



Study on Implementation of Activity-Based Costing (ABC) System on Determination of Indirect Costs in Ship Production

Sufian Imam Wahidi^{1*)}, Vialdo Muhammad Virmansyah¹⁾, Triwilaswandio Wuruk Pribadi¹⁾

¹⁾Department of Naval Architecture, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia

^{*)} Corresponding Author: sufian@its.ac.id

Article Info	Abstract
<p>Keywords: Activity Based Costing (ABC), Indirect Costs, Ship Production</p> <p>Article history: Received: 21/09/20 Last revised: 11/11/20 Accepted: 13/11/20 Available online: 13/11/20 Published: 28/02/21</p> <p>DOI: https://doi.org/10.14710/kapal.v18i1.33000</p>	<p>Currently, business development, especially in the maritime sector, has quite rapid progress in Indonesia. Recently, the shipbuilding industry's development is an effort to improve competitiveness with the global market. With the increasing development of the shipbuilding industry in Indonesia, cost accounting as a cost information system is challenged to develop the shipbuilding industry, requiring high product quality. This matter requires the company to decide on proper budget planning not to experience losses. Activity-Based Costing (ABC) System is a system to determine costs using activities to classify costs to produce indirect costs that are more systematic and relevant. Activity-based costing systems identify resources in each department's activities to provide information about a product's cost. It collects indirect costs and allocates them to various products in proportion to the product volume. Therefore, activity-based costing can estimate the product costs and individual activity costs used in the production well. The first step is classifying activities, associating various costs with various activities, determining homogeneous cost groups, and determining group rates. The second step of this stage is the determination of overhead prices selected from each cost group. This research compares indirect costs to the construction of 2x1800 HP tugboat ships according to traditional cost accounting methods with the Activity-Based Costing System method. The first method's result is 3,432,920,043 IDR and the second method is 2,231,760,472 IDR.</p> <p>Copyright © 2021 Kapal: Jurnal Ilmu Pengetahuan dan Teknologi Kelautan. This is an open access article under the CC BY-SA license (https://creativecommons.org/licenses/by-sa/4.0/).</p>

1. Introduction

The Indonesian government intensively develops the industry in the shipbuilding sector. The Ministry of Industry noted that the national shipbuilding industry had made some progress with the increase in the number of shipyards to more than 250 companies with a production capacity of up to one million DWT per year for new building ships [1]. The government also secures and optimizes the domestic market as a baseload to develop the shipbuilding industry. This policy is an opportunity for the company to compete with the global market. Companies must be able to plan and control the ship production process so that they can provide quality results and provide the right production price that competes with the global market.

In the production process of a new building of the ships, many things need to be considered in the ship production process: cost. Cost is defined as sacrificed and forgone resources, measured in units of money that have occurred or are likely to occur [2, 3, 4]. Costs used for the production process must be calculated precisely and adjusted to the budget plan planned. In general, there are four cost classifications; production costs, marketing costs, administrative costs and financial costs [5].

The problem arisen so far is that the determination of costs only focuses on the production process's costs. Simultaneously, the costs of non-production activities are not included in the project's budget plan. The company does not profit or suffer a loss because its profits were allocated for costs outside the production process. These costs cannot be identified directly in the product. However, the benefits can be enjoyed by several objects [6]. These costs contain all of the labor, materials, equipment, and subcontract costs included in each activity's overhead [7]. These matters require shipyard companies in Indonesia to make policies related to accurate and precise budget planning not to suffer losses.

The traditional costing method is considered incompatible with the type of product produced by varying processes because traditional methods tend to use a single cost driver to allocate all variable and overhead expenses so that costing does not provide accurate costing information [8]. Cost determination using traditional methods cannot determine accurately. Traditional costing methods are not flexible enough and cannot easily be adapted to fluctuations in demand [9].

Current costing must be dynamic and flexible to allow the calculation of various cost objects, i.e., products, activities, and so on [10].

activity-based costing system has emerged, which can be used as a solution [11, 12, 13]. Activity-based costing is defined as an activity-based cost information system [4]. In this sense, the determination of a product's cost is made based on the activities carried out during the production process of a product. Besides, an activity-based costing system is an accounting system that focuses on activities in consuming resources to produce a product [14]. In determining these costs, shelter overhead is allocated on the basis that imposes several factors. Activity-based costing is a system of determining costs and assigning costs to a product using various cost drivers by tracing costs from activities to products [15].

