

Analysis Of The Implementation Of Building Information Modeling For Time Control And The Implamation Methode Of Water Way Tunnel Construction In Way APU DAM, Buru District

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Submission date: 31-Mar-2021 12:47PM (UTC+0700)

Submission ID: 1547047643

File name: 4ANALY_2.PDF (496.43K)

Word count: 3747

Character count: 20218

Analysis Of The Implementation Of Building Information Modeling For Time Control And The Implamation Methode Of Water Way Tunnel Construction In Way APU DAM, Buru District

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Abstract: The waterway tunnel construction work for the way apu dam is an underground work that includes several complex works, with the possibility that the fulfillment of the construction schedule may be delayed. On the other hand, there is information technology using Building Information Modeling (BIM) which can help smooth development. Researchers are interested in examining how the three building image modeling that has been given complete information can affect the implementation method and time control. The researcher formed a model 3 building image and filled it with detailed construction information, then from the 3-dimensional model image an analysis was made to improve the implementation method and time control analysis using the Network Planning Critical Patch method. By using this case study of the waterway tunnel construction, an acceleration of the provision of information is obtained to improve the implementation method and the spatial insight of the workplace to facilitate decision making. Controlling the implementation time by utilizing information from BIM resulted in an acceleration of the implementation completion time of 2 months from 12 months to 10, with a performance efficiency level of time control to 83.3%

Keywords: BIM, Information, time control, effective performance.

1. INTRODUCTION

The construction of the waterway tunnel at the Way Apu dam project has a complexity of work that is limited by the space that is not too large. Most of the work is in the ground, so the smooth running of civil building works is very dependent on the geological conditions and soil movements at the time of construction. herefore innovation is needed to control time and ensure the quality of work. Some of the problems that occur in late project activities are incomplete design drawings, limited resources and inappropriate work methods Building Information Model (BIM) is an information technology in the field of Architecture, Engineering and Construction based on three-dimensional (3D) images. Currently the use of BIM information technology in Indonesia is still in a slow and immature condition (Wong et al, 2013). In theory, using BIM for project activities will become easier. Based on this explanation, the researcher intends to conduct research to find out how the influence of the use of BIM information technology on the implementation and time control method which is based on time management principles.

2. LITERATURE REVIEW

2.1 Building Information Modelling (BIM)

Building Information Modeling (BIM) is a complete building information concept that is projected into a 3D image then followed by related steps (Ilham, 2016) and not a specific software. so that in this study we will use the Autocad, Sketchup, microshoft word and microshoft excel programs.

2.2 Construction Management

Management is a process of planning, organizing, coordinating and controlling or controlling resources in achieving targets efficiently and effectively. (Fiki at all, 2016). Construction management includes work methods, equipment used, materials, finance and human resources and is equipped with time management.

2.3 Working method

The work method is an orderly action and is made technically to complete a job which includes mastering the drawing and the field and setting the stages of work at one time.

2.4 Work Breakdown Strukture Theory

Work Breakdown Structure is a technique for dividing a single job into several smaller work stages. The work that has been identified will be arranged sequentially in a complete and continuous hierarchy with respect to the duration of the work completion.

2.5 Network Planning

Networking planning is a technique for scheduling and monitoring work activities using a time approach which is depicted in the form of symbols and diagrams. One type of network planning is the critical path diagram method which uses a circle as an event and an arrow as an activity. When analyzing using the critical patsch method, the critical path will be obtained. The critical path shows the same number of EET (Early Event Times) and LET (Lates Event Times). If activities on this route are postponed, it will cause completion of work to be delayed

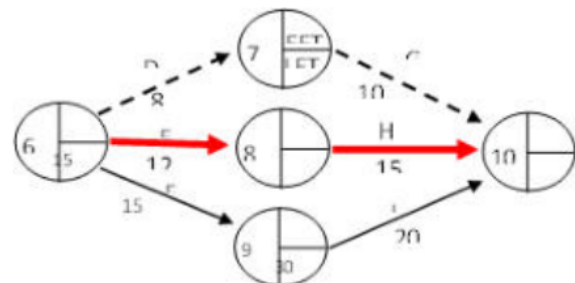
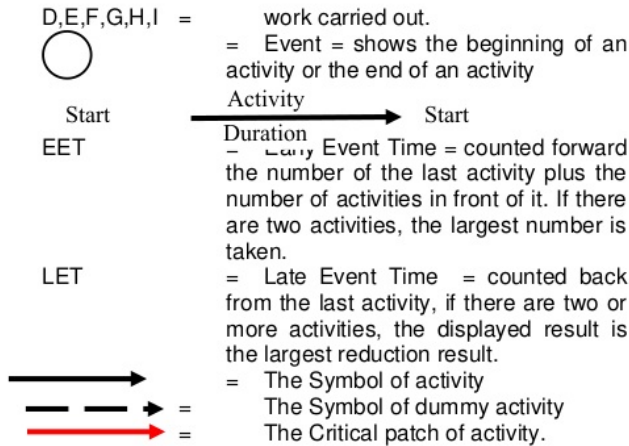


