

Indonesian State Owned Oil and Gas Company Cost Estimating against GAO and NPS Best Practice: A benchmarking study

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ABSTRACT

The estimation is an important part of the process of a project stage, where this process contributes to the success of a project. The company is always faced with the problem of a low estimated value of the value offered by the contractor, consequently is the objective of the project to be completed on time to be hampered. In this paper, a comparative study has been conducted using the approach of both the US Government Accountability Office (GAO) and the US National Park Services (US-NPS). Based on benchmarking study company estimation process must be improved by considering GAO best practice (1) conduct risk and uncertainty analysis, (2) conduct sensitivity analysis and (3) Identify ground rules and assumptions, and based on US-NPS Estimation Template company suggest to considering (1) Design Contingencies, (2) General Conditions and (3) Bonds & Permits for reliable estimate.

Keywords : *cost estimate, benchmarking, oil and gas construction project, national park services (NPS), government accountability office (GAO), estimation process, estimation template*

1. Introduction

1.1 Indonesia Oil and Gas Project Downstream Sector

Indonesian state oil and gas company is obliged to fulfill fossil energy needs in all regions of Indonesia. In order to maintain the continuity of supply of fuel, one effort that can be done is by improving the infrastructure and addition of new facilities. The decline in world oil prices to below US\$40/bl requires companies to innovate by making variants of products that the market needs in the downstream oil industry. The downstream oil industry in Indonesia has an important role in providing energy sustainability throughout Indonesia. The characteristics of Indonesia which is a country with thousands of islands make the distribution of oil to every tip of Indonesia becomes a challenge and complicated. Development projects in the form of upgrading facilities at the downstream oil industry are routinely conducted to support the increase and reliability of oil distribution. The dynamics of changes in the market in Indonesia's downstream oil industry led to an increase in the number of projects.

1.2 Project Cost Estimation

Each project will pass through the estimation phase, a process that has an important role in producing a successful project. Each project has purpose and methodology and how far the project defines. The Project Estimating process is not a stand-alone

process, it depends on results of execution of other processes and in many cases it runs simultaneously¹. On Figure-1 and Figure-2 adopted from GPACar it explains each level of estimate class, how far the project scope definition classifies and estimating tools/technique to used.

Estimate Class	Primary Purpose	Methodology	Scope Definition	Expected Accuracy Ranges
	(What is the estimate used for)	(Estimating Tool / Technique)	As a % Complete of Total Scope of Work	Allowable Variance
Level 1	1 Conceptual Screening (Identify the Feasible Options)	Capacity Factored, Parametric Modeling, Expert Judgement or Analogy (Top Down)	< 2% ("back of an envelope" or "Conceptualization")	-50% to + 100% from Mean (P50) value
Level 2	2 Study or Feasibility (Make or Validate the Business Case)	Equipment Factored, Parametric Model or Expert Judgement	1% to 15% (pre-FEED, Schematic or Criteria Design)	-30% to + 50% from Mean (P50) value
Level 3	3 Budget Authorization or Minimum Control Level	High Level Unit Costs, (Ratio or % Factored) Assembly Cost Estimating	10% to 40% (FEED or Detailed Design)	-20% to + 30% from Mean (P50) value
Level 4	4 Ideal Control Level (Owner) Bid or Tender (Contractor)	Detailed Unit Costs, (Square Foot, Cubic Meter, Per Ton etc) Work Package Cost Estimating	30% to 70% (Detailed Design, Construction or Implementation Design)	-15% to + 20% from Mean (P50) value
Level 5	5 Check Estimate (Owner) Bid or Tender (Contractor)	Detailed Unit Costs, (Square Foot, Cubic Meter, Per Ton etc) Activity Based Cost Estimating (Bottom Up)	>70% ("Approved for Construction" or Shop Drawings)	OWNERS -10% to + 15% CONTRACTORS -5% to + 5% from Mean (P50) value

Figure-1 Level of Cost Estimation from Various Guidelines²

There are two approaches in the estimation process, namely top-down approaches and bottom-up approach. The top-down approach puts forward the whole process in one project which is then estimated. However, in the bottom-up approach, the estimator prepares the job breakdown from the bottom or in other words a Work Breakdown Structure / WBS.

	Guild of Project Controls	AACE Current	ANZI Z94.0 (PMI)	AACE (Pre-1972)	Association of Cost Engineers (AcostE) UK	Norwegian Project Management Association	American Society of Professional Estimators (ASPE)
	Level 1	Class 5	Order of Magnitude (-30% to + 50%)	Order of Magnitude	Order of Magnitude Estimate Class IV (-30% to + 30%)	Concession Estimate	Level 1
	Level 2	Class 4				Exploration Estimate		Authorization Estimate
	Level 3	Class 3	Budget Estimate (-15% to +30%)	Preliminary Estimate	Study Estimate Class III (-20% to + 20%) Budget Estimate Class II (-10% to + 10%)	Feasibility Estimate	
	Level 4	Class 2				Definitive Estimate (-5% to +15%)	Definitive Estimate
	Level 5	Class 1		Detailed Estimate		Current Control Estimate	Level 4
							Level 5
							Level 6

Figure-2 The Purpose of the Estimate, the Tools & Techniques normally used, appropriate Scope Definition and Expected Accuracy Ranges³

¹ Adapted from Epstein, Dan. (2014). Project Estimating Process. *PM World Journal*. Vol III. Retrieved from <http://pmworldjournal.net/article/project-estimating-process/>

^{2,3} Adapted from GPCCar (2015). Module 8.1 Introducing to Managing Cost Estimating & Budgeting and GAO. Retrieved from <http://www.planningplanet.com/>

1.3 Problem Statement / Research Question

In this paper, the author wants to benchmark the current practices of a major Indonesian National Oil company practically on Downstream Oil and Gas Project against both of the United States Government Accountability Office/US-GAO in the field of estimation process and United States National Park Services/US-NPS in the field of estimation template, a “best tested and proven practices” and develop a set of specific recommendations to improve our organizations owner cost estimating practices, because worst estimating on project has always potential to run *over budget* and *behind schedule*, it same founding by Al-Awaid (2014) as most of the projects are out of control with regard to budget, a better estimation of all costs is essential⁴

This benchmarks study is structured to answer some research questions, the following are some of the research questions:

1. Is the company's policy in the estimation activity appropriate, or partially appropriate and/or not at all in accordance with GAO estimates and the NPS template which is "best and proven practice"?
2. What quantitative and qualitative differences are found between the actual situation “as is” and the references obtained from GAO and NPS?
3. What corrective suggestions may be proposed to the company as a consideration to be applied to the process and template in an effort to improve the accuracy, reliability and accuracy of the estimated cost?

