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Optimization of Profitability Based on Using Percentage of Total Float in the Construction Project Implementation Schedule

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Abstract: A construction project can run well if they have efficiency in terms of time, cost, and resources. This research aims to determine an optimization of the percentage of total float use to optimize project profitability by looking at the highest Net Present Value (NPV), Return on Investment (ROI), and Benefit Cost Ratio (BCR) with a case study of the construction of a 12-story building in Surabaya. This Research uses the total float value consumption method with the variations used in this study, including Total Float values of 0%, 25%, 50%, 75%, and 100%. Each variation will produce different work weights and payment terms, which will then be used for financial analysis to calculate BCR, ROI, and NPV on each cash flow to assess the optimization of the use of total float in this study. From the results of the discussion, it is known that the most optimal cash flow planning is in scheduling conditions with the utilization of a total float value of 75% with an NPV value of Rp 7,037,643,148. With a BCR value of 1,09228 and an ROI value of 9,228%.

Kata Kunci:
Total Float; Keuntungan; ROI; BCR; NPV

Abstrak: *Suatu proyek konstruksi dapat berjalan dengan baik apabila memiliki efisiensi dari segi waktu, biaya dan sumber daya. Penelitian ini bertujuan untuk mengetahui optimalisasi persentase penggunaan total float untuk mengoptimalkan profitabilitas proyek, dengan melihat Net Present Value (NPV), Return on Investment (ROI), dan Benefit Cost Ratio (BCR) tertinggi dengan studi kasus pembangunan gedung 12 lantai di Surabaya. Penelitian ini menggunakan metode konsumsi nilai total float dengan variasi yang digunakan dalam penelitian ini meliputi penggunaan nilai Total Float sebesar 0%, 25%, 50%, 75%, dan 100%. Berdasarkan masing-masing variasi akan menghasilkan bobot pekerjaan dan termin pembayaran yang berbeda yang selanjutnya akan digunakan dalam analisis finansial untuk menghitung nilai BCR, ROI, dan NPV pada masing-masing cash flow untuk menilai optimalisasi penggunaan total float pada penelitian ini. Dari hasil pembahasan diketahui bahwa perencanaan cash flow yang paling optimal adalah pada kondisi penjadwalan dengan penggunaan nilai total float sebesar 75% dengan nilai NPV sebesar Rp 7.037.643.148. dengan nilai BCR sebesar 1.09228 dan nilai ROI sebesar 9.228%..*

INTRODUCTION

A construction project can be interpreted as a collection of a series of activities that have limitations on time, cost and, quality (Irsyad et al., 2022). A construction project can be considered good when it is efficient in terms of time, cost and quality (Priyo & Sudiro, 2017). The three parts of this construction are interconnected, therefore it is expected that with minimal costs it can achieve the expected quality and time (Fardila & Adawyah, 2021). A good strategy is needed to

produce maximum costs (Dehghan et al., 2015; Johnson & Babu, 2018). So cost planning becomes an important focus to discuss because the way to increase profitability is by optimizing financial management, including managing the value of payment terms and total float consumption (Omopariola et al., 2021).

As a construction company, increasing profits is an important aspect in finding a project. Therefore, a way is needed to increase the profits obtained by each construction company. In previous studies, there have been several attempts to increase the profits obtained, either in the form of direct profits or profits obtained when reducing fines due to delays in a construction project. One of the studies conducted was to determine changes in costs and time during the implementation period by adding working hours, labor, and equipment. And knowing the comparison between the costs of fines obtained by the contractor due to delays in the addition of resources. By using the time-cost trade-off method, a result was obtained that adding equipment and labor will increase efficiency and will have cheaper costs compared to the costs incurred due to fines for delays in construction projects (Priyo & Sudiro, 2017). Adding workers can speed up the construction work implementation time by up to 8% and with a cost reduction of 0.29% (Manuputty & Prajitno, 2023). Both studies show that increasing profits is a preventive measure to reduce losses due to construction project delays. Therefore, another method is needed that can be used to increase the profits of construction projects without having to wait for delays in scheduling.

Wiranata's research aimed to determine how large down payments and capital affect the contractor's maximum profit in the 25% progress payment terms (Wiranata et al., 2018). However, the research still provides limitations only in the initial stages of the construction project and does not cover the entire implementation period, so it still doesn't answer the existing problem.