Figure 2. Relationship between activities, events and critical paths

Source : Agus (2018)
Information :



3. RESEARCH METHODOLOGY

The research method was carried out using the BIM concept, namely doing 3 D depiction using the Skethcup software and then utilizing the information from the image to improve the implementation method and control of work scheduling by using Network Planning in the form of a Critical Path Method (CPM)research is included in the type of quantitative research that aims to prove the theory and research hypotheses based on the results of measurement data.

a Data Retrieval

The data used is secondary data taken from Balai Wilayah Sungai Maluku in the form of Tunnel technical data, work methods, and work implementation schedules

b Schedule of Implementation of The Work Under Study

The construction of the Wae Apu Dam Barrier Tunnel construction is carried out for 12 months, with the work implementation schedule as presented as follows :

Masa Pekerjaan	2018												2019											
	Jan	Feb	Mar	Apr	Mei	Jun	Juli	Agust	Sept	Oktr	Nov	Dek	Jan	Feb	Mar	Apr	Mei	Jun	Juli	Agust	Sept	Oktr	Nov	Dek
1. PEKERJAAN PENGALAMAN																								
1.1. PERBUATAN TANGKAP																								
1.2. PERBUATAN BENTUK DAN PROTEKSI																								
1.3. PERBUATAN PENJALAN DAN LALUAN																								
1.4. BANGUNAN PENGAMBILAN																								
1.5. PERBUATAN TANGKAP																								
1.6. PERBUATAN PROTEKSI DAN PENYANGGA																								
1.7. PERBUATAN BETON																								

Figure 3 work implemation Schedule Plan for Tunnel Works

4. RESULT AND DISCUSSION

c Making Three-Dimensional Modeling Of The Tunnel

The working drawing provided by the designer is a 2-dimensional autocad drawing in the form of a floor plan of the tunnel along with the open excavation at the inlet, tunnel outlet and open excavation in the floor plan shaft along with separate details in several parts. as in figure 4.

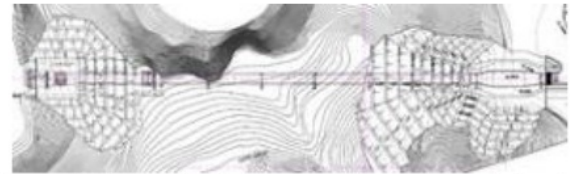


Figure 4: Tunnel plan in two-dimensional Auto cad drawing



Figure 5. Tunnel longitudinal section in two-dimensional form

Based on the contours of the land in the design included in the plan, an overall image model of the excavation of the soil outside and inside the tunnel is formed in 3 dimensions which is equipped with building shapes such as inlets, outlets and shafts as shown in figure 6 and figure 7.

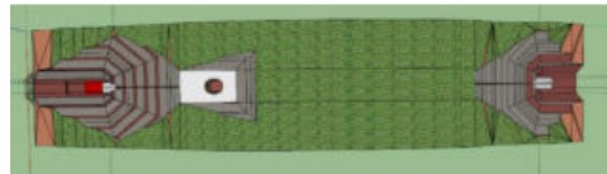


Figure 6 Top View of the Tunnel

The longitudinal section of the tunnel is seen from the side by means of the land being cut in half so that it can show the longitudinal view of the tunnel building

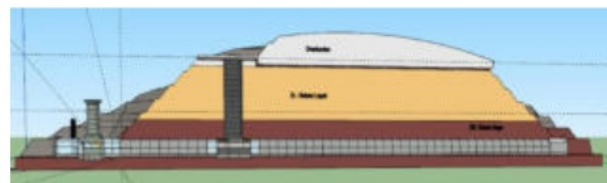


Figure 7. The longitudinal tunnel

In the three-dimensional model that is formed, all the necessary information is entered, including building tunnel protection, iron work for concrete. It is hoped that all experts can consider all the difficulties that may occur in the implementation of construction.