2. Benchmarking between GAO vs Company

2.1 GAO Estimating Process

Government Accountability Office/GAO Cost Estimation Process consists of 12 steps but it will explain more detail to be 17 steps refer to GPACar. Each step builds each other for development and a comprehensive and complete cost estimate, each of the steps is essential to ensure high quality cost estimates are developed and delivered on time to support important decisions⁵, the step process shown on Figure-3. Step (1) Initiation and research, at this step it focus on stakeholder’s want, it can look like generating more income, or win share market, on Step (2) purpose of a cost estimate is determined by its intended use, and its intended use determines its scope and detail. Step (3) refers to figure-1 and the scope definition that we want we can the fit tools to develop estimating. Step (4) Validate the level of scope definition to ensure tools we used. Step (5) identifies technical and program parameter. Step (6) defines detail Work Breakdown Structure for every activity. Step (7) made a right basic assumption in estimation process like inflation rate. Step (8) ensured using an appropriate data. Step

guild/gpccar/introduction-to-managing-cost-estimating-budgeting

⁴ Adapted from Al-Awaid, Mussalam. (2014). Oman Oil and Gas Cost Estimating vs the GAO's Best Practices in Capital Budgeting- a Benchmarking Study. PM World Journal. Vol III. Retrieved from <http://pmworldjournal.net/article/oman-oil-and-gas-cost-estimating-vs-the-gaos-best-practices-in-capital-budgeting-a-benchmarking-study/>

⁵ Adapted from AcqNotes (2017). GAO Estimating Proces. Retrieved from <http://acqnotes.com/acqnote/tasks/gao-cost-estimating-process>

(9) Develop cost model. Step (10) runs a series of test or simulations for acceptable range around that point estimate. Step (11) Do sensitivity analysis to identify which cost has the biggest impact to overall cost. Step (12) Consider cost contingency usually around P75-P90. Step (13) do crosscheck to decision makers. Step (14) ensured by go back or revise scope, timing, process and others to meet with business need. Step (15) Present to management for next decision. Step (16) Management approval, it possible project cancels or still run to next step. Step (17) Update the estimate to reflect changes in technical or program assumptions or keep it current as the program passes through new phases or milestones. All step shown on figure-3 step by step introduce by GAO

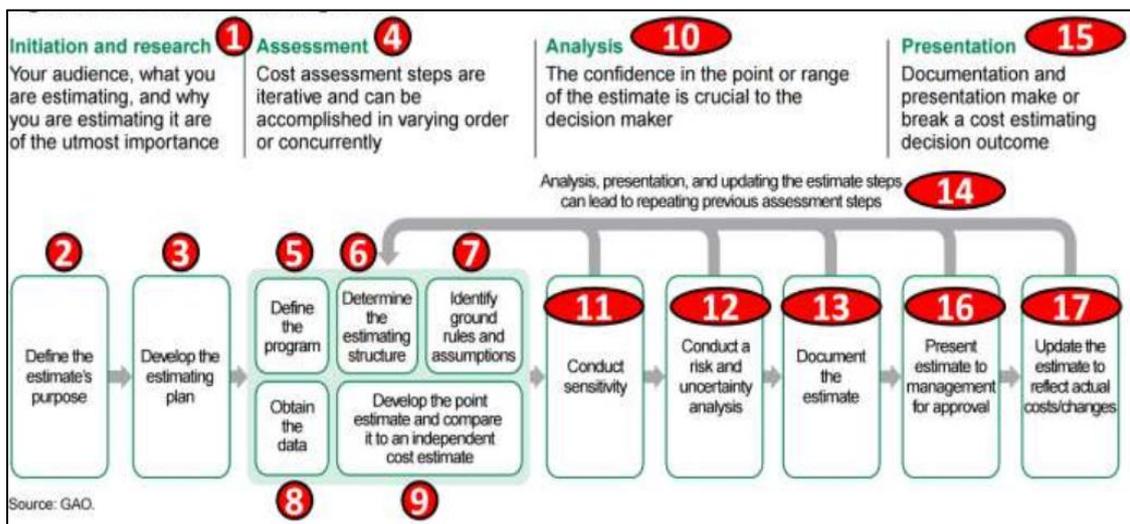


Figure-3 GAO Cost Estimating Process⁶

2.2 Current Company Estimating Process

The company's current estimation process consists of a series of stages, where in the initial stages a process of calculating the work volume is translated into a Work Breakdown Structure/WBS document. After Work Breakdown Structure/WBS is made, calculation of the amount of time required for the entire duration of the work. WBS and Schedule calculation results will be formulated next with the price data from sourcing result to supplier and result from data bank. After the estimation value is obtained, the total estimates are multiplied by the profit and risk factors referred to as the margin of the contractor, where the value of profit and risk is determined based on the value of the project. On projects with grades less than US\$ 37,000 will be given a 15% margin, for projects US\$ 37,000 - US\$ 370,000 given a 10% margin, and if more than US\$ 370,000 meals will be given an 8% margin. Furthermore, if the estimated value has been obtained then the estimated value will be checked for conformity with unit price. If appropriate, the estimated value will be signed by management. All process to describe on Figure-4.