An activity-based costing system differs from traditional methods. It models each activity's resources, connecting the product cost activities [16, 17, 18, 19]. The activity-based costing system identifies resources in each department's activities to provide information about the cost of a product [20, 21, 22]. Traditional methods do not accurately reflect the indirect cost contributions to individual activities. Conversely, activity-based costing collects indirect costs and allocates them to various products according to their volume [23]. Therefore, activity-based costing can estimate product costs and individual activity costs used in production well [24].

Activity-Based Costing provides a solution for indirect aggregating costs into several categories and then applying the results to products and services, respectively (direct costs). By using various indirect cost groups and cost triggers, activity-based costing can provide a more accurate cost description for determining costs and prices for shipyard products and services, because it is necessary to develop cost accounting in the shipbuilding industry, especially in shipbuilding as a support so that the shipyard company can compete [25].

With the background that has been mentioned, this research aims to get the results of observations of the indirect cost determination method carried out in shipbuilding at the current shipyard. The second is to identify the triggers for activities in constructing new building ships based on the activity-based costing method (ABC) system. The latter gets a formulation of the indirect costing approach using the activity-based costing (ABC) system method.

2. Methods

2.1. Existing Condition of Ship Building Financing

Determination of the selling price for the construction of new building ships by PT. DEF (DEF Company) is the same as the determination generally made by most manufacturing companies, which is known as Cost Plus Pricing. It is a method of determining the selling price by adding the company's profit to the full future cost of producing a product [4] with the formula $\text{Selling Price} = \text{Cost of Production} + \text{Overhead (tax)} + \text{Margin}$.

The company determines the cost of production in the production process of new building ships by divided into two groups, namely direct material costs and direct labor costs. Overhead costs were estimated at 5 to 10 per cent of the project value as a basis for the assignment. Meanwhile, the cost of electricity and water used in the construction process is included in the work services cost.

According to the shipbuilding contract made, the 2x1800 HP tug is an order by Pelindo 1 Company, Dumai branch. The number of ships ordered was two ships. In the case study of building a 2x1800 HP tugboat, the contract value for constructing two tugboats was IDR 135,811,032,026. The planned budget value for one ship is half of the contract value or IDR 67,905,516,013. This value is a budget plan that estimates the cost budget that will be incurred for the production process from planning to ship maintenance. The contract value does not include Value Added Tax (VAT) of 10%. Details of the contract value and price of tugboat ship building 2x1800 HP can be seen in Table 1.

Table 1. Contract Value and Price of Tugboat Ship Building 2x1800 HP

Items	Budget Plan (IDR)	Cost of Production (IDR)
Labor	1,650,953,722	1,320,762,977
General Expenses	2,544,662,882	2,035,730,306
Hull Material Cost	4,523,776,961	3,619,021,568
Hull and Deck outfitting Material Cost	8,804,922,609	7,043,938,087
Machine and Equipment Material Cost	38,532,785,663	30,826,228,531
Electrical and Nautica Equipment Cost	3,092,382,043	2,473,905,634
Overhead Cost	5,914,948,388	4,731,958,710
Difference in Cost	2,841,083,746	15,853,970,199
Total Cost	67,905,516,013	67,905,516,013

2.2. Indirect Cost Calculation Using Activity Based Costing Method

As the first step in the Activity Based Costing System, activities in the shipbuilding process are identified and classified. The identification of the resources used in each shipbuilding activity is carried out. Resources used in the development process are materials, labor, equipment, and the place used in each activity. These resources will be used as a reference in determining the costs incurred in each shipbuilding activity. Activities that are identified are all activities during the shipbuilding process, from inquiry or receiving work from the shipowner to the shipyard to delivery of the ship to the owner. The activities are as follows:

- a) Activities that occur at this contract stage include inquiry, ship specification planning, negotiation, contract making and contract signing.
- b) Activities that occur at the design stage include basic design activities, working drawing/shop drawing, finished drawing, 1:50 scale ship model, key plan drawing, and production drawing.
- c) Activities during the production preparation stage include planning manpower activities, making shipbuilding schedules, making job orders, building shipbuilding procedures, coding outfitting, estimating man-hours, procuring raw materials, procuring subcontractors, negotiating raw material prices, making purchase orders, materials, quality inspection of raw materials, placement of raw materials in warehouses and workshops, and control of raw material inventories.
- d) Activities during the preparation stage include material handling activities, straightening raw material, blasting raw material, primary coating raw material, providing slut / pillar buffer blocks, cleaning the location before keel laying, and cleaning the remaining sand from blasting.
- e) Activities that occur at the fabrication stage include jig preparation, material handling, marking, nesting, cutting, bending, and cleaning remaining plates.
- f) Activities at the sub-assembly and assembly stages include jig preparation activities, material handling, welding, and fairing.
- g) Activities at the erection stage include keel block levelling activities, material handling, fitting, deck levelling, welding, installation of piping systems, blasting, painting, machinery and propulsion installations, electrical installations, outfitting installations, cleaning sandblasting, cleaning in ship accommodation areas, and cleaning area building berth.
- h) Activities at the launching stage include launch preparation activities, cleaning the ceremony area, and sea trials.
- i) Activities in production support. Include supervision of the implementation of work by the chief of production, supervision and recapitulation of the use of human clock, supervision of the implementation of Occupational Health, Safety and Environment procedures, skills training for production staffs, an inspection of the quality of work results, class classification of IACS & supervision, licensing of letters from the Ministry of Education and Culture, construction insurance and delivery, handover, transportation, and ceremonies, the first annual docking and include annual class surveys, paintings, fuel.

2.2.1. Classification of Costs into Activity Level

From the results of the identification of activities, several components of indirect costs are obtained in the process of building a new building ship which is then classified into four levels as follows:

- a) Unit-Level Activities. This activity repeatedly occurs for each unit of production and consumption, along with the number of units produced.
- b) Batch-Level Activities. This is a type of activity consumed by a product based on the number of product batches produced and the activity that causes these costs to occur repeatedly every one batch (group).
- c) Product-Level Activities. This is a type of activity consumed by the products produced by these activities. This activity is carried out to support the production of each different product.
- d) Facility-level activity. This is a type of activity consumed by the product based on the facilities enjoyed by the product. This activity is related to units, batches and products.

2.2.2. Cost Driver Identification

After identifying the resources used in each activity and classifying these activities according to the classification of their respective activity levels, the next step is to identify each resource's cost driver. The cost driver is used to allocate the cost of the resource costs into activities that use these resources. This cost driver allocates variable costs and indirect costs to production or output activities [26].

2.2.3. Homogeneous Cost Group Determination

The next step is to combine classified resources into a cost group so that activities in a cost center will have the same task, type, level of activity and cost driver. The division of cost groups carried out among them is as shown in Table 2.

Table 2. The Division of Cost Group

No	Division of Cost Group	No	Division of Cost Group
1	Indirect labor supervisor	7	Building & non-building maintenance
2	Indirect labor manager	8	Machine maintenance
3	Indirect labor field	9	Buildings & non buildings depreciation
4	Energy cost	10	Machine depreciation
5	Material cost	11	Quality development
6	Survey costs / official travel		

2.2.4. Pool Rate Calculation and Indirect Costing

The pool rate calculation is done by dividing each activity trigger's total cost by the number of cost triggers for each activity trigger. The results obtained from this pool rate calculation will later become the basis for calculating the indirect

costing, which is determined by the use of resources in each activity during shipbuilding by calculating the unit cost driver multiplied by the group rate [27].

3. Results and Discussion

3.1. Comparison of Company Overhead Costs and Overhead Costs Based on Activity Based Costing Systems

The comparative cost of building a 2x1800 HP tugboat using the system applied by PT. DEF (existing) with an Activity Based Costing System is shown in Table 3.

