EASTERN INTERNATIONAL UNIVERSITY

Case Study 3: Cost Accounting Analysis and Budgeting for Advanced Manufacturing Center

Course Code: ACTG 360

Course Name: Cost Accounting

Prepared by: Group 3 - CLOUDS

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Table of content

1. Introduction

1.1. Background

Cost accounting and budgeting form the backbone of operational efficiency in modern manufacturing, particularly at facilities like the Advanced Manufacturing Center (AMC) of Eastern International University (EIU). As a state-of-the-art facility in Binh Duong, Vietnam, AMC bridges academia and industry by integrating advanced technologies such as CNC machining (e.g., MAKINO F5-PRO6 systems) with rigorous cost management practices. This dual focus enables the center to deliver high-quality machined products while maintaining transparency and competitiveness for its primary clients small and medium enterprises (SMEs) and start-ups.

1.2. Objectives

This project aims to apply cost accounting principles in a real manufacturing context by analyzing the production of a machined aluminum bracket. It involves identifying and calculating relevant costs, reconstructing the company's quotation, and preparing a basic production budget. By working on this case with the Advanced Manufacturing Center (AMC), we gain practical experience and deepen our understanding of how cost information supports pricing decisions and overall business operations.

1.3. Scope

The Advanced Manufacturing Center (AMC) serves as a bridge between education and industry by offering hands-on learning experiences while meeting real market needs. It plays a key role in supporting small and medium enterprises (SMEs) in Binh Duong, contributing to regional development.

Equipped with industrial-grade machinery, the AMC can carry out actual manufacturing tasks, such as machining aluminum parts. It also provides business services like quotations and production for external clients and functions as a practical training center where students gain real-world skills in manufacturing and cost accounting.

2. Company Overview

2.1. Company Profile

The AMC Advanced Manufacturing Center- AMC, affiliated with the Eastern International University, invested by Becamex IDC Corporation, is a modern facility fully equipped with advanced processing equipment (Quach, 2024). The center's goal is to meet the needs of processing, measuring, and product design for businesses, especially start-ups. The center accepts all processing orders, regardless of scale, from small to large, to provide maximum support for the development of these businesses.

To facilitate start-ups, the center is committed to providing the most preferential prices, in accordance with the policies of the Corporation and the Eastern International University. Currently, the Advanced Manufacturing Center has established 3 factory areas, serving the start-up activities of small and medium-sized enterprises in Binh Duong, contributing to the development of the local economy.