Figure 8 inlet and shaft construction



Figure 9 Outlet construction with channel normalization to the river

d Analysis of the Effect of Information Technology on Implementation Methods

Analysis of the influence of technology is carried out during pre-construction in the form of a study of design drawings to be applied to construction as well as a study of the implementation method used. Thus it is as if construction experts have worked together to carry out construction virtually.

Based on this study, the following activities were produced:

1. Design Collision Detection

There were design improvements for implementation that were useful in assisting the preparation of construction work, including repairing the joints of laying walls with different heights, as shown in Figure 10

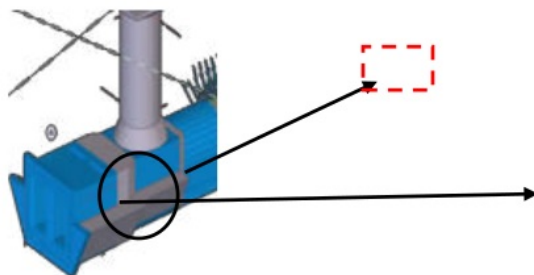


Figure 10 Detailed explanation of model wings

2. Minimizes the risk of work errors

There were several risks of work errors that would hinder implementation, including the difficulty of installing a steel liner on the shaft connection to the tunnel, namely from a circle to a horseshoe shape. In the initial work method, the steel liner was installed completely, but in fact there was a condition of movement from a circle to a horseshoe shape with different building dimensions. Based on the study, the installation of the steel liner at the top is easier if it is divided in half, while the lower part is divided into several small parts which are attached when changing the intake function. The location of the steel liner can be seen in Figure 11:

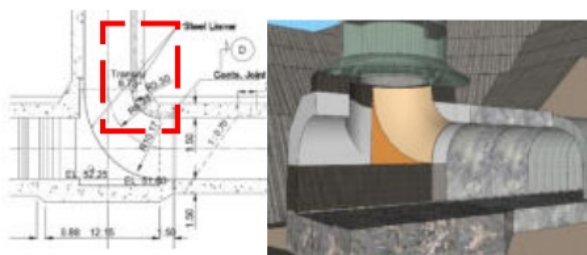


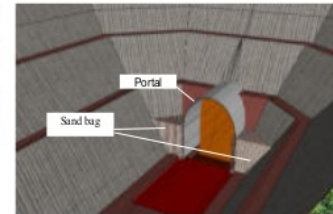
Figure 11 steel liner installation

3. Improved implementation methods.

There is an improvement in the implementation method which has resulted in several additional new equipment for implementation such as gantry cranes as a means of transporting material in the shaft work section, steel staging and sliding forms for cast work in tunnels. Among the

improvements to the implementation method are as follows:

a. Making a portal at the end of the tunnel for protection of work safety equipped with a sandbag for security stability

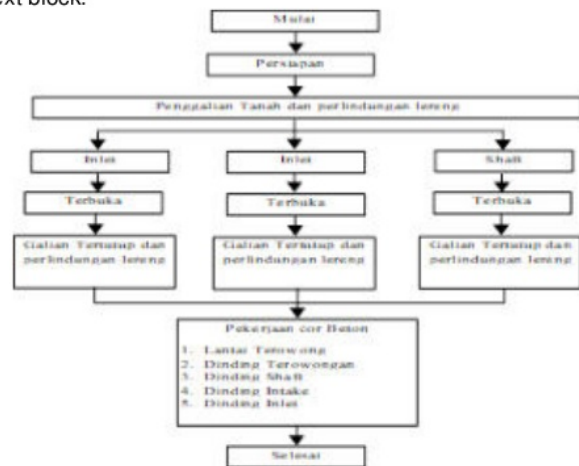


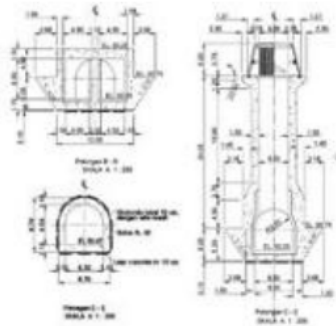
b. The method of excavating the shaft is started from top to bottom, so that the material taking from the shaft uses a basket from the gantry crane. Likewise, concrete materials can be lowered using a gantry crane



3. Concreting

D. Concrete work is refined into continuous concrete activities so that wall concreting can be carried out after the floor concrete work in front of the state is at least 15 days old, thus this work will be controlled. The adding tools used were steel staging and sliding form. The steps for the concreting work are: reinforcing and concreting the work floor approximately 4 blocks where 1 block is 12 m. It is estimated that the age of the concrete at the beginning of the floor is more than 15 days, then a sliding form is installed for the formwork and starts concreting. After the concrete is 3 days old, this sliding form can be removed and continued on the next block.