In the research conducted by Kumar it is stated that time is a very important element in a construction project that can cause financial impacts. One of the methods used in time management for scheduling a construction project is the critical path method (CPM). In this CPM method, some jobs have float that can be used as a delay time without affecting the duration of a construction project (Kumar et al., 2020). Another method commonly used in construction project planning is the Precedence Diagram Method (PDM). This method shows the relationship between each work activity during the construction process. This PDM is carried out using four important relationships, namely, Finish to Start (FS), Start to Start (SS), Finish to Finish (FF), and Start to Finish (SF). In this PDM method there is also a pause or what is commonly called float, which is also divided into two, namely total float and free float (Siregar & Ardiansyah, 2022).

Total float is the time an activity can be delayed without delaying the entire project. Meanwhile, free float is the amount of time that allows the completion time of an activity to exceed the earliest completion time without increasing the earliest start time of another activity that immediately follows. (Al Haj & El-Sayegh, 2015). In a project scheduling, activity with a total float will have a greater quantity than critical jobs. On the critical path, each job will have a total float of zero. Conversely, other activities not included in the critical path will have varying total float values. The method that has float values and critical paths is often used for scheduling (Agustiar & Handrianto, 2018). However, research that discusses the relationship between the use of total float and increased profitability for a cash flow is rarely done.

The use of total float value needs to be considered. Using this total float value is a method that can affect the profit value and scheduling. In a study conducted by Tama, delays or the use of float values for each non-critical activity can increase the total project cost by up to 0.195% of the planned cost (Tama & Angreni, 2022).

METHOD

Total float can also be interpreted as equal to the latest finish time minus the earliest finish time. Or it can also be obtained the latest start time reduces the earliest start time, so it can be seen the total float can be found using the formula:

$$TF = LF - EF = LS - ES \quad (1)$$

LF is Late Finish, EF is Early Finish, LS is Late Start, and ES is Early Start. Subtracting LF from EF is the same as the calculation resulting from subtracting LS and ES. In this research, an investment analysis will be used to analyze the value of existing investments, including:

NPV is often used to assess proposed construction projects. If the NPV value is positive (NPV > 0), then the invested funds are justified because expected returns exceed the discount rate (Miles et al., 2015; Setyawan, 2016).

$$NPV = \sum_{t=1}^{t=n} \frac{(B_t - C_t)}{(1+i)^t} \quad (2)$$

Bt is the profit value obtained in year t, Ct is the cost incurred in year t. i is the interest rate used. Then n is the time period used.

An economic evaluation tool is used to determine a project's or investments economic value by comparing the total benefits expected from a project. A project or investment can be said to be economically feasible if it has a BCR value greater than 1 (BCR > 1) (Setyawan, 2016; Susanti, 2024).

$$BCR = \sum_{t=1}^{t=n} \frac{(B_t)}{(1+i)^t} : \sum_{t=1}^{t=n} \frac{(C_t)}{(1+i)^t} \quad (3)$$

Bt is the profit value obtained in year t, Ct is the cost incurred in year t. i is the interest rate used. Then n is the time period used.

A performance measure used to evaluate the efficiency or profitability of an investment. ROI measures the amount of return on an investment relative to the cost of the investment (David & Stephen, 2017; Miles et al., 2015).

$$ROI = \frac{\text{Revenues after investment - amount Investment}}{\text{Amount Investment}} \quad (4)$$

This calculation is done by adding up all income and expenses in the cash flow, then the existing cash flow is made into net income and divided by required expenses.

The case study in this research is a 12-floor high-rise building construction project in Surabaya, East Java, Indonesia. This construction project starts on October 16, 2023, with a construction plan of 540 days. The data used in this study refers to the working drawings used in the construction project of a 12-storey building, along with supporting building facilities such as Annex, Power House, Landscape, and Ground Water Tank (GWT) in Surabaya, Indonesia. This construction work was carried out using a lump sum contract with a contract value of Rp 78,480,146,000.00. In this study, the implementation budget used to build the entire building was 85% of the total value of the existing contract, which was Rp 66,708,124,100.00.

The use of total float values in this study is to reduce the existing total float value. For example, the main structural building works with a total float value of 100 days. The variation of the use of the total float value of 25% will be reduced by 25 days until the total float value remaining is 75 days. This value is utilized by shifting the start time of work on each activity, with a variation of the use of a total float value of 100% or the same as the critical path as the upper limit of this study. All total research calculations in this study will be assisted by using MS. PROJECT.