⁶ Adapted from GPCCar (2015). Module 8.1 Introducing to Managing Cost Estimating & Budgeting and GAO. Retrieved from <http://www.planningplanet.com/guild/gpccar/introduction-to-managing-cost-estimating-budgeting>

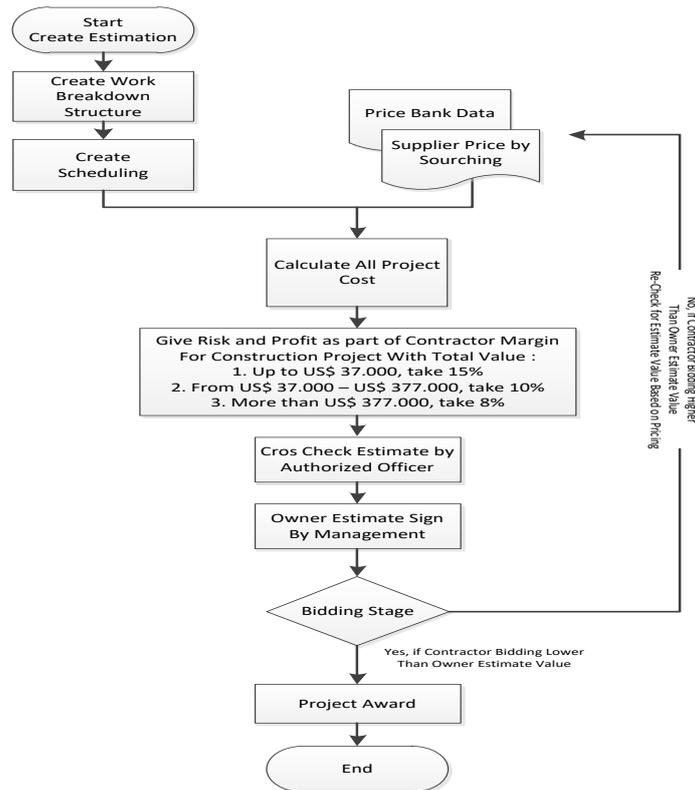


Figure-4 Company Estimate Process Flow Chart⁷

2.3 Benchmarking Estimate Process Between Company vs GAO

The company's current estimation process consists of a series of stages, where in the initial stages a process of calculating the work volume is translated into a Work Breakdown Structure. If the process comparing with 12 step GAO by using likert value which is shown on Table-1, it can develop a purpose solution for Company to create more reliable cost estimates process.

Likert Value	Likert Description Close to Current Condition	Explanation for Average Value	Purpose to Company
0,00	Does Not Meet with GAO Requirments	0 ≤ average value < 1 its mean Does Not Meet with GAO Requirments	Very Highly Consider to Implemented GAO
1,00	Partially Meets with GAO Requirments	1 ≤ average value < 2 its mean Partially Meets with GAO Requirments	Highly Consider to Implemented GAO
2,00	Meets with GAO Requirments	2 ≤ average value < 3 its mean Meets with GAO Requirments	Consider to Implemented GAO
3,00	Slightly Exceeds with GAO Requirments	3 ≤ average value < 4 its mean Slightly Exceeds with GAO Requirments	Keep on Track
4,00	Exceeds GAO Requirments	≥ 4 its mean Exceeds GAO Requirments	Keep on Track

Table -1 Likert Value for GAO vs Company⁸

⁷ Adapted from Author Company Data

⁸ Adapted from Author

Regarding to table 2 from 12 steps GAO which explains with 78 tasks to do, we can put each task with Likert values who meet with current condition of company in estimation process. After that we do average from 78 tasks divided to 12 sections then define and explain the average value for purpose to company which step must be considering or highly consider to implemented, detail each task value coding on Apendix-1. From table-3 all summarized there found only step-1 or define estimate purpose already meet with GAO, 11 step still remind to consider highly and very highly implemented. Company needs to consider GAO for a better and reliable estimating process, because 12 steps purpose by GAO as one of best practice in the process estimation.

2.4 Improvement Suggestions for Company based on Benchmarking Estimate Process Between Company vs GAO

Based on the data presented and aims to prioritize each parameter proposed to the company, it will be a priority scale using *pareto approach*⁹, where from 12 parameters that have been measured by Likert scale, then will be selected 20% of the 12 parameters or 3 parameters has the lowest Likert score that will be a proposal. The lowest parameter is chosen because the parameter is not in accordance with US-GAO requirements. The 3 parameters who purposed to company is (1) conducting risk and uncertainty analysis, (2) conduct sensitivity analysis and (3) Identify ground rules and assumptions, on figure 4, it shown the score value and selecting the lowest rank.

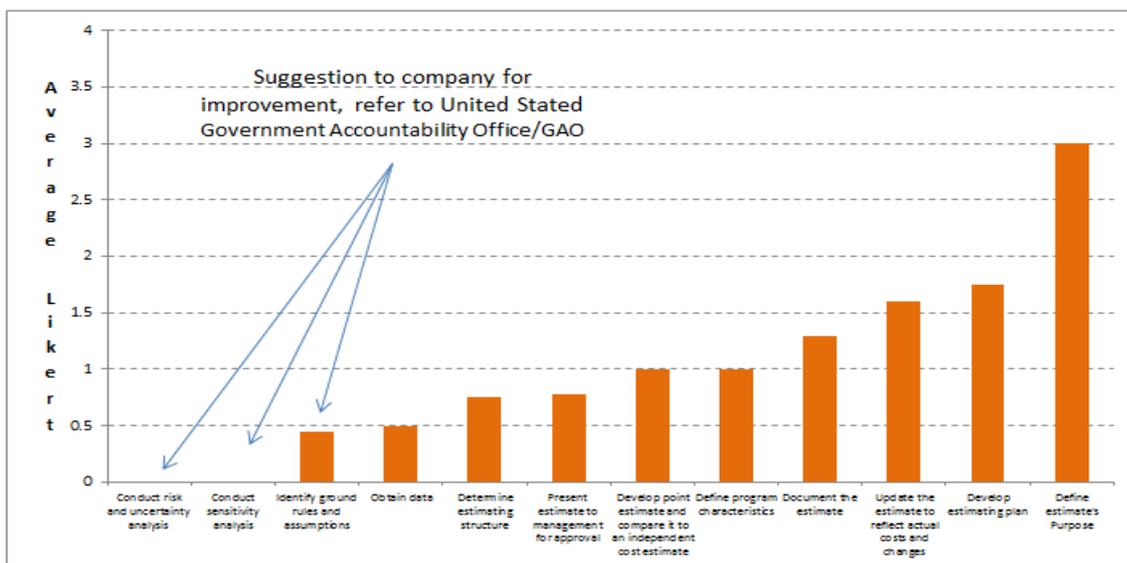


Figure-5 Priority suggestion to company to improve the estimation process, refer to GAO

