and affect the engineer's performance, such as working posture (standing allowance), muscular strength usage (muscular energy), light conditions, noise, the need for focus (close attention), and monotonous activities (monotony).



The key elements that form allowance time are illustrated in Fig. 3.

Fig. 3. Elements of Allowance Time

3.7 Determination of Buffer Time Using Allowance Values

The buffer time determined using the allowance values is obtained by multiplying the estimated completion time for each Key Performance Indicator (KPI) activity by the allowance value for each KPI activity that has been set. The calculated buffer time is then added to the estimated completion time of each KPI activity to obtain the standard or ideal time, which takes into account disruptions and rest needs. This approach makes time planning more realistic, as there is a buffer to handle delays or unavoidable disturbances.

$$\text{Buffer Time} = \text{Estimated Task Completion Time} \times \text{Allowance Value} \tag{4}$$

$$\text{Standard Time} = \text{Buffer Time} + \text{Estimated Task Completion Time} \tag{5}$$

3.8 Task Completion Duration for Department Task List 2025

The task completion duration for the Department Task List 2025 is based on the estimated completion time obtained using the expert judgment method and the complexity level of each task. By understanding the task duration accurately, the company can optimize planning and resource allocation to improve productivity.

3.9 Project Management Alternative 1

This alternative solution is designed to optimize project planning and execution to ensure the timely completion of the Department Task List 2025, in accordance with the deadlines set by management. This is achieved by calculating the FTE index value for each engineer to determine the optimal number of engineers required, as well as by developing the Department Activity Plan 2025 for Alternative Project Management 1.

The calculation of the optimal number of engineers is based on the FTE method, which considers the workload of each engineer (FTE index = 1 – 1.28), the company's FTE, and other factors such as work efficiency, avoiding excessive multitasking, and resource limitations. The optimal number of engineers is determined by summing the total workload (regardless of level) and dividing it by the effective working time per year, as shown in Table 6, where the largest effective working time of 1952 hours per year in 2025 is used. The results of the calculation of the optimal number of engineers can be seen in Table 7.

The resulting calculation of the optimal number of engineers for Alternative 1 is presented in Table 7.

Table 7. Calculation Results of the Optimal Number of Engineers for Alternative 1

Total Workload (Hrs)	10400
Company's FTE (Hrs)	1952
Optimum Engineer	5.33
Current Engineer	3

In the table above, the total workload is 10,400 hours, and with the company's FTE total being 1,952 hours, the optimal number of engineers required is 5.33. When rounded, there are two options: rounding down (5 engineers) or rounding up (6 engineers).

Option 1

If using the rounding down option (5 engineers), as shown in Table 7, the company's FTE total required to complete the total workload becomes 2,080 hours. This company's FTE total is slower than the ideal company's FTE.

The rounding-down scenario (5 engineers) and its resulting company FTE are shown in Table 8.

Table 8. Calculation Results of the Optimal Number of Engineers for Alternative 1 (Option 1)

Total Workload (Hrs)	10400
Optimum Engineer	5
Company's FTE (Hrs)	2080

After determining the optimal number of engineers required to complete the Department Task List 2025, the next step is to design the Department Activity Plan 2025 Alternative 1 (Option 1) using the multi-project-based Critical Chain Project Management method, which is applied in environments where several projects run in parallel utilizing the same resources. In this study, there are 18 projects in 2025, each containing improvement activities. Every improvement activity has a uniform critical chain activity structure, namely the Key Performance Indicator (KPI) activities (as shown in Table 3 and Table 4). The human resources used in Option 1 consist of five people (as shown in Table 8), requiring intensive involvement of the same workforce for each improvement activity. By adopting the multi-project-based Critical Chain Project Management approach, projects are scheduled not simultaneously but in a coordinated manner to avoid resource conflicts. The design of the Department Activity Plan 2025 Alternative 1 (Option 1) can be developed using Microsoft Project.

The distribution of total workload per engineer for Alternative 1 (Option 1) is shown in Fig. 4.

