

Developing a Standardized, Multidimensional WBS/CBS Coding Structure for Storage Tanks ¹

Ivan Pradibta

ABSTRACT

As a national Oil and gas Company, PERTAMINA guarantees optimal Fuel Storage capacity throughout Indonesia. This paper responds to the pressing demand for streamlining planning and construction activities related to New Storage Tanks so that PERTAMINA can fulfill its target. The solution presented is a standardized Work and Cost Breakdown Structure (WBS/CBS) that was crafted for effortless implementation and could ease the scheduling and cost estimation processes. Furthermore, the author thoughtfully designed this framework to integrate it into the BIM system, boosting its efficiency and effectiveness. Utilizing Multi-Attribute Decision Making (MADM), the author chose the Omni Class WBS standard for constructing the WBS/CBS. The study concludes with a comprehensive proposal for a functional 3D WBS architecture. The emphasis lies on precise definitions, comprehensive stakeholder coverage, and seamless integration into the Building Information Modeling (BIM) system. Moreover, this paper suggests potential research areas for the future, including coding structure development, improved cost estimation process using new WBS/CBS, and technology integration (WBS, CBS, BIM) for more efficient PERTAMINA project control.

Keywords: Multidimensional WBS, New Tank Storage, CBS, Building Information Modeling (BIM)

INTRODUCTION

“Indonesia’s energy consumption trends show the increase of GDP correlated highly with an increment of energy consumption”². Based on contemporary trends, we can see “that

¹ How to cite this paper: Pradibta, I. (2024). Developing a Standardized, Multidimensional WBS/CBS Coding Structure for Storage Tanks; *PM World Journal*, Vol. XIII, Issue III, March.

²Azam, M., Khan, A. Q., Zaman, K., & Ahmad, M. (2015). Factors determining energy consumption: Evidence from Indonesia, Malaysia and Thailand. *Renewable and Sustainable Energy Reviews*, 42, 1123-1131.

<https://doi.org/10.1016/j.rser.2014.10.061>

Indonesia as a country relied heavily on oil as the main source of energy supplier for all its economic activities.”³

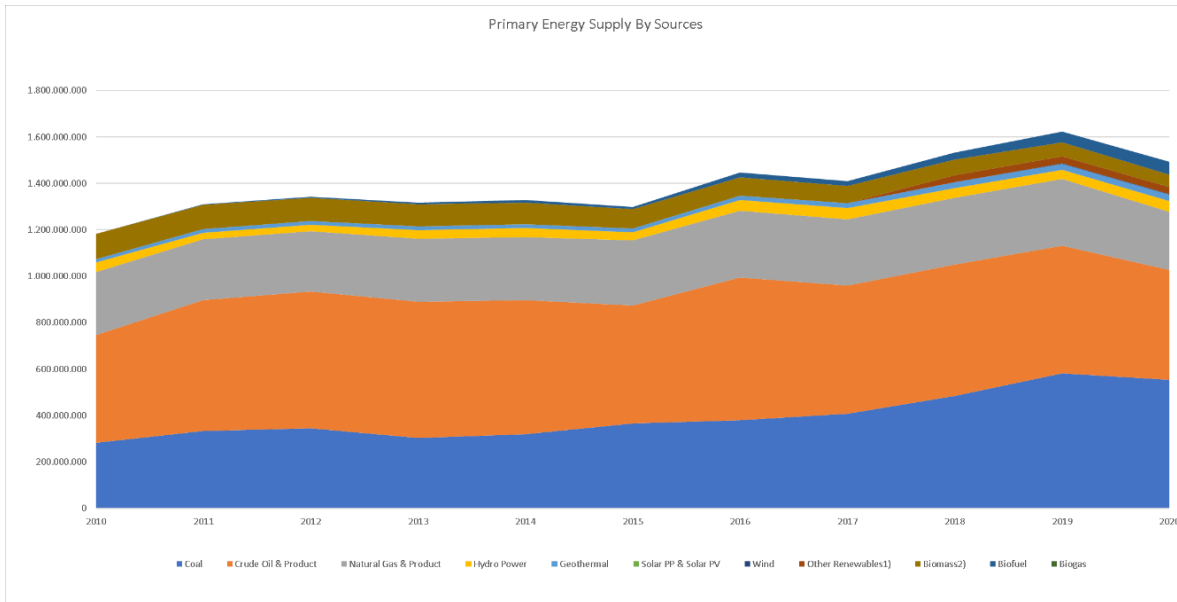


Figure 1 – Indonesia Primary Energy Supply by Sources⁴

“Most of the energy produced from the Gasoil Product goes to 1st Transportation and 2nd Industrial (Manufacturing/Production) activities and 3rd residential”.⁵This means that the nature of the oil product distribution is quite decentralized (unlike the industrial complex, which is mostly centralized), and this only means that the government must make sure that the oil product can be delivered throughout all parts of Indonesia so that the citizen could obtain it quite easily with proper price.

As one of Indonesia’s largest Oil and Gas companies, Pertamina has an important task - distributing fuel across the country. With such a crucial responsibility, Pertamina Subholding C&T (now known as Pertamina Patra Niaga) prioritizes establishing an adequate storage infrastructure in all corners of Indonesia to meet its obligations effectively. This commitment

³ Narayan, M. (2023, February 2). Indonesia 2023 gasoline demand, imports likely to exceed 2022 records. Reuters. <https://www.reuters.com/business/energy/indonesia-2023-gasoline-demand-imports-likely-exceed-2022-records-2023-02-02/>

⁴ Government of Indonesia, MEMR. 2020. *Handbook of Energy & Economic Statistics of Indonesia 2019*. Jakarta.

⁵ International Energy Agency. (2020). Key energy statistics Indonesia, 2020. <https://www.iea.org/countries/indonesia>

is made clear through the company’s annual town hall meetings, emphasizing expanding storage capacity.

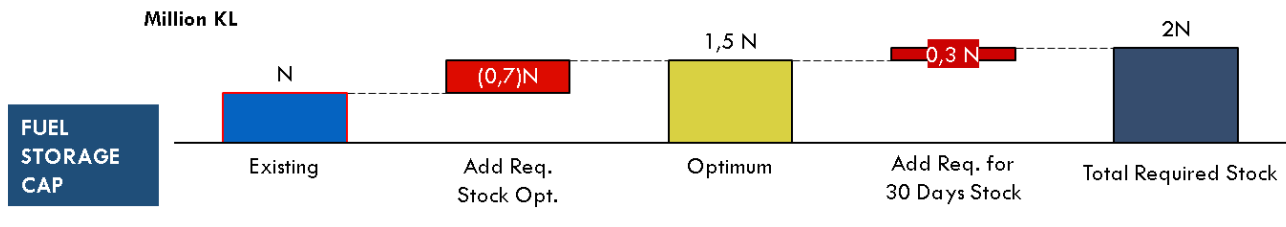


Figure 2. Total Tank Storage Capacity Needed for Pertamina Subholding C&T (Due to its sensitive Nature, The Author hides the actual number)⁶

As shown above, we can conclude that the importance of new tank storage facilities, especially for Subholding C&T, is to reliably deliver fuel to all corners of Indonesia. This situation presents a great chance to make designing activities and keeping track of the new storage tanks easier than before. We can do this using a set plan or a "Standardized WBS Template" coupled with a "Standardized Bidding Template" that can be copied into other projects, making the process much more straightforward and efficient.

New Tank Storage WBS and Procurement Activities

In order to make the New Tank Storage construction and monitoring activities easier, the Author believes that the three things that the Company needs to address are shown below:

1. Tank Storage Specification Standardization

The purpose is so the tank that the company plans to build won't have too much variance so The Company could cut back the planning phase when one had to decide the tank storage specification that could work with other facilities inside the Fuel Terminal.

2. Standardized Work Breakdown Structure (WBS) for New Tank Storage Project

"WBS is a structure that separates the project into manageable work packages, components or WBS elements to provide a standard mechanism for scheduling scope, costs, distribution of responsibilities, communication, risk assessment,

⁶ Pertamina Subholding C&T Infrastructure Roadmap 2021-2024 (internal document)

monitoring, and control.”⁷ The standardized WBS could help to build a reliable database that people can refer to when a product occur repeatedly. This could help erase one of the major causes of cost overrun, which is “Omit Probable Scope from Estimate and Omit Probable Risk from Analysis”⁸

3. Proper New Tank Storage Bidding Template

The proper bidding template could help ease the estimating process both for the owner and Contractor so that the estimated value of the project could help cover all of the scope needed to realize the project (in this case, new tank storage). A proper Bidding Template could help the companies in such ways as follows:

1. “Project costs can be better managed to stay within previously Authorized and appropriate limits.
2. Project costs and scope changes will be easier to manage and track through the planning, design, and construction process.
3. Increasing the reliability of early cost estimates can reduce the redesign activities necessary to bring projects within budget.
4. Rely on project planning to control and manage performance. Integrating the planning process is essential to managing the relationship between cost, time, and scope. Coordinating cost, time, and scope requirements is the path to achieving project success.
5. Improved estimate documentation will improve review efficiencies and shorter review cycle times.
6. Facilitate development and maintenance of The Company’s cost database. We can use this to establish a baseline and assist in planning and estimating future projects.”⁹

Based on The Company’s current practices, all bidding activities conducted at Class 2 Estimate Class where maturity is already around 30-75% refer to AACE Recommended Practice 18R-97. The problem arises because, until now, our current bidding template hasn’t been measured or compared to other best practices bidding templates, such as the National Park Service or any other top institutions, as shown in Figure 3 below. Comparing

⁷ Al Farizi, S., & Latief, Y. (2018). Development of Standardized WBS (Work Breakdown Structure) For Planning the Schedule Based on Risk In Steel Bridge Construction Projects. Retrieved from <http://www.ieomsociety.org/ieom2018/papers/167.pdf>

⁸ 1.4.1.10 unit 10- Managing cost estimating and budgeting. (2022, October 24). PTMC. <https://build-project-management-competency.com/1-4-1-10-unit-10/>

⁹ National Park Services. (2023). Construction Cost Estimating Requirements Handbook. National Park Service (NPS) - Denver Service Center (DSC).

