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Optimizing Human Resource Allocation in Construction Projects: A Case Study

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ABSTRACT. In construction, human resources are essential for workers to carry out tasks and work optimally from project initiation to completion. This entails having workers with the requisite skills and abilities for each job description. This research focuses on analyzing the feasibility of constructing the Iskandar Muda Military Regional Finance Office in Banda Aceh City from a human resources perspective. Findings from productivity calculations reveal a decrease in the relationship between duration and work productivity progress, rendering the current number of workers ineffective in ensuring construction feasibility from a human resources standpoint. Despite the presence of 32 workers with skills aligned with job descriptions, the research underscores the importance of optimizing labor allocation and time utilization to enhance productivity. By implementing efficient methods tailored for repetitive tasks and adjusting labor requirements throughout the project duration, this approach proves feasible and effective in achieving better overall results in constructing the Iskandar Muda Military Regional Finance Office.

KEYWORDS: Construction, human resources, feasibility analysis

1. INTRODUCTION

A construction project is a series of activities that are only carried out once, have a beginning and an end, and are generally short-term. Construction projects have three characteristics that can be viewed in three dimensions: they are unique and they require resources (Rani, 2016). In the process of achieving the goals of a project, limits need to be determined, namely the amount of costs allocated, the schedule, and the quality that must be met (Rani, 2021). The main components of the project consist of feasibility assessment, design, procurement, and construction (Sugianto, et al., 2022). Products include the construction of bridges, buildings, ports, and roads. These construction projects are becoming increasingly complex and sophisticated, involving the use of resources in the form of human power, materials, equipment, and increasingly large amounts of funds (Peng & Liu, 2024).

Overall feasibility analysis in the construction of the Iskandar Muda Military Regional Finance Office in Banda Aceh City from the aspect of human resources. Managing the number of workers within the project duration is not excessive and forms a curve according to the maximum number of needs every day, every week, and every month so that supplies do not exceed the company's capabilities.

Managing the number of workers within the project duration is not excessive and forms a curve according to the maximum number of needs every day, every week, and every month so that supplies do not exceed the company's capabilities. The expected level of worker requirements for the project is that at the beginning of the project, the number of workers is small and continues to increase according to the volume required for each worker. This is different from the labor requirements at the start of the project. The number of skills is large, and the skills required differ according to the volume of work and expertise. On each job until the end of project completion. The problem formulation in the initial research was to analyze the feasibility of developing Iskandar Muda Military Regional Finance Office in Banda Aceh City in terms of human resource aspects. This research aims to determine the number of workers in the field efficiently by influencing the duration and productivity of the workforce.

2. MATERIAL AND METHODS

2.1 Feasibility analysis

To anticipate the risk of uncertainty from investments made, it is necessary to assess aspects of investment feasibility. The aspects reviewed in conducting a feasibility analysis are as follows: technical aspects, managerial and administrative aspects, organizational aspects, commercial aspects, financial aspects, economic aspects, legal aspects, and environmental aspects. Feasibility analysis is carried out based on stages starting from the main aspects (Thamrin & Wiyati, 2014).

Feasibility studies are indirectly related to society and government to see the impact of business on people's lives and economic growth related to employment, increased foreign exchange, and tax revenues. Taxes on the added value of products are generated from business or income tax. A comprehensive assessment is seen from various aspects (Nurmalina et al., 2018).

2.2 Human resources aspects

According to Supriyadi, et al. (2020), human resources are people who do work and have a function as assets of an organization or company, which can be calculated based on numbers. Human resources have the potential to become the driving force in an organization, which is different from other resources (Willy & Sekarsari, 2020). Its human values require that human resources be needed simultaneously with other human resources (Tuhuteru, 2020). In general, according to experts, human resources are people, both individuals and groups, who work for a company to achieve organizational goals (Yudha, et al., 2023). Human resources are experts needed to complete a project optimally, which means according to budget costs, quality, and time (Zamzam & El-Kharbotly, 2024). Human resources aspects include (Melyana & Sulistio, 2022):

a. Work competency: the ability of a worker to carry out tasks or work, both in an organization and in a government or private agency. Competence must be a fundamental factor, where each person must have average abilities, and this will be related to the characteristics of each person at work.
b. Work motivation: the driving force for workers to contribute as much as possible to produce organizational success and achieve its goals.
c. Work loyalty: one element of assessment to identify employee loyalty to their job, position, and organization, which is reflected by the employee's willingness to protect and be able to defend the organization both inside and outside of work from irresponsible people. Work loyalty can be seen in the attitude of workers who are willing to give all their abilities, thoughts, skills, and expertise to achieve company or organizational goals, carry out their duties with full responsibility, discipline, and honesty in their work, participate in protecting all company secrets, and behave loyally towards the company so as not to move elsewhere.
d. Work discipline: the attitude and behavior of a person who has demonstrated obedience, conformity, loyalty, regularity, and order to company and organizational regulations and applicable social norms.

