

Enhancing Project Management Efficiency in PERTAMINA through Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) Integration ^{1, 2}

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ABSTRACT

The optimization of project management processes within PERTAMINA through the strategic integration of Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) methodologies. The study aims to improve project planning, resource allocation, and cost estimation by leveraging the synergy between these two structures. Through an empirical analysis, the paper demonstrates how the combined approach enhances project monitoring, control, and decision-making, leading to more efficient project execution and successful outcomes. This research contributes to project management by offering practical insights into leveraging WBS and CBS integration as a powerful tool for achieving greater efficiency and effectiveness in complex projects within the PERTAMINA context. The conclusion identifies areas where the integration of Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) could be advantageous. Preparing for implementing Building Information Modeling (BIM) in PERTAMINA requires careful planning, coordination, and alignment with the organization's goals and objectives. Some potential areas for future research related to the integration of Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) in the context of PERTAMINA: Optimal Coding Structures, Integration and Technology, and Cost Estimation Accuracy.

Keywords: CBS, WBS, Project Management, Efficiency, Cost Estimation, Multi-dimensional, BIM, Object-oriented Databases, OmniClass, Relational Databases.

INTRODUCTION

1. 1. PERTAMINA Energizing Our Nation

With the 'Renew Your Spirit mentality,' all PERTAMINA employees diligently provide the nation with the best possible service. Consequently, in 2022, PERTAMINA has demonstrated its capacity to evolve and achieve remarkable results. These remarkable accomplishments include PERTAMINA's success in collaborating with national and

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² This paper was originally prepared during a 6-month long Graduate-Level Competency Development/Capacity Building Program developed by PT Mitrata Citragraha and led by Dr. Paul D. Giammalvo to prepare candidates for AACE CCP or other Certifications. <https://build-project-management-competency.com/our-faqs/>

international business partners to implement the government's decarbonization program, accelerate the growth and development of new and renewable energy (NRE), and reach the Net-Zero Emissions (NZE) target by 2060 or sooner. "Along with the ongoing global energy transition, it is anticipated that PERTAMINA, whose core business is fossil-based energy, will lose approximately 50% of its revenue by 2030 if the company does not immediately develop new and renewable energy as an alternative source of revenue."³

PERTAMINA implements changes in an integrated manner to address increasingly dynamic and complex industry challenges, which have prompted PERTAMINA to implement changes to maintain operational and financial performance. PERTAMINA must restructure its business to accelerate the value expansion of the company. Building a focused, lean, agile, and effective organization requires change. With the formation of a sub-holding from upstream to downstream, which aims to enhance competitiveness, business development, partnership flexibility, organizational dynamics, and energy security, change and transformation are becoming more apparent.

As a state-owned enterprise, PERTAMINA must assist the government in realizing equitable energy distribution for the community (public service obligation/PSO). "In 2022, the Government designated RON 90 gasoline with the trade name Peralite as a Special Assignment Fuel Type (JBKP), replacing RON 88 or Premium gasoline through the Decree of the Minister of Energy and Mineral Resources Number 37.K/HK.02/MEM.M/2022 concerning Special Assignment Fuel Types signed on March 10, 2022."⁴ "In addition, PERTAMINA also received an assignment to Provide and Distribute 3 Kg LPG Cylinders (LPG PSO), based on the Decree of the Minister of Energy and Mineral Resources Number 134.K/HK.02/ DJM/2022 concerning Changes to the Decision of the Minister of Energy and Mineral Resources Number 1.K/HK.02/DJM/2022 about Assignment to PT PERTAMINA (Persero) in Providing and Distributing Refills of 3 Kg Liquefied Gas Cylinders in 2022."⁵ The Sub-Holding Commercial and Trading carry out the Provision and Distribution of Fuel and LPG PSO. The overall distribution of Fuel and LPG PSO products in 2022 has increased compared to 2021. This is in line with the increase in community economic activity, which is gradually returning to normal after the COVID-19 pandemic conditions have subsided.

³ PERTAMINA (2023). *Publikasi Laporan Tahunan*. Retrieved from <https://PERTAMINA.com/id/>

⁴ PERTAMINA (2023). *Publikasi Laporan Tahunan*. Retrieved from <https://PERTAMINA.com/id/>

⁵ PERTAMINA (2023). *Publikasi Laporan Tahunan*. Retrieved from <https://PERTAMINA.com/id/>

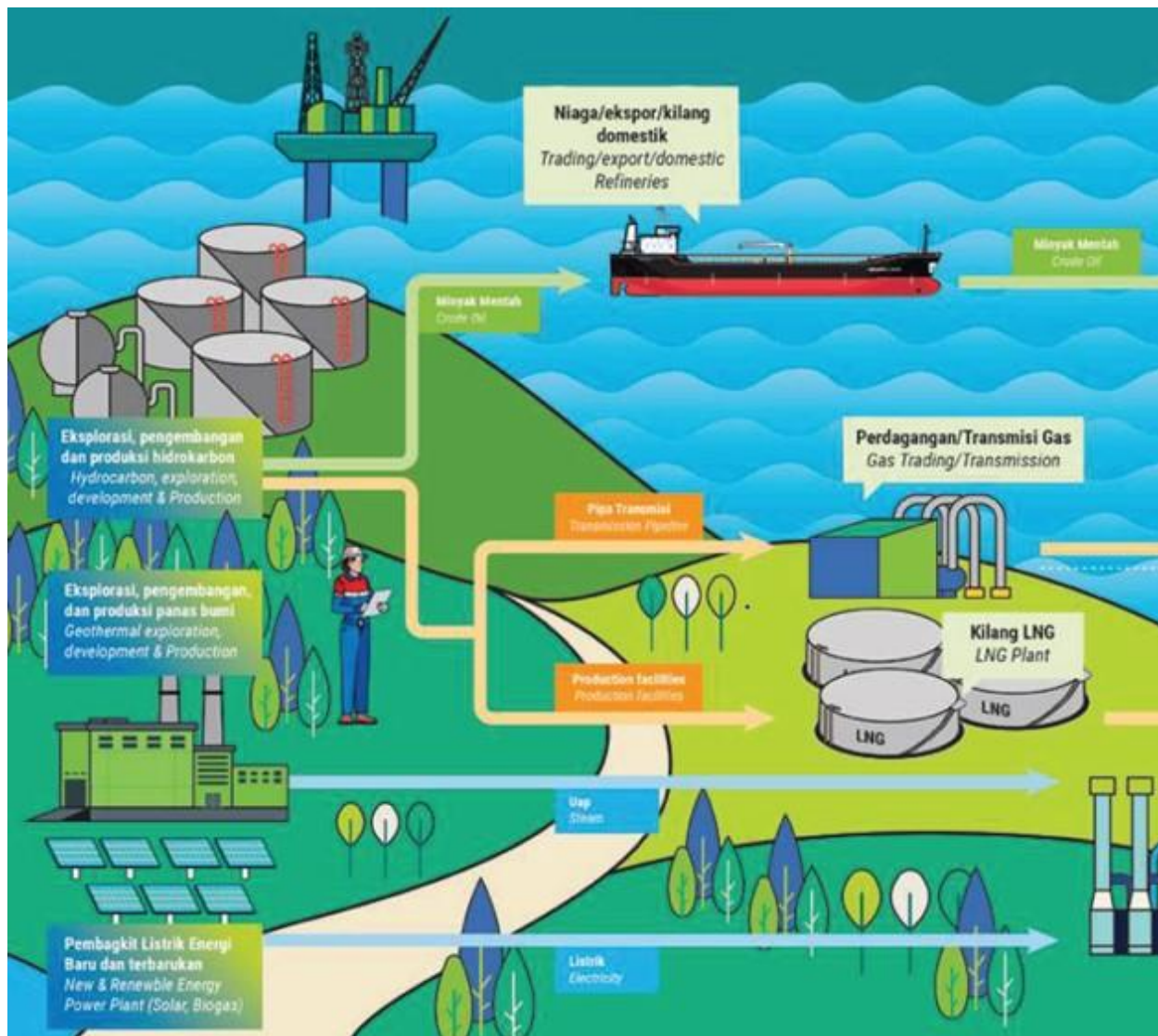


Figure 1 PERTAMINA Integrated Business (Upstream)⁶

⁶ PERTAMINA (2023). *Publikasi Laporan Tahunan*. Retrieved from <https://PERTAMINA.com/id/>