2.2. Product Description

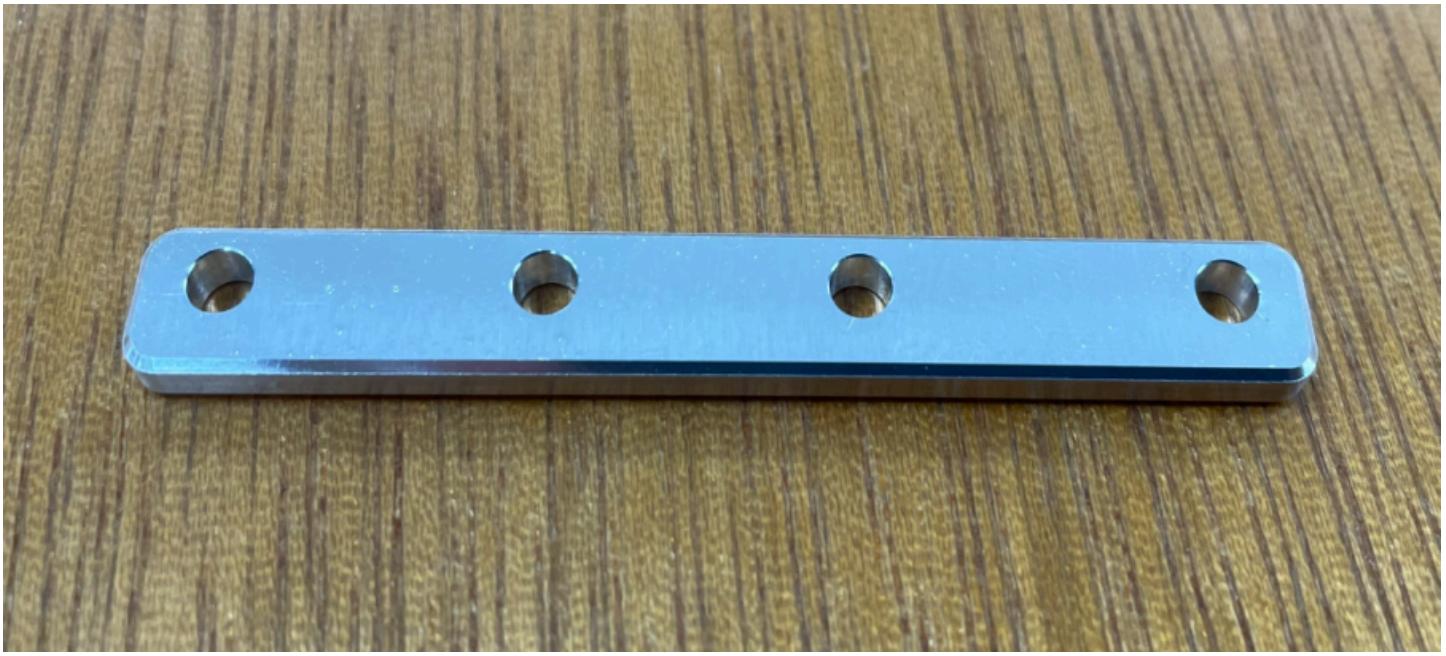

Figure 1: Real image of the product

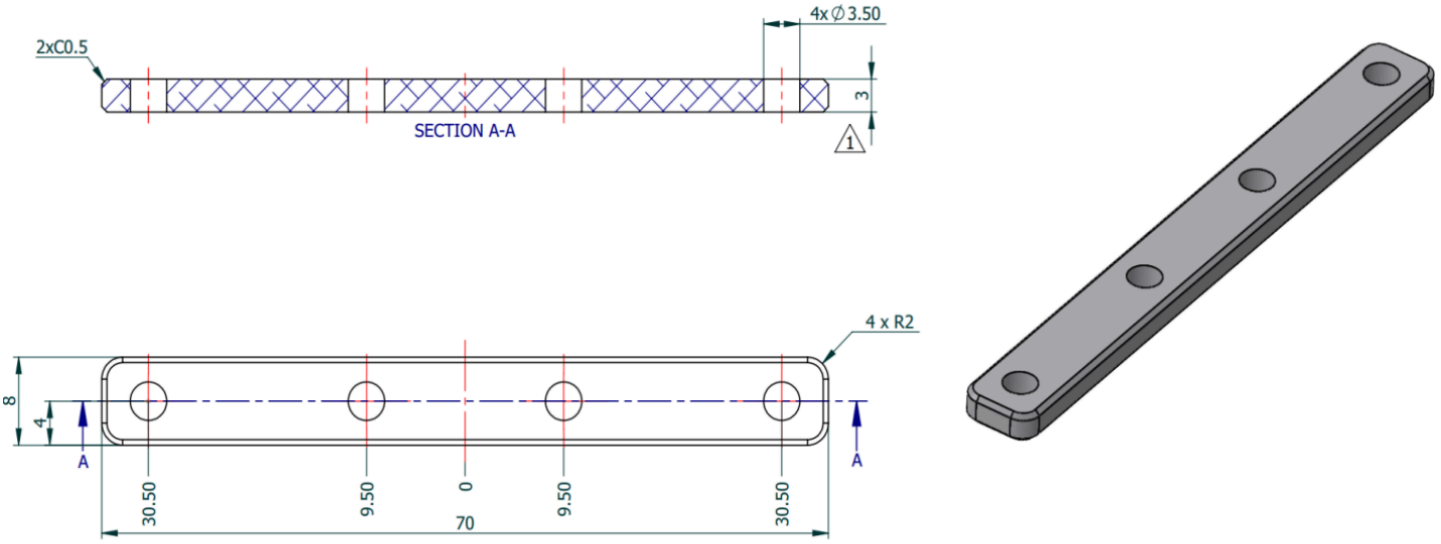

Figure 2: Technical drawing or blueprint of a mechanical part

Product Analysis:

The machined aluminum bracket appears to be a metal connecting bar with these specifications:

- Rectangular flat bar with 4 evenly spaced holes.
- Total length appears to be 70mm based on the drawing.
- Width is approximately 8mm.
- Thickness is around 3mm.
- Holes are evenly spaced at roughly 19mm intervals.
- There are 4 holes with a diameter of 4 mm each, positioned symmetrically along the length.
- The edges have a 2x0.5 mm chamfer on both ends.
- The corners of the holes have a 4 mm radius (4x R2).

3. Cost Calculation Methodology

3.1. Costing Methods Used

Based on the analysis of the product and production process in the case study, job-order costing is identified as the most suitable costing method. Since the product is manufactured in low volumes with a high degree of customization, requiring detailed tracking of materials, labor, and overhead for each specific job. Job-order costing enables accurate cost assignment and control at the individual project level, which is essential for customized and small-batch manufacturing. To further enhance cost accuracy, activity-based costing (ABC) can also be applied in parallel to allocate indirect costs more precisely using drivers such as machine hours and setup time. This combined approach aligns well with the operational model of the Advanced Manufacturing Center and supports informed pricing and production decisions.

3.2. Data Collection

Data for cost accounting and budgeting at the Advanced Manufacturing Center (AMC) was gathered through a combination of direct observation, departmental records, and internal reports. Actual production data-including labor hours, material usage, and equipment costs (such as machine depreciation and electricity)-was systematically recorded during the manufacturing process. Cycle times and production rates were tracked to evaluate operational efficiency. Additional information was sourced from related departments like purchasing and engineering to obtain up-to-date prices for raw materials, tools, and customer specifications. Financial statements, production reports, and inventory records were used to calculate per-unit costs for the production order. This comprehensive approach ensures that all relevant cost elements are captured accurately for analysis and budgeting purposes for an order of 1300 aluminum parts.

3.3. Assumption Made

The following key assumptions were made to ensure a consistent and realistic cost calculation:

- Production Process & Flow:
- A single MAKINO F5-PRO6 machine is used sequentially for both operations (OP1 and OP2). It is assumed that phase 2 begins only after phase 1 is fully completed.
- Overall Equipment Effectiveness (OEE) is estimated at 65% to account for availability, performance, and quality losses in a real-world production environment.
- Cost and Depreciation:
- All equipment depreciation is calculated using the straight-line method over the following useful lives: 5 years for the machine and 3 years for standard jigs, fixtures, holders, and measuring tools.
- An additional 15% is added to the raw material (billet) cost to account for bulk purchasing and initial cutting fees.
- Material and Waste:
- Material waste is estimated at 35% of the initial raw material volume after machining.
- To reduce the final cost, 50% of the potential revenue from selling this scrap (at a rate of 25,000 VND/kg) is credited back.
- Anodizing is treated as an outsourced cost, fixed at 10,000 VND per unit.
- Labor and Time:
- Standard labor time is based on an 8-hour workday and 22 working days per month.
- A separate setup time of 8 hours is included for each of the two production operations (OP1 and OP2).
- A manual measurement time of 1.5 minutes per product is included for each of the two production stages.
- Financial:
- The currency exchange rate is fixed at 1 USD = 24,500 VND.
- Oil

- The 6 liters are for a scheduled oil change. This would be a situation that changes the oil in the machine once a month or after every 500 hours of operation, regardless of whether you made 1,000 units or 1,500 units in that time. The cost driver is a period of time (e.g., once a month) or a large batch threshold. The total cost of 367,500 VND is fixed for that period. It would be a Fixed Manufacturing Overhead.

4. Cost Components

4.1. Direct Materials

- **Order & Production Requirements:**

Final Quantity of Good Products: The number of units the customer ordered (1,300 units).

Defect Rate (%NG): The percentage of units expected to fail inspection at each stage (5% per phase).

- **Raw Material Specifications:**

Dimensions of a Single Raw Unit (Billet/Ingot): Length, width, and height (75mm x 13mm x 5mm).

Material Density: The weight per unit of volume (2.72 g/cm³ for Aluminum AL6061-T6).

Purchase Price: The cost of the raw material per unit of weight (90,000 VND/kg).

- **Additional Costs & Credits:**

Ancillary Cost Percentage: A percentage added to the base material cost to account for bulk purchasing, cutting, and handling (15%).

Machining Scrap Percentage: The percentage of the raw material's volume that becomes scrap during machining (35%).

Scrap Material Selling Price: The price at which you can sell the scrap (25,000 VND/kg).

Scrap Credit Policy: The AMC's policy for how much of the scrap value is used to reduce the product cost (50% is applied).

4.2. Direct Labor

The labor cost is based on a monthly salary of $408 (10,000,000 VND), with 22 working days per month, 1 shift per day, and 8 hours per shift, resulting in an hourly rate of $2.32 (56,840 VND).

Machine Operation (Phase 1 and Phase 2):

Workers who operate the machines for machining processes. In phase 1 (machining the top surface and drilling holes) and phase 2 (machining the bottom surface), one person per machine handles the operation, including setting up the workpiece and running the machine to produce each unit.

OEE (60%–70%) reflects the efficiency of these labor activities, indicating that equipment and labor are only productive for 60%–70% of the time due to downtime, slower performance, or quality issues (5% defect rate). This inefficiency may extend the time required for direct labor tasks, affecting overall production throughput.