Company’s and the other institutions’ bidding templates could help the companies obtain the “best tested and proven practices” and develop specific recommendations to improve our Company's bidding template.

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristic		
	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges at an 80% confidence interval
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Table 1- Cost Estimate Classification Matrix for Process Industries¹⁰

¹⁰ AACE International. (2020). AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, And Construction for The Process Industries.

Park Alpha:		Park Code								Reviewed By:	
PMIS Number:		TBD or PMIS number if known								Date:	
		Asset / Project Element		Size/Count		Units				Reviewer Name	
		Asset / Project Element Name		0		Unit				Review Date	
Item No.	WBS	Description	Material Cost/Unit	Total Material Cost	Installation Cost/Unit	Total Install Cost	Direct Cost/Unit	Total Direct Costs	NET Cost/Unit	Total NET Costs	
1	A10	Foundations	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
2	A20	Basement Construction	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
3	B10	Superstructure	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
4	B20	Exterior Enclosure	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
5	B30	Roofing	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
6	C10	Interior Construction	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
7	C20	Stairs	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
8	C30	Interior Finishes	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
9	D10	Conveying Systems	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
10	D20	Plumbing Systems	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
11	D30	HVAC	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
12	D40	Fire Protection	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
13	D50	Electrical	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
14	E10	Equipment	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
15	E20	Furnishings	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
16	F10	Special Construction	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
17	F20	Selective Building Demolition	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
18	G10	Site Preparation	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
19	G20	Site Improvements	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
20	G30	Site Mechanical Utilities	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
21	G40	Site Electrical Utilities	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
22	G50	Other Site Construction	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
23	XX	Special Use - 1	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
24	XX	Special Use - 2	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
25	XX	Special Use - 3	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	#DIV/0!	
Subtotal Direct Construction Costs			#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	#DIV/0!	\$ -	
Total Value of Government Furnished Property (GFP) Included in Direct Costs				\$0.00		\$ -	\$ -	\$ -		\$ -	
Direct Cost Subtotal without GFP						\$ -		\$ -		\$ -	
Published Location Factor			0.00%							\$0	
Remoteness Factor			0.00%							\$0	
Federal Wage Rate Factor			0.00%							\$0	
State & Local Taxes			0.00%							\$0	
Design Contingency			0.00%							\$0	
Total Direct Construction Costs										\$0	
Standard General Conditions			0.00%							\$0	
Government General Conditions			0.00%							\$0	
Historic Preservation Factor			0.00%							\$0	
Subtotal NET Construction Cost										\$0	
Overhead			0.00%							\$0	
Profit			0.00%							\$0	
Estimated NET Construction Cost										\$0	
Bonds & Permits			0.00%							\$0	
Contracting Method Adjustment			0.00%							\$0	
Inflation Escalation			0	Months	Annual Rate =	0.00%	Inc. Bonds & CMA			\$0	
Total Estimated NET Cost of Construction										\$0	

Figure 3-Example of Bidding Template used by National Park Service (Best Proven Method)¹¹

Based on the information above, through this paper, the Author will attempt to answer the following research questions:

- 1) What is the best format for bidding templates for New Tank Storage Erection?
- 2) What things shall be informed to the bidder so they can bid as close as the condition where the New Tank Storage will be?

¹¹ U. S. National Park Service. (2021, May 27). Construction Cost Estimate Template. NPS.gov (U.S. National Park Service). Retrieved January 4, 2024, from https://www.nps.gov/dscw/upload/ClassBConstructionCostEstimate_Template_5-27-21.xlsx

METHODOLOGY

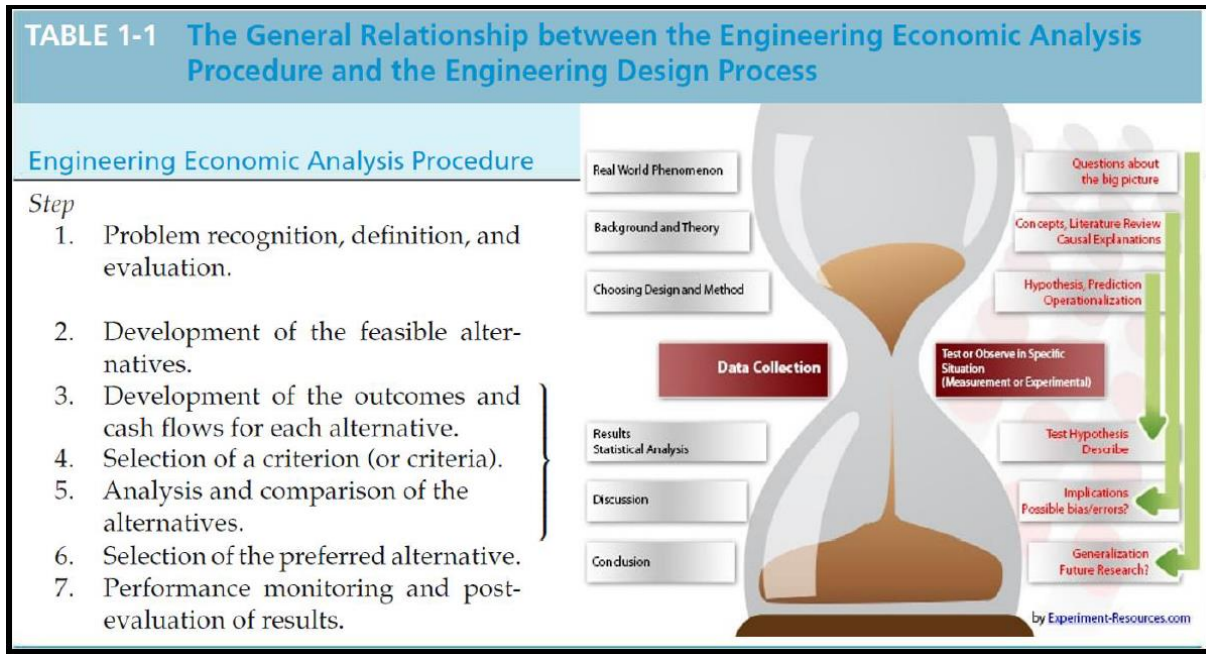


Figure 4 - Engineering Economic Analysis Procedure ¹²& Step of the Scientific Process¹³

As shown in Figure 4 above, “every research which follows the methodology of scientific work must have 4 points as follows:

1. **Problem recognition** is the step where the researcher/Author pinpoints the fundamental problem. After the Author finds the fundamental problems, the next step would be rephrasing or refining the Research Paper Question to break it down into more specific problems.
2. **Development of the Feasible Alternatives** is a verification process using other researchers to review the results by replicating the experiment and assessing its soundness to develop a range of alternative possibilities.
3. **Development of the Outcomes** and Cash Flows for each alternative accurately describe the methods and tools utilized for data gathering.
4. **Selection of a Criterion (or Criteria)** explains how the raw data is compiled and analyzed.”¹⁴

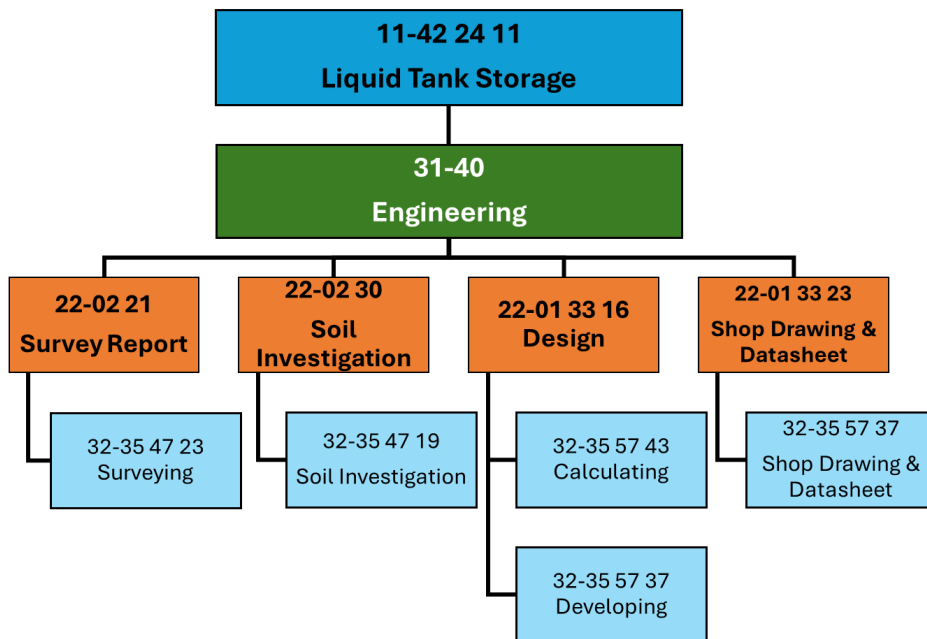
¹² Sullivan, G. W., Wicks, M. E., & Koelling, C. P. (2018). Engineering economy 16th Edition. Chapter 2 Cost Concepts and Design Economics, page 31.