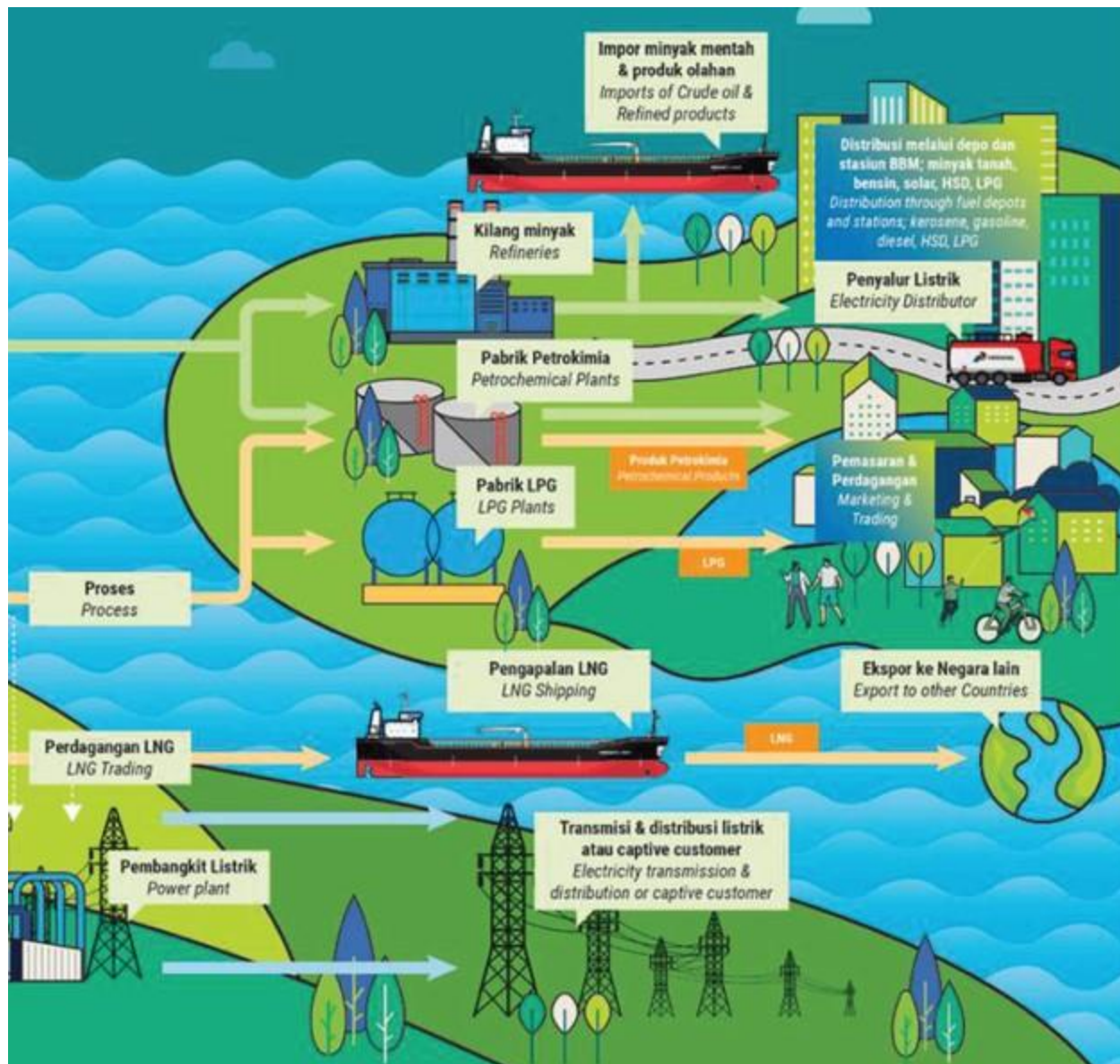


Figure 2 PERTAMINA Integrated Business (Downstream)⁷

1.2. Project Management Paradigm

Commercial and Trading (C&T) Sub-holding also continues to develop infrastructure to support the energy distribution program, including fuel and non-fuel storage construction. There has been an additional fuel storage capacity of 345.7 thousand KL throughout Indonesia. The availability of infrastructure is PERTAMINA's priority so that the big goal of achieving easy accessibility of energy for the community can be even better. Effective

⁷ PERTAMINA (2023). *Publikasi Laporan Tahunan*. Retrieved from <https://PERTAMINA.com/id/>

project management has become a critical component of success for companies such as PERTAMINA in the highly competitive and dynamic energy industry. PERTAMINA, one of the largest state-owned oil and energy companies in Indonesia, strives to improve its project execution continuously processes to increase efficiency, reduce costs, and guarantee timely project delivery. To achieve this objective, PERTAMINA acknowledges the importance of implementing structured project management methodologies, such as the Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS).

Kinerja Penjualan BBM dan Non-BBM Segmen Commercial & Trading Fuel and Non-Fuel Sales Performance of Commercial & Trading Segment						
Uraian Description	Satuan Unit	2022	2021	2020	Δ%	
		1	2	3	(1-2):2	(2-3):3
Penjualan BBM Fuel Sales	Juta KL Million KL	79	75	72	5.3	3.3
Penjualan Non-BBM Non-Fuel Sales		19	18	17	4.9	7.5

Kinerja Penjualan Produk Ritel Segmen Commercial & Trading Retail Product Sales Performance of Commercial & Trading Segment						
Uraian Description	Satuan Unit	2022	2021	2020	Δ%	
		1	2	3	(1-2):2	(2-3):3
BBM JBT	Juta KL Million KL	17.96	15.90	14.39	12.96	10.50
BBM JBKP		29.50	3.42	8.48	763.6	-59.67
BBM JBU		24.46	29.66	22.67	-17.53	30.83
LPG PSO		13.91	13.29	12.72	4.67	4.48
LPG Non-PSO		1.16	1.48	1.61	-21.62	-8.07
Total Penjualan Ritel Total Retail Sales	Juta KL Million KL	69.318	63.75	59.87		

Figure 3 Sales Performance of C&T Sub-Holding⁸

The Work Breakdown Structure (WBS) is an essential project management tool that divides complex undertakings into smaller, more manageable components. It hierarchically organizes the project's scope, allowing for more efficient resource allocation, risk management, and progress monitoring. Alternatively, the Cost Breakdown Structure (CBS) complements the Work Breakdown Structure (WBS) by providing a detailed summary of project costs, thereby enabling improved cost control, budget estimation, and financial accountability throughout the project's lifecycle.

PERTAMINA has experienced remarkable development in recent years, increasing the number and complexity of projects. Consequently, the need to enhance project management effectiveness has become more pressing. Using the WBS and CBS methodologies can substantially improve PERTAMINA's project planning, execution, and

⁸ PERTAMINA (2023). *Publikasi Laporan Tahunan*. Retrieved from <https://PERTAMINA.com/id/>

control processes, ensuring that resources are optimally utilized, and project objectives are met within the predefined constraints.

The correlation between Work Breakdown Structure (WBS), Cost Breakdown Structure (CBS), and Building Information Modeling (BIM) lies in their complementary roles within construction and project management. Each concept serves a specific purpose, and their integration can enhance project planning, execution, and coordination. Integrating WBS with BIM involves aligning the work breakdown in the WBS with the physical and functional components of the building model in BIM. This linkage ensures that project activities and tasks in the WBS correspond directly to the elements and systems modeled in the BIM environment. This integration enhances coordination, communication, and data exchange between project managers, designers, and construction teams. Integrating CBS with BIM involves associating cost data with the elements and systems represented in the BIM model. By linking cost information to specific BIM components, project teams can visualize and analyze how costs are distributed across different building elements. This integration enables real-time cost tracking and budget monitoring and helps make informed decisions throughout the project.

BIM provides a detailed visual representation of the project, allowing project teams to see how the physical components fit together. By aligning the WBS and CBS with BIM, project managers can directly link project tasks, costs, and scheduling information to specific BIM elements. This integration enhances project coordination, allows for better visualization of the work breakdown, and enables accurate estimation and tracking of costs associated with each element.

This paper aims to investigate the potential advantages of integrating WBS and CBS into PERTAMINA's project management framework. Through an in-depth analysis of extant project management practices and pertinent case studies, we intend to demonstrate how adopting these methodologies can result in streamlined project execution, decreased costs, and enhanced stakeholder communication. In addition, we will discuss the challenges associated with implementing WBS and CBS in a company as large and diverse as PERTAMINA and propose effective adoption strategies.

