International Journal of Multidisciplinary Research and Growth Evaluation.

Optimization of Planning and Scheduling of 2-Storey Bird's Nest House Project Using CPM (Critical Path Method)

Armini Ningsih [1], Zuhriah [2], Seldinan Marcella [3*], Leony Marasing [4], Selvi [5], Diyah Kusrihandani [6], Tandi Kadang [7]
Samarinda State Polytechnic, Indonesia

* Corresponding Author: **Seldinan Marcella**

Article Info

ISSN (online): 2582-7138
Volume: 06
Issue: 03
May - June 2025
Received: 18-04-2025
Accepted: 20-05-2025
Published: 15-06-2025
Page No: 1883-1889

Abstract
This study examines the planning and scheduling of a two-storey 4x8-meter swallow's nest house construction project located in a semi-rural area. The increasing demand for swallow nests is driving the construction of swallow houses in various regions, but construction implementation often faces delays due to a lack of structured planning. The purpose of this research is to improve the effectiveness of project planning and scheduling through the application of the Critical Path Method (CPM) method. The research uses a quantitative approach with data collection techniques in the form of field observations, interviews, and project documentation. The analysis is performed using Microsoft Project software to structure the work network, calculate the duration, determine the sequence of activities, and identify critical project paths. The results show that the CPM method can accelerate the duration of the project from 62 days to 44 working days with a critical path of A-B-C-D-E-F-G-I activities. The conclusion of this study is that the CPM method is effective in accelerating project implementation, avoiding delays, and providing a more systematic schedule. This method can be applied to small to medium-scale construction projects, especially for the construction of swallow houses.

Keywords: Critical path, Project management, Microsoft Project, CPM Method, Construction scheduling

1. Introduction

In the last decade, the swallow's nest cultivation industry in Indonesia has experienced significant growth. This phenomenon is not only caused by the high demand of the domestic and international markets, but also by the potential for promising profits for business actors. According to data from the Ministry of Agriculture, the value of Indonesia's bird's nest exports reached more than 1 trillion rupiah in 2022, showing how profitable this sector is (Sari & Sudiana, 2022) [24].

In the last decade, the swallow's nest cultivation industry in Indonesia has experienced significant growth. This phenomenon is not only caused by the high demand of the domestic and international markets, but also by the potential for promising profits for business actors. According to data from the Ministry of Agriculture, the value of Indonesia's bird's nest exports reached more than 1 trillion rupiah in 2022, showing how profitable this sector is (Sari & Sudiana, 2022) [24].

To support the growth of this industry, various swallow house construction projects began to be developed in various regions. One example of a swallow house construction project studied in this article is the construction of a two-story swallow house measuring 4 x 8 meters located in a semi-rural area with modest resource conditions. Based on the Cost Budget Plan (RAB) document, this project consists of various stages of work ranging from land measurement, foundation excavation, construction of concrete structures, to final completion work. The total initial cost recorded for the foundation and sloof work has reached more than Rp 2 million, not including the more complex and time-consuming advanced stages Although the construction of swallow houses promises high profits, its implementation often faces various challenges such as project delays, waste of costs, and inefficient use of resources. This problem generally arises due to weak project planning and scheduling, as well as the lack of systematic project management methods. For this reason, the Critical Path Method (CPM) approach is used in this study to optimize project planning and scheduling.

The CPM method allows the identification of critical paths of the construction activity sequence, so that the project implementer can know which activities should not be delayed as they will affect the overall turnaround time. With the CPM analysis, it is hoped that the implementation of the construction of swallow houses can be more efficient in terms of time, and be able to reduce the risk of delays (Aboma, 2015) [1].

The main objective of this study is to apply the CPM method to the construction of a bird's nest house, by analyzing the sequence of activities, duration, and dependencies between jobs. The results of this study will provide a more structured picture of the project implementation process and serve as a reference in the planning of similar projects in the future.

