

Evaluation of the Dredging Work Method at Entrance Channel and Harbor Pool Terminal Kalibaru Phase 1b Tanjung Priok Port–Based Risk to Improve Time Performance

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Abstract

The method of carrying out the work is a process, method, or procedure for doing something by providing a structure to complete the work. The project of dredging the Kalibaru terminal stage 1B Tanjung Priok Port is a work to increase the depth of the pool and entrance channel from -4 mLws to -16 mLws. In its implementation, there is a work error method that has an impact on the implementation of project time. Basically, the dredging work of the Kalibaru entrance channel and pool terminal phase 1B Tanjung Priok Port has a method of carrying out the work but there are still some things that are not standardized and incomplete. This research uses survey methods, literature studies, and case studies, and then data analysis uses the Delphi method. This research was also conducted to develop dredging work methods to improve risk-based time performance. The results of this research hope to provide input and guidelines for new methods of dredging work that will be carried out in the future.

Keywords

Work method, dredging work, risk, dredging stage, and dredging process.

1. Introduction

A method is a process, a way, or a procedure to do something by providing a structure to get the job done (Kimbell and Julier 2019). Methods are also defined as procedures, techniques, or systematic means of investigation used by or according to a particular discipline (Merriam-Webster 2013). Methods are expected to be a guide for a person or organization in making or compiling work steps. So, making or doing something is mandatory according to the existing steps. The methods' accuracy will provide a higher success rate of project work (Wells 2012).

The Kalibaru terminal entrance channel and harbor pool dredging work project phase 1B of Tanjung Priok Port is a work to increase the depth of the pond and shipping channel from -4 mLws to -16 mLws So that the port in the future can serve large ships so that the organization's revenue can increase. In its implementation, there are dredging work activities with improper work methods that impact time performance and increase operational costs.

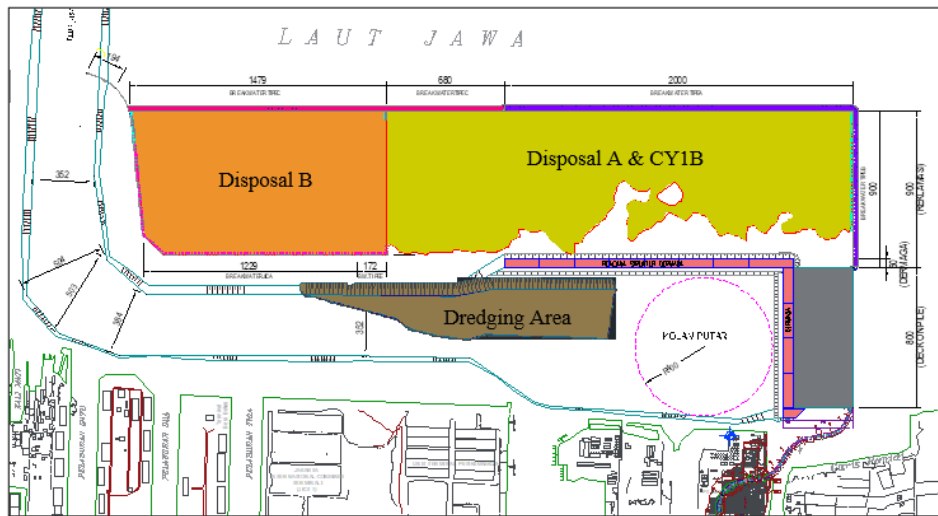


Figure 1. Project location



Figure 2. Project activity

Table 1. Work Dredging Process and Stages

Work Activity	Description	Causes	Impact
Dredging Cutter Suction Dredger (CSD)	Distribution of waste material unevenly at the CY1B disposal site and disposal A so that there is a buildup of material	The discharge pipe is only available in 1,500 m of the 3,000 m plan	Leveling the material by bringing in heavy equipment Grab Dredger ship
Work Activity	Description	Causes	Impact