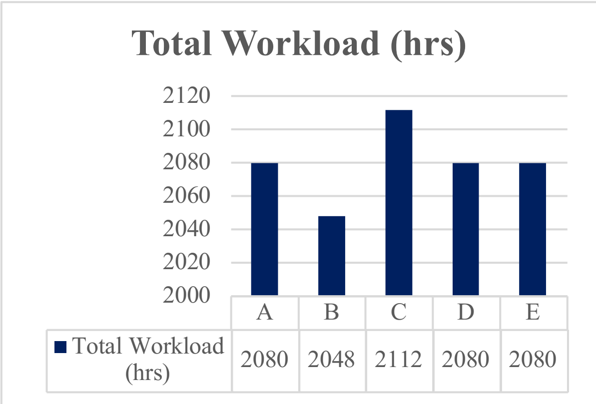


Fig. 4. Total Workload of Each Engineer (hrs) Project Management Alternative 1 (Option 1)

In Fig. 4 above, a recap of the data regarding the workload of each engineer in hours is presented after designing the Department Task List 2025 Alternative 1 (Option 1) to complete the total workload. Based on the results of Project Management Alternative 1 (Option 1), if five engineers are utilized to complete a total workload of 10,400 hours, the company's FTE total required to complete the workload is 2,080 hours, which is slower than the ideal company's FTE (1,952 hours). Therefore, the average workload per engineer from the optimal number of engineers (five people) is 2,080 hours with an FTE value of 1.00 (normal).

Option 2

If using the rounding-up option (6 engineers), as shown in Table 9, the company's FTE total required to complete the total workload becomes 1,733.3 hours, which is faster than the ideal company's FTE.

The rounding-up scenario (6 engineers) and its resulting company FTE are shown in Table 9.

Table 9. Calculation Results of the Optimal Number of Engineers for Alternative 1 (Option 2)

Total Workload (Hrs)	10400
Optimum Engineer	6
Company's FTE (Hrs)	1733.3

After determining the optimal number of engineers required to complete the Department Task List 2025, the next step is to design the Department Activity Plan 2025 Alternative 1 (Option 2) using the multi-project-based Critical Chain Project Management method, which is applied in environments where multiple projects are carried out in parallel using the same resources. In this study, there are 18 projects planned for 2025, each of which includes improvement activities. Every improvement activity has a uniform critical chain activity structure, namely Key Performance Indicator (KPI) activities (as shown in Table 3 and Table 4). The human resources used in Option 2 consist of six people (as shown in Table 9), requiring intensive involvement of the same workforce for each improvement activity. By adopting the multi-project-based Critical Chain Project Management approach, projects are scheduled not simultaneously but in a coordinated manner to avoid resource conflicts. The design of the Department Activity Plan 2025 Alternative 1 (Option 2) can be developed using Microsoft Project.

The distribution of total workload per engineer for Alternative 1 (Option 2) is shown in Fig. 5.

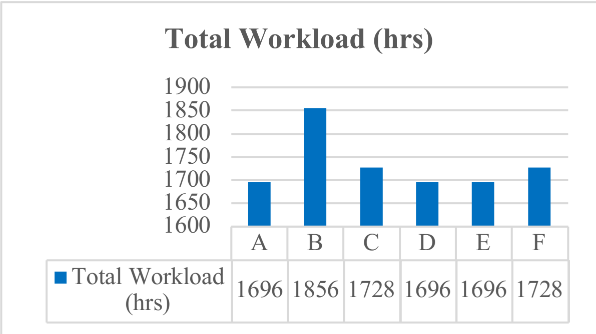


Fig. 5. Total Workload of Each Engineer (hrs) Project Management Alternative 1 (Option 2)

In Fig. 5 above, a recap of the data regarding the workload of each engineer in hours is presented after designing the Department Task List 2025 Alternative 1 (Option 2) to complete the total workload. Based on the results of Project Management Alternative 1 (Option 2), if six engineers are utilized to complete a total workload of 10,400 hours, the company's FTE total required to complete the workload is 1,733.3 hours, which is faster than the ideal company's FTE (1,952 hours). Therefore, the average workload per engineer from the optimal number of engineers (six people) is 1,733.3 hours with an FTE value of 1.00 (normal).

3.10 Project Management Alternative 2

This alternative is designed to focus project planning and execution by taking into account and aligning with the current number of available engineers (3 engineers).

The calculation of the optimal company's FTE is based on the FTE method, which considers the workload of each engineer (FTE index = 1 – 1.28), taking into account and adjusting for the number of engineers currently available, which is 3 engineers.

The optimal company's FTE is obtained by summing the total workload (without differentiating levels) and then dividing it by the number of engineers currently available, as shown in Table 2. The results of the optimal company's FTE calculation can be found in Table 10.