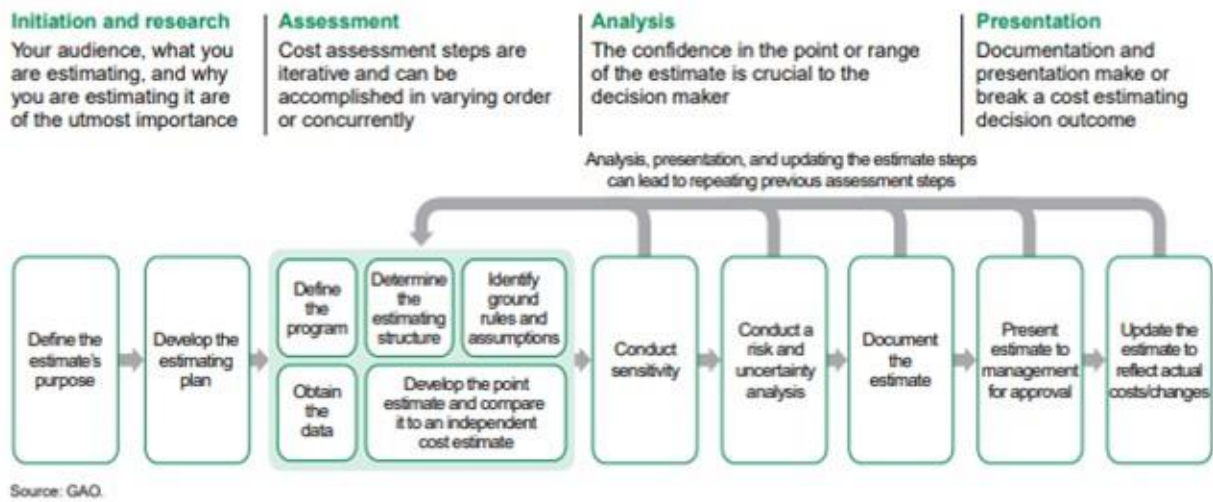


Figure 4 The Process of Cost Estimating⁹

The objective of the paper will be as follows:

1. How to provide an overview of PERTAMINA's current project management practices and identify areas where the integration of WBS and CBS could be advantageous?
2. Preparing for eventual implement the Building Information Modeling (BIM) in PERTAMINA?

METHODOLOGY

Research is a scientific endeavor; consequently, it must be conducted methodically, logically, or sensibly with accurate data or facts. Below is an illustration of the development methodology:

⁹ The United States. Government Accountability Office. (2009, March). GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs. Washington, DC: Government Printing Office. Retrieved from <https://www.gao.gov/new.items/d093sp.pdf>

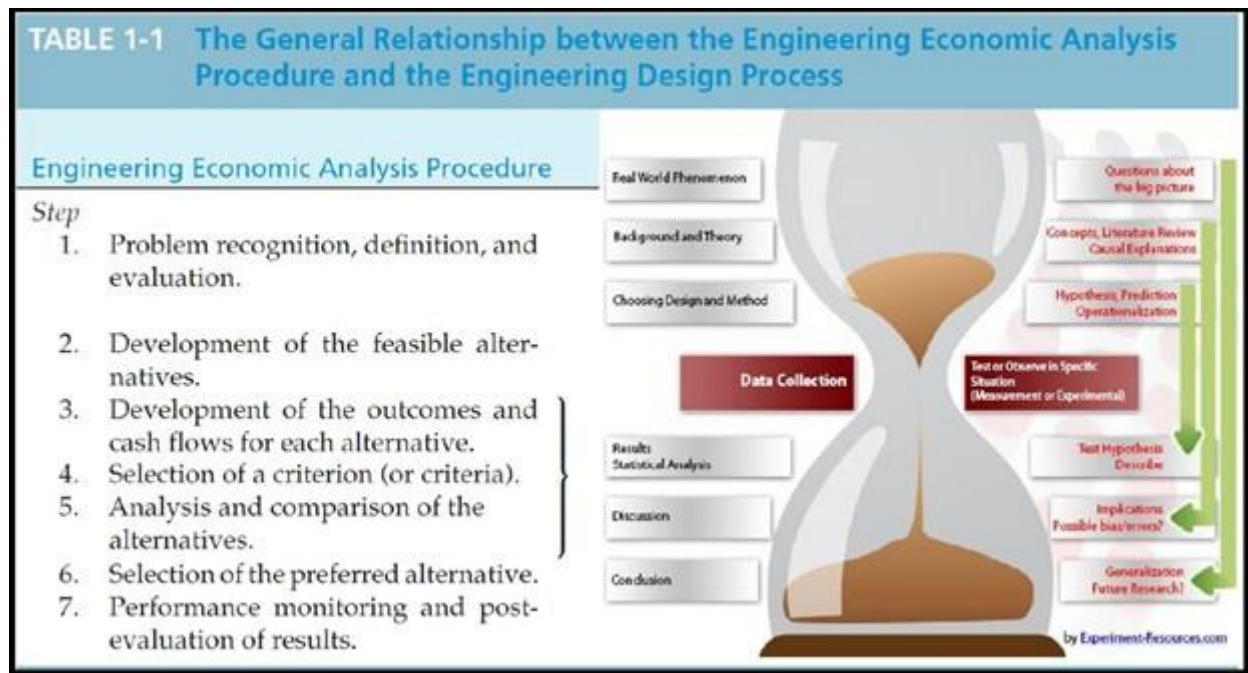


Figure 5 Procedure of Engineering Economics Analysis¹⁰

Step 1 – Problem Definition

PERTAMINA's current project management practices may face obstacles that hinder its overall efficiency and effectiveness. Inadequate visibility into the project's scope, duties, timelines, and costs could be one of these obstacles, leading to potential delays, budget overruns, and suboptimal resource utilization. Integrating Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) methodologies into PERTAMINA's project management processes is a potential solution for addressing these issues and improving project management efficacy.

Current PERTAMINA project management practices are inefficient and jeopardize project delivery, cost management, and resource utilization. There is insufficient visibility into project scopes, duties, milestones, and associated costs, resulting in difficulties with planning, monitoring, and control. This disconnected strategy can result in failed deadlines, budget overruns, and suboptimal resource allocation. Consequently, there is a need to improve project management efficiency by integrating WBS and CBS methodologies to provide a unified framework for organizing, monitoring, and managing projects.

¹⁰ Sullivan, G. W., Wicks, M. E., & Koelling, C. P. (2019). *Engineering Economy* 17th Edition. Chapter 2 Cost Concepts and Design Economics, Page 31.

Step 2 – Development of the Feasible Alternatives

Several feasible alternatives can be considered to enhance project management efficiency in PERTAMINA through Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) integration. Each alternative offers a unique approach to implementing the integration and addressing the identified challenges. We can determine as follows:

GAO (Government Accountability Office)¹¹

The U.S. Government Accountability Office (GAO) does not have a widely known or standardized classification system with a specific coding structure like some other organizations. Instead, GAO uses various methods to categorize and organize its reports, audits, and evaluations. These methods are designed to facilitate the efficient retrieval and management of information for Congress, government agencies, and the public.

NASA (National Aeronautics and Space Administration)¹²

NASA employs a classification system called the "NASA Master Directory (NMD) Data Structure" for coding and categorizing various data related to its missions, projects, and research activities. The NMD Data Structure is used to organize and catalog information in a consistent and structured manner, allowing for efficient retrieval and management of data. This system helps NASA personnel, researchers, and the public access and understand the wealth of information the agency produces.

OmniClass (Classification System for the Built Environment)¹³

OmniClass is a comprehensive classification system designed to categorize and organize information related to the built environment, including construction, architecture, engineering, and facility management. It provides a standardized framework for classifying various elements and components of projects, making it easier to communicate, exchange data, and manage information throughout the project lifecycle.

OmniClass uses a coding structure consisting of tables and categories, further organized into divisions, groups, and classes. Each level of the coding structure represents a progressively more specific level of detail. The coding structure is designed to be flexible and adaptable to various projects and industries.

¹¹ The United States. Government Accountability Office. (2009, March). GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs. Washington, DC: Government Printing Office. Retrieved from <https://www.gao.gov/new.items/d093sp.pdf>

¹² NASA cost estimating handbook (CEH). (2016, May 19). NASA. Retrieved from <https://www.nasa.gov/offices/ocfo/nasa-cost-estimating-handbook-ceh>

¹³ OmniClass® - Construction specifications institute. (2020). Construction Specifications Institute. Retrieved from <https://www.csiresources.org/standards/omniclass>

NORSOK¹⁴

NORSOK standards are a set of technical guidelines and standards developed by the Norwegian petroleum industry to ensure safety, cost-effectiveness, and efficiency in oil and gas operations, particularly in the upstream division. The NORSOK classification system, particularly the "Z-014 Standard Cost Coding System," provides a structured framework for classifying and coding costs associated with oil and gas projects. This coding system organizes and categorizes various project costs, facilitating accurate cost estimation, budgeting, and reporting.

The NORSOK Z-014 Standard Cost Coding System consists of a hierarchical coding structure that includes different levels of detail. It is designed to cover the entire project lifecycle, from concept development to decommissioning.