Grab Dredger (GD)	The ship cannot enter disposal area B with 4 N miles	The capacity of the tool used is too large, namely 2,600 m ³ not according to plan, namely 500 m ³ and 1,000 m ³	Dredge material must be disposed of offshore which is 21 N miles away
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In the project, work methods is an important role so that the project does not experience delays, good project implementation methods if they meet technical requirements, meet economic requirements, meet non-technical considerations and are the best alternative/choice (Syah 2004) and if the results of the analysis show indications of project scheduling deviations, it is necessary to take corrective steps. Rectification actions can be in the form of relocation of resources, increasing the number of workers, alternative schedules, changing work methods, and work splitting (Clough and Sears 1991). The work method is a guide to ensure that project or organizational activities run according to their goals (Sailendra 2015). Ponnert and Svensson (2016) reveal that methods/procedures are often used to reduce uncertainty. In addition, the work method also has a function to minimize errors that may occur (Gidey Amare 2012).

Based on previous research, delays in a project will cause a waste of time and costs (Alfakhri et al. 2018 and Amoatey et al. 2015). In addition, the impact of project delays causes losses to contractors, supervisory consultants, and owners (Oetomo et al. 2015). There are frequent impacts on project completion, namely additional costs, additional time, project rescheduling, poor quality of work, project delays, and breach of contract (Carlo et al. 2019; Kikwasi 2012, Sambasivan and Soon 2017). There are several main factors that cause project delays, namely improper methods, inaccurate time estimates, inaccurate cost estimates, lack of contractor experience, improper project planning and scheduling, incompetent project teams, use of outdated technology, design errors, rework, equipment shortages (Aziz and Abdel-Hakam 2016). Factors causing delays are improper execution methods, lack of contractor experience, and incomplete drawings (Thapanon et al. 2018). Factors influencing project delays include incorrect implementation methods, material shortages, ineffective planning and scheduling, weather conditions, and slow decisions due to bureaucratic owners (Seboru 2015). The causes of delays in project completion include improper implementation of stages of work, changes in work methods, inadequate equipment, lack of technical personnel, and slow mobilization (Kamanga and Steyn 2013).

From the problems that occur in the dredging work of the Kalibaru terminal entrance channel and harbor pool phase 1B Tanjung Priok Port, an evaluation of the method of dredging work is needed which consists of the dredging process and dredging procedures with the aim of improving time performance based on the assessment of risk factors arising in the project.

1.1 Objectives

In this journal, the author will identify the dredging process and stages of dredging work and then discuss the risks that will occur based on dredging work activities. The findings of this journal can provide information about what risks must be considered so that they can be minimized when dredging work activities are running and the accuracy of time performance can be improved.

2. Literature Review

A method is a process, a way, or a procedure to do something by providing a structure to get the job done (Kimbell and Julier 2019). According to Hendrik-Jan Seper (2001) that the dredging work process starts from the pre-tender phase which consists of initiation then continues the tender phase consisting of design & development and pricing & contracting, the next phase is execution which consists of the preparation and implementation of the project and the last is the handover of work. According to Dredging Guidelines for Major Ports Ministry of Port, Shipping and Waterways (2021) the dredging work process consists of planning, auctioning, construction, monitoring, evaluating, and handing over work. According to Worgu F and Wordu A. A (2019) the process for dredging work starts from the planning, design, auction, construction preparation, and handover phases of work. According to Jui-Shen Chou and Yin-Chen Chiu (2020), the dredging work process starts from the initiation stage, planning stage, design stage, auction stage, preparation stage, construction stage, monitoring stage, and final stage. Based on the Regulation of the Director General of Sea Transportation No HK.103/1/8/DJPL_17 (2017) in Indonesia the dredging work process consists of the planning stage, licensing stage, preparation stage, implementation stage, supervision stage, and evaluation stage.

A risk is an event that can arise that can adversely affect the mission or target (Podean et al. 2010). Risk is the effect of uncertainty on the acquisition of goals or objectives (ISO 31000:2009). The definition of risk is an event or situation that cannot be determined, and if it occurs, it can have an impact on project implementation and performance which can have an impact on the time, cost, quantity, and quality of the project (PMBOK Guide 6th Edition 2017). Objectives of risk management according to Asiyanto (Risk Management for Contractors 2009) are as follows: Minimize the potential for the emergence of recognized risks from frequent to no longer occurring, it can also be explained as the control of the causes that can generate these risks, minimizing the influence that can occur from familiar risks so that they no longer scale "fatal" and become a "meaningless" scale.