2. Literature Review

1. Definition of Buildings

A building is a physical structure that is built to meet various human needs, such as housing, business, or activities. In the field of architecture and civil engineering, buildings are defined as the result of construction that is tied to their location, either partially or wholly located on or in the ground and/or water, and functions as a space for human activity (Ahmad dkk., 2021) [2].

Especially for swallow nest houses, the building is designed with environmental factors and the biological needs of the swallow in mind, such as temperature, humidity, and lighting regulation Kirana dkk., (2023) [15]. Therefore, the design is different from ordinary residential house buildings.

2. Determining Factors of Room Temperature

Temperature The room greatly affects the thermal comfort and success of the building's function, especially in the bird's nest house the air humidity also affects the condition of the bird's nest, generally, in order to control humidity, a water pool is made in the room as an air reservoir. The air from the pool helps to stabilize, creating conditions resembling a natural cave Syarif dkk., (2021) [28]. Room temperature is influenced by various interrelated factors. Building orientation refers to the determination of the direction of the building in relation to sun exposure. The application of the right orientation is very important because it is part of the effort to fulfill the principles *sustainable design.* This is mainly because the façade of a building plays a crucial role in the design planning of a structure (Aisah & Subiyantoro, 2020) [3].

Building materials also play an important role, where materials that absorb heat quickly can increase indoor temperature. Good ventilation, such as cross-circulation, helps keep the air cool and the temperature more controlled. The size of the room also has an effect, because larger rooms tend to change temperature more slowly, not easily hot or cold. Insulation on the roof and walls can minimize heat transfer from the outside. In addition, the surrounding environmental conditions, vegetation, soil type, and surrounding buildings, can also affect the temperature of the room. In addition, swallows prefer a light intensity of 0 lux (total dark conditions) when nesting Syarif dkk., (2021) [28] All of these factors are interrelated and need to be considered to create indoor comfort. In swallow nests, the ideal temperature is 26°C–29°C, so temperature regulation is a crucial aspect in the planning and implementation of development (Handoko, 2022) [8].

3. Structural Selection Considerations

The selection of construction structures is influenced by various interrelated factors. First, the function of the building is the basis for consideration of the design of the structure must be in accordance with needs, for example the structure for the bird's nest must be able to create a calm and stable environment Jatnika dkk., (2024) [12]. Second, soil conditions and project locations also play an important role, as geotechnical and topographic characteristics will affect the most appropriate and safe type of structure (Mardizal & Andayono, 2023) [19].

In addition, the ease of construction implementation also needs to be considered so that the construction process runs smoothly and efficiently. The availability of local materials is also a key factor, as the use of readily available materials can cut costs and processing time Utomo, (2017) [29]. Time and budget efficiency should also be optimized, especially if the project implements planning methods such as CPM Sulaksana, (2022) [27]. Last but not least, the strength and safety aspects of the structure must meet technical standards to ensure that the building remains sturdy and usable Ichsan *et al*., (2019) [10]. Examples of structures that are often used are reinforced concrete frames or combinations with mild steel, especially for the second floor that require strength but remain lightweight.

4. Building Construction Engineering

Construction method refers to the method or technique of implementing the construction of a building. The selection of this method greatly affects the efficiency of time, cost, and labor, which can be optimized through the CMP method Buna'i, (2022) [5]. There are be What are the construction methods commonly used in construction, each with advantages and characteristics Its own. Method conventional is the most common technique, where the entire process of working is doneu By Manual, starting from foundations, columns, beams, walls, to roofs. This method is suitable for small to medium-scale projects Wibowo *et al*., (2018) [30]. Meanwhile, the Pre-Print (Precast) using structural components that are first manufactured in the factory, then assembled at the project site. The main advantages of this method are faster turnaround times as well as more guaranteed construction quality Gusmao, (2015) [7].

