Analysis of Schedule Project Management’s Indicators and Cost Project Management’s Indicators in Interior Construction

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Abstract. The development of the construction is growing rapidly, both large-scale projects and small-scale projects. In practice, when the project is seen in terms of cost and resources, construction has limitation. With this limitation, a construction project management is needed. Schedule planning and cost planning for a project is one part of construction project management. Apart from quality, the achievement of a project can be in terms of cost and time. A symptom of poor project management will cause irregularities in terms of project completion time and in terms of cost. With good project management it will be possible to take preventative measures so that the project is carried out according to plan. Planning work schedules and planning costs that have been incurred must be measured in advance. In its implementation, a project may experience delays, acceleration, or on time according to the project plan schedule. In terms of cost, implementation in a project may experience advantages or disadvantages. Schedule and cost management planning is something that cannot be separated from each other. In this study will examine what are schedule management’s indicators and cost management’s indicator that influential or most important in interior construction.

1. Introduction
Before entering any further, what is interior that will be discussed in this study? Interior design is the layout planning and design of space in a building. Interior is formed from forming elements consisting of: floor, walls, ceiling, aesthetics, openings and light [1]. In general, the presence of these 6 elements will form a space. Small-scale projects such as interior projects, are currently developing rapidly. The interior design industry continues to grow. According to the Chairperson of the Indonesian Interior Designers Association (HDII) Rohadi, quoted from lifestyle.bisnis.com, said that this industry continues to move in line with the growth of the property and building market which in recent years has been massive, not only on Java but also on the island other islands in Indonesia. However, the interior construction industry has a short / fast period so it requires good scheduling so that project delays do not occur. If there is a delay it will affect project financing and the project finance management does not run well will affect the completion time of a project. This can affect the performance of project work. So, we must know what indicators that have influence in schedule management and cost management before arranging scheduling and financing properly. By conducting a literature review and a relevant research study can help to understand it and can improve work performance in the project.
Therefore, to optimize the performance of a project this research will be carried out. Through this research, it is hoped that it can help small-scale service providers how to plan schedules well and analyze costs so that costs are not excessive. Understanding planning of work schedules and planning costs that are known in advance can help improve project performance. This research will use a case study from the XYZ company’s project whose company is engaged as an interior contractor.

2. Literature

2.1. Project Schedule Management

Scheduling is an activity to determine the time a project can be completed [2]. In project schedule management includes activities that are needed to ensure the project is completed within the approved time. Understanding of these factors is done by reviewing the 6 stages in the scheduling process, included identification of project’s activities, estimation of activities’ time, preparation of project work plans, scheduling project’s activities, review and analysis of the schedule that has been made, and finally application of the schedule [3]

2.1.1 Work Breakdown Structure (WBS). Work Breakdown Structure is a list of project’s activities that is organized. WBS provides a hierarchical structure that acts as a bridge or a link between the scope of the project and the detailed plan of the project. WBS breaks down or divides the project into smaller components. [4] [5]

2.2. Project Cost Management

In project cost management includes activities that are needed to ensure the project is completed within the approved budget. Project manager must ensure that project has estimation of completion time and cost accurately. There are 3 main activities on project cost management, there are cost estimation, budget estimation and cost controlling [6]

2.2.1. Earned Value. Earned Value (EV) is a project management technique for measuring project performance and progress within construction time. The concept of Earned Value combines cost, schedule and job performance. There are 3 indicators used: Actual Cost of Work Performed (ACWP), Budgeted Cost of Work Performed (BCWP) and Budgeted Cost of Work Schedule (BCWS). ACWP is the actual amount of expenditure or funds used to carry out the work in a certain period of time. BCWP is the value of the results from the value of work completed on the budget provided to carry out of the work. BCWS is the amount of the budget for the work that is linked to the implementation schedule. [7]

2.2.1.1 Cost Variance (CV). Cost Variance is the difference between the value obtained after completing work packages with actual costs during project implementation. CV’s value can be found by subtract BCWP’s value and ACWP’s value

\[ CV = BCWP - ACWP \]