The previous research done by Dewi, et al. (2016) about human resources aspects of performance on construction projects. Based on the results of the t-test calculation research, the competency t-count value was 1.859, the motivation t-count value was 3.092, the loyalty t-count value was 2.667, and the work discipline t-count value was 2.998. These four values are greater than the table, namely 1.708. The adjusted R square value of 0.462, or 46.2%, can be explained by the four independent variables; the remaining 53.8% is caused by other factors.

2.3 Labor productivity

According to Iskandar & Pranata (2024), productivity that is often observed is related to labor. The definition of labor is every person who can do work to produce goods and/or services to meet their own needs and those of the community (Albus & Huber, 2023). In construction projects, one of the factors that determines success is the performance of the workforce, which will affect productivity (Liang, et al., 2021). Productivity describes the workforce's ability to complete a quantity of work per unit of time (Lythio & Gondokusumo, 2022). Productivity in the construction sector is broadly defined as output per labor-day, so it can be formulated as follows (Hutasoit, et al., 2017):

To find out the implementation time for work:

$$T = \frac{K \times V}{n} \quad (1)$$

Where:

T = implementation time/duration
K = Labor coefficient in unit price analysis
V = job quantity
N = number of workers

To calculate labor productivity, use:

$$P = \frac{V}{T \times n} \quad (2)$$

Where:

P = labor productivity, namely the quantity that can be completed by a worker each day
T = job duration
V = job quantity
N = number of workers

Based on research results by Lestari (2016), it is calculated that one house unit can be completed in 4 months; building five house units takes 20 months. If the optimization of human resources to build five housing units, can be completed within five months, it saves 75% of the time.

2.4 Methodology

This research was conducted on the Iskandar Muda Military Regional Finance Office Building construction project located in Banda Aceh City. This location is a financial management building to support the use of financial resources in the tasks of work units within the TNI and units that carry out financial budget support.

The stages in research to analyze the feasibility of building the Iskandar Muda Military Regional Finance Office in Banda Aceh City in terms of human resources aspects are primary and secondary data. The primary data used in this research is a survey in the field in the form of the number of workers present during the work process. The collection of secondary data is obtained based on references and literature

related to the material, scientific works related to research, or by visiting relevant agencies to collect the necessary data. The secondary data required is needed to determine the geographical conditions at the Military Regional Finance Office to facilitate the research process. This research will be carried out at the Iskandar Muda Military Regional Finance Office in Banda Aceh City, simplifying the research process. The Iskandar Muda Military Regional Finance Office cost budget plan is needed to know the cost calculations and calculate work productivity, which makes this research easier.

3. RESULTS AND DISCUSSION

The results of the research and discussion were obtained from the calculation results from the cost budget plan (RAB) data. Processing in this research consists of analyzing the number of workers and continuing with the line-of-balance method. In this case, this data is input into Excel so that the output will be the number of workers at the construction of the Iskandar Muda Military Regional Finance Office in Banda Aceh City.

3.1 Human resources aspects

The human resources aspect is an aspect that includes the workforce in planning, building, and managing the work team involved in the project. Human resource aspects in terms of labor requirements include the provision of labor requirements and handling problems among project team members. The need for project performance personnel also requires good skills and communication so that they can work effectively to achieve project goals and be effective and efficient. Labor needs are assessed by what has been achieved by carrying out the task. The need for good workers will produce good projects, however, in implementing construction projects, contractors sometimes pay little attention to this, because contractors want to gain more profits by keeping operational costs to a minimum.

3.2 Analyzing the number of workers

The number of workers needed can be determined by looking at the stages of work and using work unit analysis to determine labor productivity and efficiency. To calculate the number of workers, it is necessary to consider factors to determine what type of work is carried out by the craftsmen, starting with construction work, structural work, and other work, so that it can be determined how long the work will take.

Craftsman labor also requires a level of work skill required for the job by their skills and how much work must be completed with estimates of productivity taking into account weather conditions, which can influence the number of craftsmen doing the work within the time specified for the work used.