Furthermore, the Modular utilizing ready-to-use building modules that only need to be installed on site. These systems are generally used for projects that require fast turnaround times and are repetitive, such as temporary residential buildings or emergency facilities Irianie, (2013) [11]. As for the system half-slab and beams Pre-Print It is a combination of conventional and precast methods, in which some components, such as floor plates and beams, are made in a factory and then combined with other elements that are machined on site. This system is often used in two-story buildings in an effort to save time on flooring Wibowo *et al*., (2018) [30]. The selection of construction methods must take into account the critical duration in the CPM so that the main activities do not hinder the overall running of the project (Malawauw dkk., 2025) [18].

3. Research Methods

This research using quantitative to analyze the pan CPM in the project planning of the construction of a two-story swallow's nest. This approach was chosen because of its ability deep Download Present the objective data necessary

to identify the path of its ability to present the objective data necessary to identify the critical path, calculate *Float* activity and optimize project scheduling Bryman, (2016) [4]; Creswell, (2014) [6]. The results of this study are expected to improve the accuracy of time planning and resource allocation yes more efficiently (Larson & Gray, 2014) [17].

Research data from primary data that includes ESTI time and cost of each activity, as well as the sequence of construction works on the two-story bird's nest project. Data was collected through three methods, namely direct observation in the field, interviews with project developers, as well as documentation studies. Documents analyzed Includes drawings of plans, daily reports of projects, and studies documentation. Documents analyzed include drawings of plans, pro daily reports Yes, the Cost Estimate (RAB) Creswell, (2014) [6]. To ensure validation data, used triangulation technique with Compare data from different sources. This triangulation is carried out to improve the accuracy and reliability of information collected (Moleong, 2007; Patton, 1999) [20, 21].

Peren analysis time is done using the CPM method. The initial steps begin by identifying all project activities and outlining into more detailed parts of the work, based on the logical relationship between the activities Soeharto, (1997) [26]. These activities are then arranged in a network of work based on their order and dependencies Schwalbe, (2016) [25]. Stop Equalization Each activity is obtained through observation on field work productivity and interviews that discuss the number of workers, Wage levels, and daily output Heizer & Render, (2004) [9]. Once all the activities and duration are known, The calculation of the start and finish time is carried out using the concept *Early Star* (ES), *Early Finish* (EF), *Late Star* (LS), and *Late Finish* (LF) Wideman, (1992) [31]. Difference between values *Late Satr* and *Early Star* Show *Float* Zero forms a critical path, which is a series of activities that directly determine the total duration of the project. Activities on critical lanes need to be closely monitored because any delays What happens will have a knock-on effecting on the overall project schedule (Kerzner, 2005: Koskela & Howell, 2002) [13, 16].

4. Results And Discussions

1. Project Activity Process Overview

This study discusses the implementation of the two-story bird's nest house construction project which is planned to be completed within 62 working days. The project is carried out independently by two workers and is directly supervised by the project owner. All major materials such as bricks, cement, wood, and electrical fixtures have been prepared before construction begins.

Data collection was carried out through direct observation and interviews with implementers. Event scheduling uses the CPM method processed with Microsoft Project apps. This method helps to identify the sequence of work, the relationship of dependency between activities, and the estimation of the duration of normal implementation and acceleration. Project schedule visualization in the form of Gantt Charts and network diagrams provides a clear picture of the critical paths and work steps that must be prioritized in order for the project to run on schedule.

Table 1: Project Activity Recapitulation

	Employment Code	Code	Duration (Days) Normal	Duration (Days) *Quick Time*	Predecessor
1	Preparation	A	6	5	-
2	Foundation Work	B	10	8	A
3	Sloof Jobs	C	10	8	B
4	Structure Work	D	15	12	C
5	Roofing Work	E	10	8	D
6	Monkey Homework	F	9	7	E
7	Air Circulation Work	G	5	4	F
8	Nest Place Work (Basket)	H	1	1	G
9	Electrical Work	I	6	4	G

Source: Processed Data (2025)

2. Work Networks with Normal Duration Using CPM

Based on the summary of project activities in Table 1, the researcher will explain the diagram of the work network with normal duration. The process of building the swallow's nest house began on February 3, 2025 and is expected to be completed on April 5, 2025, with a total normal duration of 62 working days. The project planning was prepared using the CPM approach to map the sequence of work and The entire content of the article is presented in narrative form, determine the critical path of all existing activities.