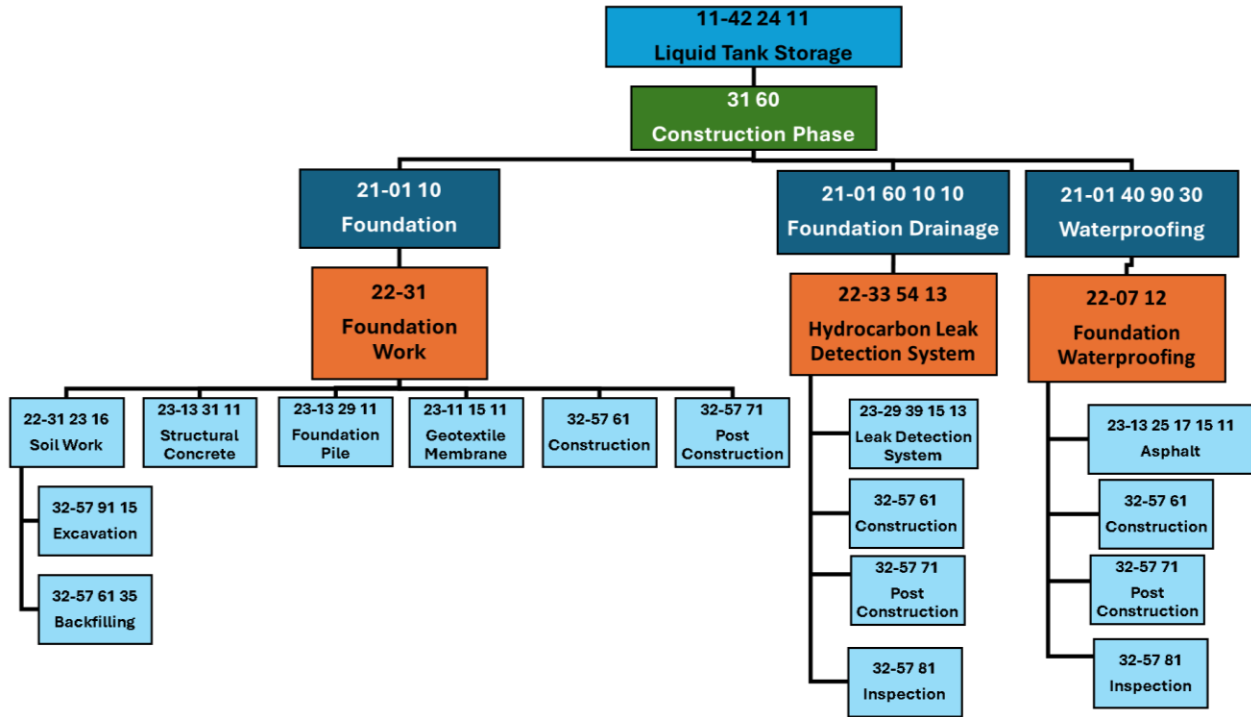
¹³ Martyn Shuttleworth (2008). What is Research? Retrieved from: <https://explorable.com/what-is-research>

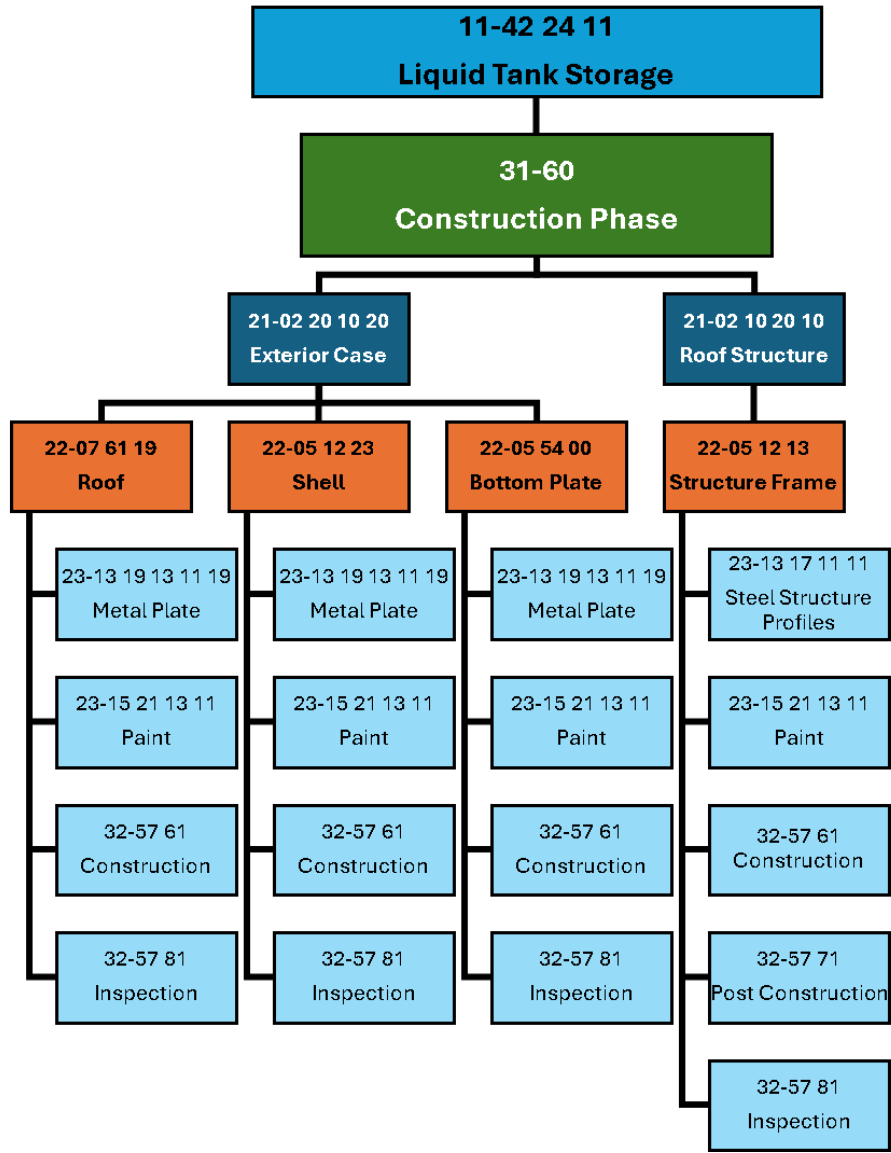
¹⁴ Sullivan, G. W., Wicks, M. E., & Koelling, C. P. (2023). Engineering Economy 17th Edition. Chapter 1 Introduction to Engineering Economy, page 7-12.