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⁹ Adapted from Pareto Analysis (2017). Retrieved from https://www.mindtools.com/pages/article/newTED_01.htm

¹⁰ Adapted from Author

Step	Attribute	Average Likert Value	Explanation for Average Value	Purpose to Company
1	Define estimate's Purpose	3,00	$3 \leq$ average value < 4 its mean Slightly Exceeds with GAO Requirments	Keep on Track
2	Develop estimating plan	1,75	$1 \leq$ average value < 2 its mean Partially Meets with GAO Requirments	Highly Consider to Implemented GAO
3	Define program characteristics	1,00	$1 \leq$ average value < 2 its mean Partially Meets with GAO Requirments	Highly Consider to Implemented GAO
4	Determine estimating structure	0,75	$0 \leq$ average value < 1 its mean Does Not Meets with GAO Requirments	Very Highly Consider to Implemented GAO
5	Identify ground rules and assumptions	0,44	$0 \leq$ average value < 1 its mean Does Not Meets with GAO Requirments	Very Highly Consider to Implemented GAO
6	Obtain data	0,50	$0 \leq$ average value < 1 its mean Does Not Meets with GAO Requirments	Very Highly Consider to Implemented GAO
7	Develop point estimate and compare it to an independent cost estimate	1,00	$1 \leq$ average value < 2 its mean Partially Meets with GAO Requirments	Highly Consider to Implemented GAO
8	Conduct sensitivity analysis	0,00	$0 \leq$ average value < 1 its mean Does Not Meets with GAO Requirments	Very Highly Consider to Implemented GAO
9	Conduct risk and uncertainty analysis	0,00	$0 \leq$ average value < 1 its mean Does Not Meets with GAO Requirments	Very Highly Consider to Implemented GAO
10	Document the estimate	1,30	$1 \leq$ average value < 2 its mean Partially Meets with GAO Requirments	Highly Consider to Implemented GAO
11	Present estimate to management for approval	0,78	$0 \leq$ average value < 1 its mean Does Not Meets with GAO Requirments	Very Highly Consider to Implemented GAO
12	Update the estimate to reflect actual costs and changes	1,60	$1 \leq$ average value < 2 its mean Partially Meets with GAO Requirments	Highly Consider to Implemented GAO

Table-2 Result of GAO vs Company Estimating Process

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¹¹ Adapted from Author

3. Benchmarking between US-NPS Template vs Company

Annually company invests in infrastructure development on downstream sector, a lot of projects are executed every year, but in fact from the planning process until the project begins to enter the construction phase, it takes a long time. It often happens during the auction process the owner's estimated value is always lower than the contractor's estimated value. This situation in fact resulted in the auction process repeated up to 2 to 3 times, where for one stage of the tender process takes one month, and if up to 3 times the process must be repeated then the time required to realize the project will be hampered long enough, on table-3 it shown that a kind of project failed on bidding process because of contractors bids coming in higher than owner estimation. Based this situation it can be concluded that the less accurate estimation process has had a stunted impact on the project, where the process of handover of the project that should provide benefits to the company has shifted for a longer time and the other unpleasant thing is the opportunity of investing through the project to generate income going lost.

Project Name	Contractor Offering (US\$)	Owner Estimation (US \$)	Deviation
Project - 1	1.909.434	1.668.151	14,46%
Project - 2	24.453	18.420	32,75%
Project - 3	73.208	59.760	22,50%
Project - 4	275.472	251.059	9,72%
Project - 5	370.121	341.509	8,38%
Project - 6	402.792	369.253	9,08%
Project - 7	630.189	510.634	23,41%
Project - 8	437.937	332.347	31,77%
Project - 9	149.093	123.396	20,82%
Project - 10	37.746	34.038	10,90%
Project - 11	108.981	93.811	16,17%
Project - 12	244.377	208.000	17,49%
Project - 13	234.015	192.453	21,60%
Project - 14	128.302	96.075	33,54%
Project - 15	198.340	154.340	28,51%
Project - 16	136.151	102.415	32,94%
Project - 17	1.569.434	1.464.604	7,16%
Project - 18	2.335.849	2.187.472	6,78%
Project - 19	265.660	235.472	12,82%

Table-3. Recapitulation of Project Data Failed Auction

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¹² Adapted from Author Company Data

3.1 United State National Park Services/US-NPS Estimate Template

All cost estimates should be clear, basic definition estimates statement describing in detail exactly what the scope of the estimated construction work is, as well as the information and assumptions that are relied upon to develop forecasts. National Park Services has 3 levels of estimating Class C, Class B and Class A, below description of each class level estimate¹³.

a) Class A Construction Cost Estimate

Class A Construction Cost Estimates are referred to as **actual estimates** by the design and construction industry, on class A construction cost estimate, it can category if contain of : Draft 100% Construction Documents (Draft CD), 100% Complete Construction Documents (Complete CD), Final Construction Documents (Final CD). Accuracy Class A –5 % to +15 %. With this as the accepted accuracy a \$1,000,000.00 Class A Construction Cost Estimate would have an accepted range of \$950,000.00 to \$1,150,000.00

b) Class B Construction Cost Estimate

Class B Construction Cost Estimates are referred to as **budgetary estimates** by the design and construction industry, on class B construction cost estimate, it can category if contain of : Schematic Design (SD) submittal of preferred design alternative, Design Development (DD) submittal, Other intermediate design level budget purposes. Accuracy Class B –15 % to +30 %. With this as the accepted accuracy a \$1,000,000.00 Class B Construction Cost Estimate would have an accepted range of \$850,000.00 to \$1,300,000.00

c) Class C Construction Cost Estimate

Class C Construction Cost Estimates are referred to as **conceptual estimates** by the design and construction industry, on class C construction cost estimate, it can category if contain of : General Management Plans (GMP), Condition Assessments Cost (CAC) estimates using FMSS and CESS, Preliminary cost estimates used for project initiation and entry into the Project Management Information System (PMIS), Pre Design (PD) programming estimates are used for development of project scope and preliminary validation of PMIS Estimate, Schematic Design (SD) concept estimates for comparing design alternatives for use in Value Analysis studies during the early stage in the Schematic Design Phase). Accuracy Class C –30% to +50 %. With this as the accepted accuracy a \$1,000,000.00 Class C Construction Cost Estimate would have an accepted range of \$700,000.00 to \$1,500,000.00

Regarding to United States National Park Services/US-NPS Class Estimate, the best fit with Company estimating are Class A estimating, where Class A Construction Cost Estimates is referred to as actual estimates by design. These estimates are generally prepared with a fully defined scope of work. On figure-6 it showed the template use by National Park Services for estimate project with Class A estimate level.

