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EVALUATING ALTERNATIVE PRODUCTION STRATEGIES FOR CLAMP SADDLE PRODUCTS TO IMPROVE PROFITABILITY: A CASE STUDY OF PT SENTRA PIPA NUSANTARA

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Abstract

The plastic piping industry depends on a complete portfolio of pipes and fittings to serve infrastructure, clean-water distribution, and industrial applications. PT Sentra Pipa Nusantara (a disguised name) completes part of its fitting portfolio through imported products, including the clamp saddle 63 mm × 1¼" that is currently purchased as a finished good under a third-party Malaysian brand. Although operationally simple, this import-based model limits the company's control over product cost, brand ownership, and product design, and exposes profitability to supplier price, exchange-rate movement, and landed-cost components. At present the import model yields only about a 20% markup over cost (16.7% gross margin on the net selling price), and management has formally mandated a feasibility study to assess whether in-house production or contract manufacturing of an own-brand product could improve profitability. The study therefore addresses a clear managerial problem: under a constrained selling price, profitability improvement depends on the company's ability to reduce unit cost and strengthen its sourcing strategy. This study compares three production-strategy alternatives, namely continuing to import, in-house production, and contract manufacturing (an indicative tolling or makloon scenario) and pursues three objectives: to compare the alternatives in terms of unit cost and unit margin against the net selling price; to test the sensitivity of each alternative to selected key cost drivers; and to recommend the most feasible strategy through a weighted multi-criteria feasibility assessment. The analysis proceeds in three connected stages. First, the unit cost of each alternative is built on a common per-acceptable-unit basis: import through a total landed-cost approach, in-house production through manufacturing-cost decomposition with units-of-production tooling allocation, and contract manufacturing through the indicative tolling scenario. Subsequently, the unit margin and margin ratio are then calculated against the actual net selling price. Second, a threshold sensitivity analysis varies five declared cost drivers (resin price, exchange rate, contract-manufacturing fee, reject rate, and tooling investment) one at a time to test the robustness of the ranking. Third, a weighted scoring matrix following the Simple Additive Weighting method integrates three quantitative criteria (comparative cost and margin, sensitivity robustness, and investment or MOQ commitment) and four qualitative criteria (implementation readiness, vendor dependency, market and customer acceptance, and intellectual-property consideration). Primary data were obtained through semi-structured interviews and internal consultations across the relevant functions, while the contract-manufacturing scenario and the reject rate were treated as validated planning assumptions; product quality was treated as a mandatory baseline and the recommendation as decision support rather than a final commercial decision. The results show that in-house production is the most economical and the most profitable route. It carries the lowest unit cost (Rp 19,208 per unit) and the widest unit margin (Rp 21,958, a 114.3% markup over cost), ahead of contract manufacturing (Rp 24,905; Rp 16,261; 65.3%) and import (Rp 34,305; Rp 6,861; 20.0%); both own-brand routes clear the 20% management target, whereas import only meets it at the threshold. This advantage is robust: across all eleven sensitivity scenarios in-house production remains the lowest-cost option and the ordering in-house < contract manufacturing < import is never reversed, with resin price the dominant driver for the own-brand routes and the exchange rate for import. In the weighted assessment, in-house production records the highest validated score (4.60 out of 5.0, against 2.72 for contract manufacturing and 2.46 for import) while staying within the Rp 300 million investment limit. The study therefore recommends a staged transition from import to in-house production of an own-brand clamp saddle, executed through a stage-gate roadmap and escalated to the CEO for the final go or no-go decision, with contract manufacturing retained as a fallback. The contribution of the study is a transparent and replicable evaluation framework — combining unit-cost build-up, threshold sensitivity, and a

validated weighted scoring matrix — that can be applied to other imported fittings to support margin-improvement decisions.

Keywords: *Cost-margin analysis, Feasibility assessment, Make-or-buy, Margin improvement, Production strategy, Sensitivity analysis*

Introduction

This chapter presents the background of the study, the profile of PT Sentra Pipa Nusantara, the business issue, the research questions and objectives, and the research scope and limitation. Together, these sections establish why the evaluation of alternative production strategies for the clamp saddle 63 mm x 1 1/4″ product is relevant to the company's profitability improvement.