4. Facilitate and speed up decision making

When working using conventional methods, the spatial layout of the work location is still a two-dimensional image, so there are often errors in setting the use of tools and labor, improving work drawings when problems occur in the development area. When using the Information Technology Building Information Modeling (BIM) application, stake holders, both contractors, consultants or owners, will be able to see calmly in one image and get all the information in the field along with the layout of the work location. This condition will be very beneficial when arranging work, distributing human resources, tools and materials, monitoring work and making decisions to solve problems and to accelerate the implementation of construction activities as well as to save financing..

e Analysis of Testing Construction Implementation Schedule with Construction Management Principles.

The construction of the Way Apu Dam tunnel construction work includes several works such as excavation of earth and concrete works. All stages of work will be identified and arranged in a hierarchical order of work such as the following flow chart:

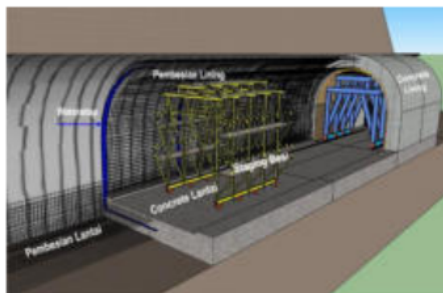


Figure 12 Flowchart of the structure of the construction stages

The next step is to determine the completion time of each activity that has been adjusted to the construction implementation method into a systematic work sequence. Then the results are arranged in a beating diagram which states the time in months.

Table 1. Analysis of Initial Work Implementation Schedule

No	Jenis Pekerjaan	Bulan ke												Ket	
		1	2	3	4	5	6	7	8	9	10	11	12		
1	Pekerjaan Tanah														
1.1	Galian Terbuka inlet dan outlet														
1.2	Galian Terowongan														
a	Dari Inlet														
b	Dari Outlet														
1.3	Galian Shaft														
a	Instal gantry crane														
b	galian fondasi gantri crane														
c	Tahapan 2														
d	Bottom Shaft														
2	Pekerjaan Beton														
a	pondasi gantri crane														
b	Portif shaft														
c	pembetonan lantai terowong														
d	Pembetonan dinding terowong														
e	dasar shaft														
f	dinding shaft														
g	lantai														
3	Proteksi dan penyanga														
a	Lereng tebing														
b	dinding Terowongan														
c	Dinding Shaft														
4	Pekerjaan Lain-lain														
a	pembesian														
b	pengeboran dan grouting														

The results of the bar chart are arranged in a table that states the work that precedes, the work that is preceded and the duration of the work

Table 2 Description of the types of work with work that precedes, is preceded, the duration

No	Kode	Nama Pekerjaan	P. Preceded	Preceded	Durasi (Bulan)
1	1.1	Galian Terbuka inlet dan outlet			1
2	1.2	Galian Terowongan	1.1		1
3	1.3	Galian Shaft	1.1		1
4	1.3.1	Instal gantry crane	1.3		1
5	1.3.2	galian fondasi gantri crane	1.3.1		1
6	1.3.3	Tahapan 2	1.3.2		1
7	1.3.4	Bottom Shaft	1.3.3		1
8	2.1	pondasi gantri crane	1.3.4		1
9	2.2	Portif shaft	1.3.4		1
10	2.3	pembetonan lantai terowong	1.3.4		1
11	2.4	Pembetonan dinding terowong	1.3.4		1
12	2.5	dasar shaft	1.3.4		1
13	2.6	dinding shaft	1.3.4		1
14	2.7	lantai	1.3.4		1
15	3.1	Proteksi dan penyanga	1.3.4		1
16	3.2	Lereng tebing	1.3.4		1
17	3.3	dinding Terowongan	1.3.4		1
18	3.4	Dinding Shaft	1.3.4		1
19	4.1	pembesian	1.3.4		1
20	4.2	pengeboran dan grouting	1.3.4		1