¹³ Adapted from Cost Estimating Requirments Handbook (2011). United State National Park Services

United States Department of the Interior National Park Service Class A Construction Cost Estimate PROJECT COST SUMMARY													
Project: <u>Oso Comida Trailhead Improvements:</u> Park: <u>Bear Arbor NRA</u> Park Alpha: <u>BEAR</u> PMIS Number: <u>XXXXXX</u>											Estimate By: <u>YIB</u> Date: <u>01/12/11</u> Reviewed By: <u>BBB</u> Date: <u>01/17/11</u>		
Bid Item No.	Bid Item Description	Total Material Cost	Total Labor Cost	Total Equipment Cost	Total Direct Construction Costs	Design Contingency 2.00%	General Conditions 3.00%	General Contractor Overhead 8.50%	General Contractor Profit 10.00%	Contracting Method Adjustment 15.00%	Inflation Escalation		Bid Item Total
											APR	Month	
Bid Item: 1	Replace Pit Toilets with New Comfort Station	TOTAL VALUE OF GOVERNMENT FURNISHED PROPERTY (if any):											\$ 46,000.00
A10	Foundations	\$ 30,026	\$ 33,082	\$ 7,293	\$ 70,403								
A20	Basement Construction	\$ -	\$ -	\$ -	\$ -								
B10	Superstructure	\$ 15,622	\$ 13,198	\$ 460	\$ 29,280								
B20	Exterior Enclosure	\$ 35,992	\$ 29,477	\$ -	\$ 65,469								
B30	Roofing	\$ 18,471	\$ 8,706	\$ -	\$ 27,177								
C10	Interior Construction	\$ 25,573	\$ 9,308	\$ -	\$ 34,881								
C30	Interior Finishes	\$ 4,476	\$ 13,424	\$ -	\$ 17,900								
D20	Plumbing Systems	\$ 26,655	\$ 16,121	\$ -	\$ 42,776								
D30	HVAC	\$ 1,269	\$ 1,170	\$ -	\$ 2,439								
D50	Electrical	\$ 8,753	\$ 9,366	\$ -	\$ 18,119								
F20	Selective Building Demolition	\$ 463	\$ 1,990	\$ 3,862	\$ 6,315								
G10	Site Preparation	\$ 2,188	\$ 4,362	\$ 6,952	\$ 13,502								
G20	Site Improvements	\$ 8,900	\$ 7,300	\$ -	\$ 16,200								
G30	Site Mechanical	\$ 86,213	\$ 32,582	\$ 44,542	\$ 163,337								
G40	Site Electrical	\$ 5,000	\$ -	\$ -	\$ 5,000								
XX	Standard General Conditions	\$ 31,900	\$ 101,200	\$ 18,610	\$ 151,710								
Total - Bid Item 1	Replace Pit Toilets with New Comfort Station	\$ 301,503	\$ 281,296	\$ 81,719	\$ 664,508	\$ 12,370	\$ 18,926	\$ 55,233	\$ 64,980	\$ 122,403	\$ 92,813	\$ 1,031,234	
Bid Item: 2	Construct New Parking Lot & Site Utilities	TOTAL VALUE OF GOVERNMENT FURNISHED PROPERTY (if any):											\$ -
G10	Site Preparation	\$ 2,500	\$ 11,711	\$ 19,776	\$ 33,987								
G20	Site Improvements	\$ 143,581	\$ 36,335	\$ 43,670	\$ 223,586								
G30	Site Mechanical	\$ 12,153	\$ 14,232	\$ 4,241	\$ 30,626								
XX	Standard General Conditions	\$ 12,925	\$ 8,350	\$ 6,500	\$ 27,775								
Total - Bid Item 2	Construct New Parking Lot & Site Utilities	\$ 171,159	\$ 70,628	\$ 74,187	\$ 315,974	\$ 6,310	\$ 9,669	\$ 28,217	\$ 33,196	\$ 59,006	\$ 44,742	\$ 497,123	
Bid Item: 3	Picnic Area & Trailhead Improvements	TOTAL VALUE OF GOVERNMENT FURNISHED PROPERTY (if any):											\$ -
G10	Site Preparation	\$ -	\$ 11,860	\$ 4,845	\$ 16,705								
G20	Site Improvements	\$ 59,448	\$ 25,960	\$ 12,270	\$ 97,678								
G30	Site Mechanical	\$ 2,125	\$ 2,275	\$ 330	\$ 4,730								
XX	Standard General Conditions	\$ 5,775	\$ 7,550	\$ 2,500	\$ 15,825								
Total - Bid Item 3	Picnic Area & Trailhead Improvements	\$ 67,348	\$ 47,645	\$ 19,945	\$ 134,938	\$ 2,699	\$ 4,129	\$ 12,050	\$ 14,177	\$ 25,199	\$ 19,107	\$ 212,299	
Total Bid Items 1-3		\$ 540,010	\$ 399,559	\$ 175,851	\$ 1,115,420	\$ 21,388	\$ 32,724	\$ 95,500	\$ 112,353	\$ 206,608	\$ 156,662	\$ 1,740,656	

Figure-6 National Park Services Template Class A Construction Cost Estimate

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3.2 Current Company Estimate Summary Template

In the bidding process, the contractor is given the opportunity to offer a work package, which provides a number of job descriptions in a certain volume and comes with the material and services columns which determine into work breakdown structure/WBS, then each material and services sum at the end, at end of column contractor given profit and risk component. Company has regulation to determine how much contractor can take profit and absorb the project risk, it consists of with a range value of 8% - 15% depending on the value of the project, for projects with grades less than US\$ 37,000 will be given a 15% margin, for projects US\$ 37,000 - US\$ 370,000 given a 10% margin, and if more than US\$ 370,000 meals will be given an 8% margin. On figure-5 it describe the template of company on Bill of Quantity/BoQ.