4.3. Manufacturing Overhead

4.3.1. Fixed Overhead Cost

Fixed overhead costs are expenses that stay the same no matter how much a company produces or sells. These costs remain unchanged regardless of fluctuations in production volume. Below is an overview of common types of fixed overhead costs:

a. **Machine Depreciation:**

	OPERATION 1	**OPERATION 2**
Machine Name	MAKINO F5-PRO 6	MAKINO F5-PRO 6

Cost (Dollar)	180,000	180,000
Cost (VND)	4,410,000,000	4,410,000,000
Useful life	5 years	5 years
Depreciation per year (VND)	882,000,000	882,000,000
Depreciation per hour (VND)	416,614	416,614

Table 1: Machine information

Same for 2 operations:

Depreciation per year: 4,410,000,000 VND ÷ 5 years = 882,000,000 VND/year.

Depreciation per hour: 882,000,000 VND ÷ (22 × 12 × 8) = 416,614 VND/hour.

b. Jig and Fixture (standard) Depreciation:

	OPERATION 1	**OPERATION 2**
Cost (Dollar)	2,000	2,000
Cost (VND)	49,000,000	49,000,000
Useful life	3 years	3 years
Depreciation per year (VND)	16,333,333	16,333,333
Depreciation per hour (VND)	7,734	7,734

Table 2: Jig and Fixture information

Same for 2 operations:

Depreciation per year: 49,000,000 VND ÷ 3 years = 16,333,333 VND/year.

Depreciation per hour: 16,333,415 VND ÷ (22 × 12 × 8) = 7,734 VND/hour.

c. Knife Depreciation

Knife	Name	Cost (Dollar)
OPERATION 1	F3AA0600AWS45	**50**
	F3AA0300AWS45	**45**
	Chamfer D4	**30**
	Total	**125**
OPERATION 2	F3AA0800AWM45	**30**
	Chamfer D4	**30**
	Total	**60**

Table 3: Knife general information

	OPERATION 1	OPERATION 2
Cost (Dollar)	125	60
Cost (VND)	3,062,500	1,470,000
Useful life	2500 items	2500 items
Depreciation per unit (VND)	1,225	588

Table 4: Knife depreciation information

Operation 1: Depreciation per item: 3,062,500 VND ÷ 2500 items = 1,225 VND/item.

Operation 2: Depreciation per item: 1,470,000 VND ÷ 2500 items = 588 VND/item.

d. Holder Depreciation:

Holder	Name	Cost (Dollar)
OPERATION 1	A63 CTH10-75	170
	C10-6-P	65
	A63 CTH10-75	170
	C10-4-P	65
	A63 CTH10-75	170
	C10-4-P	65
	Total	**705**
OPERATION 2	A63 CTH10-75	170
	C10-8-P	65

	A63 CTH10-75	170
	C10-4-P	65
	Total	**470**

Table 5: Holder general information

	OPERATION 1	**OPERATION 2**
Cost (Dollar)	705	470
Cost (VND)	17,272,500	11,515,000
Useful life	3 years	3 years
Depreciation per year (VND)	5,757,500	3,838,333
Depreciation per hour (VND)	2,726	1,817

Table 6: Holder depreciation information

Operation 1:

Depreciation per year: 17,272,500 VND ÷ 3 years = 5,757,500 VND/year.

Depreciation per hour: 5,757,500 VND ÷ (22 × 12 × 8) = 2,726 VND/hour

Operation 2:

Depreciation per year: 11,515,000 VND ÷ 3 years = 3,838,333 VND/year.

Depreciation per hour: 3,838,333 VND ÷ (22 × 12 × 8) = 1,817 VND/hour

e. Measuring Tool Depreciation:

Measuring tool	Name	Cost (Dollar)
OPERATION 1 & 2	Digi. Caliper 0-200	200
	Digi. Indicator 192-630-10	800
	Total	**1,000**

Table 7: Measuring tool general information

	OPERATION 1	OPERATION 2
Cost (Dollar)	1000	1000
Cost (VND)	24,500,000	24,500,000
Useful life	3 years	3 years
Depreciation per year (VND)	8,166,667	8,166,667
Depreciation per hour (VND)	3,867	3,867

Table 8: Measuring tool information

Same for 2 operation:

Depreciation per year: 24,500,000 VND ÷ 3 years = 8,166,667 VND/year.

Depreciation per hour: 8,166,667 VND ÷ (22 × 12 × 8) = 3,867 VND/hour

f. Jig and Fixture (Special) Depreciation:

	OPERATION 1	OPERATION 2
Cost (Dollar)	0	20
Cost (VND)	0	490,000

Table 9: Jig and Fixture (Special) general information

g. Setup labor cost

Setup time is 8 hours in each operation

Salary per hour: 56,840 VND

Number of workers: 1

h. Packaging labor

Packaging time is 1 hours in whole process

Salary per hour; 56,840 VND

Number of workers: 1

i. **Oil expense:** Cost of oil = 2.5 USD = 61,250 VND per liter, 3 liters will be used in each operation

So the total quantity of oil used will be 6 liters, then we have total oil expense equal: 6 x 61,250 = 367,500 VND

4.3.2. Variable Overhead Costs

Measuring labor costs

Cycle Time			
	OPERATION 1	OPERATION 2	Total
Machine time per item (s)	330	210	540
Measuring time per item (s)	180	180	360
Total time per item (s)	510	390	900
Total time per item (h)	8.5	6.5	15
Machine time per item (s)	0.14	0.11	0.25

Units Needed			
	OPERATION 1	OPERATION 2	Ending
%NG	5%	5%	
Units Needed	1442	1369	1300
	1442	1369	1300
	OPERATION 1	OPERATION 2	Total
Measuring time (hour)	72.05	68.45	140.5

Table 10: Measuring labor cost general information

For Operation 1, we need to measure 1,442 units, with two measuring tools, each accounting for 90 seconds, so the total measuring time for Operation 1 is 180 seconds. Measuring all of 1,441 units need: 180 x 1,442 = 259,380 seconds or 72.05 hours

Operation 2, we have found that 5% of total units are defected, after eliminating them, we have 1,369 units left. Similar to operation 1 (the same measuring tools and measuring time), measuring time for operation 2 equal: 180 x 1,369 = 246,420 seconds or 68.45 hours

Salary per hour: 56,840 VND

Electricity expense: Electricity cost per hour is 1.35 USD = 33,075 VND

Packaging Materials: One time packaging, the fee is 3 USD = 73,500 VND

Transportation cost: One time delivery, the shipping fee is 15 USD = 367,500 VND

Outsourcing cost: Outsourcing cost per item is 10,000 VND

5. Cost Calculation

5.1. Capacity

		OPERATION 1	OPERATION 2	Total
Cycle Time(s)		330	210	540
Theoretical Output/Hour		10.91	17.14	28.05
Overall Equipment Effectiveness (OEE)		65%	65%	130%
One machine	Output per Machine per Hour	7.09	11.14	18.23
	Output per Machine per Day	56.7	89.1	145.9
	Output per Machine per Month	1,248.104	1,960.8	3,208.9
	Working Days	22.9	14.6	37.5
Actual number of machines	Machine needed	1	1	1
	Output per Day	56.7	89.1	145.9
	Output per Month	1,248.104	1,960.8	3,208.9
	Actual Working Days	22.9	14.6	37.5

Table 11: Capacity Calculation

If the customer requires to produce 1300 products within 60 days, one machine will be required for each phase. Estimated completion time is 37.5 days.