The work path starts from the preparation work, continued with the foundation, sloof, building structure, to the top such as the roof and monkey house. Once the main structure is completed, the project proceeds to system work such as air circulation, nesting place, and electrical installation. Based on the information in Table 1, a normal duration work network diagram can be prepared as follows:

avoid bullet points. proper example:

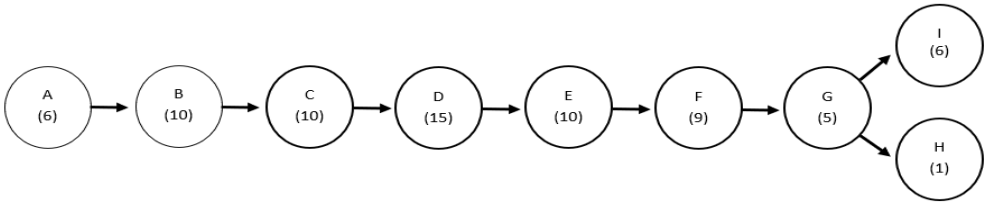


Fig 1: Normal Time Plan Scheme

3. Job Networking with *Quick Time* Using CPM

In the implementation of the work network, quick time follows steps that are almost similar to the arrangement of the network based on normal duration. The difference only lies in the use of acceleration time for each activity. This preparation still refers to the activity data that has been summarized in Table 1 as the basis for planning. By using the duration of quick time, the total project time can be reduced to a shorter time, while still maintaining the order of work and the interconnectedness between activities.

Table 2: Quick Time Activities

	Employment Code	Code	Duration (Days) *Quick Time*	Predecessor
1	Preparation	A	5	-
2	Foundation Work	B	8	4
3	Sloof Jobs	C	8	12
4	Structure Work	D	12	20
5	Roofing Work	E	8	32
6	Monkey Homework	F	7	40
7	Air Circulation Work	G	4	47
8	Nest Place Work (Basket)	H	1	51
9	Electrical Work	I	4	52

Source: Processed Data (2025)

The process of implementing the construction of the swallow's nest began on February 3, 2025 and was completed on March 26, 2025. From this process, an efficient network diagram is produced, as shown in the following figure.