¹⁴ Adapted from Cost Estimating Requirments Handbook (2011). United State National Park Services

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 II						\$	\$
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-7 Company Bidding Template ¹⁵

3.3 Benchmarking Estimate Template Between Company vs NPS

Regarding to company process and National Park Services/NPS, there are gap between them from estimate mark-ups aspect, there is 12 aspects consider by NPS for creating an estimation, from Published Location Factor, Remoteness Factor, Federal Wage Rate Factor, Taxes, Design Contingency, General Condition, Historic Preservation Factor, Overhead, Profit, Contracting Method Adjustment, Bond Permits, Inflation & Escalation, to identify each aspect author develop using likert to define which aspect must be consider, after that author can make purpose suggestion to company for a better estimate template, the likert score explain on table-5.

Regarding from table-5 it found in average/overall that company very highly recommended to adopted National Park Services/US-NPS template, because it effects on estimate value and the fact that estimation value always lowers than contractor bidding value. Based on Tabel-5 it found that a critical like Published Location Factor and Remoteness Factor not consider in fact all oil and gas field always found on remote condition, very less if found close to city or easy access, so this item has impact with cost of contractor to mobilize resources such as equipment or man power. And other critical thing that Bond and Permit, actually contractor using bank to funding the project, at this situation bank deduct contractor with obligation such as bank interest, but company didn't consider this as a part of estimation on template, as we know Bond and Permit can impact to contractor cash flow.

¹⁵ Adapted from Author Company Data

Likert Value	Likert Description Close to Current Condition	Explanation for Average Value	Purpose to Company
0,00	Does Not Meet with US-NPS Requirments	0 ≤ average value < 1 its mean Does Not Meet with US-NPS Requirments	Very Highly Consider to Implemented US-NPS
1,00	Partially Meets with US-NPS Requirments	1 ≤ average value < 2 its mean Partially Meets with US-NPS Requirments	Highly Consider to Implemented US-NPS
2,00	Meets with US-NPS Requirments	2 ≤ average value < 3 its mean Meets with US-NPS Requirments	Consider to Implemented US-NPS
3,00	Slightly Exceeds with US-NPS Requirments	3 ≤ average value < 4 its mean Slightly Exceeds with US-NPS Requirments	Keep on Track
4,00	Exceeds US-NPS Requirments	≥ 4 its mean Exceeds US-NPS Requirments	Keep on Track

Table-4 Likert Value for US-NPS vs Company Estimation Template

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No	National Park Services Mark Up Estimate	Likert Value	Check List Compaare With Company	Notes to Current Process	National Park Services Contingency Value
1	Published Location Factor	1	Partially Meets with US-NPS Requirments	its depend on project location and availability of data	All direct cost items for the project should already take the local market conditions into account
2	Remoteness Factor	1	Partially Meets with US-NPS Requirments	Company not consider this	1% for every 10 miles from Commercial Area to Project Site
3	Federal Wage Rate Factor	2	Meets with US-NPS Requirments	Company annually update wage factor	Depend on Government
4	Taxes	0	Does Not Meet with US-NPS Requirments	Because of Government regulation, taxes payed by Company, so the estimate do not consider that	Depend on Government Regulation
5	Design Contingencies	0	Does Not Meet with US-NPS Requirments	Company not consider this	for Class A is 0% to 10%
6	General Conditions	0	Does Not Meet with US-NPS Requirments	Company not consider this	4% to 20% of the cost of construction, depending on the size, location and complexity
7	Historic Preservation Factor	0	Does Not Meet with US-NPS Requirments	Company not consider this	Judgment depend on field condition
8	Overhead	1	Partially Meets with US-NPS Requirments	Practically only EPCC Project consider overhead	NPS suggest the normal range for Overhead & Profit should be 10-25%, depending on the project size, complexity and level of risk associated with work
9	Profit	3	Slightly Exceeds with US-NPS Requirments	On projects with grades less than US\$.37,000 will be given a 15% margin, for projects US\$.37,000 - US\$.370,000 given a 10% margin, and if more than US\$.370,000 meals will be given an 8% margin	
10	Contracting Method Adjustment	1	Partially Meets with US-NPS Requirments	Company not consider this	Add 5% or more to the cost of contracting over the purely, lowest price,competitive bid procurement processes
11	Bonds & Permits	0	Does Not Meet with US-NPS Requirments	Company not consider Bonds, but for permit at cost and or company takes care of the licensing fees first	1% to 3% normal range for bonds and permits
12	Inflation Escalation	1	Partially Meets with US-NPS Requirments	Company consider this depend on government	inflation escalation factor is based on the projected inflation rates from the time of the estimate until the mid-point of construction, compounded annually
Average of 12 Aspect		0,83	0 ≤ average value < 1 its mean Does Not Meet with US-NPS Requirments, Very Highly Consider to Implemented US-NPS		

Table 5. Comparison Between US-NPS and Company Estimate Template

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3.4 Improvement Suggestion to Company Based on Benchmarking Estimate Template Between Company vs NPS

Based on the data presented and aims to prioritize each parameter refers to US-NPS which proposed to the company, it will be a priority scale using *pareto approach* ¹⁸,

^{16,17} Adapted from Author

¹⁸ Adapted from Pareto Analysis (2017).Retrieved from https://www.mindtools.com/pages/article/newTED_01.htm

where from 12 parameters that have been measured by Likert scale, then will be selected 20% of the 12 parameters or 3 parameters has the lowest Likert score that will be a proposal. The lowest parameter is chosen because the parameter is not in accordance with US-NPS requirements. There is 5 parameters can suggest to company as improvement based on score (same score), but only 3 parameters selected by authors. it can be explained more detail only (1) Design Contingencies, (2) General Conditions and (3) Bonds & Permits, as part of the improvement suggestion to the company. Taxes and Historic Preservation Factor can not suggest because of the Indonesian government has regulation for state owned company/BUMN for taxes collection is paid by themself/project owner to Tax Ministry, so the taxes parameters become invalid used in the estimation template, for Historic Preservation Factor, company strongly avoid the location of the project that intersects with the location of cultural heritage. On figure 7, it shows each parameter from US-NPS template.