Table 3. Comparison of the Cost of Building Tugboats 2x1800 HP

Type of Cost	Existing (IDR)	ABC (IDR)
Direct Cost	47,319,587,103	47,631,813,879
Indirect Costs	4,731,958,710	3,432,920,043
Management and Administration	660,000,000	660,000,000
Income Tax (Article 23)	1,358,110,320	1,358,110,320
Difference in Cost	13,835,859,879	14,822,671,771
Total	67,905,516,013	67,905,516,013

The existing method results are IDR 52,051,545,814 with direct costs of IDR 47,319,587,103, indirect costs of IDR 4,731,958,710 for company management and administration fees of IDR 660,000,000, and the cost of income tax article 23 in the amount of 2% of the planned cost budget or of IDR 1,358,110,320 so that the difference between the planned cost budget and development costs was IDR 3,835,859,879.

The calculation of the cost of building one ship using the activity-based costing system method for constructing a 2x1800HP tugboat is IDR 51,064,733,921. The direct cost is IDR 48,229,449,879, and indirect cost is IDR 3,432,920,043. Management and company administration costs are IDR 660,000,000. The cost of income tax article 23 of 2% of the planned cost budget is IDR 1,358,110,320. The difference between the planned cost budget and development costs is IDR 14,281,669,327.

From these results, the calculation of costs using the method of activity-based costing system results in calculating the cost of goods manufactured, which is smaller than the calculation of costs using the method currently used by PT. DEF. The decrease in the cost of production was due to a decrease in indirect costs in calculating costs. In determining the indirect costs, PT. DEF performs calculations by determining the percentage of total raw material costs plus labor costs and general expenses. Indirect costs to PT. DEF charges about 5-10% of the total cost of raw materials, direct labor costs and general expenses to be allocated as indirect costs during the construction process.

PT. DEF has several considerations in determining the indirect costs to be charged, namely competitors of other shipbuilding companies. With the method currently used by PT. DEF is obtained from the calculation of indirect costs of IDR 4,731,958,710. Meanwhile, the determination of indirect costs based on activity-based costing itself consists of 2 stages. The first stage's procedure is to classify activities and determine indirect costs based on the resources used in the second stage.

In the imposition of indirect costs, the activity-based costing system uses a cost driver as the basis for charging in determining indirect costs for shipbuilding. This method is in line with the explanation in SPAR associates' research entitled Shipyard Cost Models Using Activity-Based Costing Method, which explains that activity-based costing can collect indirect costs into several categories and then apply the respective results to products and services. This is because the traditional accounting system does not have the flexibility to show a diverse set of costs and then apply them to the cost group for a product and service in the shipbuilding industry. Activity-based costing can provide a more accurate cost description for determining shipyard products and services' costs and prices by using various indirect costs and cost drivers [13].

Based on the activity-based costing method, it is found that the cost components that cause indirect costs include the use of indirect materials such as the use of water for labor, the use of indirect production and non-production labor such as managers and supervisors, maintenance of machines and facilities, and depreciation of machines and facilities.

3.2. Building Cost Comparison between Two Tugboats 2x1800 HP

The comparison of the cost of production for the construction of 2 tugboats using an activity-based costing system has a different value if identified on each ship. So, in this case, of course, the cost composition of each ship will be different from one another. The calculation of the production cost carried out on each ship can be seen in Table 4. The table describes a building cost calculation result on each 2x1800HP tugboats using activity-based costing. The production cost on the first tugboat using activity-based costing obtained a total of IDR 50,778,127,907 with a composition of direct costs of IDR 47,431,841,421 with a percentage of 93% and indirect costs of IDR 3,346,286,487 with a percentage of 7%.

Whereas on the second tugboat, the total cost of goods manufactured was IDR 49,406,854,819 with a composition of direct costs of IDR 47,078,088,297 with a percentage of 93% and indirect costs of IDR 2,328,766,522 with a percentage of 4%. There was a difference in the production cost between 2 ships built in 1 production group, which was carried out simultaneously, where the production cost of the second tugboat decreased by IDR 1,371,273,088 or by 3%. From these calculations, the composition of direct and indirect costs for each activity is also obtained.