Table 10. Calculation Results of the Optimal Company's FTE

Total Workload (Hrs)	*10400*
Current Engineer	*3*
Company's FTE (Hrs)	***3466.7***

In the table above, the total workload is 10,400 hours with the current number of engineers being 3. The calculation results of the Company's optimal FTE are 3446.7 hours, where this company's FTE total is slower than the ideal company's FTE.

After determining the optimal company's FTE required to complete the Department Task List 2025 by considering and adjusting to the current number of available engineers, the next step is to design the Department Activity Plan 2025 Alternative 2 using the multi-project-based Critical Chain Project Management method, which is applied in environments where multiple projects are executed in parallel using the same resources. In this study, there are 18 projects planned for 2025, each of which includes improvement activities. Every improvement activity has a uniform critical chain activity structure, namely Key Performance Indicator (KPI) activities (as shown in Table 3 and Table 4). The currently available human resources consist of three people (as shown in Table 9), requiring intensive involvement of the same workforce for each improvement activity. By adopting the multi-project-based Critical Chain Project Management approach, projects are scheduled not simultaneously but in a coordinated manner to avoid resource conflicts. The design of the Department Activity Plan 2025 Alternative 2 can be developed using Microsoft Project.

The distribution of total workload per engineer for Alternative 2 is shown in Fig. 6.

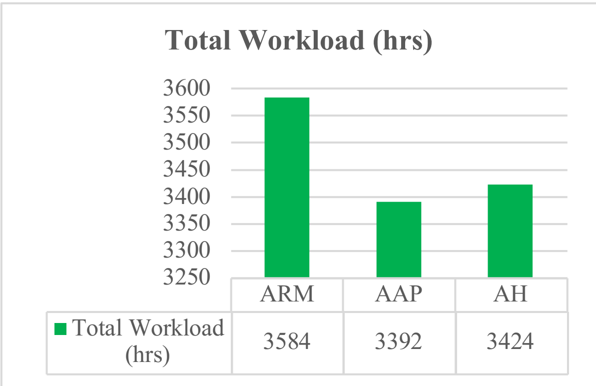


Fig. 6. Total Workload of Each Engineer (hrs) Project Management Alternative 2

In Fig. 6 above, a recap of the data regarding the workload of each engineer in hours is presented after designing the Department Task List 2025 Alternative 2 to complete the total workload. Based on the results of Project Management Alternative 2, if the current number of engineers, namely three people, is used to complete a total workload of 10,400 hours, the company's FTE total required to complete the workload is 3,466.7 hours, which is slower than the ideal company's FTE (1,952 hours). Therefore, the average workload per engineer from the current total number of engineers (three people) is 3,466.7 hours with an FTE value of 1.00 (normal).

3.11 Comparison Analysis of Alternative 1 and Alternative 2

Project Management Alternative 1 and Project Management Alternative 2 each have their respective advantages and disadvantages, which can serve as the basis for management to decide which project management design to implement. Both Project Management Alternative 1 and Project Management Alternative 2 share one similarity: the average engineer has an FTE value of 1.00 (normal), ensuring that the workload is evenly distributed across engineers and does not exceed their capacity (overload)

In the Project Management Alternative 1 design, there are 2 design options, namely: Project Management Alternative 1 (Option 1) and Project Management Alternative 1 (Option 2). Each of these options has its strengths and weaknesses. The advantages and disadvantages of Project Management Alternative 1 (Option 1) are as follows:

- Advantages: Requires fewer optimal engineers (5 people) compared to Project Management Alternative 1 (Option 2).
- Disadvantages: The time required to complete the total workload is slower than it should be (1952 hours).

Advantages and Disadvantages of Project Management Alternative 1 (Option 2):

- Advantages: The time required to complete the total workload is faster than the ideal company's FTE (1952 hours).
- Disadvantages: Requires more optimal engineers (6 engineers) compared to Project Management Alternative 1 (Option 1).

Advantages and Disadvantages of Project Management Alternative 2:

- Advantages: Utilizes the current number of engineers, which is 3, thus eliminating the need for additional hiring.
- Disadvantages: The time required to complete the total workload is slower than the ideal company's FTE (1952 hours) and slower than the Project Management Alternative 1 plan.