NPS (The National Park Service)¹⁵

The National Park Service (NPS) classification system coding structure is used to categorize and organize information related to the management, preservation, and interpretation of national parks and other protected areas within the United States. The classification system helps NPS professionals and stakeholders efficiently manage and communicate information about park resources, facilities, programs, and activities.

While NPS does not have a standardized coding structure applicable to all aspects of its operations, it employs various classification systems and coding schemes to serve specific purposes within different areas of park management.

TCMF AACE International¹⁶

The Total Cost Management Framework (TCMF) by AACE International provides a structured approach to cost management across all phases of a project's lifecycle. While TCMF does not have a standardized classification system coding structure in the same way that some other systems (e.g., OmniClass) do, it offers guidance and best practices for organizing and categorizing costs and activities within the context of total cost management. TCMF focuses on creating a comprehensive cost management framework rather than a specific coding structure.

¹⁴ NORSOK standards. (n.d.). Retrieved from <https://www.standard.no/en/sectors/energi-og-klima/petroleum/norsok-standard-categories/z-stand-cost-coding/z-0142/>

¹⁵ National Park Service. (2011). Cost Estimating Requirements Handbook. Retrieved from https://www.nps.gov/dscw/upload/CostEstimatingHandbook_2-3-11.pdf.

¹⁶ Lance Stephenson, H. (2015). Total Cost Management Framework, 2nd Edition, AACE International.

Skill and Knowledge of Cost Engineering AACE International¹⁷

AACE International's "Skills and Knowledge of Cost Engineering" does not follow a specific classification system coding structure like some other frameworks. Instead, it provides a comprehensive outline of the various skills, competencies, and knowledge areas important for cost engineering professionals and project controls. This resource is designed to guide individuals in developing expertise in cost engineering practices and related disciplines. The "Skills and Knowledge" document is organized into chapters, sections, and sub-sections, each addressing different areas of knowledge and skills required for practical cost engineering. These areas include project planning, cost estimating, cost control, risk management, scheduling, and more.

PMO Handbook “Best Tested and Proven”¹⁸

The classification system coding structure that a Project Management Office (PMO) adopts can vary based on the organization's industry, size, type of projects, and specific needs.

However, PMOs often utilize established project management methodologies, frameworks, and standards to guide their practices, which may include classification systems for organizing information.

Below is a general comparison of how these entities may structure their WBS and CBS:

Descriptions		Alternative 1 (GAO)	Alternative 2 (NASA)
WBS	Level 1	Project Title and Identification	Project Title and Identification
	Level 2	Major Program or Audit Areas (e.g., Financial Audit, Performance Evaluation).	Major Mission Components (e.g., Spacecraft, Launch, Ground Support)
	Level 3	Specific Tasks and Objectives within each Audit Area	Specific Work Packages for Each Mission Component
	Level 4	Detailed Sub-Tasks and Activities for Each Objective	Detailed Sub-Tasks and Activities for Each Work Package
CBS	Level 1	Project Title and Identification	Project Title and Identification
	Level 2	Major Cost Categories (e.g., Personnel, Travel, Equipment)	Major Cost Categories (e.g., Launch Costs, Research and Development, Mission Operations)
	Level 3	Subcategories under Each Major Cost Category (e.g., Personnel: Auditors, Analysts, Administrative Staff)	Subcategories under Each Major Cost Category (e.g., Launch Costs: Propulsion Fuel, Range Support)

Table 1 Alternative Comparison (1)¹⁹

¹⁷ Hastak, Makarand (2015). Skills and Knowledge of Cost Engineering, 6th Edition, AACE International.

¹⁸ PTMC, & Giammalvo, P. D. (2021). 1.4.1.3 unit 13 – Managing Databases. <https://build-project-management-competency.com/1-4-1-3-unit-13/>

¹⁹ The author

Descriptions		Alternative 3 (Omniclass)	Alternative 4 (NORSOK)
WBS	Level 1	Project Title and Identification	Project Title and Identification
	Level 2	Major Systems or Elements (e.g., Structural, Architectural, Mechanical)	Major Project Phases (e.g., Exploration, Drilling, Production)
	Level 3	Specific Work Results or Elements within Each Major System	Specific Work Packages for Each Project Phase
	Level 4	Detailed Sub-Elements and Components for Each Work Result	Detailed Sub-Tasks and Activities for Each Work Package
CBS	Level 1	Project Title and Identification	Project Title and Identification
	Level 2	Major Cost Categories (e.g., Labor, Materials, Equipment)	Major Cost Categories (e.g., Engineering, Materials, Labor)
	Level 3	Subcategories under Each Major Cost Category (e.g., Labor: Construction Workers, Supervisors, Engineers)	Subcategories under Each Major Cost Category (e.g., Engineering: Design, Analysis, Procurement)

Table 2 Alternative Comparison (2)²⁰

Descriptions		Alternative 5 (NPS)	Alternative 6 (TCMF AACE International)
WBS	Level 1	Project Title and Identification	The TCMF provides a comprehensive framework for structuring the WBS based on the AACE International Body of Knowledge. It emphasizes consistent hierarchical levels and provides guidance for WBS element descriptions and codes.
	Level 2	Major Project Phases (e.g., Design, Construction, Operations)	
	Level 3	Specific Work Packages for Each Project Phase	
	Level 4	Detailed Sub-Tasks and Activities for Each Work Package	
CBS	Level 1	Project Title and Identification	Similar to the WBS, the TCMF provides a structured approach to developing CBS, aligning cost categories with the WBS and enabling effective cost control and reporting.
	Level 2	Major Cost Categories (e.g., Labor, Materials, Overhead)	
	Level 3	Subcategories under Each Major Cost Category (e.g., Labor: Park Rangers, Maintenance Crews, Administrative Staff)	

Table 3 Alternative Comparison (3)²¹

Descriptions		Alternative 7 (S&K AACE International)	Alternative 8 (PMO Handbook)
WBS	Level 1	AACE International's "Skill and Knowledge" resources provide guidelines for project professionals to develop the competencies and expertise required in various aspects of project management, including cost engineering, planning, scheduling, risk management, and more. While these resources don't explicitly focus on WBS and CBS development, they offer insights into the skills and knowledge needed to implement successful project management practices.	Customized based on the organization's projects and industry (e.g., IT projects, Construction projects, etc.)
	Level 2		
	Level 3		
	Level 4		
CBS	Level 1	"Skill and Knowledge AACE" provides a broader focus on developing competencies and expertise across project management disciplines	Customized based on the organization's projects and industry (e.g., Labor, Hardware, Software, Training)
	Level 2		
	Level 3		

Table 4 Alternative Comparison (4)²²

It is important to note that each organization's specific WBS and CBS structures may vary depending on the complexity and nature of individual projects. These examples are general and not based on specific projects from the mentioned organizations.

²⁰ The author

²¹ The author

²² The author

Step 3 – Development of the Outcomes

“Activity-Based Costing (ABC) is a cost accounting method that assigns costs to specific activities and processes based on their consumption of resources.”^{23,24} Unlike traditional costing methods that allocate costs based on broad averages or direct labor hours, ABC seeks to provide a more accurate and detailed understanding of the costs associated with producing goods or providing services. In ABC, costs are traced to individual activities or cost drivers, which are then allocated to products, services, or projects based on the extent to which they use those activities. This approach is beneficial when products or services have different levels of complexity, variety, or resource consumption.



Figure 6 Flow of Activity-based costing²⁵

However, implementing ABC can be complex and resource-intensive, requiring a comprehensive understanding of the organization's activities and resource consumption. It is often more suitable for organizations with diverse products or services and varying degrees of resource consumption across activities. Before executing this and determining Danilo Arba's (2020) paper, we must construct our MADM scoring model using "Key Words" analysis to match the various attributes from our chosen international standards.