2.2.1.2 Schedule Variance (SV). Schedule Variance is an indicator of whether a project schedule is ahead or behind. SV’s value can be found by subtract BCWP’s value and BCWS’s value

\[ SV = BCWP - BCWS \]

2.2.1.3 Cost Performance Index (CPI). Cost Performance Index is a measure of the financial effectiveness and efficiency of a project. It represents the amount of completed work for every unit of cost spent. CPI’s value can be found by dividing BCWP’s value and ACWP’s value.
\[ \text{CPI} = \frac{\text{BCWP}}{\text{ACWP}} \]

CPI’s Indicator Value, if CPI < 1 means project is over budget, if CPI = 1 means project is on budget and if CPI > 1 means project is under budget.

2.2.1.4 Schedule Performance Index (SPI). Schedule Performance Index is a measure of how close the project is to being completed compared to the schedule. SPI’s value can be found by dividing BCWP’s value and BCWS’s value.

\[ \text{SPI} = \frac{\text{BCWP}}{\text{BCWS}} \]

CPI’s Indicator Value, if SPI < 1 means project is behind schedule, if SPI = 1 means project is on schedule, and if SPI > 1 means project is ahead of schedule.

2.2.1.5 Critical Ratio (CR). CR combines both cost performance index (CPI) and schedule performance index (SPI) to represent the project status. CR’s value can be found by BCWP’s value times ACWP’s value. [8] [9] [10]

\[ \text{CR} = \text{CPI} \times \text{SPI} \]

CR’s Indicator Value, if CR < 1 means poor project performance, if CR = 1 means project performance is on target and if CR > 1 means good project performance.

2.3. Research Process

This study starts from PT XYZ that has problem in managing schedule and cost in their projects. In this journal study will only discuss about first until third problems. The first problem is how is the portrait from this research? The second problem is what are schedule management project’s indicators in this study? And the last problem is what are cost management project’s indicators in this study? After the problems are found, literature study and study research will be done. After that, the study will compare between the theories and the real data, and conclusion can be found.

![Figure 1 Research Process Plot](image-url)
3. Study Case and Discussion

In interior, review and analysis of the schedule that has been made, is an important part. In schedule management there are 6 stages in the scheduling process, included identification of project’s activities, estimation of activities’ time, preparation of project work plans, scheduling project’s activities, review and analysis of the schedule that has been made, and finally application of the schedule. In interior construction, schedule that has been used have to be reviewed in case there is a delay and it will affect project cost too. Short term project has higher risk because of faster pace of working. To prevent delay, review and analysis of the schedule that has been made and used is the most important thing to do in schedule management of interior construction. Cost management in interior, there are 3 main activities on project cost management, there are cost estimation, budget estimation and cost controlling. In interior project’s case, budget controlling has an important part to ensure the project is completed within the approved budget. Short term project has higher risk to lead spending more money and become over budget within short time.

This study will use PT XYZ’s finished project to show how important reviewing and analysis of the schedule that has been made and used and cost controlling in project.

3.1. Study Case.
The purpose of this study is to review PT XYZ’s project. This project works time is 28 days (4 weeks) calendar days. This project contract’s value is 306.136.075,575 (after tax). This project has done in 2019. Data analysis will use the Earned Value method. The Earned Value method can be used to review whether it was completed with the initial plan of the project schedule in the reporting period as well as the amount of profit or loss at the end of the project.

3.2. Data
This study case included many works, like preliminary works, civil interior and MEP works.

![Figure 2 Study Case’s Work Breakdown Structure](image)

From figure 2 we can see study case’s details. From this data we can make schedule for the project. PT XYZ’s WBS divided into 3 level. We can see the detail from each works, in preliminary works, it contains 4 parts (cleaning, weekly project report, as build drawing and mobilisation), in civil interior works, it contains 6 parts (Preparation works, flooring works, partition works, shopfront works, ceiling works and build in fixtures) and the last one in MEP works, it contains 5 parts (plumbing sanitary works, electrical works, camera works, fire protection works and HVAC works).