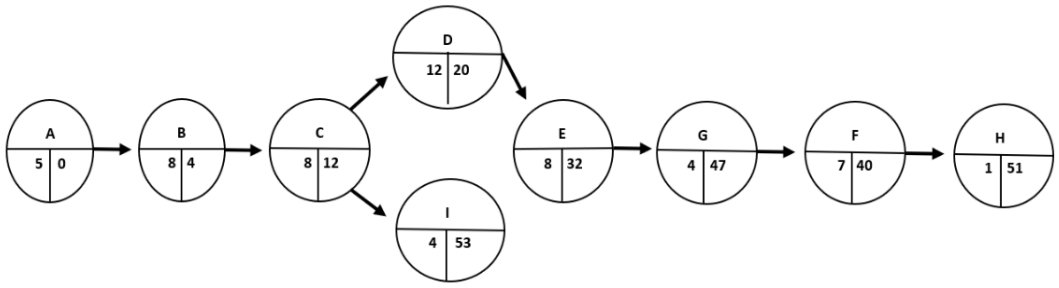
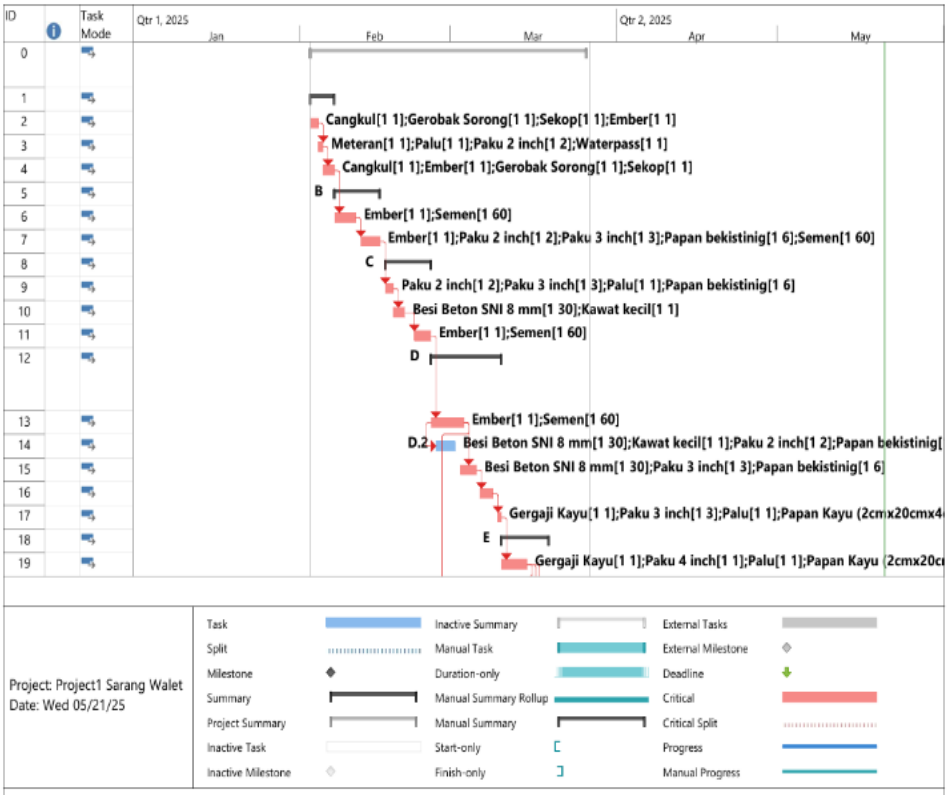


Fig 2: Quick Time Plan Scheme

Description: Critical Path

Based on Figure 2, the most efficient time sequence can be seen through the Gantt Chart as follows:



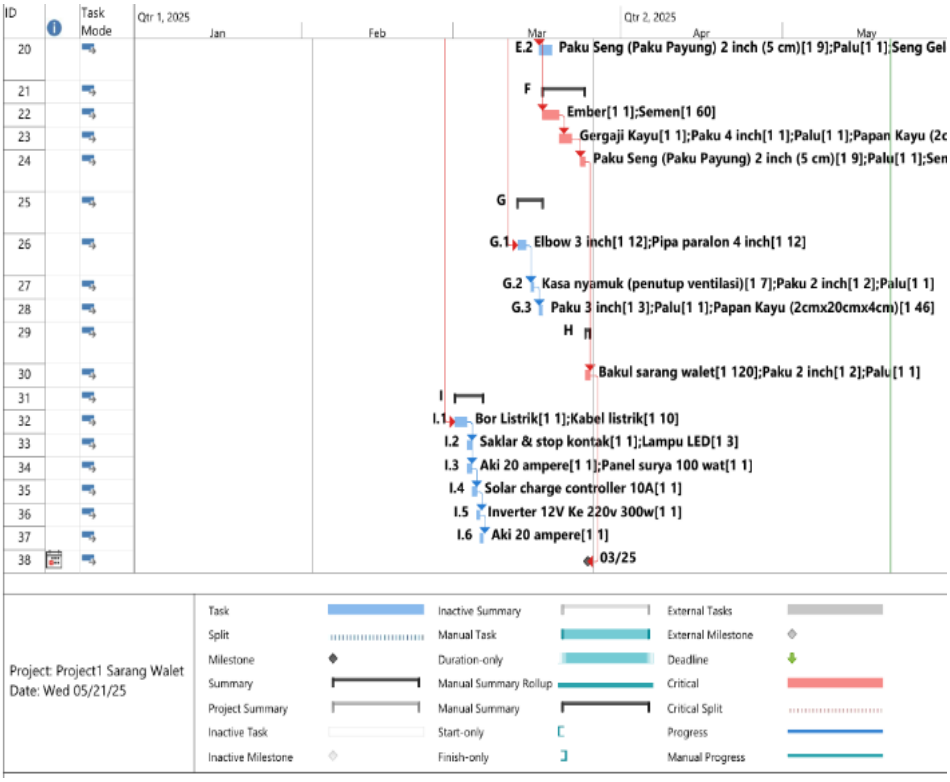


Fig 3: Gantt Chart Quick Time on Microsoft Project

Figure 2 shows the identification of critical paths and the calculation of the time required for each activity in the swallow's nest house construction project. The critical path is determined using the method on the normal time scheme. The main difference between a normal time chart and other paths lies in the sum of the execution duration of the entire series of activities. In this schema, the critical path is consistently defined as a series of activities: A-B-C-D-E-G-F-H.

The critical path provides an overview of a series of activities that determine the total project time and have no reserve time (float) in its implementation. Therefore, delays in critical line activities will have a direct impact on the overall completion of the project Pramesti & Listyawan, (2023) [23]. CPM is applied to estimate project implementation time in a structured manner by accumulating the duration of interrelated activities (Polii *et al*., 2017) [22].

Based on the sequence of activities on the critical path, the estimated minimum time to complete the bird's nest house construction project is carried out through CPM modeling. The overall duration of activities on the line is calculated in aggregate to obtain the most efficient estimate of completion time Khotimah *et al*., (2024) [14]. The analysis shows that the fastest time required to complete a swallow's nest house construction project is 44 days.

5. Conclusion

Based on the sequence of activities on the critical path, the estimated minimum time to complete the bird's nest house construction project is carried out through CPM modeling. The overall duration of activities on the line is calculated in aggregate to obtain the most efficient estimate of completion time Khotimah *et al*., (2024) [14]. The analysis shows that the fastest time required to complete a swallow's nest house construction project is 44 days.

6. Thank-You Note

Appreciation to the Business Administration Département and P3M of Samarinda State Polytechnic who have helped during the project, both providing motivational and financial support.

7. Reference

1. Aboma B. Optimalisasi manajemen dan analisa jaringan kerja pada proyek konstruksi pembangunan Yayasan Sekolah Cinta Budaya. 2015. Available from: https://repositori.uma.ac.id/jspui/handle/123456789/21069
2. Ahmad SN, Hanafie IM, Sriwati M, Kamba C, Lapian FEP, Risfawany LD, *et al*. Pemanfaatan material alternatif (sebagai bahan penyusun konstruksi). Tohar Media; 2021. Available from: https://books.google.com/books?hl=id&lr=&id=L2RaEAAAQBAJ&oi=fnd&pg=PA1&dq=Dalam+bidang+arsitektur+dan+teknik+sipil,+bangunan+diartikan+sebagai+hasil+konstruksi+yang+terikat+pada+lokasinya,+baik+sebagian+maupun+seluruhnya+terletak+di+atas+atau+di+dalam+tanah+dan/atau+air,+serta+berfungsi+sebagai+ruang+aktivitas+manusia.&ots=vo7sXbzrBU&sig=GJcjL1pegwtupkMZYa_-1-syiVg
3. Aisah NS, Subiyantoro H. Analisis bangunan tingkat menengah terhadap arah orientasi matahari di Gresik. Widyastana. 2020;1(1):54-62.
4. Bryman A. Social research methods. Oxford University Press; 2016. Available from: https://books.google.com/books?hl=id&lr=&id=N2zQCgAAQBAJ&oi=fnd&pg=PP1&dq=+Social+Research+Methods+(4th+ed.).+Oxford+University+Press.&ots=dqMxGSKbue&sig=taVDy6AS71TdrtBJWOF8nF5sP7U
5. Buna'i MA. Manajemen kurikulum. Duta Media Publishing; 2022. Available