The work weight calculation will be carried out after calculating the total float value used in each variation. The calculation of the work weight is done by dividing the volume of work done by the total contract value. In the research, the weight of work each week is the data used to calculate how much profit is obtained by using variations in the total float value. This weekly work weight is an accumulation of daily weights carried out every day. The weight of work in each variation of the use of this total float value will be different each week. This difference occurs

due to the use of the total float value carried out in each variation. The greater the use of the total float value, the greater the work weight at the end of the construction project. This difference in work weight is used as calculation data for investment analysis. The variation in the work weight in each variation will produce different cash-in and cash-out flows. As presented in Figure 1, there are 5 variations of the use of total float values carried out in this experiment, namely variations of the use of total float values of 0%, 25%, 50%, 75%, and 100%.

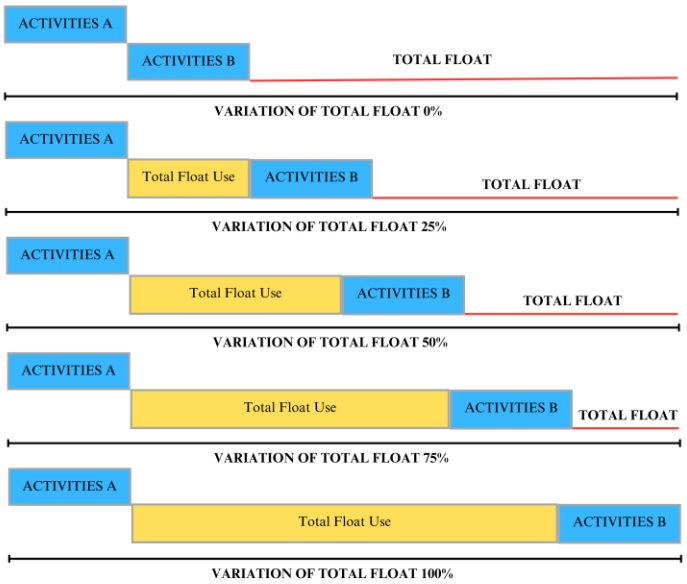

Figure 1. Total Float Variation

Table 1 explains the Work Breakdown Structure used in this study, along with the duration of each job, there is also a total float value for each job. The total float value in this data will then be used as a reference in the study to conduct experiments on variations using the total float value for each work item.

Table 1. Schedule and Total Float

Task Name	Duration	Start	Finish	Total Float
Tower 3	540 days	10/17/2023	3/31/25	0 days
Structural Works	420 days	10/17/2023	12/9/24	100 days
Main Building Structural	420 days	10/17/2023	12/9/24	100 days
Preparation	420 days	10/17/2023	12/9/24	112 days
Earthwork	112 days	12/24/2023	4/13/24	105 days
Foundation Work	103 days	1/2/24	4/13/24	23 days
Concrete Work	225 days	3/8/24	10/18/2024	37 days
Steel Work	28 days	10/4/24	10/31/2024	151 days
Annex Building	125 days	3/5/24	7/7/24	151 days
Powerhouse And Pump House	236 days	10/17/2023	6/8/24	275 days
Sewage Treatment Plant (STP)	29 days	3/11/24	4/8/24	159 days
Architectural Works	298 days	6/7/24	3/31/25	0 days
Main Building Architectural	294 days	6/11/24	3/31/25	0 days
Roof Architectural Work	84 days	11/18/2024	2/9/25	29 days
Facade Architectural	47 days	12/23/2024	2/7/25	27 days
Annex Architectural Works	133 days	6/7/24	10/17/2024	165 days

Task Name	Duration	Start	Finish	Total Float
Architectural GWT	89 days	6/9/24	9/5/24	207 days
Other Architectural Work	100 days	11/23/2024	3/2/25	29 days
Mechanical, Electrical, & Plumbing	352 days	4/14/24	3/31/25	0 days

RESULTS AND DISCUSSION

In this study, the total duration of the construction project has not changed because the use of the total float value does not affect the critical path, which is in line with research by Anggraeni (Anggraeni et al., 2019; Magdy et al., 2020). Unlike when doing the crashing method, which can affect the total duration of construction implementation (Manuputty & Prajitno, 2023; Putra & Hartati, 2017). Based on research conducted by Love, in line with this research, which shows that by scheduling an adjustment date that is later than the beginning but still within the minimum total float value, it will provide interest benefits on money that does not need to be spent (Love, 1983).