Using the same machine for two phases. Phase 2 begins when phase 1 is completely completed.

OP1: Cycle time = Machining Time + Handle Time = 300 + 30 = 330s

Theoretical Output/Hour= 3600s/ Cycle time= 3600/ 330= 10.9 units/hour

Output per Machine per Hour = Theoretical Output/Hour* OEE = 10.91 * 65%= 7.09 units/hour = 56.7 units/ day

Actual Working Days = $\frac{Total\ Product\ needed}{Output\ per\ day} = \frac{1300}{56.7}$ = 22.91 days

OP2: Cycle time = Machining Time + Handle Time = 180 + 30 = 210

Theoretical Output/Hour= 3600/ Cycle time= 3600/ 210= 17.14 units/hour

Output per Machine per Hour = Theoretical Output/Hour* OEE = 17.14 * 65%= 11.14 units/hour = 89.1 units/ day

Actual Working Days = $\frac{Total\ Product\ needed}{Output\ per\ day} = \frac{1300}{89.1}$ = 14.6 days

Total Actual Working Days = Actual Working Days OP1 + Actual Working Days OP2

= 22.9 + 14.6 = 37.5 days

Total Actual Working Hours = Total Actual Working Days x 8 hours = 300 hours

5.2. Materials Cost Calculation

The order needs two phases, the failure rate for phase 1 is 5% and phase 2 is 5%

The order called for 1300 items, so the ingot needed for the order is:

Phase 2: 1300/(1-5%)= 1368.42 pcs. Rounded up to **1,369 pcs**

Phase 1: 1369/(1-5%)= 1441.05 pcs. Rounded up to **1,442 pcs**

Total quantity of ingot required: **1,442 units**

Raw Material Dimensions:

75mm x 13mm x 5mm=> Volume=Length x Width x Height= 75 x 13 x 5= 4.875 cm^3

The weight of one raw material is: Volume x density= 4.875 cm^3 x 2.72g/cm3= 13.26g = 0.01326kg

Cost of material per unit:

Price of AL6061-T6: 90,000 VND/kg

Cost= 0.01326kg x 90,000 VND/kg= 1,193.4 VND

Total raw material cost (A): 1,442 pcs x 1,193.4= 1,720,882.8VND

Additional cost for raw material

- Add 15% to account for bulk purchasing, cutting, etc.:

1,720,882.8 x 0.15= 258,132.42VND

- Total raw material cost:

1,720,882.8+258,132.42= 1,979,015.22VND

Cost per product:

1,979,015.22/1300=1,522.32VND

Calculate Scrap Value: 35% of the workpiece volume is scrap after machining.

- Scrap volume: 4.875 x 0.35= 1.70625 cm^3
- Scrap weight: 1.70625 cm^3 x 2.72 g/cm^3= 4.641g = 0.004641 kg
- Scrap value per ingot: 0.004641 kg x 25,000 VND/kg= 116.025 VND
- Total scrap value for 1,442 ingot: 116.025 VND x 1,442= 167,308.05 VND
- Scrap value per product: 167,308.05 VND/ 1300 = 128.7 VND/ product
- Apply 50% of scrap value to reduce product cost: 128.7 x 50%= 64.349 VND/ product

For products that are defective during production, it will be calculated according to the price of the excess blank. Defective product = 1442- 1300= 142 pcs

Defective product Dimensions: 70mm x8mm x3mm= => Volume=Length x Width x Height= 70 x 8 x 3= 1.68 cm^3

The weight of one Defective product is: Volume x density= 1.68 cm^3 x 2.72g/cm3= 4.5696 g= 0.0045696 kg

Defective Product value= 0.0045696 kg x 25,000 VND = 114.24 VND/ product

142 Defective Product value= 114.24 x 142= 16,222.08 VND

Apply 50% of scrap value to reduce product cost: 16,222.08 VND x 0.5= 8,111.04 VND

Defective Product value per product= 8,111.04 VND/ 1300= 6.2 VND

The direct material cost for one product

1,522.32 VND- 64.349VND - 6.2 VND= **1,451.771 VND** (approximately **0.0593 USD** at the exchange rate of 24,500 VND/USD).

5.3. Labor Cost Calculation

Salary per month per worker	$408	10,000,000 VND
Working days per month	22 days	22 days
Shift per day	1	1
Hour per shift	8 hours	8 hours
Daily wage	$18.55	455,000 VND
Hourly wage	$2.32	56,840 VND
%OEE	65%	65%

Table 12: Labor cost information

	Operation 1	Operation 2	Total
Number of worker	1	1	1
Salary/hour	$2.32	$2.32	$4.64
Daily wage	$18.56	$18.56	$37.12
Actual Working Days	22.9 days	14.6 days	37.5 days
Total Direct labor cost	$425.298	$270.712	$696.01
Total Direct labor cost in VND	VND 10,419,801	VND 6,632,444	VND 17,052,245
Direct labor cost per item	VND 8,015.23	VND 5,101.88	VND 13,117

Table 13: Direct Labor cost calculation

Daily wage Salary/hour x 8 = $2.32 x 8 = $18.56

OP1: Total Direct labor cost = Actual Working Days x Daily wage = $18.56 x 22.9 days = $425.298

Total Direct labor cost in VND = $425.298 x 24,500 = VND 10,419,801

Direct labor cost per item =VND 10,419,801/ 1300 = VND 8,015.23

OP2: Total Direct labor cost = Actual Working Days x Daily wage = $18.56 x 14.6 days = $270.712

Total Direct labor cost in VND = $270.712 x 24,500 = VND 6,632,444

Direct labor cost per item = VND 6,632,444 / 1300 = VND 5,101.88

5.4. Overhead Allocation

5.4.1. Fixed Manufacturing Overhead

a. Depreciation expense for MAKINO machine

Machine expense per item = (Depreciation cost per hour x Total Actual Working Hours) / Quantity order = (417,614 x 300) / 1300 = 96,372 VND

b. Depreciation expense for Knife

Total Depreciation expense for Knife per item = Total Depreciation expense for Knife per item in operation 1 + Total Depreciation expense for Knife per item in operation 2 = 1,225 + 588 = 1,813 VND

c. Depreciation expense for Holder

Holder cost per item = [(Holder cost per hour in operation 1 + Holder cost per hour in operation 2) x Total Actual Working Hours)] / Quantity order = [(2,726 + 1,817) x 300)] / 1,300 = 1,048 VND

d. Depreciation expense for Jig and Fixture (Standard)