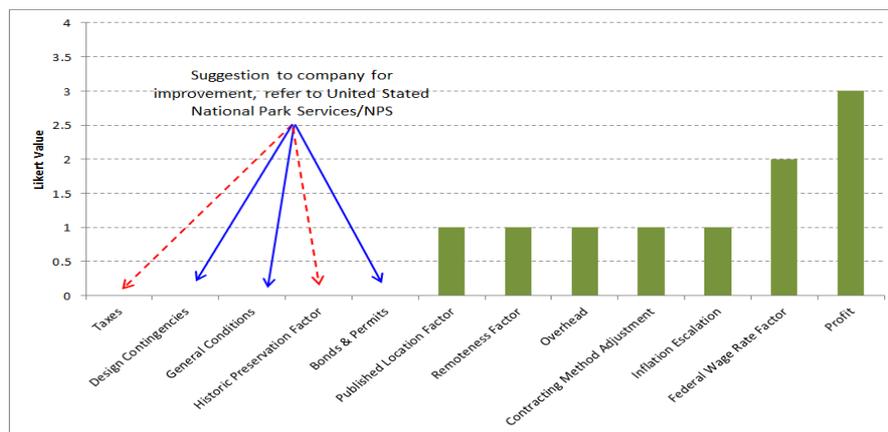


Figure-8 Priority suggestion to company improve estimation template refer to US-NPS

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4. Conclusion

The original purpose of this benchmarking study was to tests and validates answers to the following questions:

- 1) Is the company's policy in the estimation activity appropriate, or partially appropriate and or not at all in accordance with GAO estimates and the NPS template which is "best and proven practice"?

Answer : Based on qualitative and quantitative analysis that has been done in this research, obtained some weaknesses and strengths, both in the estimation process and in the estimation template used.

- 2) What quantitative and qualitative differences are found between the actual situation "as is" and the references obtained from GAO and NPS?

¹⁹ Adapted from Author

Answer : By applying Pareto Analysis, Figure 4 quantified and rank ordered the weaknesses in the PROCESS ESTIMATION while Figure 7 quantified and rank ordered the weaknesses in the ESTIMATION TEMPLATE.

- 3) What corrective suggestions may be proposed to the company as a consideration to be applied to the process and template in an effort to improve the accuracy, reliability and accuracy of the estimated cost?

Answer:

- a. Author recommended the top 3 immediate improvement for company to adopt GAO on Estimation PROCESS, these are:
 - 1) Company should conduct risk and uncertainty analysis
 - 2) Company should conduct sensitivity analysis
 - 3) Company should Identify ground rules and assumptions

- b. Author recommended top 3 immediate improvement for company to adopt US-NPS on Estimation TEMPLATE, these are:
 - 1) Company should put Design Contingencies as a part of cost on estimation template.
 - 2) Company should consider General Conditions.
 - 3) Company should consider Bonds & Permits as a part real cost must be contractor buy at field.

APENDIX-1: US Government Accountability Office (GAO) vs Company Likert Value

Step	Attribute	Coding	GAO Estimating Process	Company Estimating Process with Likert Scale	Average Likert Value	Explanation for Average Value	Purpose to Company
1	Define estimate's Purpose	1A	Determine estimate's purpose, required level of detail, and overall scope	3	3,00	3 ≤ average value < 4 its mean Slightly Exceeds with GAO Requirements	Consider to Implemented GAO
		1B	Determine who will receive the estimate	3			
2	Develop estimating plan	2A	Determine the cost estimating team and develop its master schedule	2	1,75	1 ≤ average value < 2 its mean Partially Meets with GAO Requirements	Highly Consider to Implemented GAO
		2B	Determine who will do the independent cost estimate;	3			
		2C	Outline the cost estimating approach;	1			
		2D	Develop the estimate timeline	1			
3	Define program characteristics	3A	In a technical baseline description document, identify the program's purpose and its system and performance characteristics and all system configurations	1	1,00	1 ≤ average value < 2 its mean Partially Meets with GAO Requirements	Highly Consider to Implemented GAO
		3B	Any technology implications	1			
		3C	Its program acquisition schedule and acquisition strategy	0			
		3D	Its relationship to other existing systems, including predecessor or similar legacy systems	2			
		3E	Support (manpower, training, etc.) and security needs and risk items;	1			
		3F	System quantities for development, test, and production	1			
		3G	Deployment and maintenance plans	1			
4	Determine estimating structure	4A	Define a work breakdown structure (WBS) and describe each element in a WBS dictionary (a major automated information system may have only a cost element structure	1	0,75	0 ≤ average value < 1 its mean Does Not Meets with GAO Requirements	Very Highly Consider to Implemented GAO
		4B	Choose the best estimating method for each WBS element	1			
		4C	Identify potential cross-checks for likely cost and schedule drivers	1			
		4D	Develop a cost estimating checklist	0			
5	Identify ground rules and assumptions	5A	Clearly define what the estimate includes and excludes	1	0,44	0 ≤ average value < 1 its mean Does Not Meets with GAO Requirements	Very Highly Consider to Implemented GAO
		5B	Identify global and program-specific assumptions, such as the estimate's base year, including time-phasing and life cycle	1			
		5C	Identify program schedule information by phase and program acquisition strategy	1			