²³ Gary Cokins. (n.d.). Retrieved from <https://www.garycokins.com/downloadable-articles>

²⁴ Giammalvo, P.D. (2018). Mapping ERP “Charts of Account” to Building Information Modeling Software Using OmniClass Coding Structures and Activity-Based Costing/Management – A CONTRACTOR’s Perspective, PM World Journal, Vol. VII, Issue IV, April. Retrieved from <https://pmworldlibrary.net/wp-content/uploads/2018/04/pmwj69-Apr2018-Giammalvo-ERP-and-BIM-Omniclass-coding-marriage-featured-paper-1.pdf>

²⁵ Cerezo-Narváez, A.; Otero-Mateo, M.; Pastor-Fernández, A. Influence of scope management in construction industry projects. DYNA Manag. 2016, 4, 1–15

No.	Keywords	International Standard								TOTAL BY ROW
		GAO	NASA	OmniClass	NORSOK	NPS	TCMF AACE	S&K AACE	PMO Handbook	
1	Activities	1	1	1	1		1	1	1	7
2	Agents				1			1	1	3
3	Aids									0
4	Built Spaces									0
5	CAD		1					1		2
6	Classes	1						1		2
7	Complexes/Complexity	1	1		1	1	1	1	1	7
8	Components	1	1	1	1	1	1	1	1	8
9	Disciplines	1	1	1			1	1	1	6
10	Documents	1	1			1	1	1	1	6
11	Elements	1	1	1		1	1	1	1	7
12	Entities by Function			1					1	2
13	Entities by Form			1					1	2
14	Equipment	1	1			1	1	1	1	6
15	Forms						1	1	1	3
16	Functions		1	1		1	1	1	1	6
17	Information		1	1		1	1	1	1	6
18	Job Titles							1	1	2
19	Landscape			1		1	1		1	4
20	Locations			1		1		1	1	4
21	Management Processes		1	1			1	1	1	5
22	Materials	1	1	1		1		1	1	6
23	Organizational Roles			1			1			2
24	Phases	1	1	1		1	1	1	1	7
25	PM							1		1
26	Production				1			1		2
27	Products	1	1	1		1	1	1	1	7
28	Properties			1			1			2
29	Resources	1	1	1	1	1	1	1	1	8
30	Roles	1	1	1			1	1	1	6
31	Services	1		1		1	1	1	1	6
32	Spaces			1		1				2
33	Spaces by Function			1					1	2
34	Spaces by Form			1					1	2
35	Systems	1	1			1	1	1	1	6
36	Technical		1			1	1	1	1	5
37	Tools	1	1	1			1	1	1	6
38	User Spaces									0
39	Work Results			1					1	2
	TOTAL BY COLUMN	16	19	24	6	17	22	27	29	

Table 5 MADM analysis scoring by column²⁶

²⁶ The author

No.	Keywords	International Standard								TOTAL BY ROW
		GAO	NASA	OmniClass	NORSOK	NPS	TCMF AACE	S&K AACE	PMO Handbook	
1	Components	1	1	1	1	1	1	1	1	8
2	Resources	1	1	1	1	1	1	1	1	8
3	Activities	1	1	1	1		1	1	1	7
4	Complexes/Complexity	1	1		1	1	1	1	1	7
5	Elements	1	1	1		1	1	1	1	7
6	Phases	1	1	1		1	1	1	1	7
7	Products	1	1	1		1	1	1	1	7
8	Disciplines	1	1	1			1	1	1	6
9	Documents	1	1			1	1	1	1	6
10	Equipment	1	1			1	1	1	1	6
11	Functions		1	1		1	1	1	1	6
12	Information		1	1		1	1	1	1	6
13	Materials	1	1	1		1		1	1	6
14	Roles	1	1	1			1	1	1	6
15	Services	1		1		1	1	1	1	6
16	Systems	1	1			1	1	1	1	6
17	Tools	1	1	1			1	1	1	6
18	Management Processes		1	1			1	1	1	5
19	Technical		1			1	1	1	1	5
20	Landscape			1		1	1		1	4
21	Locations			1		1		1	1	4
22	Agents				1			1	1	3
23	Forms						1	1	1	3
24	CAD		1					1		2
25	Classes	1						1		2
26	Entities by Function			1					1	2
27	Entities by Form			1					1	2
28	Job Titles							1	1	2
29	Organizational Roles			1			1			2
30	Production				1			1		2
31	Properties			1			1			2
32	Spaces			1		1				2
33	Spaces by Function			1					1	2
34	Spaces by Form			1					1	2
35	Work Results			1					1	2
36	PM							1		1
37	Aids									0
38	Built Spaces									0
39	User Spaces									0
	TOTAL BY COLUMN	16	19	24	6	17	22	27	29	

Table 6 MADM analysis scoring combination²⁷

Step 4 – Selection of the Criterion

As a result of our analysis, we can now exclude international standards that do not comply with the specifications. We chose the top three of the highest scoring in Table 7.

Since we have all the information necessary to determine which standard best matches our needs and whether or not we need to add additional criteria to comply with the technical requirements, we will be able to determine which answers to the questions posed in our technical papers.

²⁷ The author

No.	Keywords	International Standard			TOTAL BY ROW
		OmniClass	S&K AACE	PMO Handbook	
1	Components	1	1	1	3
2	Resources	1	1	1	3
3	Activities	1	1	1	3
4	Elements	1	1	1	3
5	Phases	1	1	1	3
6	Products	1	1	1	3
7	Disciplines	1	1	1	3
8	Functions	1	1	1	3
9	Information	1	1	1	3
10	Materials	1	1	1	3
11	Roles	1	1	1	3
12	Services	1	1	1	3
13	Tools	1	1	1	3
14	Management Processes	1	1	1	3
15	Locations	1	1	1	3
16	Complexes/Complexity		1	1	2
17	Documents		1	1	2
18	Equipment		1	1	2
19	Systems		1	1	2
20	Technical		1	1	2
21	Landscape	1		1	2
22	Agents		1	1	2
23	Forms		1	1	2
24	Entities by Function	1		1	2
25	Entities by Form	1		1	2
26	Job Titles		1	1	2
27	Spaces by Function	1		1	2
28	Spaces by Form	1		1	2
29	Work Results	1		1	2
30	CAD		1		1
31	Classes		1		1
32	Organizational Roles	1			1
33	Production		1		1
34	Properties	1			1
35	Spaces	1			1
36	PM		1		1
37	Aids				0
38	Built Spaces				0
39	User Spaces				0
	TOTAL BY COLUMN	24	27	29	

Table 7 Rank Ordered by Number of International Standard²⁸

²⁸ The author

FINDINGS

Step 5 – Analysis and Comparison among Alternatives

Based on the outcomes of step 4, it is evident which standards have the highest score and that the measures only concur on the first fifteen scoring criteria.

No.	Keywords	International Standard			TOTAL BY ROW
		OmniClass	S&K AACE	PMO Handbook	
1	Components	1	1	1	3
2	Resources	1	1	1	3
3	Activities	1	1	1	3
4	Elements	1	1	1	3
5	Phases	1	1	1	3
6	Products	1	1	1	3
7	Disciplines	1	1	1	3
8	Functions	1	1	1	3
9	Information	1	1	1	3
10	Materials	1	1	1	3
11	Roles	1	1	1	3
12	Services	1	1	1	3
13	Tools	1	1	1	3
14	Management Processes	1	1	1	3
15	Locations	1	1	1	3

Table 8 Top criterion against the international standards²⁹

Furthermore, the standards do not entirely agree or omit specific details for the remaining criterion. The following characteristics are addressed by only two of our chosen standards:

No.	Keywords	International Standard			TOTAL BY ROW
		OmniClass	S&K AACE	PMO Handbook	
16	Complexes/Complexity		1	1	2
17	Documents		1	1	2
18	Equipment		1	1	2
19	Systems		1	1	2
20	Technical		1	1	2
21	Landscape	1		1	2
22	Agents		1	1	2
23	Forms		1	1	2
24	Entities by Function	1		1	2
25	Entities by Form	1		1	2
26	Job Titles		1	1	2
27	Spaces by Function	1		1	2
28	Spaces by Form	1		1	2
29	Work Results	1		1	2

Table 9 Criterion that agreed by two of the international standards³⁰

²⁹ The author

³⁰ The author

We can now view the criterion only met by one of the standards as we continue our selection.

No.	Keywords	International Standard			TOTAL BY ROW
		OmniClass	S&K AACE	PMO Handbook	
30	CAD		1		1
31	Classes		1		1
32	Organizational Roles	1			1
33	Production		1		1
34	Properties	1			1
35	Spaces	1			1
36	PM		1		1

Table 10 Criterion that agreed only one of the international standards³¹

Lastly, some criteria are not fulfilled by any of the standards.

No.	Keywords	International Standard			TOTAL BY ROW
		OmniClass	S&K AACE	PMO Handbook	
37	Aids				0
38	Built Spaces				0
39	User Spaces				0

Table 11 Criterion that agreed with none of the international standards³²

Project management mapping entails the creation of visual representations or diagrams that aid stakeholders in understanding a project's scope, schedule, resources, and interdependencies. Figure 7 demonstrates that the stakeholders must answer the eight queries listed below.