A risk is an uncertain event if it occurs that has a negative or positive impact on the goals and objectives of the project (Project Management Institute 2017). Project risk is also perceived by contractors as the possibility of unforeseen factors that could affect the successful completion of a project in terms of time, cost, and quality (Akintoye and Macleod 1997). Risks in dredging work cause losses in the aspect of time so they need to be managed to improve the efficiency of job completion (Zhu et al. 2017).

3. Methods

This research begins with identifying the problems formulated from the issues that occur, then making research questions and conducting literature reviews that are relevant to the research topic, and determining research methods. This research raises 3 research issues, RQ1: What are the processes in the implementation of current dredging work? RQ2: What are the stages/procedures in dredging work? RQ3: What are the risk factors for each activity in dredging work?

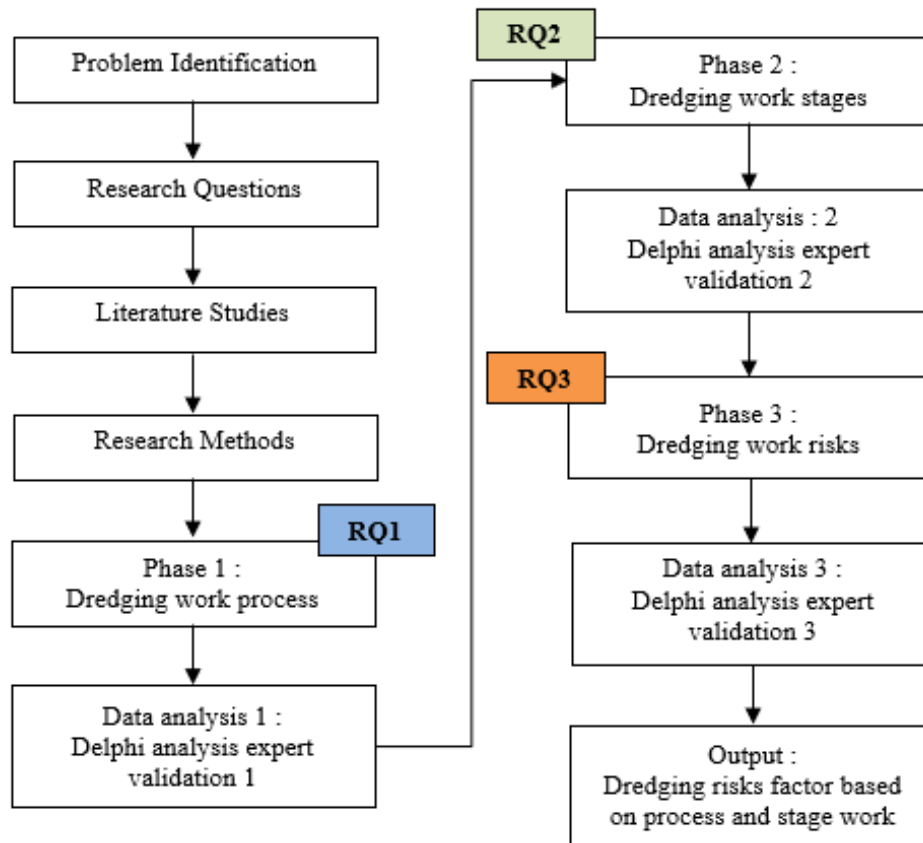


Figure 3. Research Flowchart

4. Data Collection

In this study, questionnaires were distributed at each stage of the research formulation to experts in the field of dredging who were directly involved in the project on this study. Furthermore, the results will be analyzed using the

Delphi method. The Delphi method is a process carried out in groups to conduct surveys and collect opinions from experts. After distributing a closed questionnaire to experts who have more than 10 years of experience, the results of the expert responses are then processed to get final validation of whether the variables given are in accordance with the topic proposed. If there are still differences of opinion, then the next round will be carried out until all experts agree on each variable.