To determine whether an engineer can still be assigned tasks and ensure workload distribution, the results of the project management plan integrating the Critical Chain Project Management (CCPM) method and the Modified Full-Time Equivalent (M-FTE) method can serve as a reference. In this approach, engineers who finish their tasks ahead of others and fall into the FTE underload category can be prioritized when new or follow-up tasks arise. From the project management plan, several engineers can be assigned additional or follow-up tasks. For example, in the case of Project Management Alternative 1 (Option 1), Engineer B has a lower total workload than other engineers, indicating that Engineer B completed their tasks ahead of others and falls under the FTE underload category. As a result, Engineer B can be given additional tasks or follow-up assignments. To ensure efficiency, a partial handover or 'back-to-back' task assignment can be implemented, where Engineer C transfers some of their tasks to Engineer B. This way, both Engineer B and Engineer C will have an equal total workload of 2080 hours, ensuring that all tasks are completed on time, and in line with the project's target and schedule.

4 Conclusion

After integrating the Critical Chain Project Management (CCPM) method with the Modified Full Time Equivalent (M-FTE) method in the Applied Technology Department, specifically in the Mechanical Design Engineer section, the following conclusions can be drawn:

1. Determination of the optimal number of engineers
   - Alternative 1 (Option 1) requires 5 engineers, with each engineer having an average total company FTE of 2,080 hours, which is only 6.6% above the ideal capacity of 1,952 hours per engineer. The M-FTE per engineer is 1.00 (normal).
   - Alternative 1 (Option 2) requires 6 engineers, with each engineer having an average total company FTE of 1,733.3 hours, which is 11% below the ideal capacity of 1,952 hours per engineer. The M-FTE per engineer is 1.00 (normal).
   - Alternative 2 utilizes the current engineering team of 3 engineers, with each engineer having an average total company FTE of 3,466.7 hours, which is 1.7 times higher than the ideal capacity of 1,952 hours per engineer.
2. The addition of allowance in FTE calculation (M-FTE) provides a more realistic estimate of the workload compared to conventional FTE.
3. Integration of the Critical Chain Project Management (CCPM) method with the Modified Full Time Equivalent (M-FTE) method can be used to design project management by considering the engineer's workload over time, determining the optimal number of engineers, and balancing the workload from qualitative data while considering the complexity and level of the project.

5 Recommendation

Several recommendations can be provided based on this research, namely:

1. To achieve an M-FTE calculation result of 1–1.28 (normal), develop project management practices that minimize multitasking for each engineer, and implement task handovers — whether full or partial — from engineers experiencing workload overload to those with underload conditions.
2. Digitize project management by utilizing Microsoft Project or developing a real-time dashboard that displays FTE status, buffer consumption, and critical chain schedules, to facilitate managers in monitoring and assessing the current condition of available resources.

3. Establish HR policies by setting an FTE standard of 1–1.28 for each engineer and provide training to reduce monotony while expanding the competencies of each engineer.

References

1. Adawiyah, W., Sukmawati, A.: Analisis Beban Kerja Sumber Daya Manusia dalam Aktivitas Produksi Komoditi Sayuran Selada (Studi Kasus: CV Spirit Wira Utama), Jurnal Manajemen dan Organisasi, **4**(2), 128-143 (2016)
2. Berseneva, K. V., Natsubidze, A. S.: Human resource planning in implementation of industrial enterprises' strategy. World Applied Sciences Journal, **29**(3), 433–437 (2014)
3. Goldratt, E. M.: Critical Chain. North River Press, Massachusetts (1997)
4. Kementerian Pendayagunaan Aparatur Negara.: KEP/75/M.PAN/7/2004 Pedoman Perhitungan Kebutuhan Pegawai Berdasarkan Beban Kerja dalam Rangka Penyusunan Formasi Pegawai Negeri Sipil. Indonesia: (2004)
5. Rachmuddin, Y., Dewi, D. S., Dewi, R. S.: Workload Analysis Using Modified Full Time Equivalent (M-FTE) and NASA-TLX Methods to Optimize Engineer Headcount in the Engineering Service Department. In: IOP Conference Series: Materials Science and Engineering, pp. 175-180. IOP Publishing, Bristol (2021)
6. Raz, T., Barnes, R., Dvir, D.: A Critical Look at Critical Chain Project Management. IEEE Engineering Management Review **32**(2), 35-44 (2004)