Jig and Fixture cost per item = (Jig and Fixture Depreciation cost per hour x Total Actual Working Hours) / Quantity order = (7,733.6 x 300) / 1300 = 1,785 VND

e. Depreciation expense for Jig and Fixture (Special)

Special Jig and Fixture cost per item = Special Jig and Fixture cost per item for operation 1 + Special Jig and Fixture cost per item for operation 2 = 0 + (Special Jig and Fixture cost / Quantity in operation 2) = 0 + [(490,000)/1,369] = 358 VND per item

f. **Depreciation expense for Measuring Tools**

Measuring Tools expense per item = (Depreciation cost per hour x Total Actual Working Hours) / Quantity order = (3,867 x 140.5) / 1300 = 418 VND

g. Setup labor cost

Setup cost are the same in operation 1 and operation 2

Setup cost in operation 1 = Setup cost in operation 2 = Work hour x Salary per hour x Number of workers = 8 x 56,840 x 1 = 454,720 VND

Total Setup cost = Setup cost in operation 1 + Setup cost in operation 2 = 454,720 + 454,720 = 909,440 VND

Setup cost per item = Total Setup cost/Quantity order = 909,440/1,300 = 700 VND

h. Packaging labor

One labor, one hour of packaging, so the packaging labor cost = Salary per hour x Number of working hours x Number of workers = 56,840 x 1 x 1 = 56,840 VND

Packaging cost per item = Packaging labor cost/Quantity order = 56,840/1,300 = 43.72 VND per item

i. Oil expense

- Total oil expense = 6 x 61,250 = 367,500 VND
- Oil cost per item = Total oil expense/Quantity order = 367,500/1,300 = 282.7 VND per item

5.4.2. Variable Manufacturing Overhead

a. Measuring labor cost

Total measuring time = Measuring time in operation 1 + Measuring time in operation 2 = 72.05 + 68.45 =140.5 hours

Measuring cost per item = (Total measuring time x Salary per hour) / Quantity order = (140.5 x 56,840) /1,300 = 6,145 VND per item

b. Packaging material

Packaging material per item = Packaging cost/Quantity order = 73,500/1,300 = 56.5 VND per item

c. Transportation cost

Transportation cost per item = The shipping fee/Quantity order = 367,500/1,300 = 282.7 VND per item

d. Outsourcing cost

Outsourcing cost per item is 10,000 VND

e. Electricity expense

The total electricity expense = Electricity cost per hour x Total number of working hours

= 33,075 x 300 = 9,922,500 VND

Electricity cost per item = Total electricity expense/quantity order = 9,922,500 VND / 1,300 = 7,633 VND

TOTAL MANUFACTURING COST PER UNIT (VND)		
Process cost per item	Machine	96,372
	Knife	1,813
	Holder	1,048
	Jig and Fixture (Standard)	1,785
	Jig and Fixture (Special)	358
	Measuring Tools	418
Other Expenses	Setup cost	700

	Packaging material	57
	Packaging labor	43.72
	Measuring labor cost	6,145
	Transportation cost	282.7
	Outsourcing cost	10,000
	Electricity expense	7,633
	Oil expense	283
TOTAL		126,938.42

Table 14: Total Manufacturing Cost Per Unit (Vnd)

5.5. Cost summary and quotation price calculation

5.5.1. Material Cost

- **Raw material cost (after adjusting for defect and waste):**
  - Total ingots needed: 1,442 pcs
  - Base cost:1,720,882.8 VND
  - +15% Additional cost: 258,132.42 VND
  - Total material cost: 1,979,015.22 VND
  - Per unit: 1,522.32 VND

- **Scrap value adjustment (50% applied):**
  - Scrap offset per unit: 64.349 VND
  - Defective Product value per product= 6.2 VND
  - The direct material cost for one product: **1,451.771** VND/unit

5.5.2. Labor Cost

- Direct labor cost per item: 13,117 VND

5.5.3. Overhead Allocation Cost

- Machine expense per unit = 96,372 VND/unit
- Total Depreciation expense for Knife per unit = 1,813 VND/unit
- Holder cost per unit = 1,048 VND/unit
- Total Jig and Fixture (standard) cost per unit for operation 1 and 2 = 1,785 VND/unit
- Total Jig and Fixture (special) cost per unit for operation 2 = 358 VND/unit
- Total measuring tool cost per unit = 418 VND/unit
- Total measuring labor cost per unit = 6,145 VND/unit
- Total setup labor cost per unit = 700 VND/unit
- Packaging materials cost per unit = 57 VND/unit
- Packaging labor cost per unit = 43.72 VND/unit
- Transportation cost per unit = 282.7 VND/unit
- Outsourcing cost per unit = 10,000 VND/unit
- Electricity cost per unit = 7,633 VND/unit
- Oil expenses = 283 VND/unit

5.5.3. Quotation price

- **Cost inputs:**
  - Direct Material = 1,451.771 VND/unit
  - Direct Labor = 13,806 VND/unit
  - Overhead cost = 126,938.42 VND/unit
  - **Total Cost inputs** = 142,196.19 VND/unit
- **Quotation Pricing:**

- Manufacturing Expenses = 90%
- Fixed Factory Expenses = 5%
- Profit = 5%
- **Sale Price per unit**: Manufacturing cost + 5% x Sale price + 5% x sale price = sale price

142,196.19 + 5% x Sale price + 5% x sale price = sale price

=> Sale price = 157,995.77 VND/unit

- **Total Sale Price for 1,300 units** = Sale Price per unit x 1,300 = **205,394,498.1 VND**

7. Budgeting Analysis

- **Cost inputs:**
  - Direct Material = 1,451.771 VND/unit
  - Direct Labor = 13,117 VND/unit
  - Overhead cost = 127,480 VND/unit
  - **Total Cost inputs** = 142,048.9 VND/unit

Calculate Price:

- Manufacturing Expenses = 90%
- Fixed Factory Expenses = 5%
- Profit = 5%
- **Sale Price per unit**: Manufacturing cost + 5% x Sale price + 5% x sale price = sale price

142,048.9 + 5% x Sale price + 5% x sale price = sale price

=> Sale price = 157,832.11 VND/unit

- **Total Sale Price for 1,000 units** = Sale Price per unit x 1,000 = **157,832,110 VND**

7.1. Sales Budget

Units sold	1000
Selling price	157,832.11
Budgeted revenue	157,832,110

Table 15: Sale Budget

7.2. Production Budget

Budgeted unit sales	1000
Units Needed for Operation 2	1052.6
Units Needed for Operation 1	1108.42
Budgeted production	1109

Table 16: Production Budget

Phase 2: 1000/(1-5%)= 1052.6 pcs. Rounded up to **1,053 pcs**

Phase 1: 1053/(1-5%)= 1108.42 pcs. Rounded up to **1,109 pcs**

7.3. Direct Material Budget

No change for some costs: The direct material cost for one product = 1,451.771 VND/unit

Direct Material Budget = The direct material cost for one product x Budget production = 1,451.771 x 1109 = 1,610,014.039 VND

7.4. Direct Labor Budget

No change for some costs: Direct labor cost per item: 13,117 VND

Direct Labor Budget = The direct labor cost for one product x Budget production = 13,117 VND x 1000 units = 13,117,000 VND

7.5. Manufacturing Overhead Budget

Variable manufacturing overhead costs per item (adjust 1,000 items) = Measuring labor cost + Packaging material cost + Transportation cost + Outsourcing cost + Electricity expense = 6,145 + 74 + 368 + 10,000 + 7,633 = 24,220 VND per item

Fixed manufacturing overhead costs per item (adjust 1,000 items) = Depreciation expense for Machine + Depreciation expense for Knife + Depreciation expense for Holder + Depreciation expense for Jig and Fixture (Standard) + Depreciation expense for Jig and Fixture (Special) + Depreciation expense for Measuring tools + Setup cost + Packaging labor + Oil expense = 96,372 + 1,813 + 1,048 + 1,785 + 490 + 418 + 909 + 57 + 368 = 103,260VND per item.