5. Results and Discussion

Dredging work projects have many risks or uncertainties such as risks to the environment and society, so they often cause the duration of work to be long (Jui-Sheng Chou and Ji-Wei Lin 2020). Risks related to the availability of dredges and incorrect selection of dredges can lead to a deterioration in the project completion schedule and can also result in environmental pollution because sedimentary materials cannot be taken and disposed of following the method as previously calculated (Rizki Krisna 2018).

From the validation results that have been carried out, 8 dredging work processes were obtained, 30 stages of dredging work. From the results of the validation of the process and stages by experts, the risk factors of each stage of dredging work are examined. The results can be seen in the following table:

Table 2. Work Dredging Process and Stages

Work Dredging Process and Stages	
X1.1 Planning	X1.5 Execution
X1.1.1 Hydroseanographic survey	X1.5.1 Installing signs of dredge work
X1.1.2 Geotechnical survey	X1.5.2 Conducting dredging activity
X1.1.3 Pre-dredge sounding	X1.5.3 Check sounding survey
X1.1.4 Study of sedimentation and stability	X1.5.4 Sounding progress survey
X1.1.5 Design	X1.5.5 Volume calculation
X1.1.6 Dredging method	X1.6 Supervision
X1.1.7 Dredging equipment selection	X1.6.1 Reviewing bathymetric maps
X1.1.8 Volume calculation	X1.6.2 Checking the calculation results of bathymetric surveys
X1.1.9 Budget plan calculation	X1.6.3 Check the schedule of job execution
X1.2 Tender	X1.7 Evaluation
X1.2.1 Evaluation and clarification of administrative and technical documents	X1.7.1 Record constraints and work progress
X1.2.2 Price negotiations	X1.8 Hand over
X1.3 Project Permission	X1.8.1 Conducting a final sounding survey
X1.3.1 Bathymetric survey	X1.8.2 Volume calculation
X1.3.2 Volume calculation	
X1.4 Preparation	
X1.4.1 Mobilization of dredge equipment and personnel	
X1.4.2 Creating a method of executing work	
X1.4.3 Field office setup	
X1.4.4 Determining the schedule	
X1.4.5 Resounding Survey	
X1.4.6 Volume calculation	

Each stage of the dredging work is then described and analyzed what risk factors affect the activity so that the output is not achieved through the opinion of the dredging expert. Risk analysis is carried out by calculating the average value of the impact of risk and probability. But first, the collected data must be converted into a risk assessment system according to PMBOK 6th Edition. After the impact and probability are determined, the risk matrix can be calculated by the following formula:

$$R = P \times I$$

Where:
 R = Risk
 P = Probability
 I = Impact

Table 3. Probability and Impact Risk Matrix

		impact				
		Very Low 0.05	Low 0.1	Medium 0.2	high 0.4	Very High 0.8
probability	Very High 0.9	0.05	0.09	0.18	0.36	0.72
	High 0.7	0.04	0.07	0.14	0.28	0.56
	Medium 0.5	0.03	0.05	0.10	0.20	0.40
	Low 0.3	0.02	0.03	0.06	0.12	0.24
	Very Low 0.1	0.01	0.01	0.02	0.04	0.08