Based on this, it shows that the number of workers needed is 32, but each worker has their own skills, such as:

a. For earthworks, 5 diggers and 6 carpenters are needed in the bow plank pair so that the number of handymen needed is divided into each earthwork according to the volume required.
b. Partner work requires 6 carpenters, 6 bricklayers, and 7 ironworkers in each job description, divided further according to the needs of the craftsmen in terms of their skills and volume requirements.
c. Wood, iron, and aluminum work requires 6 carpenters, 7 ironworkers, and 2 aluminum workers in each job description, divided further according to the needs of the craftsmen for their skills and volume requirements.
d. Hanging equipment work requires two aluminum craftsmen for each job description, divided further according to the craftsman's needs for their skills and volume requirements.

Painting work requires 2 painters for each job description, divided further according to the needs of the craftsmen according to their skills and volume requirements.

3.3 Implementation time

In planning construction work, the time for carrying out the work must be planned as well as possible because it greatly influences estimating the cost of the work. The execution time required to do a job is determined by the number of workers doing it. In estimating the time needed to work on a work item, it is important to know the volume of work and also the labor required to do it. Therefore, as a basis for planning, unit price analysis is used to calculate the time needed to do the work. The calculation of the time required to carry out a work item can be done as follows:

Table 1. Earthworks: Bowplank pair

Volume	67.40 m2
Number of workers	7 people
Labor coefficients	
Carpenter	0.100 OH
Worker	0.100 OH
Foreman	0.010 OH
Supervisor	0.005 OH
Total	0.215 OH

According to the results of research on earthworks on bowplank pairs, the duration of work required to complete the work was 2 days with a work quantity of 0.215 OH and 7 workers.

Table 2. Pair work: Foundation stone masonry 1:4

Volume	44.17 m3
Number of workers	12 people
Labor coefficients	
Carpenter	1.500 OH
Worker	0.750 OH
Foreman	0.075 OH

Supervisor	0.075 OH
Total	2.400 OH

According to the results of research on bowplank earthworks, the duration of work required to complete the work was 9 days with a work quantity of 2.40 OH and 12 workers.

3.4 Labor Productivity

Labor is one of the four important components required in implementing a project; these components include materials, equipment, labor, and implementation methods. The labor required in implementing a project depends on many factors, namely: level of expertise, equipment used. Field conditions, and so on. Labor productivity is very necessary in determining the number of workers needed to complete a job. The calculation of labor productivity can be done, the calculation of which is as follows:

Table 3. Earthworks: Bowplank pair

Volume	67.40 m2
Number of workers	7 people
Duration of execution	2 days

From the results of the planning research that has been done, the productivity of labor on earthworks for installing bowplanks with a work quantity of 0.215 OH carried out for 2 days with a total workforce of 7 people is 4.65 m2/day/person.

Table 4. Masonry work: 1:4 Foundation stone masonry

Volume	44.17 m3
Number of workers	12 people
Duration of execution	9 days

From the results of the planning research that has been done, labor productivity in pair work, namely 1:4 foundation stone masonry with a work quantity of 2.40 OH done for 9 days with a total of 12 workers, is 0.42 m2 per day per person.

4. CONCLUSION

From the analysis of the results of the discussion of the Iskandar Muda Military Regional Finance Office Building Construction Analysis from the Human Resources Aspect, which includes implementation in the field, it can be concluded that labor productivity in the field is more profitable than labor productivity based on the results of the calculation analysis data. Labor productivity in the field based on calculations is most visible in the work of installing light steel roof frames and mental tiles, which, based on the implementation time of 20 days, is carried out by 4 workers with a volume of metal tile roof pairs and light steel frame pairs of 259.65 m2 and an analysis coefficient of 0.31. Based on the analysis, it is known that labor productivity is 3.23 m2/day per person. From the results of the analysis of the construction of the Iskandar Muda Military Regional Finance office building viewed from the human resources aspect, it is recommended that in future research, the analysis of feasibility from the human resources aspect using the line of balance method should involve comparisons on large projects with similar activities, as staff must have expertise according to their respective roles. Additionally, this research serves as a valuable reference for analyzing feasibility in terms of human resource aspects.