³¹ The author

³² The author

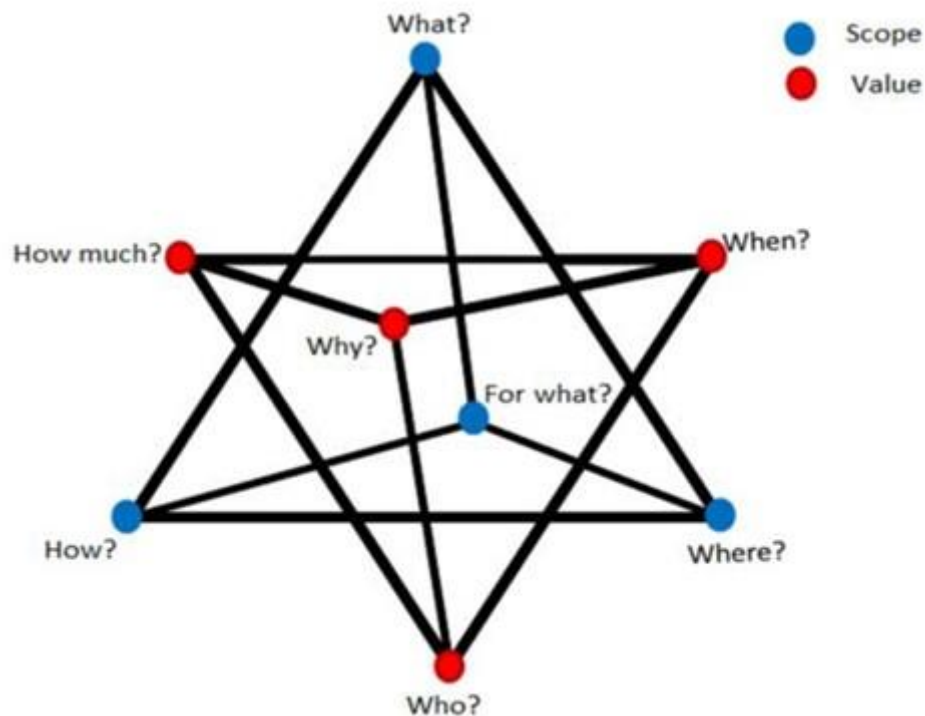


Figure 7 Stakeholders Needs³³

On this basis, we define the work content through the WBS, but a categorization system must be established to classify all this information. This will enable us to archive and retrieve project information using the WBS. Choosing an appropriate classification system (aggregated) is, therefore, the first stage in developing the WBS.

Based on these observations, how does each of our eight high-level questions compare to the 39 criteria, whether we have any vulnerabilities, strengths, opportunities, or threats, and which critical work best answers our eight high-level questions? Before making our recommendations, we conducted extensive research.

³³ Arba, D. (2020). Multi-dimensional Project Breakdown Structures to Ensure Efficient Delivery of Hospital Construction, PM World Journal, Vol. IX, Issue XI, November.

No.	Keywords	High-Level Questions								TOTAL BY ROW
		HOW	WHO	WHAT	HOW MUCH	FOR WHAT	WHERE	WHEN	WHY	
1	Documents		1	1	1			1		4
2	Activities	1		1				1		3
3	Built Spaces			1	1		1			3
4	Production	1			1			1		3
5	Resources	1	1		1					3
6	Spaces			1		1	1			3
7	Disciplines		1		1					2
8	Information	1		1						2
9	Services		1		1					2
10	Technical	1	1							2
11	Elements			1			1			2
12	Equipment	1			1					2
13	Management Processes	1	1							2
14	Materials			1	1					2
15	Roles	1	1							2
16	Spaces by Function			1			1			2
17	Work Results	1			1	1				3
18	Functions			1		1				2
19	Components						1			1
20	Entities by Function					1			1	2
21	Classes		1							1
22	Complexes/Complexity	1								1
23	Products			1						1
24	Properties			1						1
25	Agents		1							1
26	Phases							1		1
27	PM		1							1
28	Tools	1								1
29	Entities by Form					1			1	2
30	Locations						1			1
31	Organizational Roles		1			1				2
32	Aids	1								1
33	CAD	1								1
34	Job Titles		1							1
35	Spaces by Form						1			1
36	Systems	1				1				2
37	User Spaces		1							1
38	Forms					1				1
39	Landscape									0
	TOTAL BY COLUMN	14	13	11	9	8	7	4	2	

Table 12 Eight high-level questions vs Keywords³⁴

After determining how the eight advanced-level queries correspond to our criterion, we must substitute them into our top three international standards.

Our top three standards conform to our eight high-level queries the most or provide the best answers. If we rank the order of how the criterion compares to each of our questions, we can identify several issues with the international standards.

³⁴ The author

No.	Keywords	International Standard			TOTAL BY ROW
		OmniClass	S&K AACE	PMO Handbook	
1	Documents		1	1	2
2	Activities	1	1	1	3
3	Built Spaces				0
4	Production		1		1
5	Resources	1	1	1	3
6	Spaces	1			1
7	Disciplines	1	1	1	3
8	Information	1	1	1	3
9	Services	1	1	1	3
10	Technical		1	1	2
11	Elements	1	1	1	3
12	Equipment		1	1	2
13	Management Processes	1	1	1	3
14	Materials	1	1	1	3
15	Roles	1	1	1	3
16	Spaces by Function	1		1	2
17	Work Results	1		1	2
18	Functions	1	1	1	3
19	Components	1	1	1	3
20	Entities by Function	1		1	2
21	Classes		1		1
22	Complexes/Complexity		1	1	2
23	Products	1	1	1	3
24	Properties	1			1
25	Agents		1	1	2
26	Phases	1	1	1	3
27	PM		1		1
28	Tools	1	1	1	3
29	Entities by Form	1		1	2
30	Locations	1	1	1	3
31	Organizational Roles	1			1
32	Aids				0
33	CAD		1		1
34	Job Titles		1	1	2
35	Spaces by Form	1		1	2
36	Systems		1	1	2
37	User Spaces				0
38	Forms		1	1	2
39	Landscape	1		1	2
	TOTAL BY COLUMN	24	27	29	

Table 13 Highest rank criterion based on high-level questions³⁵

None of the standards can fully address the eight high-level questions, with the Skill and Knowledge of Cost Engineering from AACE International being able to answer the most questions based on the ten most frequently occurring keywords. Noting that none

³⁵ The author

of the standards can respond to two of the top ten keywords is also essential. Now that we have determined the advantages, disadvantages, opportunities, and threats of our international standards, we can make our recommendations.

In contrast to Table 4, S&K AACE International's resources do not explicitly focus on WBS and CBS development, even though S&K AACE International achieved a superior ranking. Following the PMO Handbook's "Best Tested and Proven," the author mentions OmniClass. It is intended to organize information and facilitate communication in the construction industry. It covers various topics, such as work breakdown structures (WBS) and cost breakdown structures (CBS). OmniClass offers several benefits that make it suitable for coding structures like WBS and CBS in construction projects. Omniclass has been adopted by Bentley Systems, Autodesk, AutoCAD, and all the other major BIM software vendors³⁶ it appears to have become the dominant WBS/CBS coding structure, at least at this point in the evolution.

We can conclude that from the author's perspective what can be proposed for management based on OmniClass Tables are:

2012 DRAFT OmniClass Table 31 - Phases		
Number	Level 1 Title	Definition
31-30 00 00	Criteria Definition Phase	Phase to create and refine schematic diagrams of the basic project elements - substructure, shell, interiors, equipment, services, equipment and furnishings, special construction and demolition, and building sitework - that fully establish project spatial and element criteria as the Basis of Design.
31-40 00 00	Design Phase	Phase in which project team establishes means of satisfying project Basis of Design requirements with technical solutions, evaluates alternatives through value analysis or similar processes, and completes initial documentation - Drawings and specified Work Results - for the designed project.
31-50 00 00	Coordination Phase	Phase that bridges the design effort with implementation by integrating constructability and feasibility evaluations of the design in order to further develop spaces, elements, products, and materials necessary for the procurement and execution of the Work irrespective of the method of delivery.
31-60 00 00	Implementation Phase	Phase to implement the coordinated design through construction planning, prefabrication, and field execution characterized by constructor 'means and methods,' and Basis of Construction strategies, controlled by quality assurance and control protocols.
31-70 00 00	Handover Phase	Phase to evaluate the completed Work through testing, inspection, and commissioning activities, including for any Owner-furnished equipment, to ensure that design/performance criteria are met while conforming to applicable codes and standards, and transfer project knowledge from the design/construction team to the Owner/facility management team via demonstrations, training, and documentation.
31-90 00 00	Closure Phase	Phase which includes facility closure, preparation for unknown future use, demolition in whole or part, foreclosure, sale, or similar dispensation initiated by the decision that the facility no longer meets the needs of the Owner and cannot be feasibly reconfigured for continued use by that Owner.