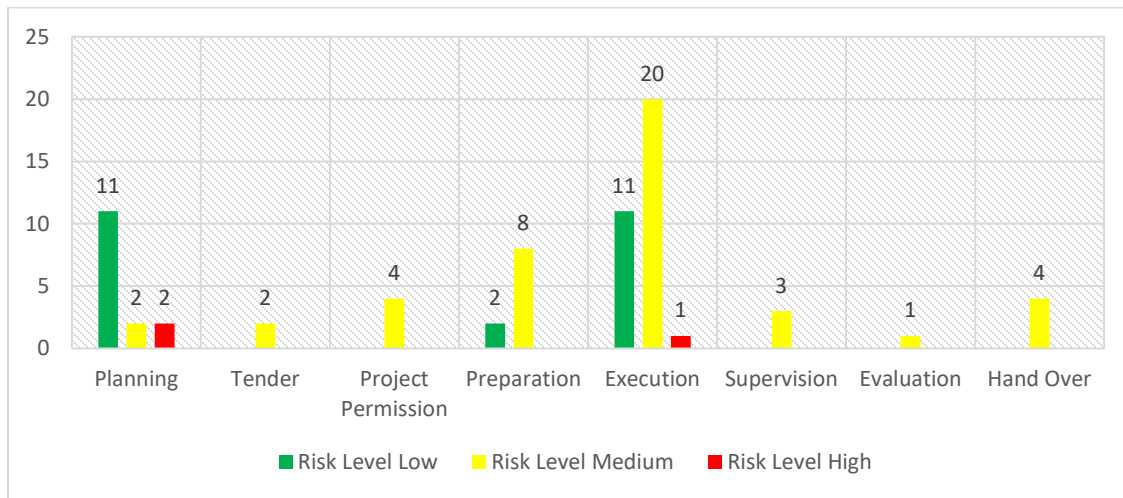


Figure 4. Risk level

From a total of 71 risk factors in the dredging work, the results of risk analysis in the planning process were obtained there were 11 low-risk variables and 2 medium-risk variables and 2 high risk variables, in the preparation process there were 2 low risk variables and 8 medium risk variables, in the execution process there were 11 low risk variables, 20 medium risk variables and 1 high risk variable, In the tender process there are 2 medium risk variables, project permission 4 medium risk variables, supervision 3 medium risk variables, evaluation 1 medium risk variable and hand over 4 medium risk variables

The main acquired risk factors are as follows:

Table 4. Risk Factor Work Dredging

Code	Stages	Risk	Probability	Impact	Risk Score	Risk Level
F1	Conducting dredging activity	Dredger damage	0,518	0,615	0,319	High
F2	Dredging equipment selection	Mistake dredger selection	0,456	0,604	0,275	High
		Dredger is not available	0,409	0,613	0,251	High

Based on the results of the risk analysis, 3 risk factors with a high level of risk namely: dredger damage, mistake dredger selection, and dredger are not available. Where these risks are contained in the planning and execution process.

5.2 Proposed Improvements

Risk analysis in a project is important because it can minimize the negative impact that will cause losses to the project. It is necessary to map the risks in each process and stage of work so that the type of risk, probability value, and impact value can be known so that a project can make its risk level. Furthermore, the project can avoid the emergence of impacts and minimize risks that occur so that the risk level can decrease.

6. Conclusion

From the discussion in this study, it can be concluded that in dredging work there are risks in every process and stage. 3 high risks were obtained namely: dredger damage, mistake dredger selection, and dredger not available. Where these risks are contained in the planning and execution process. So, it is necessary to map the risks in each process and stage of work so that the type of risk, probability value, and impact value can be known so that the risk level is made. Furthermore, the project can avoid the emergence of impacts and minimize the risks that occur so that the risk level can decrease. Considering the results of these risks, it is expected to be a guide in the implementation of dredging work to improve the performance of work time.

References

- Akintoye, A.S. and Macleod, M.J., Risk Analysis and Management in Construction, Ghana, 1997.
- Alfakhri, A.Y.Y, Ismail, A. and Khoiry, M.A., The Effects In Road Construction Projects In Tripoli. Libya. *International Journal Of Technology*, vol. 9, no. 4, pp. 766-744, 2018.
- Amoatey, C.T, Ameyyaw, Y.A, Adaku, E. and Famiyeh, S., Analysing Delay Causes And Effects In Ghanaian State Housing Construction Projects. *International Journal Of Managing Project In Business*, vol 8, no. 1, pp. 98-214, 2015.
- Asiyanto., Manajemen Risiko Untuk Kontraktor, Jakarta, Pradnya Paramita, 2009.
- Aziz, R.F. and Abdel-Hakam, A., Exploring Delay Causes of Road Construction Projects in Egypt. *Alexandria Engineering Journal*, vol. 55, no. 2, pp. 1515-1539, 2016.
- Carlo, N, Rita, E, Nandi. and Jaya, I., Dampak dan Solusi Akibat KETERLAMBATAN Proyek Konstruksi Jalan di Sumatera Barat. Proseding Konferensi Nasional Teknik Jalan ke 10, November 4-7, Jakarta, Indonesia, 2019.
- Clough, R.H. and Sears, G.A., Construction Project Management, New Jersey (US): John Willet & Sons Inc, 1991.
- Direktorat Kepelabuhanan Dirjen Perhubungan Laut Kementerian Perhubungan., Pedoman Teknis Pengerukan Alur Pelayaran dan/atau Kolam Pelabuhan Nomor HK.103/1/8/DTPL.17, Indonesia, 2017.
- Gidey, Amare., Reviewing the Values of a Standard Operating Procedure, *Ethiopian Journal of Health Sciences*, vol.22, no.3, 2012.
- Government of India Ministry of Ports, Shipping and Waterways., Dredging Guidelines for Major Ports, India, 2021.
- Hendrik-Jan Sepers., Risk Management for A Dredging Contractor, Netherland, 2001.
- International Organization for Standardization 31000., Risk Management-Principles and Guidelines, 2009.
- Kamanga, M. and Steyn, W., Cause of Delay in Road Construction in Malawi. *J.S. Afr. Civ. Eng.*, vol. 55, no. 3, pp. 79-85, 2013.
- Kikwasi, G.J., Causes and Effects of Delays and Disruptions In Construction Projects In Tanzania. *Australasian Journal of Construction Economics and Building*, vol. 1, no. 2, pp. 52-59, 2012.