Total manufacturing overhead costs per unit= 24,588+ 102,892=127,480 VND

Variable manufacturing overhead costs	24,220,000 VND
Fixed manufacturing overhead costs	103,260,000 VND
Total manufacturing overhead costs	127,480,000 VND

Table 17: Manufacturing overhead costs

7.6. Cost of good manufactured budget

Cost Components	**Amount (VND)**
Direct Materials Budget	1,610,014.039 VND
Direct Labor Budget	13,117,000 VND
Manufacturing Overhead Budget	127,480,000 VND
Total Cost of good manufactured budget	142,207,014 VND

Table 18: Cost of good manufactured budget

7.7. Projected income statement

Advanced Manufacturing Center Budgeted Income Statement for 2025 (in VND)	
Sales Revenue	157,832,110 VND
Cost of goods sold	142,207,014 VND
Gross Margin	15,625,096 VND
Operating cost	
Administrative Costs	7,891,605,5 VND
Operating income	7,733,490.5 VND

Table 19: Budgeted Income Statement

Gross Margin is calculated as Sales Revenue minus COGS (157,832,110 - 142,207,014 = 15,625,096 VND)

Operating Income is derived by subtracting Operating Cost from Gross Margin (15,625,096 - 7,891,605.5 = 7,733,490.5 VND)

Fixed factory expenses = 157,832,110 VND * 5% = 7,891,605.5 VND

7.8. Assumptions Used in Budget Preparation

To prepare an accurate and practical budget for the production of aluminum brackets, the following assumptions were made:

- **Production Volume**: A total of 1,109 units will be produced to ensure a final output of 1,000 good units, accounting for a 5% defect rate per operation.
- **Efficiency:** Overall Equipment Effectiveness (OEE) is assumed to be 65%, reflecting current operational efficiency levels.

- **Working Schedule**: Production is scheduled for 8 hours per day, 22 days per month.
- **Labor Cost**: The labor rate is 56,840 VND per hour, based on a monthly salary of 10,000,000 VND.
- **Material Waste**: 35% of billet volume becomes scrap. 50% of the scrap value is used to offset material costs.
- **Anodizing**: Anodizing cost is fixed at 10,000 VND per unit.
- **Oil Usage**: The 6 liters are for a scheduled oil change. This would be a situation that change the oil in the machine once a month or after every 500 hours of operation, regardless of whether you made 1,000 units or 1,500 units in that time. The cost driver is a period of time (e.g., once a month) or a large batch threshold. The total cost of 367,500 VND is fixed for that period. It would be a Fixed Manufacturing Overhead.
- **Electricity**: Costed at 33,075 VND per hour.
- **Exchange Rate**: Applied at 24,500 VND per USD.
- **Other Costs**: Packaging, transportation, and setup costs are consistent with historical data.

7.9. The Role of Budgeting

Budgeting is a vital management tool that supports planning, control, and informed decision-making at AMC. It ensures operations align with organizational goals, especially in a vocational context where balancing cost, quality, and training outcomes is key.

For production planning, budgeting helps estimate required resources such as materials, labor, and machine time. This enables timely procurement, efficient scheduling, and proper machine use. At AMC, such planning ensures smooth production while accommodating student training needs.

Budgeting also strengthens cost control. By highlighting major cost drivers—like labor, electricity, and material waste—management can monitor spending and quickly address variances. This keeps operations within budget and supports continuous improvement.

Accurate budgeting also supports pricing decisions. With clear cost data, AMC can set competitive and fair quotations for SME clients. This avoids pricing errors, maintains profitability, and enhances trust with partners while sustaining its educational mission.