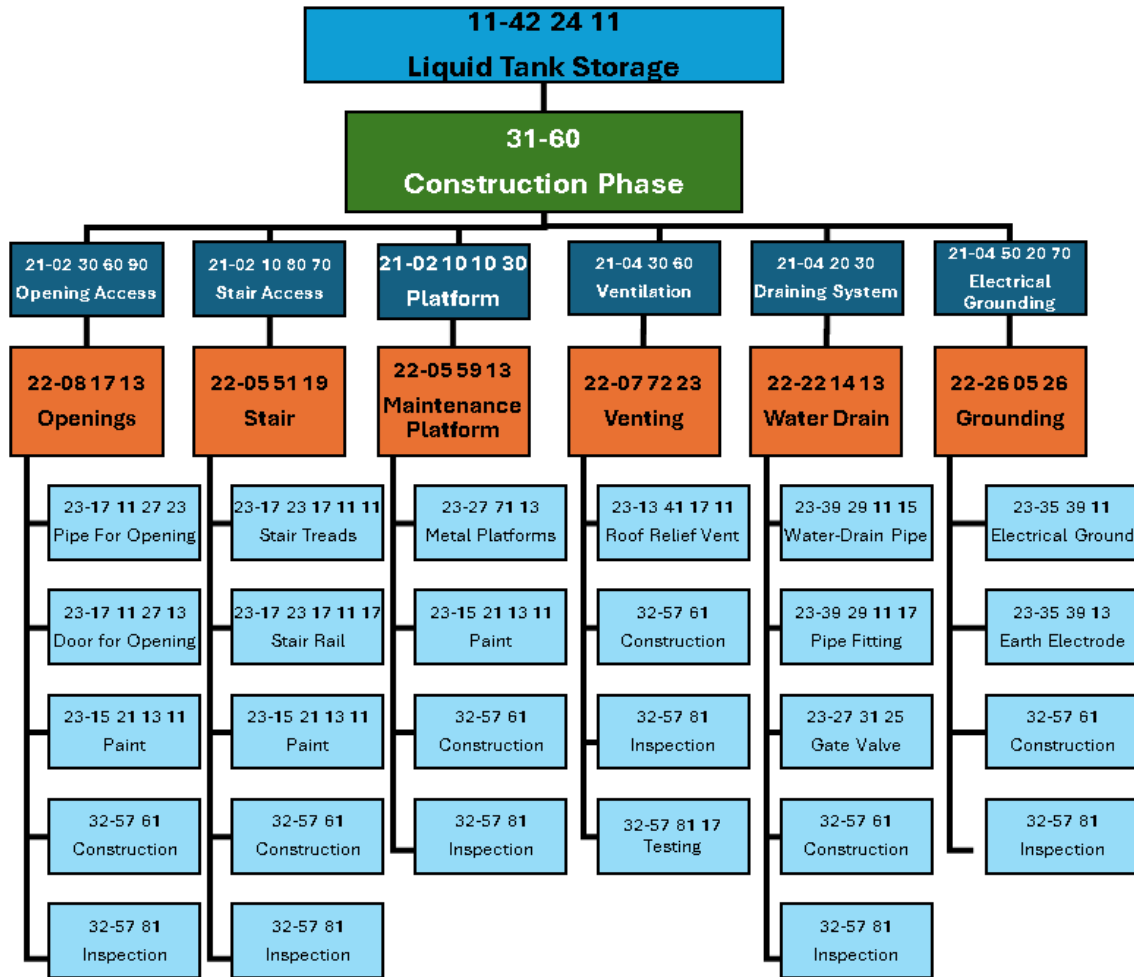
Step 1 – Problem Definition

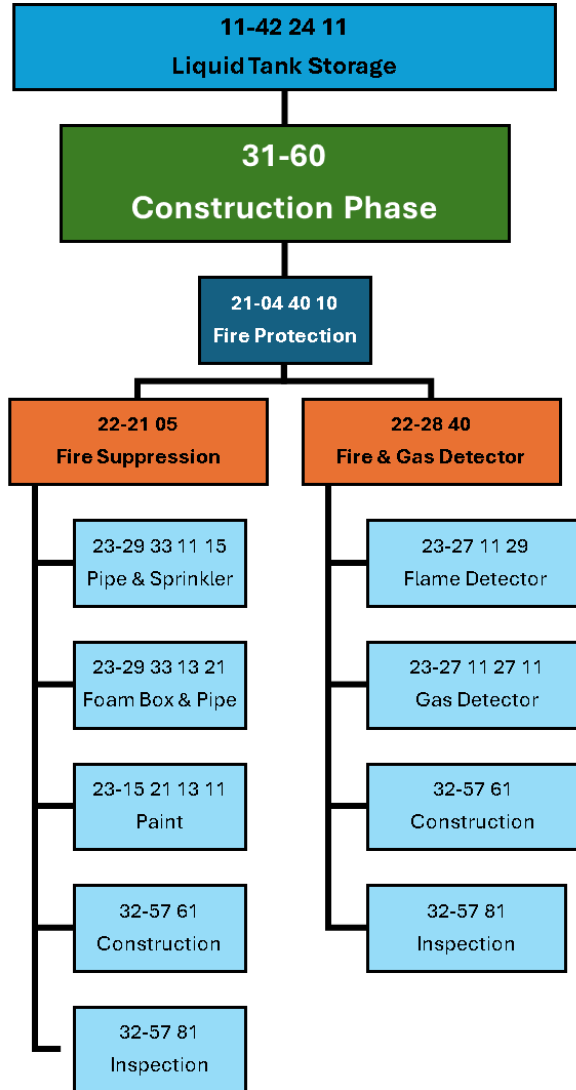
As stipulated in the sub-chapter above, there is an urgency to make a standardized format for the New Tank Storage Bidding Template, which stemmed from the standardized WBS for said assets. The Author previously has taken the liberty to create the WBS of New Tank Storage (for engineering and construction Phase) from Omniclass Table 11, 21, 22, 23, 31, 32, and 41. as shown in Figure 5 below along with the detail of WBS Elements from said Omniclass Tables (Table 2).











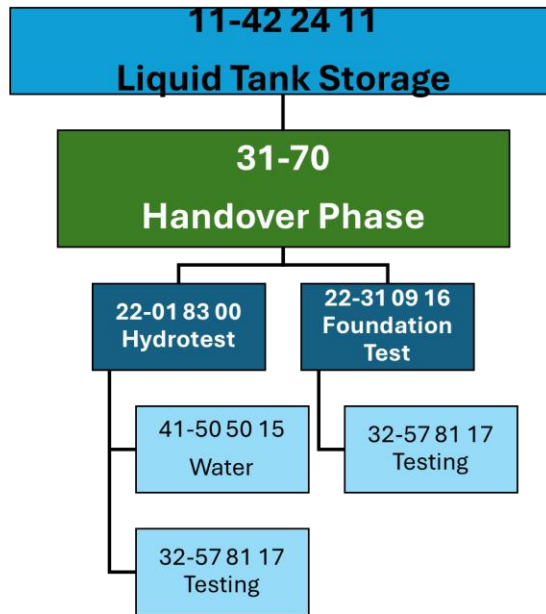


Figure 5 – The WBS Organization from Omniclass for New Tank Storage Construction¹⁵¹⁶

¹⁵ Author

¹⁶ Pullarcot, S. (2015). Above Ground Storage Tanks: Practical Guide to Construction, Inspection, and Testing. Taylor & Francis Group, LLC

OmniClass Number	Omniclass Title	Criterion Fullfiled
Table 11 (Construction Entities by Function)		
11-42 24 11	Liquid Fuel Storage	Level 1
Table 31 (Phases)		
31-40 00 00	Design Phase	Design Phase
31-60 00 00	Implementation Phase	Construction Phase
31-70 00 00	Handover Phase	Handover Phase
Table 41 (Material)		
41-50 50 15	Ocean Water (Body of Water)	Water
Table 32 (Service)		
32-35 47 23	Surveying	Survey
32-35 47 19	Investigating	Soil Investigation
32-57 91 15	Excavation	Soil Excavation
32-57 61 35	Backfilling	
32-35 57 37	Developing	Design
32-35 57 43	Calculating	
32-57 61 00	Constructing	Construction
32-57 71 00	Post Constructing	
32-57 81 00	Assuring	
32-57 81 17	Testing	Hydrotest and Foundation Test

OmniClass Number	Omniclass Title	Criterion Fullfiled
Table 21 (Element)		
21-01 10	Foundation	Foundation
21-01 60 10 10	Foundation Drainage	Leak Detection System
21-01 40 90 30	Waterproofing	Waterproofing
21-02 10 20 20	Roof Decks, Slabs, and Sheathing	Roof
21-02 10 20 10	Roof Structural Frame	Roof Structural Frame
21-02 20 10 20	Exterior Wall Construction	Shell
21-02 10 10 20	Floor Decks, Slabs, and Toppings	Bottom Plate
21-02 30 60 90	Horizontal Opening Supplementary Components	Nozzle
21-02 30 60 90	Horizontal Opening Supplementary Components	Nozzle Cover
21-02 10 80 70	Metal Walkways	Stair
21-02 10 10 30	Balcony Floor Construction	Platforms
21-04 30 60	Ventilation	Venting
21-04 20 30	Building Support Plumbing Systems	Water Drain
21-04 50 20 70	Facility Grounding	Grounding
21-04 40 10	Fire Suppression	Fire Suppression
Table 22 (Work Result)		
22-02 21 00	Surveys	Survey
22-02 30 00	Subsurface Investigation	Soil Investigation
22-01 33 16	Design Data	Design
22-01 33 23	Shop Drawings, Product Data, and Samples	

OmniClass Number	Omniclass Title	Criterion Fullfiled
Table 22 (Work Result)		
22-31 05 00	Common Work Results for Earthwork	Foundation
22-31 23 16	Excavation	
22-31 23 23	Fill	
22-31 60 00	Special Foundations and Load-Bearing Elements	
22-31 08 00	Commissioning of Earthwork	
22-33 54 13	Liquid Hydrocarbon Leak Detection Equipment	Leak Detection System
22-07 12 00	Built-Up Bituminous Waterproofing	Waterproofing
22-07 61 19	Flat Seam Sheet Metal Roofing	Roof
22-05 12 13	Architecturally-Exposed Structural Steel Framing	Roof Structural Frame
22-05 12 23	Structural Steel for Buildings	Shell
22-05 54 00	Metal Floor Plates	Bottom Plate
22-08 17 13	Integrated Metal Door Opening Assemblies	Nozzle
22-05 51 19	Metal Grating Stairs	Stair
22-05 59 13	Metal Balconies	Platforms
22-07 72 23	Relief Vents	Venting
22-22 14 13	Facility Storm Drainage Piping	Water Drain
22-26 05 26	Grounding and Bonding for Electrical Systems	Grounding
22-21 05 00	Common Work Results for Fire Suppression	Fire Suppression
22-28 41 00	Radiation Detection and Alarm	Fire Gas Monitoring System
22-01 83 00	Facility Shell Performance Requirements	Hydrotest
22-31 09 16	Foundation Performance Instrumentation	Foundation Test

OmniClass Number	Omniclass Title	Criterion Fullfiled
Table 23 (Products)		
23-13 31 11	Structural Concrete	Foundation
23-11 15 11	Sheeting Geotextiles	
23-13 29 11	Foundation Piles	
23-29 39 15 13	Service Leak Detection	Leak Detection System
23-13 25 17 15	Fluid Applied Waterproofing	Waterproofing
23-13 19 13 11 19	Solid Metal Sheets	Roof
23-15 21 13 11	Corrosion Prevention Paints	
23-13 17 11 11	Ferrous Metal Rigid Profiles	Roof Structural Frame
23-15 21 13 11	Corrosion Prevention Paints	
23-13 19 13 11 19	Solid Metal Sheets	Shell
23-15 21 13 11	Corrosion Prevention Paints	
23-13 19 13 11 19	Solid Metal Sheets	Bottom Plate
23-15 21 13 11	Corrosion Prevention Paints	
23-17 11 27 23	Manhole Access	Nozzle
23-17 11 27 13	Access Doors	Nozzle Cover
23-17 23 17 11 11	Stair Treads	Stair
23-15 21 13 11	Corrosion Prevention Paints	
23-17 23 17 11 17	Stair Rail	Railings
23-15 21 13 11	Corrosion Prevention Paints	

OmniClass Number	Omniclass Title	Criterion Fullfiled
Table 23 (Products)		
23-27 71 13	Building Maintenance Cradles and Platforms	Platforms
23-15 21 13 11	Corrosion Prevention Paints	
23-13 41 17 11	Roof Relief Vents	Venting
23-39 29 11 15	Waste Water Drainage Pipes, Couplings, Collectors	Water Drain
23-39 29 11 17	Wastewater Pipework Access Fittings	
23-27 31 25	Gate Valves	
23-35 39 11	Electrical Grounding Device	Grounding
23-35 39 13	Earth Connection Electrodes	
23-29 33 11 15	Side Wall Sprinkler Heads	Fire Suppression
23-15 21 13 11	Corrosion Prevention Paints	
23-29 33 13 21	Foam Fire Suppression Equipment	
23-27 11 29	Infrared Instrument And Controls	Fire Gas Monitoring System
23-27 11 27 11	Gas Alarm Modules	

Table 2 – Proposed Codes for New Tank Storage WBS^{17,18}

¹⁷ Author

¹⁸ Omni Class. (2020). Construction Entity by Function - Table 11, 21, 22, 23, 31 and 32.