- Kimbell, L. and Julier, G., *Confronting Bureaucracies and Assessing Value in The Co-Production of Social Design*, London, 2019.
- Kresna, Rizki., *Maritime Safety Risk Analysis in Alur Pelayaran Barat Surabaya (APBS) During Dredging Process, Indonesia : Research Gate*, 2018.
- Merriam-Webster., “method”. Retrieved November 23, <http://www.merriam-webster.com/dictionary/method>, 2013.
- Oetomo, W, Moetrisono, H, Witjaksana, B. and Reboono, S., *Factor Analysis for Delay Project MERR-IIC Road Construction at Surabaya Indonesia, Proceedings of Narotama International Conference on Civil Engineering*, 6-7 November, Surabaya, 2015.
- Podean, Ioan Marius, Benta. Dan. and Mircean, Cristian., *Overlapping Boundaries of the Project Time Management and Project Risk Management, Romania, Informatica Economica*, vol. 14, no.4, pp. 156-163, 2010.
- Ponnert, Lina. and Svensson, Kerstin., *Standardization – The End of Professional Discretion*, vol.19, no.14. pp. 586-599, 2016.
- Project Management Institute., *Project Management Body of Knowledge – 6th Edition*. Pennsylvania: Project Management Institute, Inc, 2017.
- Sailendra, A., *Langkah-langkah Praktis Membuat SOP*, Media Publishing, Yogyakarta, 2015.
- Shen Chou, Jui. and Chen Chiu, Yin., *Identifying Critical Risk Factors and Responses of River Dredging Projects for Knowledge Management Within Organization: China: Blackwell Publishing Ltd*, 2020.
- Sambasivan, M. and Soon, Y.W., *Causes and Effect of delays in Malaysia Construction Industry. International Journal of Project Management*, vol. 25, no. 5, pp. 517-526, 2017.
- Seboru, M.A., *An Investigation Into Factors Causing Delays in Road Construction Projects in Kenya, American Journal of Civil Engineering*, vol. 3, no. 3, pp. 51-63, 2015.
- Syah, M.S. *Manajemen Proyek Kiat Sukses Mengelola Proyek*, Gramedia, Jakarta, 2004.
- Thapanont, P, Santi, C. and Prusthipung, X., *Cause of Delay on High Construction Project in Thailand. MATEC Web Conference 192*, 2018.
- Wells, H. *How Effective Are Project Management Methodologies: An Explorative Evaluation of Their Benefits in Practice, Project Management Journal*, vol.43, no.6, pp. 43-58, 2012.
- Worgu, F. and Wordu, A.A., *Project Evaluation Technique Model to Dredging Operations in Niger Delta, Nigeria, EJERS*, vol.4, no.3, pp. 190-195, 2019.
- Zhu., Pan., Miao. and He., *Study on the Risk Management of Dredging Engineering, China, JSAER*, vol.4, no.4, pp. 86-90, 2017.

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