8. Recommendations

8.1. Cost Reduction Strategies

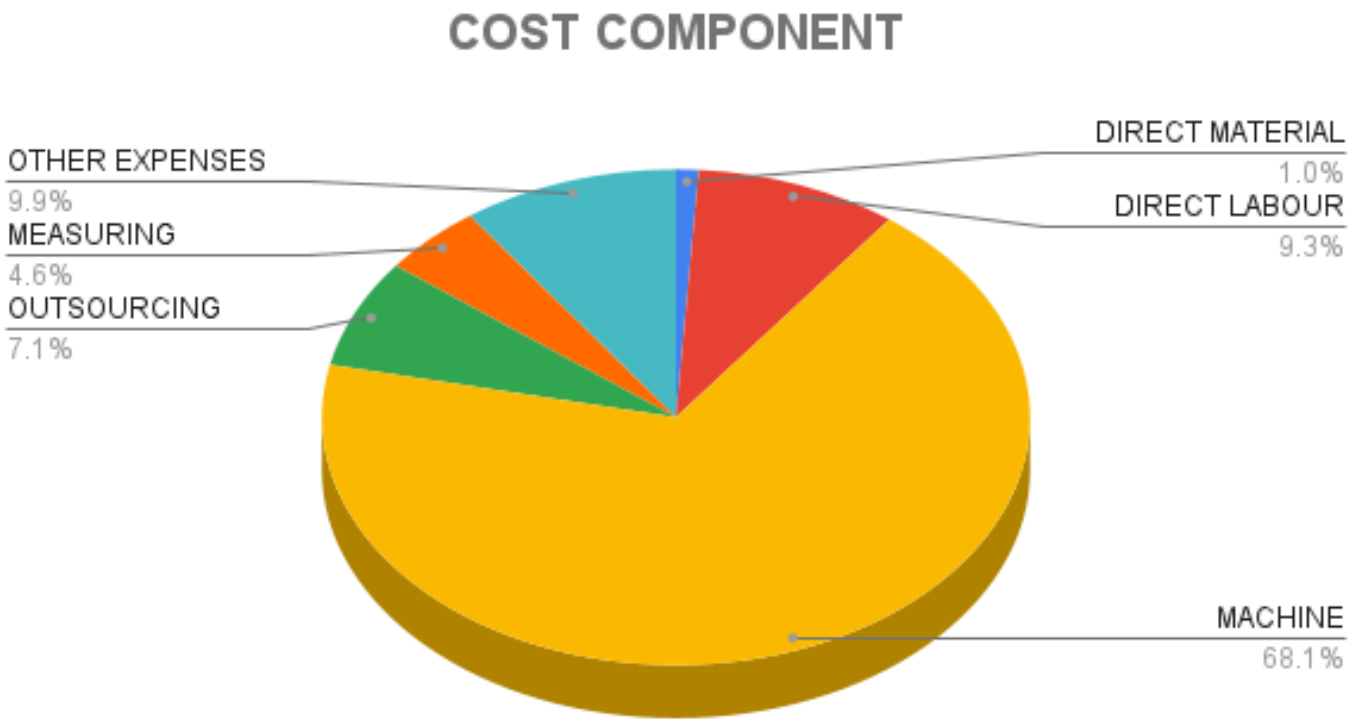

Figure 3: Pie chart of cost components

The current manufacturing cost per unit is heavily influenced by high overhead and specific process costs. The following strategies target the largest cost drivers:

First problem is that the current manufacturing cost per unit is heavily influenced by high overhead and specific process costs, with the largest cost drivers being machine depreciation, setup times, quality defects, and manual measurement processes. The Overall Equipment Effectiveness (OEE) is only 65%, indicating significant losses

due to downtime, slow performance, and defects. To address these issues, targeted strategies can optimize machine utilization, improve quality control, and streamline workflows. The following recommendations focus on reducing setup times, improving quality, and optimizing performance to enhance OEE and lower costs.

To improve OEE, focus on reducing setup times, addressing quality losses, and analyzing performance issues. The 8-hour setup time for each operation significantly contributes to machine downtime. Implementing Single-Minute Exchange of Die (SMED) principles, such as preparing tools, fixtures, and materials for the next operation during the current run, could reduce setup time by over 50%. A 5% defect rate at each stage drives down OEE; adopting Statistical Process Control (SPC) to monitor key dimensions can shift from defect detection to prevention. Additionally, investigating performance losses by optimizing CNC programs (feeds and speeds) and ensuring a consistent material supply can eliminate micro-stops and improve cycle times.

Second problem is high machine depreciation costs, so it should re-evaluate machine depreciation allocation. It shows a problem that the depreciation of the MAKINO F5-PRO6 machine accounts for 96,372 VND per unit, making it the single largest cost component. This high cost is due to a very expensive, high-precision machine being allocated to a relatively simple part over a short 5-year accounting life. To solve it, the most effective way to reduce the per-unit depreciation cost is to run more jobs on the machine. By increasing the total production hours across various projects, the fixed annual depreciation cost is spread over a larger base, lowering the hourly rate and the cost allocated to each part.

Thirdly, the problem is the current use of a single machine for sequential operations (OP1 and OP2) creates a significant bottleneck, resulting in a lead time of nearly 38 days. To address this, implementing parallel processing by acquiring a second, less expensive CNC machine dedicated to OP2 would allow both operations to run simultaneously, potentially halving the lead time and doubling the production capacity. Additionally, arranging the two machines into a U-shaped manufacturing cell would enable a single operator to manage both operations, improving product flow, reducing material handling, and increasing labor productivity. Furthermore, investigating the design of a custom fixture to hold the part for machining both top and bottom faces in a single

setup could eliminate the second 8-hour setup and associated handling, significantly reducing lead time and costs.

The fourth problem is the manual measurement process, requiring 180 seconds per part and performed on 100% of units, is time-consuming, costly at 6,145 VND per unit in labor, and susceptible to human error. To streamline this, equipping the MAKINO F5-PRO6 with a touch-probe system for in-machine probing would enable automated measurement of critical dimensions post-machining, offering faster and more repeatable results than manual methods. Additionally, developing simple go/no-go gauges for quick manual checks would allow operators to verify part quality in seconds, replacing time-intensive caliper and indicator measurements. Once the process is stabilized using Statistical Process Control (SPC), transitioning to a statistical sampling plan, such as inspecting one part in every ten, would significantly reduce measurement time and labor costs, enhancing overall efficiency.

For the remaining cost, we suggest some cost reduction strategies. The anodizing cost is 10,000 VND per unit, the second-largest overhead cost. This external process cost significantly impacts the final price. So, investing in in-house anodizing equipment can eliminate the current outsourcing cost of 10,000 VND per unit, potentially saving 5,000 to 7,000 VND per unit for larger production runs. Negotiating better scrap sale prices, currently at 25,000 VND/kg, could increase the scrap value offset from 50% to 75%, reducing material costs by 20-30 VND per unit. Streamlining setup and measurement processes by using quick-change fixtures or modular jigs could cut setup time from 8 hours to 4-6 hours, saving up to 8,000 VND per unit, while implementing automated measurement tools like Coordinate Measuring Machines (CMMs) could halve labor costs associated with measurement. Additionally, consolidating packaging deliveries and negotiating bulk discounts can reduce packaging and transportation costs, potentially saving 50-100 VND per unit.

8.2. Efficiency Improvement

The current process has significant opportunities for improvement, primarily related to machine utilization, quality control, and workflow.

To enhance manufacturing efficiency at the Advanced Manufacturing Center (AMC) for producing machined aluminum brackets, several strategies can be implemented. First, optimizing Overall Equipment Effectiveness (OEE), currently at 65%, is critical. Real-time optimization models enable manufacturing systems to dynamically adjust disrupted plans and schedules by leveraging up-to-date information on machine and operational status from the shop floor, supporting predictive maintenance for the MAKINO F5-PRO6 machine, which uses real-time monitoring to schedule maintenance during non-production hours, minimizing unexpected breakdowns (Ghaleb et al., 2021). Conducting a time study to identify bottlenecks in the machining and handling processes (330 seconds for Operation 1, 210 seconds for Operation 2) and optimizing CNC programming or upgrading cutting tools can reduce cycle times.

Manual human inspection often leads to visual errors, allowing defective products to go unnoticed and proceed through the production process (Vivek et al., 2022). To address this, a Machine Vision System (MVS) is employed to inspect finished parts, such as bearings, using cameras and image processing techniques to accurately identify defects (Vivek et al., 2022). This directly supports the claim that automated vision systems can reduce the 5% defect rate per operation by replacing error-prone manual inspections with precise, automated defect detection. Thereby enhancing product quality and production reliability and reducing manual measurement time (currently 180 seconds per item), minimizing human error. These efforts could increase OEE to 80%, reducing production time from 37.5 to approximately 30.5 days for 1,300 units, saving labor and overhead costs. Second, streamlining setup and measurement processes is essential. Using quick-change fixtures or modular jigs can cut setup time from 8 hours to 4-6 hours, saving 4,000-8,000 VND per unit in setup labor costs (currently 700 VND/unit). Investing in automated measurement tools, like coordinate measuring machines (CMMs), can reduce measurement time to under 60 seconds per item, potentially halving measuring labor costs (currently 6,145 VND/unit). Operator training to perform setups and measurements more efficiently can further reduce labor time.