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REFERENCES

1. Albus, M., & Huber, M. F. (2023). Resource reconfiguration and optimization in brownfield constrained robotic assembly line balancing problems. Journal of Manufacturing Systems, 67, 132–142. https://doi.org/10.1016/j.jmsy.2023.01.001
2. Dewi, A. A. D. P., Sudipta, I. G. K., & Setyowati, D. S. (2016). Analisis aspek sumber daya manusia terhadap kinerja pada proyek konstruksi di Kabupaten Badung. Jurnal Ilmiah Teknik Sipil: A Scientific Journal of Civil Engineering, 20(2), 103–109. https://doi.org/10.24843/JITS.2016.v20.i02.p05
3. Hutasoit, J. P., Sibi, M., & Inkiriwang, R. L. (2017). Analisis produktivitas tenaga kerja konstruksi pada pekerjaan pasangan lantai keramik dan plesteran dinding menggunakan metode work sampling. Jurnal Sipil Statik, 5(4), 205–214. https://ejournal.unsrat.ac.id/v3/index.php/jss/issue/view/1683
4. Iskandar, D. N., & Pranata, G. (2024). Analisis produktivitas tenaga kerja pada pengerjaan kolom di proyek DNL. JMTS: Jurnal Mitra Teknik Sipil, 7(1), 321-328. https://doi.org/10.24912/jmts.v7i1.26716
5. Lestari, D. (2016). Penerapan metode line of balance pada pembangunan perumahan (Studi kasus pada Perumahan Permata Puri Ngaliyan Semarang). Jurnal Teknik Sipil, 9. http://jurnal.untagsmg.ac.id/index.php/jts/article/view/802
6. Liang, G., Xu, L., & Chen, L. (2021). Optimization of enterprise labor resource allocation based on quality optimization model. Complexity, 2021. https://doi.org/10.1155/2021/5551762
7. Lythio, S. A., & Gondokusumo, O. (2022). Penerapan line of balance dengan target waktu penyelesaian proyek untuk optimasi penjadwalan proyek rumah tinggal. JMTS: Jurnal Mitra Teknik Sipil, 5(4), 845-856. https://doi.org/10.24912/jmts.v5i4.20607
8. Melyana, T. S., & Sulistio, H. (2022). Kinerja pekerja konstruksi yang dipengaruhi kemampuan, motivasi dan disiplin kerja di Jabodetabek. JMTS:

Jurnal Mitra Teknik Sipil, 5(3), 693–704. https://doi.org/10.24912/jmts.v5i3

9. Nurmalina, R., Sarianti, T., & Karyadi, A. (2014). Studi Kelayakan Bisnis. Bogor: IPB Press.
10. Peng, J., & Liu, X. J. (2024). Labor resource allocation under extremely short construction period based on the inverse optimization method. Engineering, Construction and Architectural Management, 31(3), 1254-1271. https://doi.org/10.1108/ECAM-06-2022-0604
11. Rani, H. A. (2021). Fungsionalitas Manajemen Proyek dalam Kesuksesan Proyek Konstruksi. Yogyakarta: Deepublish.
12. Rani, H. A. (2016). Manajemen Proyek Konstruksi. Yogyakarta: Deepublish.
13. Sugianto, K., Shiady, E., & Alifen, R. S. (2022). Penjadwalan dan optimasi sumber daya manusia dalam proyek perumahan untuk rumah dua lantai. Jurnal Dimensi Pratama Teknik Sipil, 11(1). https://publication.petra.ac.id/index.php/teknik-sipil/article/view/12108
14. Supriyadi, I., Khamdari, E., & Susilowati, F. (2020). Peran manajemen sumber daya manusia dalam peningkatan kinerja perusahaan konstruksi. ORBITH: Majalah Ilmiah Pengembangan Rekayasa dan Sosial, 16(1), 27-34. http://dx.doi.org/10.32497/orbith.v16i1.2065
15. Thamrin, M., & Wiyati, R. (2014). Analisis kelayakan penambahan gedung parkir Mall Pekanbaru. PEKBIS: Pendidikan Ekonomi dan Bisnis, 6(2), 116–126. http://dx.doi.org/10.31258/pekbis.6.2.116-126
16. Tuhuteru, E. (2020). Analisis penjadwalan waktu proyek konstruksi menggunakan metode Line of Balance (LoB) pada Perumahan Shafira Residence Kelurahan Ngade. CLAPEYRON : Jurnal Ilmiah Teknik Sipil, 1(2), 80-88. https://doi.org/10.33387/clapeyron.v1i2
17. Willy, Y., & Sekarsari, J. (2020). Analisis aspek sumber daya manusia terhadap kinerja pekerja proyek konstruksi. JMTS: Jurnal Mitra Teknik Sipil, 3(3), 523–532. https://doi.org/10.24912/jmts.v3i3.8392
18. Yudha, I. P. K., Widiastini, N. M. A., & Putu Indah Rahmawati, P. I. (2023). Strategi pengelolaan sumber daya manusia pada proyek konstruksi villa di Provinsi Bali. Publik: Jurnal Manajemen Sumber Daya Manusia, Administrasi dan Pelayanan Publik, 10(2), 646-654. https://doi.org/10.37606/publik.v10i2.701
19. Zamzam, N., & El-Kharbotly, A. K. (2024). Balancing two-sided multi-manned assembly line under time and space constraint. Ain Shams Engineering Journal, 15, 10246. https://doi.org/10.1016/j.asej.2023.102464