Table 14 OmniClass Table 31 (Owner's Perspective)³⁷

³⁶ <https://www.constructionplacements.com/bim-software/>

³⁷ OmniClass® - Construction specifications institute. (2020). Construction Specifications Institute. Retrieved from <https://www.csiresources.org/standards/omniclass>

Table 31 focuses explicitly on the phases of a construction project. Each phase represents a stage in the project's lifecycle, from conception and planning to design construction and occupancy. The owner's perspective on OmniClass Table 31 "Phases" can provide insights into how it benefits owners in managing and understanding construction projects:

Owner's Perspective on OmniClass Table 31 - Phases:

1. **Project Planning and Definition:** Owners can use OmniClass Table 31 to define and plan different project phases. Each phase represents a specific set of activities, deliverables, and milestones. This helps owners establish a clear roadmap for the project.
2. **Scope and Objectives:** Table 31 allows owners to define the scope and objectives of each project phase. By categorizing phases, owners can ensure that all necessary activities are accounted for and that the project progresses smoothly.
3. **Communication and Collaboration:** Owners can communicate their expectations, priorities, and requirements to project stakeholders more effectively by referencing specific project phases from Table 31. This enhances collaboration and minimizes misunderstandings.
4. **Project Monitoring and Reporting:** Owners can monitor and track project progress by aligning actual activities with the predefined phases. This enables accurate reporting and ensures that the project is on track.
5. **Budgeting and Resource Allocation:** Owners can allocate resources and budget for different project phases based on each phase's unique activities and requirements. This helps optimize resource utilization and financial planning.
6. **Risk Management:** By categorizing project phases, owners can identify potential risks and challenges at each stage. This allows for more targeted risk assessment and mitigation strategies.
7. **Project Governance:** OmniClass Table 31 provides owners with a standardized framework for project governance. It helps ensure that all stakeholders are aligned on the sequence and purpose of each phase.
8. **Project Handover and Closeout:** The phases in Table 31 guide the transition from one stage to the next, aiding in project handover and closeout. Owners can ensure all necessary tasks are completed before moving to the next phase.
9. **Project Documentation:** Owners can organize project documentation and records based on the phases from Table 31. This facilitates the efficient retrieval of information and historical data.

10. Facility Management: Owners can extend the use of Table 31 beyond construction to facility management. The phases can be aligned with ongoing maintenance, renovations, and operational activities.

2012-05-16 Final - National Standard OmniClass Table 21 - Elements					
Number	Level 1	Level 2	Level 3	Level 4	Table 22 Reference
21-01 00 00	Substructure				
21-01 10		Foundations			
21-01 10 10			Standard Foundations		
21-01 10 10 10				Wall Foundations	
21-01 10 10 30				Column Foundations	
21-01 10 10 90				Standard Foundation Supplementary Components	

Table 15 OmniClass Table 21 (Owner's Perspective)³⁸

OmniClass Table 21 focuses on classifying building elements based on their physical characteristics and location. From an owner's perspective, Table 21 can be valuable for understanding and categorizing the various components that make up a facility.

Owner's Perspective Benefits:

- **Asset Management:** Owners can use Table 21 to create an inventory of building elements and components, helping them manage and maintain their facilities more effectively.
- **Maintenance and Operations:** By categorizing building elements, owners can better plan for routine maintenance, repairs, and replacements, which contributes to the longevity and optimal functioning of their assets.
- **Budgeting and Cost Estimation:** Owners can estimate costs more accurately by categorizing building elements and understanding the costs associated with each category. This supports budgeting and financial planning.
- **Lifecycle Planning:** Owners can use Table 21 to develop long-term strategies for their facilities, considering factors like lifespan, replacement cycles, and upgrades.

³⁸ OmniClass® - Construction specifications institute. (2020). Construction Specifications Institute. Retrieved from <https://www.csiresources.org/standards/omniclass>

Table 22 Work Results	
22-02 00 00	Existing Conditions
22-03 00 00	Concrete
22-04 00 00	Masonry
22-05 00 00	Metals
22-06 00 00	Wood, Plastics, and Composites
22-07 00 00	Thermal and Moisture Protection
22-08 00 00	Openings
22-09 00 00	Finishes
22-10 00 00	Specialties
22-11 00 00	Equipment
22-12 00 00	Furnishings
22-13 00 00	Special Construction
22-14 00 00	Conveying Equipment
22-21 00 00	Fire Suppression
22-22 00 00	Plumbing
22-23 00 00	Heating, Ventilating, and Air-Conditioning (HVAC)
22-25 00 00	Integrated Automation
22-26 00 00	Electrical
22-27 00 00	Communications
22-28 00 00	Electronic Safety and Security
22-31 00 00	Earthwork
22-32 00 00	Exterior Improvements
22-33 00 00	Utilities
22-34 00 00	Transportation
22-35 00 00	Waterway and Marine Construction
22-40 00 00	Process Integration
22-41 00 00	Material Processing and Handling Equipment
22-42 00 00	Process Heating, Cooling, and Drying Equipment
22-43 00 00	Process Gas and Liquid Handling, Purification, and Storage Equipment
22-44 00 00	Pollution and Waste Control Equipment
22-45 00 00	Industry-Specific Manufacturing Equipment
22-46 00 00	Water and Wastewater Equipment
22-48 00 00	Electrical Power Generation

Table 16 OmniClass Table 22 (Owner’s Perspective)³⁹

OmniClass Table 22 "Work Results" is part of the OmniClass classification system, designed to categorize and organize information in the construction industry. Table 22 focuses explicitly on categorizing and classifying the outcomes or deliverables of construction activities, often referred to as "work results." The owner's perspective on OmniClass Table 22 "Work Results" can provide insights into how it benefits owners in managing construction projects and understanding the outcomes of various activities. It is important to note that the effective utilization of OmniClass Table 22 "Work Results" from an owner's perspective may depend on the specific nature of the construction

³⁹ OmniClass® - Construction specifications institute. (2020). Construction Specifications Institute. Retrieved from <https://www.csiresources.org/standards/omniclass>

project, the owner's goals, and industry practices. The owner should tailor the use of Table 22 to align with their project management and facility management requirements.

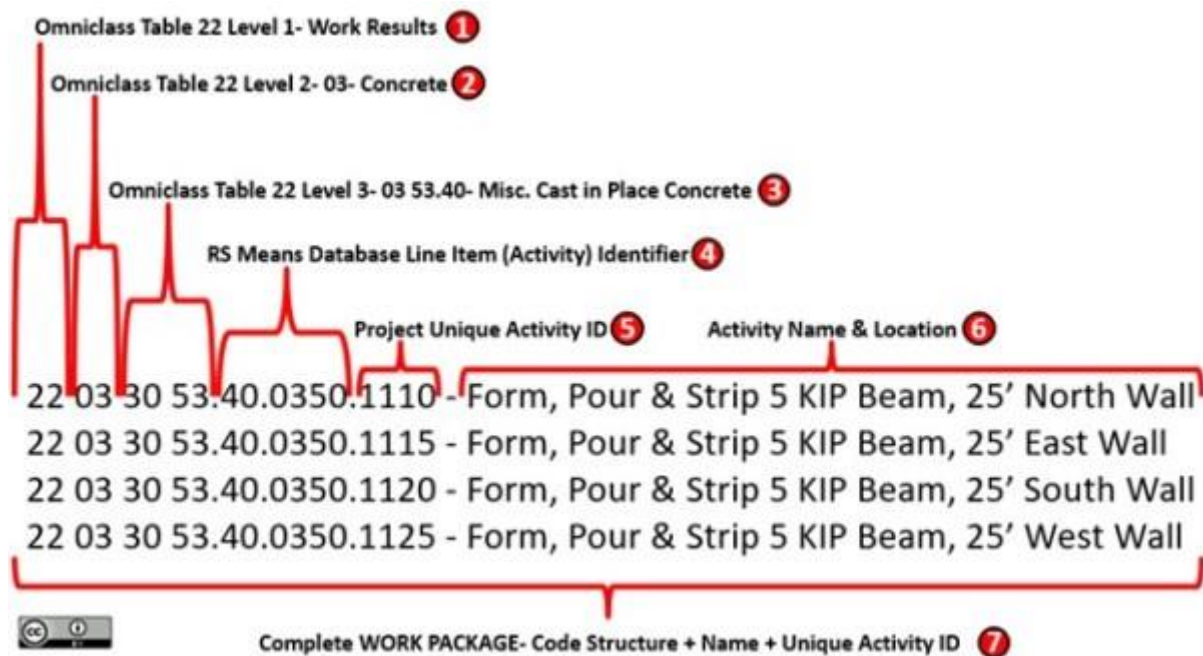


Figure 8 Integrated Omniclass Table 22 with the RS Means Database Codes⁴⁰

⁴⁰ Giammalvo, P.D. (2018). Mapping ERP “Charts of Account” to Building Information Modeling Software Using OmniClass Coding Structures and Activity-Based Costing/Management – A CONTRACTOR’S Perspective, PM World Journal, Vol. VII, Issue IV, April. Retrieved from <https://pmworldlibrary.net/wp-content/uploads/2018/04/pmwj69-Apr2018-Giammalvo-ERP-and-BIM-Omiclass-coding-marriage-featured-paper-1.pdf>