Step	Attribute	Coding	GAO Estimating Process	Company Estimating Process with Likert Scale	Average Likert Value	Explanation for Average Value	Purpose to Company
		5D	Identify any schedule or budget constraints, inflation assumptions, and travel costs	1			
		5E	Specify equipment the government is to furnish as well as the use of existing facilities or new modification or development	0			
		5F	Identify prime contractor and major subcontractors	0			
		5G	Determine technology refresh cycles, technology assumptions, and new technology to be developed	0			
		5H	Define commonality with legacy systems and assumed heritage savings	0			
		5I	Describe effects of new ways of doing business	0			
6	Obtain data	6A	Create a data collection plan with emphasis on collecting current and relevant technical, programmatic, cost, and risk data	0	0,50	0 ≤ average value < 1 its mean Does Not Meets with GAO Requirements	Very Highly Consider to Implemented GAO
		6B	Investigate possible data sources	1			
		6C	Collect data and normalize them for cost accounting, inflation, learning, and quantity adjustments	0			
		6D	Analyze the data for cost drivers, trends, and outliers and compare results against rules of thumb and standard factors derived from historical data	0			
		6E	Interview data sources and document all pertinent information, including an assessment of data reliability and accuracy	0			
		6F	Store data for future estimates	2			
7	Develop point estimate and compare it to an independent cost estimate	7A	Develop the cost model, estimating each WBS element, using the best methodology from the data collected, a and including all estimating assumptions	1	1,00	1 ≤ average value < 2 its mean Partially Meets with GAO Requirements	Highly Consider to Implemented GAO
		7B	Express costs in constant year dollars	0			
		7C	Time-phase the results by spreading costs in the years they are expected to occur, based on the program schedule	0			
		7D	Sum the WBS elements to develop the overall point estimate	1			
		7E	Validate the estimate by looking for errors like double counting and omitted costs	2			
		7F	Compare estimate against the independent cost estimate and examine where and why there are differences	1			

Step	Attribute	Coding	GAO Estimating Process	Company Estimating Process with Likert Scale	Average Likert Value	Explanation for Average Value	Purpose to Company
		7G	Perform cross-checks on cost drivers to see if results are similar	1			
		7H	Update the model as more data become available or as changes occur and compare results against previous estimates	2			
8	Conduct sensitivity analysis	8A	Test the sensitivity of cost elements to changes in estimating input values and key assumptions	0	0,00	0 ≤ average value < 1 its mean Does Not Meets with GAO Requirements	Very Highly Consider to Implemented GAO
		8B	Identify effects on the overall estimate of changing the program schedule or quantities	0			
		8C	Determine which assumptions are key cost drivers and which cost elements are affected most by changes	0			
9	Conduct risk and uncertainty analysis	9A	Determine and discuss with technical experts the level of cost, schedule, and technical risk associated with each WBS element	0	0,00	0 ≤ average value < 1 its mean Does Not Meets with GAO Requirements	Very Highly Consider to Implemented GAO
		9B	Analyze each risk for its severity and probability	0			
		9C	Develop minimum, most likely, and maximum ranges for each risk element	0			
		9D	Determine type of risk distributions and reason for their use	0			
		9E	Ensure that risks are correlated	0			
		9F	Use an acceptable statistical analysis method (e.g., Monte Carlo simulation) to develop a confidence interval around the point estimate	0			
		9G	Identify the confidence level of the point estimate	0			
		9H	Identify the amount of contingency funding and add this to the point estimate to determine the risk-adjusted cost estimate	0			
		9I	Recommend that the project or program office develop a risk management plan to track and mitigate risks	0			
10	Document the estimate	10A	Document all steps used to develop the estimate so that a cost analyst unfamiliar with the program can recreate it quickly and produce the same result	1	1,30	1 ≤ average value < 2 its mean Partially Meets with GAO Requirements	Highly Consider to Implemented GAO
		10B	Document the purpose of the estimate, the team that prepared it, and who approved the estimate and on what date	2			
		10C	Describe the program, its schedule, and the technical baseline used to create the estimate	1			

Step	Attribute	Coding	GAO Estimating Process	Company Estimating Process with Likert Scale	Average Likert Value	Explanation for Average Value	Purpose to Company
		10D	Present the program's time-phased life-cycle cost	1			
		10E	Discuss all ground rules and assumptions	2			
		10F	Include auditable and traceable data sources for each cost element and document for all data sources how the data were normalized	2			
		10G	Describe in detail the estimating methodology and rationale used to derive each WBS element's cost (prefer more detail over less)	2			
		10H	Describe the results of the risk, uncertainty, and sensitivity analyses and whether any contingency funds were identified	0			
		10I	Document how the estimate compares to the funding profile	0			
		10J	Track how this estimate compares to any previous estimates	2			
11	Present estimate to management for approval	11A	Develop a briefing that presents the documented life-cycle cost estimate	1	0,78	0 ≤ average value < 1 its mean Does Not Meets with GAO Requirements	Very Highly Consider to Implemented GAO
		11B	Include an explanation of the technical and programmatic baseline and any uncertainties	0			
		11C	Compare the estimate to an independent cost estimate (ICE) and explain any differences	1			
		11D	Compare the estimate (life-cycle cost estimate (LCCE)) or independent cost estimate to the budget with enough detail to easily defend it by showing how it is accurate, complete, and high in quality	1			
		11E	Focus in a logical manner on the largest cost elements and cost drivers	0			
		11F	Make the content clear and complete so that those who are unfamiliar with it can easily comprehend the competence that underlies the estimate results	0			
		11G	Make backup slides available for more probing questions	1			
		11H	Act on and document feedback from management	1			
		11I	Request acceptance of the estimate	2			
12	Update the estimate to reflect actual	12A	Update the estimate to reflect changes in technical or program assumptions or keep it current as the program passes through new phases or milestones	2	1,60	1 ≤ average value < 2 its mean Partially Meets with GAO Requirements	Highly Consider to Implemented GAO

Step	Attribute	Coding	GAO Estimating Process	Company Estimating Process with Likert Scale	Average Likert Value	Explanation for Average Value	Purpose to Company
	costs and changes	12B	Replace estimates with EVM EAC and independent estimate at completion (EAC) from the integrated EVM system	1			
		12C	Report progress on meeting cost and schedule estimates	2			
		12D	Perform a post mortem and document lessons learned for elements whose actual costs or schedules differ from the estimate	2			
		12E	Document all changes to the program and how they affect the cost estimate	1			

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