After all the relationships between existing activities and their duration can be found, the next step that must be taken is to make a CPM diagram as shown in Figure 13. The critical path of work will be obtained, then the researcher will analyze the possibility of occupation or acceleration of work by utilizing work outside the critical path that still has Long free time

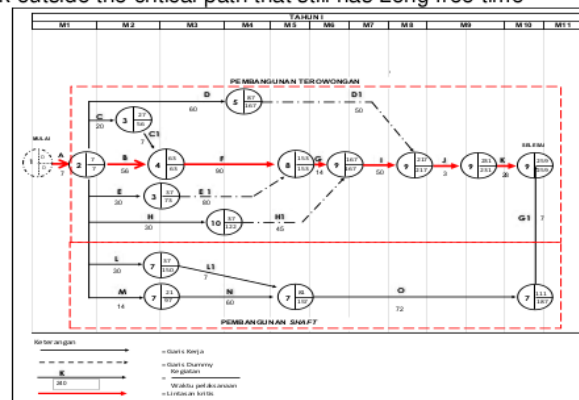


Figure 13 Network Planing of waterway Tunnel Construction Works

The critical path obtained from the CPM diagram is the A-B-F-G-I-J-K path.

From Network Planning Analysis using the Critical Path Method, it is described again into a bar chart to compile an implementation schedule as in table 3.

Table 3. Final construction schedule plan

No	Activity	month											Information
		1	2	3	4	5	6	7	8	9	10	11	
1	Earthwork	[Bar chart showing activity from month 1 to 6]											
1.1	open excavation of inlet and outlet	[Bar chart showing activity from month 1 to 3]											
1.2	Tunnel Excavation	[Bar chart showing activity from month 3 to 6]											
1.3	shaft Excavation	[Bar chart showing activity from month 3 to 5]											
2.0	Concreting	[Bar chart showing activity from month 2 to 10]											
a	Tunnel	[Bar chart showing activity from month 6 to 10]											
b	Shaft	[Bar chart showing activity from month 3 to 5]											
c	Intake	[Bar chart showing activity from month 9 to 11]											
3.0	protection and support	[Bar chart showing activity from month 1 to 6]											
a	cliff slopes	[Bar chart showing activity from month 1 to 3]											
b	Tunnel walls	[Bar chart showing activity from month 3 to 6]											
c	shaft walls	[Bar chart showing activity from month 3 to 5]											
4.0	Pekerjaan Lain-lain	[Bar chart showing activity from month 5 to 11]											
a	pembersihan	[Bar chart showing activity from month 10 to 11]											
b	Drilling and grouting	[Bar chart showing activity from month 5 to 6]											

In testing research instruments, validity and reliability test results. From the results of the analysis, it can be seen that there is a time acceleration for two months from 12 months to 10 months which also affects the effective level of performance, as presented in table 4.

Table 4 Results of the analysis of time and cost control functions

No	Activity	Result being analyzed		Keuntungan
		Before	after	
1	Construction Schedule	12 month	10 month	2 month
2.	Work effectiveness	100 %	83,33 %	16,77 %

f Discussion

1. The Effect of the Use of Information Technology BIM on the Implementation of Construction Work

The use of Building Information Modeling (BIM) information technology in the construction work of Dodge Binoculars based on the analysis that has been carried out, can facilitate the implementation of the Way Apu Dam circumvention tunnel construction activities, because it can improve implementation methods, avoid design collisions during construction, and provide information from all personnel. experts making it easier to make decisions quickly.

2. The Effect of BIM Technology on Time and Cost Control Functions.

By exploring the potential of BIM as a tool for the characteristics of construction projects in the early stages of implementation, it is very helpful to study the implementation method, show the types of assistive equipment that will be used as additional tools, show simulations of the use of the amount of work equipment that goes into the waterway tunnel for construction, and changes in traffic in the implementation of construction work. When reviewing the construction plan, all experts will provide input according to their fields in a tunnel building model.