Background

The plastic piping system industry plays an important role in supporting infrastructure development, clean water distribution, irrigation, housing, telecommunication networks, and industrial applications. In this industry, pipe fittings are not merely complementary products, but essential components that support the completeness and reliability of piping system solutions. Therefore, companies operating in PVC and HDPE piping systems need to maintain a competitive and complete product portfolio to serve various customer and project requirements.

PT Sentra Pipa Nusantara is a plastic piping system company that manufactures and distributes PVC and HDPE pipes and fittings for various applications. To complete its product portfolio, the company does not only rely on internally manufactured products, but also sources selected products through import. This approach enables the company to offer a broader product range without having to manufacture every product internally.

Figure I.1. Existing Imported Clamp Saddle 63 mm x 1 1/4" Product under brand from Malaysia

However, the import model also limits the company's ability to control product cost and improve product margin. Since the products are purchased as finished goods, the cost structure is influenced by supplier price, logistics cost, import-related cost, exchange rate movement, and other landed cost components. When the selling price is relatively constrained by market competition, profitability improvement depends strongly on the company's ability to reduce product cost or improve its sourcing and production strategy.

From an operations and supply chain management perspective, profitability can be improved not only through higher sales, but also through cost reduction and operational efficiency. Jacobs and Chase (2018) explain that operations and supply chain initiatives that reduce cost can directly affect firm profitability. They also explain that companies need to define priorities, initiatives, implementation projects, and resources required to execute operations and supply chain strategy (Jacobs & Chase, 2018). This perspective is relevant to the current issue because PT Sentra Pipa Nusantara aims to evaluate whether alternative production strategies can improve the margin of clamp saddle products while maintaining product value for customers.

The need to evaluate alternative production strategies is supported by internal management direction. Based on the company's Minutes of Meeting, management requires a feasibility analysis for clamp saddle 63 mm x 1 1/4" products by evaluating in-house production and contract manufacturing alternatives (PT Sentra Pipa Nusantara, 2026b). Therefore, the selection of clamp saddle products in this study is not based on a broad Pareto analysis of all company products. Instead, this study responds to a specific management direction that has identified clamp saddle as a product portfolio requiring feasibility calculation. The alternative strategies evaluated in this study involve the potential transition from imported third-party products to own-brand clamp saddle products under PT Sentra Pipa Nusantara's brand. This transition may provide greater product control, including limited improvement of selected product features to support better field application. However, product quality improvement is treated only as a supporting design consideration, while the main focus remains on unit cost, unit margin, sensitivity and feasibility comparison.

The proposed own-brand product design should also consider intellectual property aspects to avoid potential infringement issues. In this study, intellectual property consideration is treated as a preliminary design requirement and is also evaluated as one of the qualitative criteria in the weighted multi-criteria feasibility assessment. This project thesis focuses on comparing three production strategy alternatives for the clamp saddle product: continuing import, in-house production, and contract manufacturing. The analysis compares the alternatives in terms of unit cost and unit margin against net selling price, followed by sensitivity analysis on selected key cost drivers and a weighted multi-criteria feasibility assessment that is validated by the Director of Business Development and Research & Development as the problem owner. The validated recommendation is then escalated to the CEO, who holds the authority for the final go-or-no-go decision; the output of this thesis is therefore a decision-support recommendation rather than the final commercial go-or-no-go decision itself.

Company Profile

This section describes the profile of PT Sentra Pipa Nusantara, covering the company overview, history, corporate values, vision and mission, organizational structure, and product portfolio, to provide the organisational context of the study.