The influence of the amount of down payment and capital on the maximum profit of a contractor. This study shows an influence of the use of down payment and capital, where the greater the capital and down payment at the beginning of the project implementation period. This study uses the Precedence Diagram Method (PDM) by utilizing the float value in each work activity to compare the profit level with the actual schedule and the consumption float value. Based on the results of the analysis, the greater the initial capital, the greater the profit the contractor will obtain. (Wiranata et al., 2018).

Based on the weight of work each week, a cash flow diagram is displayed from the cash in and out based on construction costs, payment terms, down payment, and retention period payments. The term value will be reduced by 15% Down Payment and 10% retention in each payment term. The discount rate used in this research is 8.5% based on the interest rate used for the term payment terms. Based on Figures 2,3,4,5, and 6 regarding the existing cash flow presented in million rupiah, the cash flow is presented from week 0 to week 130 after the retention period is completed. In the existing cash flow diagram, it can be seen that the cash inflow shows an upward arrow and the cash outflow has a downward arrow direction. In this cash flow diagram, it is also known that there is a visible difference in the cash flow generated. It can be seen that along with the increasing use of the total float value, the payment period will increase closer to the end of the work schedule. From this cash flow diagram, an investment analysis of NPV, BCR and ROI is carried out. The most optimal value can be found by finding the NPV, BCR and ROI values that have the highest positive value from the variation in the use of the total float value used (Arga et al., 2020; Khoulenjani et al., 2024).

The analysis of Figures 2, 3, 4, 5, and 6 highlights the impact of total float value variations on payment terms. The fastest payment term is observed when the total float value is set to 0%, and as the float value increases, the additional time required for payments also grows. For instance, with a total float value of 0%, the fourth payment term occurs in the 40th week, whereas in the 50% variation, it is delayed until the 48th week. This pattern suggests that a higher total float value leads to a more prolonged payment term. Despite the delayed payment terms, investment analysis reveals that a total float value of 75% yields better financial returns compared to 0%, demonstrating that strategic float management can enhance profitability.

A structured approach to total float management is crucial in improving construction project efficiency. By carefully adjusting the float value, project schedules can remain flexible, reducing costs and improving financial performance. An optimized total float allocation ensures that payment terms align with cash flow demands without unnecessarily increasing the project duration. Nevertheless, excessive float usage should be avoided as it may disrupt planned schedules and hinder financial efficiency. Thus, total float management ensures scheduling adaptability and profitability in construction projects.