<https://www.csiresources.org/standards/Omni Class>

Bill of Quantity/BoQ							
Project Title							
Revision ... Date							
No	Work Detail	Volume	Units	Unit Price		Total Price	
				Material	Services	Material	Services
I. PREPARATION WORK							
1	Mobilitation and Demobilitation	xxx	xx	0	\$	0	\$
2	Permit & Engineering	xxx	ls	0	\$	0	\$
3	.....	xxx	ls	0	\$	0	\$
Total I						0	\$
II CIVIL WORK							
1	Concrete	xxx	xx	\$	\$	\$	\$
2	.....	xxx	xx	\$	\$	\$	\$
Total II						\$	\$
III MECHANICAL							
1	Piping	xxx	xx	\$	\$	\$	\$
2	.....	xxx	xx	\$	\$	\$	\$
Total III						\$	\$
IV CLOSING							
1	Commissioning & Testing	xxx	xx	0	\$	0	\$
2	.....	xxx	xx	0	\$	0	\$
Total IV						\$	\$
SUM OF MATERIAL + SERVICES (I+II+III+IV)						\$	\$
CONTRACTOR PROFIT AND RISK (8% OR 10% OR 15%)							\$
TOTAL							\$

Figure 6- The Company's Bidding Template¹⁹

As logic stated, all those WBS needed for the New Tank Storage Erection, As depicted in Table 2 above then, shall rearranged and put into the company bidding template as usual. As the preamble, our Company's bidding template typically categorizes each project scope of works by disciplines named Mechanical, Electrical, Instrumentation, Civil and soil, HSE, and Marine Civil (further shown in Figure 6 above, but not for Preparation Work and Engineering & Project Management activities). We also can see this phenomenon in the bidding format shown in Figure 6 above, where the assets' scope of work is categorized by disciplines.

In essence, The Company builds the bidding template using these steps:

¹⁹ Ardiansyah. (2017). Indonesian State-Owned Oil and Gas Company Cost Estimating against GAO and NPS Best Practice: A benchmarking study. [Review of Indonesian State-Owned Oil and Gas Company Cost Estimating against GAO and NPS Best Practice: A benchmarking study. PM World Journal, VI(XI), 24–44. <https://pmworldlibrary.net/wp-content/uploads/2017/11/pmwj64-Nov2017-Ardiansyah-indonesian-cost-estimating-against-gao-and-nps-best-practices.pdf>

1. Initially, the person responsible for the project bidding initiation will first try to identify all the assets that need to be realized in the project. Each asset is then broken down into a Work Breakdown Structure/WBS in a flat-file format. In this stage, the WBS is already categorized by discipline. Not under asset where it is supposed to belong to
2. After the WBS are identified, the next step is to calculate the resources needed for each WBS (the WBS has already been broken down into materials and activities needed to complete the WBS).
3. After that, we put the specification information for each asset in this project.
4. Finally, the bidding template would allow the cost estimator to input the Contractor's profit margin amount. The margin is established based on the project's value, with projects under IDR 500.000.000 (US\$ 32,000) receiving a 10% margin and one between IDR 500.000.000 and IDR 5.000.000.000 (US\$ 32,000 to US\$ 320,000) get 8% margin, and if it exceeds IDR 5.000.000.000 (more than US\$ 320,000) get 5% profit margin.²⁰

Organizing the Work Breakdown Structure (WBS) into disciplines at the top level (level 1) has made project resource tracking and bidding process more challenging. This approach doesn't display the quantity of resources, both in terms of materials and work hours, needed for each asset. Consequently, it complicates the calculation of each asset and makes it difficult to reproduce these calculations easily elsewhere. This setup can be quite burdensome for Owners and Contractors.

Step 2 – Feasible Alternatives (US-National Park Service Bidding Template)

A perfect example of a bidding template that understands the Contractor scope perspective quite well and uses that knowledge to its advantage comes from the US National Park Service (NPS) Bidding Template.²¹

²⁰ Ardiansyah. (2017). Indonesian State-Owned Oil and Gas Company Cost Estimating against GAO and NPS Best Practice: A benchmarking study. Review of Indonesian State-Owned Oil and Gas Company Cost Estimating against GAO and NPS Best Practice: A benchmarking study. PM World Journal, VI(XI), 24–44. <https://pmworldlibrary.net/wp-content/uploads/2017/11/pmwj64-Nov2017-Ardiansyah-indonesian-cost-estimating-against-gao-and-nps-best-practices.pdf>

²¹ 1.4.1.4 unit 4- Managing Scope. (2021). PTMC. <https://build-project-management-competency.com/1-4-1-4-unit-4/>

The bidding template that the NPS uses is the format for cost estimation that they urge all estimators to follow according to its usage. In essence, there are levels of Cost Estimate according to its usage based on the Cost Estimation Handbook by US NPS and hence a few formats as shown in the table below:

DOI Estimates Type	AACE Class	Typical Use	End Usage	Project Definition	Low Expected Accuracy	High Expected Accuracy
Class C	Class 5	Predesign	Concept Screening	0% to 2%	-20%	50%
Class C	Class 4	Schematic Design	Study or Feasibility	1% to 15%	-15%	30%
Class B	Class 3	Schematic Design	Budget Authorization	10% to 40%	-10%	20%
Class B	Class 2	Design Development	Control	30% to 75%	-5%	15%
Class A	Class 1	Construction Documents	Check Estimate	65% to 100%	-3%	10%

Table 3 – NPS Estimate Classification and Accuracy²²

Based on the information shown in Table 3 above, NPS recognizes three levels of estimating: Class C, Class B, and Class A. This template is classified based on the level of detail of the design from which the estimate got its information. The dichotomy is shown as follows:

a) Class A Construction Cost Estimate

Class A Construction Cost Estimates, often called **actual estimates**, apply when the work scope (WBS) definition is around 65 to 100%. These estimates are achievable with 100% Draft Construction Documents (Draft CD), 100% Complete Construction Documents (Complete CD), or Final Construction Documents. Their accuracy ranges from -3% to +10%.

Class B Construction Cost Estimate

Any Cost Estimates could fall into this Class B Cost Estimate, usually known as budgetary estimates if the SOW definition is around 10 to 75%. The minimum design shall

²² National Park Services. (2023). Construction Cost Estimating Requirements Handbook. National Park Service (NPS) - Denver Service Center (DSC).

be as follows: Schematic Design (SD) submittal of the preferred design alternative, Design Development (DD) submittal, or other intermediate design level budget purposes. Class B estimates have an accuracy range of -10 % to +20%.

b) Class C Construction Cost Estimate

Class C Construction Cost Estimates, often called conceptual estimates, are rough estimates (0% to 15%) that provide a general idea of the services or assets involved, along with their business case. The estimates inferred from various factors such as General Management Plans (GMP), Condition Assessments Cost (CAC) estimates using FMSS and CESS, Preliminary cost estimates for project initiation and entry into the Project Management Information System (PMIS), Pre Design (PD) programming estimates to develop project scope and validate PMIS Estimate, and Schematic Design (SD) concept estimates for comparing design alternatives in Value Analysis studies during the early Schematic Design Phase. Class C estimates can be accurate within the range of -20 % to +50%.

Considering various resources²³, The Class A Format is the most suitable estimation class incorporating the Contractor's Point of View on the scope of work. The formats urge us to fill the fully defined scope of work, and most of the resources needed for the asset are not in a lump sum or allowances, meaning all those resources are already “set in stone.”

Figure 7 illustrates the template the National Park Services uses for estimating projects at the Class A level.

²³ 1.4.1.4 unit 4- Managing Scope. (2021). PTMC. <https://build-project-management-competency.com/1-4-1-4-unit-4/>

Bid Item No.	Bid Item Description	Total Material Cost	Total Labor Cost	Total Equipment Cost	Total Direct Construction Costs	Design Contingency	General Conditions	General Contractor Overhead	General Contractor Profit	Contracting Method Adjustment	Inflation Escalation		Bid Item Total
											APR	month	
Bid Item: 1	Asset / Project Element 1					0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	\$ -
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
Total - Bid Item 1	Asset / Project Element 1	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Bid Item: 2	Asset / Project Element 2												\$ -
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
Total - Bid Item 2	Asset / Project Element 2	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Bid Item: 3	Asset / Project Element 3												\$ -
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
Total - Bid Item 3	Asset / Project Element 3	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Bid Item: 4	Asset / Project Element 4												\$ -
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
Total - Bid Item 4	Asset / Project Element 4	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Bid Item: 5	Asset / Project Element 5												\$ -
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
	WBS L2 WBS Description	\$ -	\$ -	\$ -	\$ -								
Total - Bid Item 5	Asset / Project Element 5	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total Bid Items 1-6		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Figure 7- National Park Services Bidding Template (Class A Construction Cost Estimate)²⁴

Step 3 – Development of the Outcome of The Alternative

After analyzing the information presented in Step 1 and 2, a fundamental distinction emerges between the NPS Bidding Template and the current Company’s Bidding Template. The primary variance lies in how the bidding template organizes the Work Breakdown Structures (WBS). The NPS Bidding Template categorizes all WBS under their respective assets or services they intend to realize. Conversely, the Company’s Bidding Template organizes WBS under its discipline.