Even though it was built with the same size, material, and time, there was a decrease in production cost in the second tugboat production. The decrease in production cost was since the calculation of the costs carried out in building the second tugboat could not be done by equalizing the cost of production for the first tugboat due to several activities simultaneously for the two ships, as shown in Table 5.

Costs incurred in these activities cannot be calculated and charged back to the second ship's construction because the activity is intended for both vessels. For example, in the inquiry process, where costs incurred from using this activity are only charged to one ship. There is a cost-saving on the production cost for constructing the second tugboat 2x1800 HP. Besides, there are direct and indirect cost calculations for several activities during the shipbuilding process, calculated according to the shipbuilding needs on the first and second ships, including the following activities, as shown in Table 6.

Table 4. Comparison of the Cost of Building 2 Tugboats 2x1800HP

Type of Cost	Tugboat 1 (IDR)	Tugboat 2 (IDR)
Direct Cost	47,431,841,421	47,078,088,297
Indirect Costs	3,346,286,487	2,328,766,522
Total Cost	50,778,127,907	49,406,854,819

Table 5. Activities Carried Out Simultaneously on The Production of 2 Tugboats

No	Activities	No	Activities
1	Inquiry	11	Create job order
2	Short specification pricing planning	12	Create building procedures
3	Negotiation	13	Outfitting coddling
4	Create and signing of contract	14	Human Clock estimation
5	Working drawing/shop drawing	15	Procurement of raw material
6	Finished drawing	16	Procurement of sub-contractor
7	Key plan drawing	17	Negotiating of raw material
8	Production drawing	18	Make purchase order material
9	Man power planning	19	Nesting
10	Create schedules		

Table 6. Activities with Direct and Indirect Costs on The Production of 2 Tugboats

No	Activities	No	Activities
1	Basic design	25	Material handling
2	Ship model / model 1:50 scale	26	Fitting
3	Inspection of the quality of raw materials	27	Deck leveling
4	Placement of raw materials in warehouses and workshops	28	Welding
5	Inventory control of raw materials	29	Piping system work
6	Material handling	30	Blasting
7	Straightening of raw material	31	Painting
8	Blasting raw material	32	Machinery & propulsion installations
9	Primer coating	33	Electrical installation
10	Provision of slut / pillar buffer blocks	34	Installation outfitting
11	Cleaning the location before keel laying	35	Cleaning sand blasting
12	Cleaning the remaining blasting sand	36	Cleaning the boat accommodation area
13	Preparation of the jig	37	Cleaning area building berth
14	Material handling	38	Launching
15	Marking	39	Cleaning the ceremony area
16	Nesting	40	Sea trial
17	Cutting	41	Supervision of work implementation
18	Bending	42	Supervision and recapitulation of the use of Job order
19	Cleaning the rest of the plate	43	Supervision of the implementation of OHS procedures
20	Preparation of jig	44	Skills training
21	Material handling	45	Inspection of the quality of work
22	Welding	46	IACS Classification & Supervision
23	Fairing	47	Licensing for letters
24	Keel block leveling		

4. Conclusion

Based on the results of research and discussion conducted by the authors at PT. DEF, the following conclusions can be drawn to answer the objectives of the research. Calculation of indirect costs at PT. DEF charges about 5-10% of the total cost of raw materials, direct labor costs, and general expenses allocated as indirect costs for constructing the first and the second tugboats occur during the construction process or around IDR 4,731,958,710.

From the identification results, 12 groups trigger activities that cause indirect costs, including indirect labor for the supervisor, manager, and field, material costs, energy costs, official travel costs, maintenance of production facilities, maintenance of the building and non-building facilities, depreciation of production facilities, and depreciation of building and non-building facilities.

Based on an activity-based costing system, the percentage of direct costs for the first tugboat is 93% of the construction cost or IDR 47,431,841,421. The percentage of indirect costs obtained is 7% of the construction cost or IDR 3,346,286,487. For the construction of the second tugboat, the percentage of direct costs is 95% of the construction cost or IDR 47,078,088,297. The percentage of indirect costs is 5% of the construction cost or IDR 2,328,766,522, with the difference in costs between the construction of the first and second tugboat is 4% or IDR 1,955,757,610. This difference is due to several activities carried out simultaneously for the two tugboats.

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