Based on time management analysis assisted by information from Information Technology, BIM can control the

construction time from 12 months to 10 months with an effective time saving rate of = $10/12 \times 100\% = 83.33\%$ or equivalent to 16.77%

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

Based on the results of the analysis and discussion, the conclusions are obtained

- The use of Building Information Modeling (BIM) information technology in the implementation of work can affect the process of development activities because all information can be entered into a virtual model. Stake holders can analyze the overall work by using a construction concept that takes into account the space affected by the work, so that the use of heavy equipment can be trimmed closer to reality in the field, facilitates management of the use of human resources, tools and materials, perfects more detailed work methods, lacks detailed building plans can be immediately found and refined, make design changes, detailed errors can be found before implementation.
- The use of Building Information Modeling (BIM) information technology in time control analysis can accelerate the time of execution of work from 12 months to 10 months

5.2 Suggestions

Researcher's suggestions regarding research using BIM Information Technology can be developed to improve implementation methods, human resource planning, tools and materials as well as study development plans related to space and time of completion of work.

REFERENCES

- Agus Alisa Putra, 2018. Perencanaan waktu dalam Konstruksi dapat mengurangi tingkat kerugian, kesalahan didalam pekerjaan suatu Proyek
- Asri Wulan, Beti Pratiwi, 2011, Analisa pembangunan terowongan air sebagai Bangunan pengelak waduk Jatigede, Sumedang, Jawa barat, Proceeding PESAT (Psikolog, Ekonomi, Sastra, Arsitektur & Sipil Universitas Gunadarma - Depok 18 - 19 Oktober 2011, Vol 4 Oktober 2011 ISSN:1858-25
- Amalia Rizka Sugiartol, M Hamzah Hasyimll, Saifoe El Unasll, 2016. Analisis Risiko Dari Penggunaan Kurva-S Dalam Monitoring Proyek Gedung-X Di Kota Batu. (fakultas T.Sipil, Universitas Brawijaya, SKR/FT/2016/1084/051700151).
- Clough, G.A, Richard H. dan Sears. (1991). Construction Project Management. Edisi 5. Canada: John Willey & Sons Inc.
- Cinthia Ayu Berlian P., Randy Putranto Adhi, Arif Hidayat, Hari Nugroho, 2016. perbandingan efisiensi waktu, biaya, dan sumber daya manusia antara metode building information modelling (bim) dan konvensional (studi kasus: perencanaan gedung 20 lantai).
- Elvira Handayani, at all, 2015. Penerapan Manajemen Waktu menggunakan Network Planning (CPM) pada Proyek Konstruksi Jalan (studi kasus peningkatan jalan sp. berembang - sp. jambi kecil). Jurnal Ilmiah Universitas Batanghari Jambi Vol.15 No.1 Tahun 2015.