Third , minimizing material waste is key. Redesigning the billet layout to nest parts more efficiently during cutting can reduce scrap from 35% to 25%, saving approximately 30 VND/unit. Enhancing machining accuracy

to lower the defect rate to 2-3% can reduce the number of ingots needed from 1,442 to around 1,350 for 1,300 units, saving approximately 100,000 VND in total material costs. Negotiating better scrap sale prices (currently 25,000 VND/kg) or finding buyers paying closer to market rates can increase the scrap value offset from 50% to 75%, reducing material costs by 20-30 VND/unit.. Finally, reducing variable overhead costs can yield significant savings. Using energy-efficient settings on the MAKINO F5-PRO6 or scheduling production during off-peak electricity hours can cut electricity costs (currently 33,075 VND/hour) by 10%, saving 764 VND/unit. Investing in in-house anodizing equipment can eliminate outsourcing costs (10,000 VND/unit), potentially saving 5,000-7,000 VND/unit for high-volume orders. Negotiating bulk discounts or consolidating deliveries for packaging materials (57 VND/unit) and transportation (283 VND/unit) can save 50-100 VND/unit. These combined strategies could reduce total manufacturing costs by 10-15%, improve production speed, and enhance AMC's competitiveness in serving SMEs and startups.

8.3. Future Considerations

AMC should continue monitoring key production metrics, such as Overall Equipment Effectiveness (OEE), defect rates, and material waste, to ensure operational efficiency. Implementing real-time tracking systems would enable the collection of actionable data, facilitating informed decision-making for cost management and process improvement. Additionally, to further reduce labor costs and enhance efficiency, AMC could consider investing in automation technologies, such as robotics or advanced machining equipment. These technologies would streamline processes, minimize reliance on manual labor, and significantly decrease variable overhead costs.

To enhance cost accuracy, AMC should refine its Activity-Based Costing (ABC) model by transitioning to a more granular system. Instead of using a single overhead rate, distinct cost pools should be established for activities such as setup labor and machine time, machining run-time, manual inspection, programming and engineering, and material handling. This approach will accurately reflect the true cost of different jobs, ensuring that complex parts requiring extensive programming and long setups are priced appropriately compared to simple, high-volume parts. By preventing simple jobs from subsidizing complex ones, this model will enable

more competitive and profitable quotations. Additionally, AMC should adopt a dynamic pricing strategy, moving away from a rigid "cost-plus" model. This flexible strategy should consider factors like machine availability, charging a premium for high-demand equipment like the MAKINO machine during peak times, customer value based on precision or quick turnaround, and strategic discounts for high-volume orders or long-term partners. By aligning prices with market demand and customer value, this approach will maximize revenue and profitability, positioning AMC as a more commercially astute operation.

To optimize operations, AMC should adopt lean manufacturing principles to eliminate waste across all production processes, encompassing not only material waste reduction but also streamlining workflows, eliminating unnecessary production steps, and boosting labor productivity. Additionally, as AMC aims to scale production for larger orders, implementing flexible, scalable production systems will be crucial to maintain cost-efficiency without sacrificing quality. These systems should quickly adapt to varying product types or order volumes, supporting future growth while keeping costs manageable. Furthermore, to ensure sustainable cost management, AMC could explore cost-effective raw material sourcing strategies, such as negotiating bulk purchasing agreements or forming partnerships with other manufacturers to secure better pricing, thereby enhancing overall cost efficiency.

9. Conclusion

The comprehensive analysis of cost calculation and budgeting practices at the Advanced Manufacturing Center (AMC) underscores the critical role of precise financial management in the production of a machined aluminum bracket. By employing job-order costing as its primary method, AMC ensures meticulous allocation of costs, encompassing direct materials, direct labor, and manufacturing overhead.

The systematic approach to data collection, which includes direct observation, departmental records, and internal reports, facilitates the accurate capture of all relevant cost elements. This thorough process, incorporating realistic production assumptions such as machine depreciation, labor rates, and material waste, results in an accurate quotation price and a detailed production budget.

The report not only highlights current practices but also identifies opportunities for cost reduction and efficiency improvements. These insights are instrumental in supporting AMC's mission to offer competitive pricing to small and medium-sized enterprises while maintaining high-quality standards.

In conclusion, accurate cost calculation in manufacturing is essential for informed pricing decisions, operational transparency, and effective budgeting. For AMC, precision in cost accounting enhances competitiveness and builds trust with clients and stakeholders. This foundation is vital for sustaining profitability, optimizing production processes, and driving strategic business growth in a competitive manufacturing landscape.

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Appendices

Appendix A: Detail Capacity

The formulas are based on:

Cycle Time = Machining Time + Handle Time

OEE adjusts the theoretical output to account for availability, performance, and quality.

Availability = (Actual Operating Time) / (Available Operating Time)

Performance = (Cycle Time × Total Products) / (Actual Operating Time)

Quality = (Total Good Products) / (Total Products)

OEE = Availability × Performance × Quality

$$OEE = \frac{\text{Cycle Time x Tổng sản phẩm OK}}{\text{Thời gian có hoạt động}} = \frac{\text{Cycle Time x Tổng sản phẩm x (100\% } - \%NG)}{\text{Thời gian có hoạt động}}$$

Group Contribution Form

Cost Accounting (ACTG 360)

Group Project (20% of TOTAL MARKS)

Please write the names of all of your group members and evaluate the degree to which each member fulfilled his/her responsibilities for completing the group project report. This contribution form must be submitted together with the group project. The possible ratings are as follows:

Excellent (5) Consistently did what he/she was supposed to do, very well prepared and cooperative.

Very Good (4) Usually did what he/she was supposed to do, acceptably prepared and cooperative.

Good (3) Often did what he/she was supposed to do, minimally prepared and cooperative.

Borderline (2) Sometimes failed to show up or contribute to group planning/report and discussions.

Lacking (1) Consistently failed to show up or contribute to group planning/report and discussions.

No Contribution (0) No participation at all.

NOTES:

Each group submits one contribution form in which all members of the group agree on the rating of all members.

These ratings should reflect each individual's level of participation, effort, and sense of responsibility, not his or her academic ability.

Group members with legitimate excuses for missing participation/meetings can make up his/her missed contribution by contributing more to other tasks.

It is up to the group to determine a fair process. Rating is as follow:

5 marks-no deductions

4 marks-10% deduction

3 marks-20% deduction

2 marks-40% deduction

1 mark-60% deduction

0 mark-no contribution, no marks.

Name	**Rating**	**Signature**
Đinh Nho Thanh Bình	5 marks	
Nguyễn Đỗ Xuân Ái	5 marks	
Bùi Thanh Thúy	5 marks	
Phạm Thị Minh Hiền	5 marks	
Nguyễn Hoàng Phong	5 marks	