All data that used in this study case is using PT XYZ’s data, the data includes ACWP which is the actual amount of expenditure or funds used to carry out the work in a certain period of time. BCWP is the value of the results from the value of work completed on the budget provided to carry out of the work. BCWS is the amount of the budget for the work that is linked to the implementation schedule.
Table 1. ACWP, BCW and BCWS data

| week | ACWP (Rp.) | BCWP (Rp.) | BCWS (Rp.) |
|------|------------|------------|------------|
| 1    | 98,809,783 | 93,455,505 | 110,209,978|
| 2    | 171,437,509| 163,826,907| 188,509,289|
| 3    | 210,643,207| 279,313,263| 278,405,468|
| 4    | 276,716,207| 306,136,076| 306,136,076|

3.3. Calculation

From data on table 1, now we can calculate CV, SV, SPI, CPI and CR. Example of calculation using first week’s value, to find CV, we use BCWP’s value minus ACWP’s value, the result is -Rp. 5,354,278. To find SV, we use BCWP’s value minus BCWS’s value, the result is -Rp. 16,754,473. To Find SPI, BCWP’s value divided to BCWS’s value, the result is 0.8479. And to find CPI, BCWP’s value divided to ACWP’s value, and the result is 0.9458. We can see the final result of the calculation in table 2.

Table 2. Result of SV, CV, SPI, and CPI calculation

| week | CV (Rp.) | SV (Rp.) | SPI | CPI |
|------|----------|----------|-----|-----|
| 1    | -5,354,278 | -16,754,473 | 0.8479 | 0.9458 |
| 2    | -7,610,602 | -24,682,382 | 0.8691 | 0.9556 |
| 3    | 68,670,056 | 907,795 | 1.0033 | 1.3260 |
| 4    | 29,419,869 | - | 1 | 1.1063 |

From the result we can conclude SPI in the first and second week are <1, it means project is behind schedule, in third week, SPI >1 means project is ahead of schedule and at the end of the fourth week the project is done and it is done on the schedule. The first week and second week, the CPI result is <1, it means the project is over budget, in the third week and last week, CPI result is >1 it means on that week the project is under budget. After SPI and CPI value is found, now we can calculate Critical Ratio Value. To find CR’s value, we times SPI and CPI. We can see the final result of CR’s calculation in table 3.

Table 3. Result of CR

| week | CR | Indicator Value |
|------|----|----------------|
| 1    | 0,8 | <1 |
| 2    | 0,83 | <1 |
| 3    | 1,33 | >1 |
| 4    | 1,11 | >1 |

From table 3, we can see on the first and second week of project the performance is poor, and in the next week the performance become good. By using this method, we can see the project performance from schedule and cost in project. By knowing this, we can prevent the problem that make project’s performance in advance for the next project. From the study case we can see how short working time in interior project. Short term project has higher risk because of faster pace of working. To know how is project’s progress all the time, review and analysis is an important case prevent if there is a distortion in project for future project. Cost management in interior, budget controlling has an important part to ensure the project is completed within the approved budget. Short term project has higher risk to lead spending more money and become over budget within short time.
4. Conclusion
The portrait from this study case which is PT XYZ’s project, there are preliminary works (cleaning, weekly project report, as build drawing and mobilisation), in civil interior works (preparation works, flooring works, partition works, shopfront works, ceiling works and build in fixtures) and the last one in MEP works (plumbing sanitary works, electrical works, camera works, fire protection works and HVAC works). From the Study case’s calculation conducted to obtain the Critical Ratio of the project. Critical ratio formula is SV times CV, it means to get higher result of CR, bigger value of SV and CV are needed. The bigger SV’s value, project’s performance to be at least on schedule or ahead of schedule. The bigger CV’s value, project’s budget to be at least on budget or under budget. The project has to be on schedule and on budget to get a good performance. Schedule project management in interior project, due to short working time, reviewing used schedule and analysis is an important case prevent if there is a distortion in project for future project. And cost project management in interior, budget controlling has an important part to ensure the project is completed within the approved budget. Short term project has higher risk to lead spending more money and become over budget within short time. In order to get good performance, the most important schedule management’s indicator is reviewing used schedule and in cost management, the most important indicator is controlling budget from past project will lead for future project for getting better.

5. References

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