The fundamental differences between both formats (The Company’s and The NPS’) become crucial when considering the preferences of stakeholders. While the Company’s Bidding Template structure might suit the needs of those seeking discipline-specific information, it is not inherently ideal for effective communication between the Contractor and the Company’s Project Control personnel. In this context, the NPS Bidding Template, with its organization under the assets or services, is deemed more intuitive and preferable.

Given these considerations, Author found that the NPS Bidding Template, aligned with the NPS Class A Estimate format, is the ideal choice. The company shall adopt this Class A

²⁴ 14. National Park Service. (2021, May 27). Class A Construction Cost Estimate Template. NPS.gov (U.S. National Park Service). https://www.nps.gov/dscw/upload/ClassAConstructionCostEstimate_Template_5-27-21.xlsx

Estimates format as the main communication tool between the Contractor and the Company’s Project Control personnel.

Step 4 – Selection Criteria

As mentioned, the NPS Class A Cost Estimate Template organizes all Work Breakdown Structures (WBS) under the respective assets or services they aim to achieve. You can find the detailed list of these services and the corresponding assets they involve in Table 4 below.

Group of Attributes	Purpose	Criteria
Engineering	These attributes are designed to evaluate whether the WBS standard could explain the work package needed for tank storage in engineering phase	Surveying
		Soil Investigation
		Design
		Drawing
Construction	These attributes comprise essential components that must be meticulously constructed and inspected during the construction phase. The author intends to assess whether the WBS standards can meet these specific attributes. These represent the fundamental criteria that the WBS should fulfill.	Foundation
		Leak Detection System
		Waterproofing
		Roof
		Roof Structural Frame
		Shell
		Bottom Plate
		Nozzle
		Stair
		Platforms
		Venting
		Water Drain
		Grounding
Fire Suppression		
Final Inspection	These attributes consist of activities needed for final test that should be fulfilled at commissioning and handover phase	Hydrotest
		Foundation Test

Table 4 – New Tank Storage Scope of Works²⁵

²⁵ Author

Step 5 – Analysis For Each Criteria

Bid Item No.	Bid Item Description	Total Material Cost	Total Labor Cost	Total Equipment Cost	Total Direct Construction Costs	Bid Item Total
Bid Item: 1	Engineering					\$ -
	22-02 21 Survey Report	\$ -	\$ -	\$ -	\$ -	
	22-02 30 Soil Investigation	\$ -	\$ -	\$ -	\$ -	
	22-01 33 16 Design Activity	\$ -	\$ -	\$ -	\$ -	
	22-01 33 23 Shop Drawing & Datasheet	\$ -	\$ -	\$ -	\$ -	
Total - Bid Item 1	Engineering	\$ -	\$ -	\$ -	\$ -	\$ -
Bid Item: 2	Construction					\$ -
	22-31 Foundation Work	\$ -	\$ -	\$ -	\$ -	
	22-33 54 13 Hydrocarbon Leak Detection System	\$ -	\$ -	\$ -	\$ -	
	22-07 21 Foundation Waterproofing	\$ -	\$ -	\$ -	\$ -	
	22-05 12 23 Tank Metal Sheel	\$ -	\$ -	\$ -	\$ -	
	22-05 12 23 Tank Metal Roof	\$ -	\$ -	\$ -	\$ -	
	22-05 54 Bottom Plate	\$ -	\$ -	\$ -	\$ -	
	22-05 12 13 Structural Frame	\$ -	\$ -	\$ -	\$ -	
	22-08 17 13 Nozzle / Openings	\$ -	\$ -	\$ -	\$ -	
	22-05 51 19 Stair	\$ -	\$ -	\$ -	\$ -	
	22-05 59 13 Maintenance Platform	\$ -	\$ -	\$ -	\$ -	
	22-07 72 23 Tank Venting	\$ -	\$ -	\$ -	\$ -	
	22-22 14 13 Water Drain	\$ -	\$ -	\$ -	\$ -	
	22-26 05 26 Grounding	\$ -	\$ -	\$ -	\$ -	
	22-21 05 Fire Suppression System	\$ -	\$ -	\$ -	\$ -	
	22-28 40 Fire & Gas Detector	\$ -	\$ -	\$ -	\$ -	
Total - Bid Item 2	Construction	\$ -	\$ -	\$ -	\$ -	\$ -
Bid Item: 5	Handover					\$ -
	22-01 83 00 Hydrotest	\$ -	\$ -	\$ -	\$ -	
	22-31 09 16 Foundation Test	\$ -	\$ -	\$ -	\$ -	
Total - Bid Item 5	Handover	\$ -	\$ -	\$ -	\$ -	\$ -
Total Bid Items 1-6		\$ -	\$ -	\$ -	\$ -	\$ -

Figure 8 – Bidding Template for New Tank Storage²⁶

So, before we make the bidding template, we need to set up this detailed breakdown structure called the Work Breakdown Structure (WBS). Figure 5 shows how the WBS looks for putting up the New Tank Storage, and Table 2 lists all the parts we need for this construction according to OmniClass WBS.

Then, the person in charge (let's just call them the Author) decides what should go into the WBS, and we can see that laid out in Table 4. After figuring out all these details in Table 4, they organize them into the Bidding Template. We can check out this arrangement in Figure 7. After they finish those, you can finally see the actual bid items, as shown in Figure 8.

These bidding templates are the go-to documents for companies looking to throw their hat in the ring. They lay out all the details, making it easier for companies to understand what's

²⁶ Author

what and compile their proposals accordingly. It's a systematic way of handling things, ensuring everyone's on the same page and making the bidding process smoother and more competitive for those interested in the project.

Step 6 – The Detail of the Bidding Template

According to various sources, the NPS Bidding Template comprises two distinct templates. The one shown in Figure 8 above is the initial template usually used by the NPS for Request for Quotation (RFQ) activities. In procurement terminology, this phase occurs during the Bidding phase, where numerous Contractors or service providers vie against each other to secure the project. For Contractors, winning a project is vital as it is their primary source of income after cash flow.

Once the bidding process concludes and a Winning Bidder emerges, the Contractor must furnish the details of their price calculations, as illustrated in Figure 8 above. These details serve as the foundation for discussions whenever there is a request for a change order. To ensure the seamless continuation of the Bidding Template for the Winning Bidder, the Author has taken the initiative to introduce the detailed Bidding Template, as depicted in the subsequent figures below.

Item No.	WBS	Description	Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Direct Cost/Unit	Total Direct Costs
1	22-02 21	Surveying Report	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2	22-02 30	Soil Investigation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3	22-01 33 16	Design Activity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
4	22-01 33 23	Shop Drawing & Datasheet	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Subtotal Direct Construction Costs			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$0

22-02 21 Surveying Report Total Cost: \$0

OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS	
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost
22-02 21	SURVEY REPORT										
32-35 47 23	Surveying Activities that shows the topography and also the state of the facilities and vegetation that occupying the land	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL SURVEY REPORT		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

22-02 30 Soil Investigation Total Cost: \$0

OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS	
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost
22-02 30	Soil Investigation										
32-35 47 19	Sondir Boring and Bore hole lab analysis. The minimum depth is 60 meters or if the sondir bore found SPT 60	0	Spot	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL Soil Investigation		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

22-01 33 Design Activity											Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		Total Cost/Unit	Total Cost
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-01 33 16	DESIGN ACTIVITY												
	The activity of Calculating the Tank Design (Usually done by Eng. With minimum of 7 years of experience) so that the foundation, the tank, the venting capacity, and other parameter are suitable (Reff. API 650)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-35 57 4	Based on the calculation on WBS 32-35 57 43, build the Design according to the API 650 and the condition on the field	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL DESIGN ACTIVITY				1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

OmniClass WBS Code	Description	Quantity	Unit	Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost
22-01 33 33	Shop Drawing & DataSheet	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

Figure 9 – Detail of Bid Item 1 (Engineering) for New Tank Storage Erection²⁷

Item No.	WBS	Description	Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Direct Cost/Unit	Total Direct Costs
1	22-31	Foundation Work	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2	22-33 54 13	Hydrocarbon Leak Detection System	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3	22-07 21	Foundation Waterproofing	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
4	22-05 12 23	Tank Metal Sheel	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
5	22-05 12 23	Tank Metal Roof	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
6	22-05 54	Bottom Plate	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
7	22-05 12 13	Structural Frame	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
8	22-08 17 13	Nozzle / Openings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
9	22-05 51 19	Stair	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
10	22-05 59 13	Maintenance Platform	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
11	22-07 72 23	Tank Venting	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
12	22-22 14 13	Water Drain	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
13	22-26 05 26	Grounding	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
14	22-21 05	Fire Suppression System	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
15	22-28 40	Fire & Gas Detector	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Subtotal Direct Construction Costs			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$0

²⁷ Author

22-31 Foundation Work											Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS			
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-31 23 16	Soil Work												
32-57 91 15	Excavating Soil From the site purposed as the foundation for the storage tank	0	m3	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-35 47 23	Surveying Activities that shows the topography and also the state of the facilities and vegetation that occupying the land	0	m3	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL	Soil Work	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS			
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-31	Foundation Work												
23-13 31 11	The concrete and the iron bar needed for to make concrete slab for the foundation with fc minimum fc 20.75 mpa	0	m3	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
23-13 29 11	Prestressed Concrete Spun Pile fc = 52 MPa (Cube 600 kg/cm2) Diameter 600mm, thick 100mm, Class A2, Penetration 54m, Length of Pile = 56m u/ FGL. Piling work is include Pile Head Treatment and Mobilitation from laydown area to pile construction area	0	ea	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
23-11 15 11	Geotextile membrane for the interface between foundation and soil (applicable only for the non pile foundation type)	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 61	Post Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL	Foundation Work	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

22-33 54 13 Hydrocarbon Leak Detection System											Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS			
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-33 54 13	Hydrocarbon Leak Detection System												
23-29 39 15 13	Leak Detection System material (Reff to API 650 for the minimum criteria)	0	unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 61	Post Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL	Hydrocarbon Leak Detection System	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