from: http://repository.iainmadura.ac.id/1253/
6. Creswell JW. Research design: Qualitative, quantitative, and mixed methods approaches. 2014. Available from: https://eduq.info/xmlui/handle/11515/19498
7. Gusmao B. Perbandingan biaya dan waktu pada pelaksanaan struktur beton sistim cast in situ dan sistim precast pada pembangunan gedung PTIIK Brawijaya Malang [PhD Thesis]. ITN Malang; 2015. Available from: http://eprints.itn.ac.id/2638/
8. Handoko R. Uji karakteristik humidifier sebagai sistem pengkabutan rumah sarang walet [PhD Thesis]. Universitas Hasanuddin; 2022. Available from: https://repository.unhas.ac.id/id/eprint/23075/
9. Heizer JH, Render B. Principles of operations management. Pearson Educación; 2004. Available from: https://books.google.com/books?hl=id&lr=&id=jVIwSsVHUfAC&oi=fnd&pg=PA1&dq=Operations+Management+(11th+ed.).+Pearson.&ots=FrDa8S2q0H&sig=DgViXN8dv0GukBv8pYq3fJvssns
10. Ichsan RN, Nasution L, Sinaga S. Studi kelayakan bisnis. CV. Sentosa Deli Mandiri; 2019. Available from: https://books.google.com/books?hl=id&lr=&id=KAACEAAAQBAJ&oi=fnd&pg=PA1&dq=Yang+tak+kalah+penting,++Aspek+kekuatan+dan+keamanan+struktur+harus+memenuhi+standar+teknis+untuk+menjamin+bangunan+tetap+kokoh+dan+layak+digunakan.++&ots=-5TE1ZaDux&sig=V-oXgnvC8P2NLAB_ZPWj41kbUuE
11. Irianie Y. Penerapan metode dan teknologi pre-cast kolom dan balok Tricon 3 Jupiter pada konstruksi bangunan gedung bertingkat. Info-Teknik. 2013;14(1):35-48.
12. Jatnika I, Suryadi D, Suryadi EE. Membangun kemandirian keuangan daerah: Kasus pendapatan asli dan belanja modal Pemda Purwakarta. Mega Press Nusantara; 2024. Available from: https://books.google.com/books?hl=id&lr=&id=3HQUEQAAQBAJ&oi=fnd&pg=PA39&dq=Pemilihan+struktur+konstruksi+dipengaruhi+oleh+berbagai+faktor+yang+saling+terkait.+Pertama,+Fungsi+bangunan+menjadi+dasar+pertimbangan+desain+strukturnya+harus+sesuai+dengan+kebutuhan,+contohnya+struktur+untuk+sarang+walet+harus+mampu+menciptakan+lingkungan+yang+tenang+dan+stabil.+Kedua,+kondisi+tanah+dan+lokasi+proyek+turut+berperan+penting,+karena+karakteristik+geoteknik+dan+topografi+akan+mempengaruhi+jenis+struktur+yang+paling+tepat+dan+aman.&ots=bf4nxwIhOU&sig=xbGj2fvvWpl2dqRoyvKkzvo25sQ
13. Kerzner H. Project Management: A Systems Approach to Planning, Scheduling. John Wiley and Sons; 2005. Available from: https://www.books1.co.uk/pdf-read/BA/Project-Management.pdf
14. Khotimah IH, Sholahuddin M, Rodhi NN, Tjandra A. Analisis pengendalian waktu proyek menggunakan metode Critical Path Method (CPM). J Tek Sipil. 2024;9(2):60-9.
15. Kirana SN, Baidhowi MF, Maharani RT, Harmunisa YR. The concept of sustainable architecture in swallow house design. ADBE. 2023;3(1):57-64.
16. Koskela LJ, Howell G. The underlying theory of project management is obsolete. 2002. Available from: https://salford-repository.worktribe.com/output/1462587
17. Larson E, Gray C. Project Management: The Managerial Process 6e. McGraw Hill; 2014. Available from: https://books.google.com/books?hl=id&lr=&id=RaRvEAAAQBAJ&oi=fnd&pg=PP1&dq=Project+Management:+The+Managerial+Process.&ots=qrRx8rH6cU&sig=1C6at1RBm6dfGgwle6ygFJT71FU