Number	Level 1 Title	Definition
31-30 00 00	Criteria Definition Phase	Phase to create and refine schematic diagrams of the basic project elements - substructure, steel, interiors, equipment, services, equipment and furnishings, special construction and demolition, and building sitework - that fully establish project spatial and element criteria as the Basis of Design.
31-40 00 00	Design Phase	Phase in which project team establishes means of satisfying project Basis of Design requirements with technical solutions, evaluates alternatives through value analysis or similar processes, and completes initial documentation - Drawings and specified Work Results - for the designed project.
31-60 00 00	Coordination Phase	Phase that integrates the design effort with implementation by integrating constructability and feasibility evaluations of the design in order to further develop spaces, elements, products, and materials necessary for the procurement and execution of the Work irrespective of the method of delivery.
31-40 00 00	Implementation Phase	Phase to implement the coordinated design through construction planning, prefabrication, and field execution characterized by contractor 'means and methods,' and Basis of Construction strategies, controlled by quality assurance and control protocols.
31-70 00 00	Handover Phase	Phase to evaluate the completed Work through testing, inspection, and commissioning activities, including for any Owner-furnished equipment, to ensure that design/performance criteria are met while conforming to applicable codes and standards, and transfer project knowledge from the design/construction team to the Owner/facility management team via demonstrations, training, and documentation.
31-90 00 00	Closure Phase	Phase which includes facility closure, preparation for unknown future use, demolition in whole or part, foreclosure, sale, or similar disposition initiated by the decision that the facility no longer meets the needs of the Owner and cannot be feasibly reconfigured for continued use by that Owner.

CSI OmniClass Table 31 - Phases

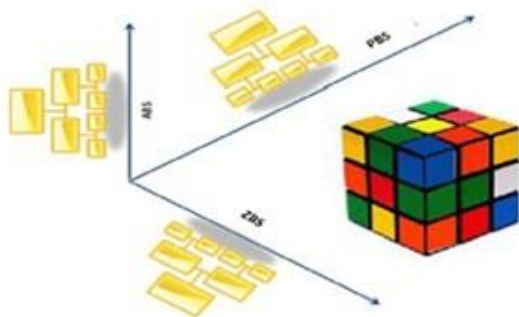


Table 22	Work Results
22-02 00 00	Existing Conditions
22-03 00 00	Concrete
22-04 00 00	Masonry
22-05 00 00	Metals
22-06 00 00	Wood, Plastics, and Composites
22-07 00 00	Thermal and Moisture Protection
22-08 00 00	Openings
22-09 00 00	Finishes
22-10 00 00	Specialties
22-11 00 00	Equipment
22-12 00 00	Furnishings
22-13 00 00	Special Construction
22-14 00 00	Conveying Equipment
22-21 00 00	Fire Suppression
22-22 00 00	Plumbing
22-23 00 00	Heating, Ventilating, and Air-Conditioning (HVAC)
22-25 00 00	Integrated Automation
22-26 00 00	Electrical
22-27 00 00	Communications
22-28 00 00	Electronic Safety and Security
22-31 00 00	Earthwork
22-32 00 00	Exterior Improvements
22-33 00 00	Utilities
22-34 00 00	Transportation
22-35 00 00	Waterway and Marine Construction
22-40 00 00	Process Integration
22-41 00 00	Material Processing and Handling Equipment
22-42 00 00	Process Heating, Cooling, and Drying Equipment
22-43 00 00	Process Gas and Liquid Handling, Purification, and Storage Equipment
22-44 00 00	Pollution and Waste Control Equipment
22-45 00 00	Industry-Specific Manufacturing Equipment
22-46 00 00	Water and Wastewater Equipment
22-48 00 00	Electrical Power Generation

CSI OmniClass Table 22 – Work Results

Number	Level 1	Level 2	Level 3	Level 4	Table 22 Reference
21-01 00 00	Substructure				
21-01 10		Foundations			
21-01 10 10			Standard Foundations		
21-01 10 10 10				Wall Foundations	
21-01 10 10 30				Column Foundations	
21-01 10 10 90				Standard Foundation Supplementary Components	

CSI OmniClass Table 21 – Elements

Figure 9 Multi-dimensional using different Tables of OmniClass (Owner's Perspective)⁴¹

Step 6 – Selection of the Preferred Alternatives

Selecting the preferred alternative for integrating Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) in project management involves carefully considering various factors and options. Ultimately, selecting the preferred alternative should align with the project's goals, context, and specific needs. It should enable effective communication, accurate cost management, and improved project control throughout the project's lifecycle. In this paper, the OmniClass standard is the preferred one.

Step 7 – Performance Monitoring

Monitoring the performance of integrating Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) in PERTAMINA involves systematically tracking and evaluating the effectiveness of the integration to ensure that project objectives are being met and resources are managed efficiently. Here are steps that might be taken to monitor the performance of WBS/CBS integration in PERTAMINA:

1. **Establish Key Performance Indicators (KPIs):** Define specific KPIs that align with the objectives of integrating WBS and CBS. KPIs could include metrics

⁴¹ The author

related to cost accuracy, resource allocation, schedule adherence, variance analysis, and project milestones.

2. **Data Collection and Integration:** Ensure accurate data is collected from the WBS and CBS components. This could involve regular updates from project teams, cost controllers, and relevant departments.
3. **Software and Tools:** Utilize project management software or tools that support integrated WBS/CBS monitoring. These tools can provide real-time visibility into project performance, cost trends, and deviations.
4. **Regular Review Meetings:** Conduct regular review meetings involving project managers, cost analysts, and stakeholders to discuss progress, challenges, and opportunities for improvement. These meetings facilitate open communication and prompt issue resolution.

It is important to note that the specific approach to monitoring WBS/CBS integration in PERTAMINA may vary based on the organization's internal processes, technology capabilities, and project management methodologies.

FUTURE RESEARCH

Some potential areas for future research related to the integration of Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) 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 and CBS 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 and CBS. 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—research whether integrated systems lead to more precise cost forecasts and better alignment with actual expenditures.

CONCLUSION

Follow a systematic research and analysis approach to provide an overview of PERTAMINA's current project management practices and identify areas where the integration of Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) could be advantageous. The steps to consider:

- Identify pain points, challenges, and inefficiencies in PERTAMINA's current project management practices. These could include cost-tracking difficulties, resource allocation, scope changes, or communication gaps.
- Assess how well PERTAMINA is currently managing project costs. Look for areas where the integration of WBS and CBS could enhance cost control, accuracy in budgeting, and variance analysis.
- Examine how resources are currently allocated across projects. Determine if integrated WBS/CBS could optimize resource utilization and alignment with project objectives.
- Analyze PERTAMINA's strategic goals and objectives. Determine how integrated WBS/CBS could contribute to achieving these goals, such as better cost control, on-time delivery, or improved project outcomes.

Preparing for implementing Building Information Modeling (BIM) in PERTAMINA requires careful planning, coordination, and alignment with the organization's goals and objectives. BIM is a digital representation of a building's physical and functional characteristics, and its successful implementation can bring significant benefits to the design, construction, and operation of facilities. The steps to consider when preparing for BIM implementation in PERTAMINA:

- Clearly articulate the objectives and goals of implementing BIM in PERTAMINA. Identify the specific benefits that aim to achieve, such as improved project coordination, cost savings, enhanced facility management, and better decision-making.
- Develop a comprehensive BIM strategy that outlines the approach, scope, and timeline for implementation. Define roles, responsibilities, and a clear roadmap for adoption.
- Assess PERTAMINA's IT infrastructure and determine whether it can support BIM implementation. Consider software, hardware, network capabilities, and data storage requirements.
- Initiate pilot BIM projects to gain practical experience and insights. Select a small-scale project to test BIM workflows, collaboration processes, and technology tools.
- Form a dedicated BIM implementation team composed of project management, design, engineering, construction, and IT experts. This team will drive the implementation effort.
- Develop a BIM Execution Plan (BEP) that outlines the specific processes, workflows, and deliverables for BIM projects. The BEP should address the design, construction, handover, and facility management phases.

- Continuously monitor BIM implementation progress, gather stakeholders' feedback, and evaluate the effectiveness of BIM workflows and processes.

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