22-07 21 Foundation Waterproofing											Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS			
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-07 21	Foundation Waterproofing												
23-13 25 17 15 11	Asphalt Spray with minimum thickness of 150 micro meter	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 61	Post Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL	Foundation Waterproofing	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

22-05 12 23		Tank Metal Shell								Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-01 33 23	Shop Drawing & Datasheet											
23-13 19 13 11 19	Steel Plate for Tank Shell. The thickness shall follow the requirement stipulated in Datasheet	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
SUBTOTAL		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0

22-05 12 23		Tank Roof								Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-01 33 23	Shop Drawing & Datasheet											
23-13 19 13 11 19	Steel Plate for Tank Shell. The thickness shall follow the requirement stipulated in Datasheet	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
SUBTOTAL		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0

22-05 12 23		Tank Bottom								Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-01 33 23	Shop Drawing & Datasheet											
23-13 19 13 11 19	Steel Plate for Tank Shell. The thickness shall follow the requirement stipulated in Datasheet	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
SUBTOTAL		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0

22-05 12 13		Structural Frame									Total Cost:	\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-05 12 13	Structural Frame											
23-13 17 11 11	Steel Frame for Structural. The thickness and dimension follows the requirement in the drawing and datasheet	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
SUBTOTAL	Structural Frame	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	

22-08 17 13		Nozzle / Openings									Total Cost:	\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-08 17 13	Nozzle / Openings											
23-17 11 27 23	The Pipes used for the extension of the opening in tank shell and tank roof. Pipe spec, thickness and Diameter are following the requirement in the Datasheet	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
23-17 11 27 13	Tank Opening Door that usually mad from steel plate with same thickness. This item also include the reinforcement plate for the opening, the nut & bolt and also davit for the opening	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
SUBTOTAL	Nozzle / Openings	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	

22-05 51 19		Stair									Total Cost:	\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-05 51 19	Stair											
23-17 23 17 11 11	Grated Metal Plate that used as the stair steps. The dimension shall follow the drawings and the datasheet	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
23-17 23 17 11 17	Steel Pipe used for tank rail. This item also include the rod used to connect the stair rail to the stair steps. The dimension following the drawing	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	
SUBTOTAL	Stair	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	

22-05 59 13		Maintenance Platform									Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS			
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-05 51 19	Stair												
23-27 71 13	Grated Metal Plate that used as the platform for maintenance. Usually placed on roof or near the Fire Suppression System Facilities. Completed with rail. The dimension follows the drawing	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
SUBTOTAL		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	

22-07 72 23		Tank Venting									Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS			
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-07 72 23	Tank Venting												
23-13 41 17 11	Ventilation system for the storage tank. The specification shall follows the datasheet built by Engineer previously	0	unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
32-57 81 17	Field Acceptance and Site Acceptance Test including certification if necessary for the material being installed	0	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
SUBTOTAL		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	

22-22 14 13		Water Drain									Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS			
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost		
22-22 14 13	Water Drain												
23-39 29 11 15	Steel Pipe used for Water drain. The spec and form following the datasheet and the drawing	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
23-39 29 11 17	Fitting for drain steel pipe. The dimension and the specification shall follow the datasheet and the drawing	0	kg	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
23-27 31 25	Gate valve for isolation of drain steel pipe. The amount and the dimension shall follow the drawing and the datasheet	0	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	
SUBTOTAL		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0	

22-26 05 26		Grounding								Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-26 05 26	Grounding											
23-35 39 11	Electrical Rod for grounding that buried under the soil. The spec shall follow datasheet and the acceptance only viable if the installed rod (along with cable) resistance under 1 Ohm	0	unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
23-35 39 13	Connector between tank and the electrical rod	0	unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
SUBTOTAL	Grounding	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0

22-21 05		Fire Suppression System								Total Cost:		\$0
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS		
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost	
22-21 05	Fire Suppression System											
23-29 33 11 15	Water Sprinkler pipe that circling the tank's shell (not include header) and the sprinkler nozzle. The amount shall be shown in the picture	0	package	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
23-29 33 13 21	Foam Box Unit. The specification based on Datasheet	0	unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
23-15 21 13 11	Corrosion Protection Paint. The thickness and the composition also the number of layer shall follow the requirement as stipulated in Datasheet	0	m2	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0
SUBTOTAL	Fire Suppression System	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$0

OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS	
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost
22-28 40	Fire & Gas Detector										
23-27 11 29	Flame Detector. The accessories and specification follow datasheet	0	unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
23-27 11 27 11	Gas Detector. The Accessories and specification follow datasheet	0	unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 81	Inspection Activity for the work result and the material being installed (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 61	Construction Activity (the price include tools and PPE)	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL	Fire & Gas Detector	1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

Figure 10 – Detail of Bid Item 2 (Construction) for New Tank Storage Erection²⁸

²⁸ Author

Item No.	WBS	Description	Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Direct Cost/Unit	Total Direct Costs
1	22-02 21	Hydrotest	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2	22-02 30	Foundation Test	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Subtotal Direct Construction Costs			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$0

22-02 21 Hydrotest		Total Cost: \$0									
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS	
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost
22-02 21	Hydrotest										
41-50 50 15	Water used for Hydrotest. The water can be obtained from any body of water as long as they comply to the specification on the instruction	0	m3	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
32-57 81 17	Reviewing the hydrotest result whether it comply to API 650 or not	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL Hydrotest		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

22-02 30 Foundation Test		Total Cost: \$0									
OmniClass WBS Code	Description	Quantity	Unit	MATERIAL		LABOR		EQUIPMENT		TOTALS	
				Material Cost/Unit	Total Material Cost	Labor Cost/Unit	Total Labor Cost	Equipment Cost/Unit	Total Equipment Cost	Total Cost/Unit	Total Cost
22-02 30	Soil Investigation										
32-57 81 17	Reviewing the foundation test result while hydrotesting whether it comply to API 650 or not	0	Manhour	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0
SUBTOTAL Soil Investigation		1	Unit	\$ -	\$0	\$ -	\$0	\$ -	\$0	\$ -	\$0

Figure 11 – Detail Bid Item 3 (Handover) for New Tank Storage Erection²⁹

In summary, the detailed tables in Figure 9 lay out a thorough breakdown of the Work Breakdown Structure (WBS) for Bid item 1, focusing on the various Engineering Design activities. The Engineering Design phase aims to create detailed datasheets and drawings for the tank and its accessories based on field data gathered earlier.

After that, the comprehensive tables shown in Figure 10 detail the breakdown of the WBS for Bid item 2, emphasizing the various Construction activities. The Construction Phase involves building the actual New Tank Storage on the site using the drawings and datasheets developed in the Engineering Design Phase.

Finally, the tables in Figure 11 provide a detailed breakdown of the WBS for Bid item 3, highlighting the meticulous Handover activities. The Handover Phase involves a final inspection after the completion of the New Tank Storage and its accessories' construction, ensuring it operates at full capacity without any outstanding Punch list items. It's important to note that the Author intentionally excludes Commissioning activities from this phase, as they require connecting the newly constructed tank storage to Piping Facilities and accessories for liquid transfer, which will be covered in other discussions.

²⁹ Author

Step 7 – Building Standard Procedure for Bidding Template

The bidding template shall serve the final purpose for the activities related to Standardized New Tank Storage Erection. To monitor the performance of these standardized WBS and bidding templates for New Tank Storage Erection, one should try to seek whether anyone can implement both Standardized WBS and Bidding Template right away without any delay and review control to check whether there is any part of the New Tank Storage Erection in the construction phase and the bidding process not met by the WBS and Bidding Template Format. In order to implement those two things, there are a few things that the Company shall do before and during the implementation of this WBS, which are described as follows:

- 1. Pre-implementation Review:** During this phase, the organization should determine whether the WBS and the Bidding Template are too distant from the current practices used by the personnel responsible for monitoring the New Tank Storage bidding and construction activities. After that, we shall analyze again whether the format of those two things is logically coherent with the activities in the field and easy to implement. Lastly, we shall exercise the possibility of implementing both Standardized WBS and Bidding Templates without hassle. Based on Technology Acceptance Model 2 (TAM 2), the theory put forward by Venkatesh and Davis in 2000 that stipulates, “The intention of someone adopting a new system/technology influenced by their perceived ease of use of the new system and also the perceived usefulness of it.” The easiness of implementation is usually shown by the fact that the method before and after implementation is similar and whether all the implementors can understand the new format presented on both WBS and Bidding Template. The more it is similar, the easier it is to be understood the easier it is to be adopted.
- 2. Establish Key Performance Indicators (KPIs):** Define specific KPIs that align with the objectives of this WBS/CBS and Bidding Template Standardization. KPIs could include metrics related to cost accuracy, resource allocation, schedule adherence, variance analysis, and project milestones.
- 3. Regular Review Meetings:** Conduct regular review meetings involving all stakeholders to discuss the proposed WBS and Bidding Template and discuss the possibility to improve both Standardized WBS and Bidding Template. These meetings facilitate open communication and prompt issue resolution.