- [7] Ervianto, I.W. (2005). Manajemen Proyek Konstruksi Edisi Revisi. Yogyakarta. Andi offset.
- [8] Fiki Aryani, Rafie ., Syahrudin,2016, Analisa Penerapan Manajemen Waktu Pada Proyek Konstruksi Jalan Lingkungan Lokasi Kalimantan Barat, Jurnal Mahasiswa Teknik Sipil Universitas Tanjungpura vol 1 no1 2016
- [9] Hamzah B. Uno dan Nina Lamatenggo, Teknologi Komunikasi dan Informasi Pembelajaran, Jakarta: PT Bumi Aksara, 2011, cet, 2
- [10] Handika Rizky Utama, Jane Sekarsari, 2014. Analisa faktor penghambat penerapan building Information modeling dalam proyek konstruksi. (Program Studi Magister Teknik Sipil Universitas Trisakti, 2014)
- [11] Husen, Abrar. 2009. Manajemen Proyek. Yogyakarta: Andi Offset
- [12] Ilham fajar putra, 2016. Mempelajari Penerapan Building Information Modeling (BIM) di Amerika Serikat.
- [13] Juan Sebastian Simatupang A. K. T. Dundu, Mochtar Sibi ,2015. Pengaruh Percepatan Durasi Terhadap Waktu Pada Proyek Konstruksi (studi kasus : pembangunan persekolahan eben haezar Manado). Fakultas Teknik Jurusan Sipil Universitas Sam Ratulangi Manado Jurnal Sipil Statik Vol.3 No.5 Mei 2015 (281-280) ISSN: 2337-6732.
- [14] Kukuh Kurniawan DS,2018. Aplikasi Building Informasi Modeling (Bim) Tekla Structure Pada Konstruksi Atap Dome Gedung Olahraga Utp Surakarta (Jurnal Teknik Sipil Vol. 3 No. 2, Halaman: 273 – 281 Oktober 2018).
- [15] Kerzner H. 1995. Project Management: A System Approach to Planning, Schedulling and Controlling. New York (US): Van Nostrand Reinhold.
- [16] Langi J E C, Rantung J P, Sibi M, Tolangi M F. 2012. Analisis Cash Flow Optimal pada Kontraktor Proyek Pembangunan Perumahan. Jurnal Sipil Statik. 1(1): 60-64.
- [17] Lee, C.(2008). BIM: Changing the AEC Industry. PMI Global Congress 2008. Project Management Institute, Denver, Colorado, USA
- [18] Nasrul. 2015. Manajemen Risiko Dalam Proyek Konstruksi Ditinjau dari Sisi Manajemen Waktu. Jurnal Momentum. 17(1): 50-54 ISSN 1693-752.
- [19] Pambudi, Lilianto Rio and Ichsandi, Mustar , 2017. Metode Pelaksanaan Pembangunan Terowongan Pengelak (Tunnel) Pada Proyek Waduk Bendung Ponorogo. Diploma thesis, Institut Teknologi Sepuluh Nopember.
- [20] PT.Indrakarya,2017 Laporan Akhir pekerjaan Investigasi Tambahan dan Sertifikasi Desain Bendungan Way Apu, Kabupaten Buru, Provinsi Maluku.
- [21] PT. Indra Karya - PT. Raya konsult-Pt. Multimerah Harapan- PT. Inaco internasional Konsulindo KSO, 2018 Laporan Pendahuluan supervisi pembangunan bendungan Way Apu,
- [22] PT.Indrakarya,2017, Album Gambar pekerjaan Investigasi Tambahan dan Sertifikasi Desain Bendungan Way Apu, Kabupaten Buru, Provinsi Maluku,2017
- [23] Rezki Ikhsan Rizaldi, Indra Fami, Rini Mulyani,2016. Kajian Potensi Bangunan Building Information Modeling (Bim) Dalam Merencanakan Gedung Di Indonesia.
- [24] Raflis, Bambang Endro Yuwono, Ripsky Rayshanda, 2018. Manfaat Penggunaan Building Information (Bim) Pada Proyek Konstruksi Modelling Sebagai Media Komunikasi Stakeholders. Department of Civil Engineering, Universitas Trisakti. Jurnal cesd E-ISSN : 2621-4164 Vol. 01 No 02 Desember 2018.
- [25] Rayendra1, Biemo W. Soemardi, 2014, Studi Aplikasi Teknologi Building Information Modeling Untuk Pra-Konstruksi. (Simposium Nasional RAPI XIII - 2014 FT UMS ISSN 1412-9612).
- [26] Syarifudin Kamaludin, T A M. Tilaar, Fahira F, 2017. Analisis Faktor Yang Mempengaruhi Kinerja Pengawas Lapangan pada Pelaksanaan Proyek Peningkatan Jalan di Kabupaten Morowali Utara (Prosiding Seminar Hasil Penelitian (SNP2M) 2017 (pp.184-189) 978-602-60766-3-2)
- [27] Setyadi Asnuddin Jermias Tjakra, Mochtar Sibi,2018. Penerapan manajemen konstruksi pada tahap controlling proyek. (studi kasus : bangunan laboratorium fakultas teknik universitas sam ratulangi manado) Jurnal Sipil Statik Vol.6 No.11 November 2018 (895-906) ISSN: 2337-6732.
- [28] Smith, Deke, 2007. An Introduction to Building Information Modelling (BIM), Journal of Building Information Modelling, 4-12.
- [29] Subandiyah, 2016. Catatan Kuliah S2 Manajemen Proyek Institut Teknologi Nasional Malang.
- [30] Umami Chasanah dan Sulistyowati, 2017. Penerapan Manajemen Konstruksi Dalam Pelaksanaan Konstruksi, Jurnal Neo Teknik Vol 3. No. 1, Juni 2017, hal. 35-39.
- [31] Wisnu Adi Prasetya, 2018. Tinjauan bim (building information modelling) dalam Bidang ict ,konstruksi di negara asean. Seminar Nasional Edusainstek FMIPA UNIMUS 2018 ISBN : 978-602-5614-35-4
- [32] Wong, K., & Fan, Q. (2013). Building nformation modelling (BIM) for sustainable building design. Facilities, 31(3/4), 138–157.
- [33] Triarman, Christopher & Sekarsari, Jane. (2018). Analisis faktor penyebab keterlambatan waktu pada pekerjaan struktur atas proyek konstruksi. Penelitian dan karya ilmiah. 3. 1. 10.25105/pdk.v3i2.2980

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