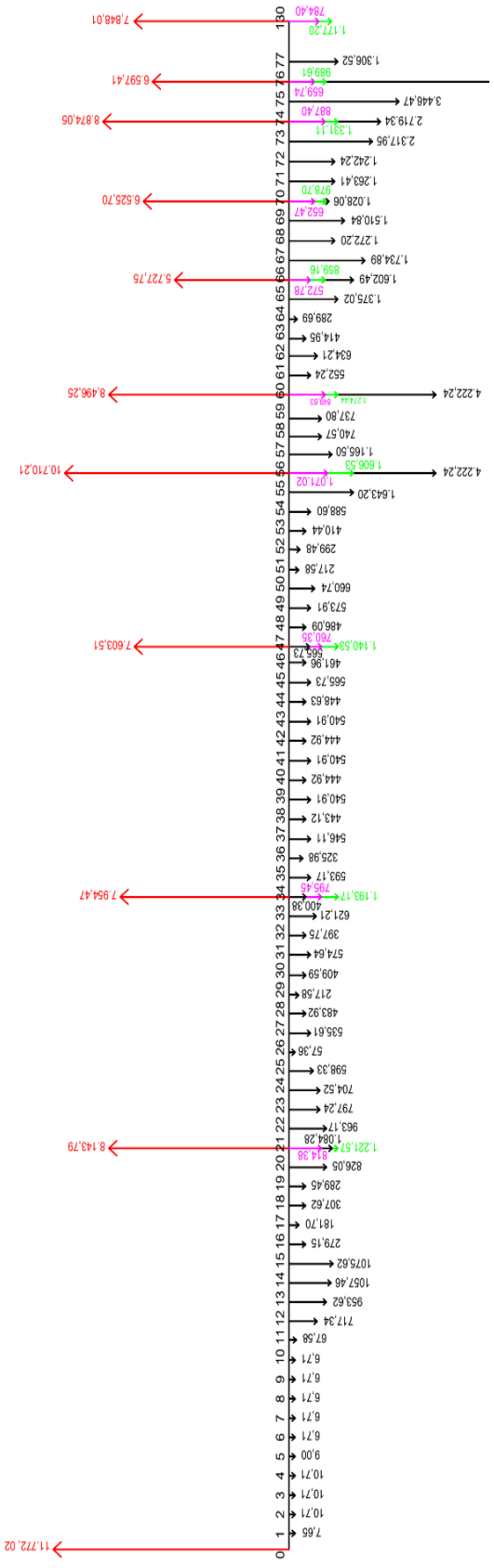

Figure 3. Cashflow Variation in 100% Total float

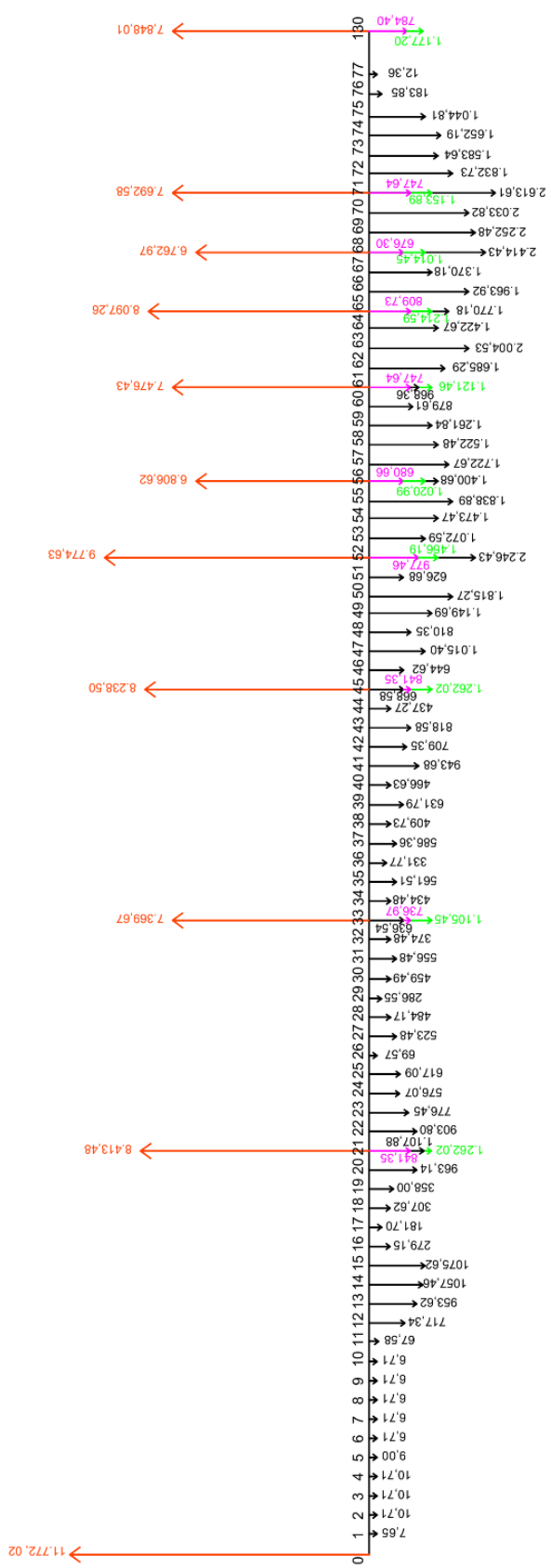

Figure 2. Cashflow Variation in 75% Total float

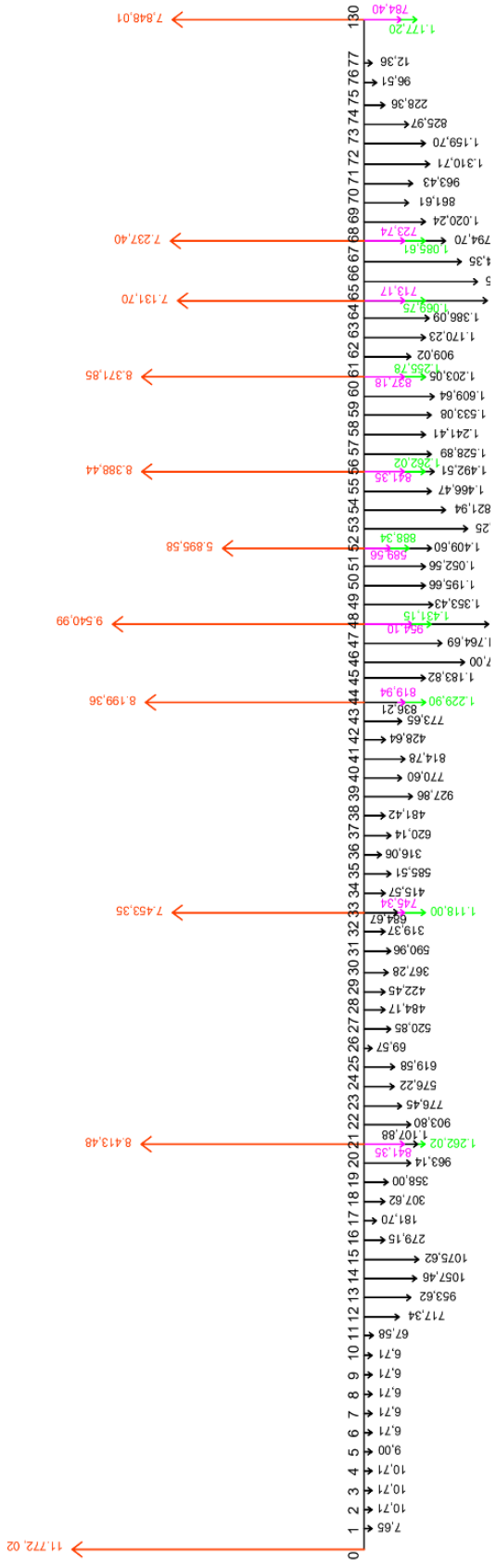

Figure 4. Cashflow Variation in 50% Total float

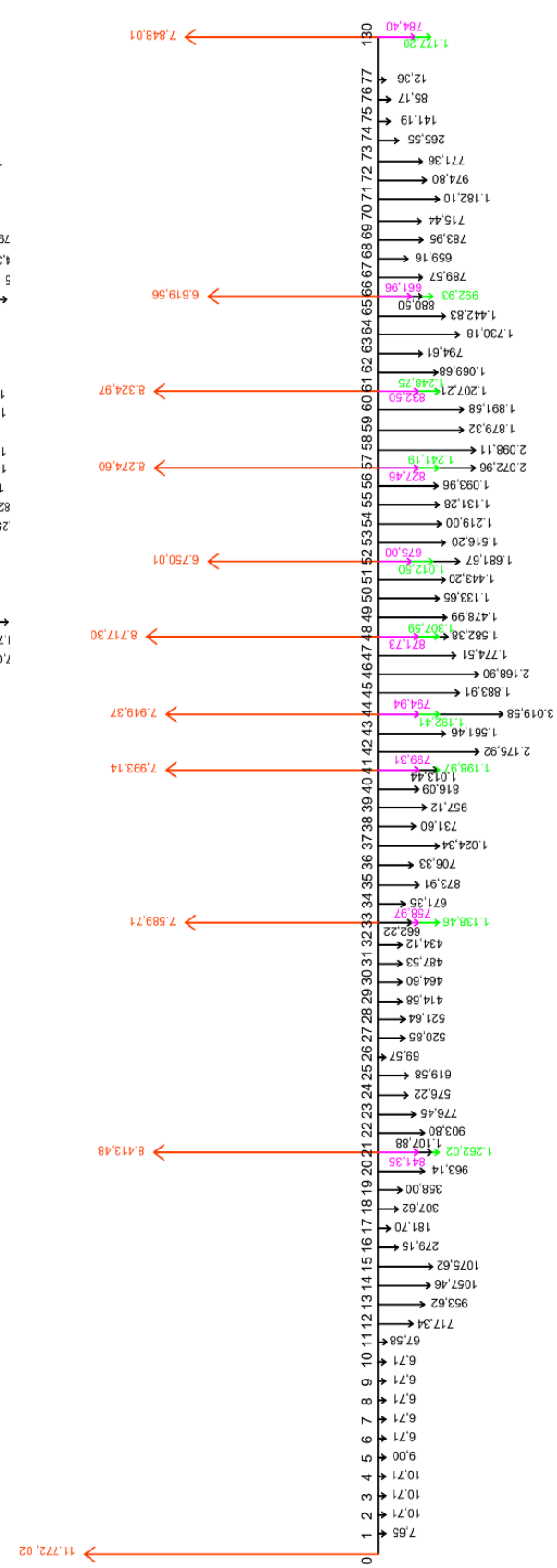

Figure 5. Cashflow Variation in 25% Total float

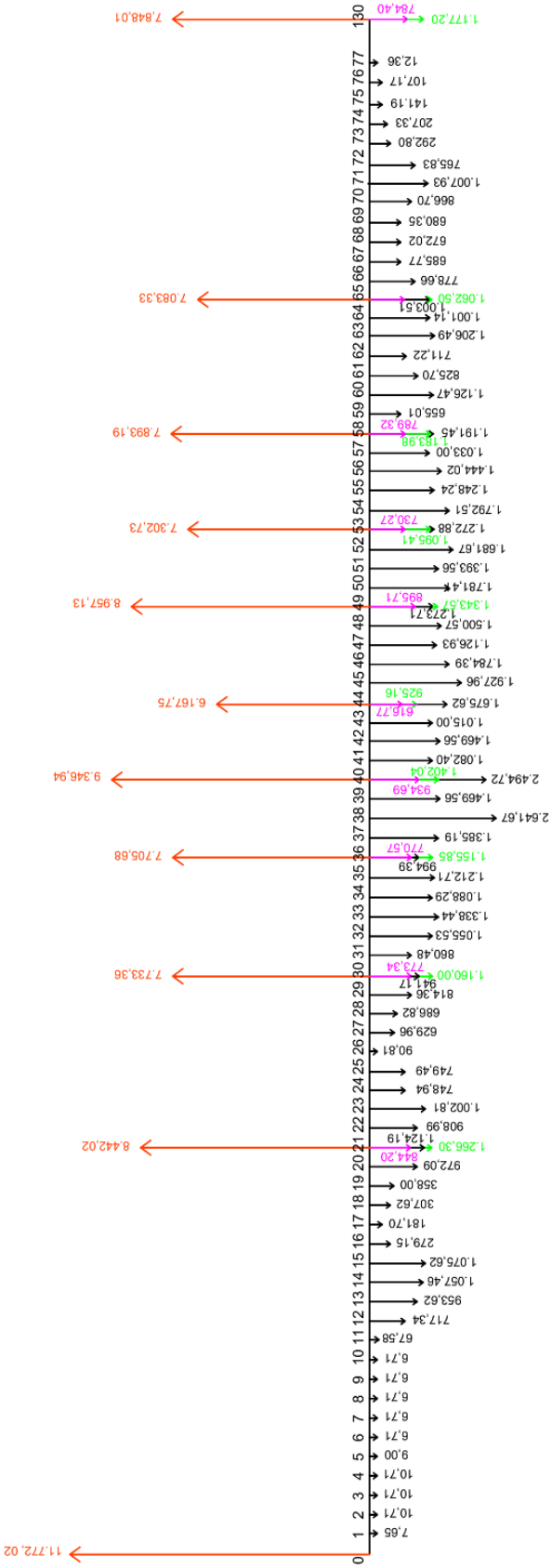

Figure 6. Cashflow Variation in 0% Total float

Looking at Figure 2, the cash flow variations in a scenario with a total float value of 100% reveal significant workloads concentrated in weeks 56, 60, and 76. This work clustering indicates a piling up of tasks, which can pose practical challenges during real-world implementation. In an actual construction setting, spatial constraints and site-specific limitations must be considered,