FUTURE RESEARCH

Some potential areas for future research related to the Standardized New Tank Storage WBS/CBS and Bidding Template in the context of PERTAMINA. These areas could help improve project management, cost control, and resource allocation:

- **Optimal Coding Structures:** Explore the development of coding structures within the WBS/CBS and Bidding Template tailored to PERTAMINA's specific project types, sizes, and complexities—research how custom coding structures can improve accuracy and alignment with project goals.
- **Integration and Technology:** Study the use of advanced project management software and technology tools to facilitate seamless integration between WBS/CBS and Bidding Template Format. Research the impact of digital solutions on data accuracy, real-time reporting, and decision-making.
- **Cost Estimation Accuracy:** Study cost estimation accuracy when using integrated WBS/CBS that could lead to a proper Bidding Template for this New Tank Storage Erection — research whether integrated systems lead to more precise cost forecasts and better alignment with actual expenditures.
- **The Calculation Method for Buffer:** If we seek back the NPS Class A Cost Estimation Template, there are various part of the template that push us to calculate the cost estimation incorporating some buffer due to some uncertainty found on the field such as design buffer, permit, social conditions, remoteness etc. The NPS has conducted their study regarding this matter religiously, which documented in their Cost Estimating Handbook. The problem is those buffers they regulate in the handbook are mostly applicable in the United States of America. The Author finds that it is urgent and quite compelling for The Company to pull resources researching this matter to implement both Standardized WBS and Bidding Template. Hopefully, the bidding process will be smoother, and the cost estimation for the project will be more precise to the conditions on the field.

CONCLUSION

Given that one of the priorities for PERTAMINA is catching up with the ideal tank storage capacity, it is important to create a standardized WBS/CBS and Bidding Template using the best-proven methods that exist in the world for New Tank Storage Erection Project, which could help the organization in scheduling, cost estimating, and RFQ (Request for Quotation) activities and make sure those two standards could be replicated all over Indonesia.

After we finish building the WBS/CBS using Omni Class Standard, we can build the Bidding Template using the WBS we built previously. Based on The Author's study building the standardized Bidding Template, the question for the research could be answered as follows:

1. The proper template for the Company's Bidding Template that produced by the United States of America's National Park Service (US-NPS), to be precise, the Class A Cost Estimate Template.
2. The proper template for the Company's Bidding Template is the one produced by the United States of America's National Park Service (US-NPS), to be precise, the Class A Cost Estimate Template.

REFERENCES

1. 1.4.1.4 Unit 4- Managing Scope. (2021). PTMC. <https://build-project-management-competency.com/1-4-1-4-unit-4/>
2. 1.4.1.10 Unit 10- *Managing cost estimating and budgeting*. (2022, October 24). PTMC. <https://build-project-management-competency.com/1-4-1-10-unit-10/>
3. AACE International. (2020). *AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, And Construction for The Process Industries*.
4. Al Farizi, S., & Latief, Y. (2018). *Development of Standardized WBS (Work Breakdown Structure) For Planning The Schedule Based On Risk In Steel Bridge Construction Projects*. Retrieved from <http://www.ieomsociety.org/ieom2018/papers/167.pdf>
5. Ardiansyah. (2017). *Indonesian State-Owned Oil and Gas Company Cost Estimating against GAO and NPS Best Practice: A benchmarking study*. [Review of Indonesian State-Owned Oil and Gas Company Cost Estimating against GAO and NPS Best Practice: A benchmarking study. PM World Journal, VI(XI), 24–44. <https://pmworldlibrary.net/wp-content/uploads/2017/11/pmwj64-Nov2017-Ardiansyah-indonesian-cost-estimating-against-gao-and-nps-best-practices.pdf>
6. Azam, M., Khan, A. Q., Zaman, K., & Ahmad, M. (2015). *Factors determining energy consumption: Evidence from Indonesia, Malaysia and Thailand*. *Renewable and Sustainable Energy Reviews*, 42, 1123-1131. <https://doi.org/10.1016/j.rser.2014.10.061>

7. Cerezo-Narváez, A.; Otero-Mateo, M.; Pastor-Fernández, A. Influence of scope management in construction industry projects. *DYNA Manag.* 2016, 4, 1–15.
<https://doi.org/10.6036/MN7943>
8. Epstein, Dan. (2014). *Project Estimating Process*. PM World Journal. Vol III. Retrieved from <https://pmworldlibrary.net/wp-content/uploads/2018/11/pmwj76-Nov2018-Epstein-estimating-process-series-article.pdf>
9. Humphreys, G.C. (2018). *Project Management Using Earned Value*, Chapter 2, pages 39 to 51. Humphreys & Associates, Fourth Edition.
10. Integration of cost and work breakdown structures in the management of construction projects. (2020, February 19). Retrieved from:
https://www.researchgate.net/publication/339353789_Integration_of_Cost_and_Work
11. Leynaud, X., Giammalvo, P. D., & Moine, J. Y. (2019). *Multi-Dimensional Project Breakdown Structures - The Secret to Successful Building Information Modelling (BIM) Integration*. DBC Publishing.
12. Government of Indonesia, MEMR. 2020. *Handbook of Energy & Economic Statistics of Indonesia 2019*. Jakarta.
13. Giammalvo, P.D. (2018). Mapping ERP “Charts of Account” to Building Information Modeling Software Using Omni Class Coding Structures and Activity-Based Costing/Management – A CONTRACTOR’s Perspective, *PM World Journal*, Vol. VII, Issue IV, April. <https://pmworldlibrary.net/wp-content/uploads/2018/04/pmwj69-Apr2018-Giammalvo-ERP-and-BIM-Omniclass-coding-marriage-featured-paper-1.pdf>
14. International Energy Agency. (2020). *Key energy statistics Indonesia, 2020*.
<https://www.iea.org/countries/indonesia>
15. Martyn Shuttleworth (2008). *What is Research?* <https://explorable.com/what-is-research>
16. National Park Services. (2023). *Construction Cost Estimating Requirements Handbook*. National Park Service (NPS) - Denver Service Center (DSC).
17. National Park Service. (2021, May 27). *Class A Construction Cost Estimate Template*. NPS.gov (U.S. National Park Service).
https://www.nps.gov/dscw/upload/ClassAConstructionCostEstimate_Template_5-27-21.xlsx

18. National Park Service. (2011, January 26). Class A Const. Cost Estimate Sample. NPS.gov (U.S. National Park Service).
https://www.nps.gov/dscw/upload/classaconstcostestimatesample_1-26-11.pdf
19. Narayan, M. (2023, February 2). *Indonesia 2023 gasoline demand, imports likely to exceed 2022 records*. Reuters. <https://www.reuters.com/business/energy/indonesia-2023-gasoline-demand-imports-likely-exceed-2022-records-2023-02-02/>
20. Noorwicaksono, T. (2021). *Building Multidimensional Standardized Work Breakdown Structure, Cost Breakdown Structure, and Cost Estimation of The Battery Laboratory Project*, PM World Journal, Vol. X, Issue I, January. <https://pmworldlibrary.net/wp-content/uploads/2021/01/pmwj101-Jan2021-Noorwicaksono-the-battery-laboratory-project.pdf>
21. Omni Class. (2020). *Introduction and User's Guide*.
https://www.csiresources.org/standards/Omni_Class
22. Omni Class. (2020). *Construction Entity by Function - Table 11*.
https://www.csiresources.org/standards/Omni_Class
23. Omni Class. (2020). *Construction Entity by Function - Table 12*.
https://www.csiresources.org/standards/Omni_Class
24. Omni Class. (2020). *Elements (includes Designed Elements) - Table 21*.
https://www.csiresources.org/standards/Omni_Class
25. Omni Class. (2020). *Work Results - Table 22*. https://www.csiresources.org/standards/Omni_Class
26. Omni Class. (2020). *Products - Table 23*. https://www.csiresources.org/standards/Omni_Class
27. Omni Class. (2020). *Phases - Table 31*. https://www.csiresources.org/standards/Omni_Class
28. Omni Class. (2020). *Services - Table 32*. https://www.csiresources.org/standards/Omni_Class
29. United States Government Accountability Office. (2020). *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs* (2020 ed.).
<https://gaoinnovations.gov/cost-guide/index.html>
30. U. S. National Park Service. (2021, May 27). *Construction Cost Estimate Template*. NPS.gov (U.S. National Park Service). Retrieved January 4, 2024, from
https://www.nps.gov/dscw/upload/ClassBConstructionCostEstimate_Template_5-27-21.xlsx

31. U.S. National Park Service. (n.d.). NPS.gov (U.S. National Park Service).
<https://www.nps.gov/dscw/index.htm>
32. Pertamina Subholding C&T Infrastructure Roadmap 2021-2024 (internal document)
33. Pullarcot, S. (2015). Above Ground Storage Tanks: Practical Guide to Construction, Inspection, and Testing. Taylor & Francis Group, LLC
34. Sullivan, G. W., Wicks, M. E., & Koelling, C. P. (2018). Engineering Economy 17th Edition
35. United States Government Accountability Office. (2020). Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program.
36. Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, 46(2), 186-204.
<https://doi.org/10.1287/mnsc.46.2.186.11926>
37. Wain, Y. A. (2021). Development of Cost Estimate for Engineering, Procurement and Construction (EPC) Project in 3 Steps; *PM World Journal*, Vol. X, Issue V, May.
<https://pmworldlibrary.net/wp-content/uploads/2021/05/pmwj105-May2021-Wain-development-of-epc-project-cost-estimate-in-3-steps.pdf>

About the Author



Ivan Pradibta

Jakarta, Indonesia



Ivan Pradibta is a Cost and Budget Controller for Project Management with nine years of experience in procurement, reliability, construction, and engineering in oil and energy industries. Currently, he work as an Ast of Cost and Budget Control for Project Management at the Indonesian national energy company. He possesses a Bachelor of Science in Telecommunication Engineering from Bandung Institute of Technology (ITB) and Master of Management form Diponegoro University (Undip). He is enrolled in a distance learning mentoring course taught by Dr. Paul D. Giammalvo, CDT, CCE, MScPM, MRICS, and GPM-m Senior Technical Advisor, PT Mitratata Citragraha, to achieve Certified Cost Professional certification from AACE International.

Ivan Pradibta resides in Jakarta, Indonesia, and his email address is ivan.pradibta@gmail.com.