18. Malawauw JM, Jamlaay O, Sahusilawane T. Analisis waktu pelaksanaan proyek pembangunan jembatan Wai Pulu di Desa Ulahahan Kecamatan Telutih Kabupaten Maluku Tengah. J Penelit Multidisiplin Bangsa. 2025;1(10):1930-9.
19. Mardizal J, Andayono T. Manajemen irigasi dan bangunan air. Eureka Media Aksara; 2023. Available from: https://books.google.com/books?hl=id&lr=&id=0TnOEAAAQBAJ&oi=fnd&pg=PA1&dq=Kedua,+kondisi+tanah+dan+lokasi+proyek+turut+berperan+penting,+karena+karakteristik+geoteknik+dan+topografi+akan+mempengaruhi+jenis+struktur+yang+paling+tepat+dan+aman+&ots=jPdQmJA0AE&sig=ZhKcRRAa-CKMeGU3I5qc8ANPlgM
20. Moleong LJ. Metodologi penelitian kualitatif edisi revisi. 2007. Available from: https://library.stik-ptik.ac.id/detail?id=7251&lokasi=lokal
21. Patton MQ. Enhancing the quality and credibility of qualitative analysis. Health Serv Res. 1999;34(5 Pt 2):1189.
22. Polii BR, Walangitan ORD, Tjakra J. Sistem pengendalian waktu dengan Critical Path Method (CPM) pada proyek konstruksi. J Sipil Statik. 2017;5(6). Available from: https://ejournal.unsrat.ac.id/index.php/jss/article/download/16754/16270
23. Pramesti HR, Listyawan AB. Analisa pengendalian waktu dengan metode Critical Path Method (CPM) pada proyek pembangunan Pondok Iqro', Surakarta. Pros Semin Nas Tek Sipil UMS. 2023:560-6. Available from: https://proceedings.ums.ac.id/sipil/article/view/2762
24. Sari P, Sudiana I. Analisis daya saing dan faktor yang mempengaruhi ekspor sarang burung walet Indonesia di pasar Hongkong. E-J Ekon Pembang Unud. 2022;11(1). Available from: https://scholar.archive.org/work/d3v3lmv4lrbntfycjkzqijc35m/access/wayback/https://ojs.unud.ac.id/index.php/eep/article/download/58299/43068/
25. Schwalbe K. Information technology project management. Cengage Learning; 2016.
26. Soeharto I. Manajemen proyek dari konseptual sampai operasional. 1997.
27. Sulaksana IP. Analisis perbandingan waktu dan biaya pelaksanaan proyek metode Fast Track dengan metode konvensional [PhD Thesis]. Universitas Mahasaraswati Denpasar; 2022. Available from: http://eprints.unmas.ac.id/id/eprint/1763/
28. Syarif A, Kusrini K, Pramono E. Sistem pengendalian suhu serta kelembaban ruang sarang walet menggunakan fuzzy berbasis mikrokontroler. Creat Inf Technol J. 2021;6(2):132-41.
29. Utomo PP. Analisis perbandingan biaya dan waktu pelaksanaan pekerjaan dinding eksterior menggunakan dinding beton pracetak dan dinding panel beton ringan pada proyek Apartemen Gunawangsa Merr Surabaya [PhD Thesis]. Institut Teknologi Sepuluh Nopember; 2017. Available from: https://core.ac.uk/download/pdf/291461258.pdf

30. Wibowo JH, Djoko D, Irawan MS. Desain modifikasi perkantoran One Galaxy dengan metode beton pracetak dan dengan sistem Half Slab [PhD Thesis]. Institut Teknologi Sepuluh Nopember; 2018. Available from: https://repository.its.ac.id/57306/1/03111440000062-Undergraduate_Theses.pdf
31. Wideman RM. Project and program risk management: A guide to managing project risks and opportunities. 1992. Available from: https://cir.nii.ac.jp/crid/1130000793907488512