including land availability for material storage and equipment mobility. Excessive workload accumulation within short periods may lead to logistical difficulties, preventing smooth project execution.

Therefore, while a well-measured total float can increase flexibility and profitability, its application should be carefully balanced with real-world constraints. Construction projects must consider scheduling efficiency and on-site feasibility to avoid operational bottlenecks. The findings of this study emphasize the importance of integrating total float adjustments into an overarching project management strategy. With a properly optimized float value, projects can achieve financial benefits while maintaining operational stability and efficiency in execution.

Table 2. ROI, BCR, NPV Calculation

NO	FLOAT	ROI	BCR	NPV		RANK
1	0%	8,988%	1,089876929	Rp	6,939,725,991	4
2	25%	9,076%	1,090763453	Rp	6,976,453,777	3
3	50%	9,161%	1,091605106	Rp	7,012,284,284	2
4	75%	9,229%	1,092285154	Rp	7,037,643,148	1
5	100%	6,275%	1,062748072	Rp	4,898,601,512	5

Based on table 2, the results of this study show that the ranking in the use of total float values from the smallest to the highest is the variation of the use of total float values of 100%, 0%, 25%, 50%, and 75%. Each variation of the use of the total float value will affect the ROI, BCR, and NPV values. For example, in the variation of the use of the total float value of 0%, the ROI is 8.988%, the BCR is 1.08988, and the NPV is Rp 6,939,725,991. In this study, a linear increase in profit from the use of variations of 0%, 25%, 50%, and 75% was also seen, with the highest profit in the variation of 75%, with an ROI value of 9.229%, BCR with a value of 1.09228, and NPV of Rp 7,037,643,148.

However, this study also shows that using the full total float value, 100% will reduce the ROI value to 6.275%, with a BCR of 1.06274 and NPV reaching Rp 4,898,601,512. This shows an optimal limit on each use of the total float value, but the author assumes that no optimum limit figure can be used as a reference in every construction project. This is because each construction job has its uniqueness. In this study, it can be emphasized that excessive use of the total float value can have a negative impact on project profits. Using a total float value of up to 100% will make all work a critical activity. In addition to being inefficient in terms of cost, it will also be risky in terms of time, which will affect the final total completion of the project.

Utilization of the total float value in a construction project has an inseparable relationship with resource management, especially in the procurement planning, storage, and distribution of resources to the project location. The use of total float impacts the flow of this material, so the purchase of materials will be carried out strategically. In addition, contractors can postpone expenses that are not yet needed so that funds can be allocated to more urgent needs, thereby increasing the overall financial efficiency of the project.

In addition, the material arrival schedule can also be scheduled more flexibly, allowing contractors to adjust the ordering time to suit the use of the total float value carried out. This is important to avoid additional costs due to excessive material storage and ensure the smooth running of the construction project. For example, the delivery of materials for each job can be carried out in stages according to actual needs in the field. This aims to prevent the accumulation of materials that will interfere with the movement of workers or equipment.

In this study the use of variations in the total float value is limited to variations of 0%, 25%, 50%, 75%, and 100%. This is because each schedule will have a different total float value. This study focuses more on determining which variation in the use of the total float value has the highest efficiency in increasing profitability, so it can be applied in construction activities. This study also shows that when the total float value is used entirely, the profit obtained does not increase, but instead experiences a significant decrease. This is because when the float value used

reaches 100%, each work item will become a critical job without having a delay time that can be utilized.

With this research, it is hoped that professionals will not only focus on monitoring and evaluating critical work. However, they can monitor and evaluate work with a total float value. Monitoring work with a total float value will further improve the quality of evaluation and monitoring. This can happen because every monitoring and evaluation will be carried out on all activities to get the optimal construction profit costs. In addition, this study also shows the importance of cash flow management in a construction project. Optimally managing expenditures and receipts of funds obtained will positively impact the project's financial stability and increase its profitability.

The benefits obtained in this study are expected to be used as considerations and to increase the importance of good coordination between various interests. This is necessary because without a good relationship between various interests, using the total float value to increase this profit will be difficult. The project team can flexibly adjust the schedule and resource allocation by coordinating with various parties, contributing to increased communication and collaboration between related parties. This helps reduce the potential for conflict and improves the overall effectiveness of the project.

CONCLUSION

The NPV value obtained from this calculation shows that this project has a positive value, which means it experiences profits for every variation in the use of the total float used with the highest value found in the use of variations in total float of 75% with a value Rp 7,037,643,148. In the analysis the BCR value obtained also shows a value of more than 1, which means that each variation has an economic value that is feasible to work with the highest BCR value of 1.0922 for variations using a total float of 75%. ROI calculation shows that all variations in the use of total float show a linear increase between the increase in profits and the use of the total float value, with the highest value found in the use of variations in total float of 75%, with a value of 9,229%. In this study, it can also be seen that if the total float value is used completely or 100%, there will be a decrease in the ROI value to 6.275%, with a BCR of 1.06274 and NPV reaching Rp 4,898,601,512

By increasing profits using the total float value usage method, it is hoped that construction management will not only focus on work that is on the critical path, with this research it can be seen that work items that are not on the critical path if managed properly can increase the profit value in a construction project. However, there are still some limitations that must also be considered when using this total float value. Material procurement, worker schedules, and land availability are the focus that must be considered further in order to be able to implement the method of using the total float value properly. Ignoring these limitations will not only reduce the level of profit but can also cause losses, such as late fines. By monitoring the utilization of total float and its impact on schedule and budget, project managers can identify areas for improvement and implement corrective actions if necessary. This ensures that the project is on track and achieving its stated goals. In this study, the total float value can be used as a reference in further research regarding the relationship between its use and material procurement, the relationship between it and worker scheduling, and the application of this method directly in the field.

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