Company Overview

PT Sentra Pipa Nusantara (PT SPN) is a disguised company name used in this thesis due to confidentiality requirements. The actual company is part of a manufacturing and distribution group in Indonesia that focuses on providing piping system solutions. The company began operations in 1979 in Jakarta and has developed into one of the pioneers in the national piping industry. The company provides piping system products for household, infrastructure, industrial, and large-scale utility applications, including uPVC, PE, and PP-R materials, supported by accessories such as fittings and valves. The company's products are primarily sold in the domestic market in Indonesia, including retail, project, industrial, and infrastructure customers (PT Sentra Pipa Nusantara, 2026a).

The company operates with the support of German-based production technology (Krah pipe) and a strict quality control system to produce pipes and piping components (SNI, ISO, etc). Along with the development of the group, PT Sentra Pipa Nusantara has expanded its business operations and manufacturing capacity. The group currently consists of more than a dozen business entities with approximately 1,400 employees. The company operates two main manufacturing facilities: one factory in Bogor, West Java, and another modern factory in Mojokerto, East Java, which supports distribution capacity and market demand in Eastern Indonesia.

Company History

The history of PT Sentra Pipa Nusantara began with the business activities of its founder in the early 1960s through a trading business in Central Jakarta. The business initially traded various goods, including sanitary products and piping-related products. A major transformation occurred in 1979 when PT Sentra Pipa Nusantara was officially established in Jakarta and began producing uPVC pipes through its first factory. In the early 1990s, the company expanded its production portfolio to include PE pipes for several applications, such as clean water distribution, wastewater, telecommunication cable protection, electrical installations, and gas applications. These products were developed to comply with relevant national and international standards. In 1993, the company strengthened its manufacturing and distribution capability by constructing a modern factory in Bogor as part of its strategy to expand its national production network.

The company's growth was further supported by several quality and industry achievements. In 2003, the company obtained ISO 9001 certification, reflecting its commitment to quality management. In 2007, the company received a MURI record as the first manufacturer in Indonesia to produce PE pipes with a diameter of 1,200 mm. The group continued to expand its production reach by establishing a second factory in Mojokerto in 2018. In addition, the company strengthened its commitment to quality, safety, and sustainability through certifications such as ISO 14001, Green Label Indonesia, and SMK3. Through this development, PT Sentra Pipa Nusantara has grown into an integrated piping solution provider with a broad portfolio of pipes, fittings, valves, sanitary products, and supporting services.

Corporate Value

PT Sentra Pipa Nusantara applies leadership values summarized as RIGHT, which consists of Responsibility, Improvement, Good Adaptability, Honesty and Respect, and Teamwork.

Responsibility reflects the company's expectation that employees are highly motivated to contribute to the company's success, work collaboratively with coworkers, commit to their duties and responsibilities, uphold work ethics, and comply with company regulations.

Improvement emphasizes the ability to identify problems, formulate solutions, resolve issues thoroughly, and continuously improve work processes to prevent recurring problems and maintain operational stability.

Good Adaptability reflects the company's commitment to following technological developments and global trends in the piping industry. Employees are encouraged to seek innovative solutions, improve product and process quality, develop personal skills, and support continuous learning.

Honesty and Respect represents the company's commitment to integrity, reliability, and a respectful work environment. Employees are expected to respect differences, admit and correct mistakes, and report irregularities to management.

Teamwork emphasizes that organizational success is the result of collective effort. The company encourages collaboration, mutual respect among roles, and the exchange of ideas to produce the best solutions.

Vision, Mission, and Strategic Theme

The vision of PT Sentra Pipa Nusantara is: To become a leading manufacturer and distributor of high-quality piping systems in Indonesia.

The company's missions are:

- To provide the most comprehensive piping system solutions.
- To provide the best service to customers.
- To encourage excellence and continuous improvement throughout the process.
- To respect individuals and build teamwork.
- To contribute to the well-being of the nation and society.

The strategic theme of PT Sentra Pipa Nusantara is to transform into one of the most comprehensive and high-quality piping system manufacturers in Indonesia by emphasizing innovation, product development, and sustainable living. This strategy is reflected in the development of high-technology products, such as KRAH pipes based on German licenses. These initiatives strengthen the company's position as a major player in the national piping industry.

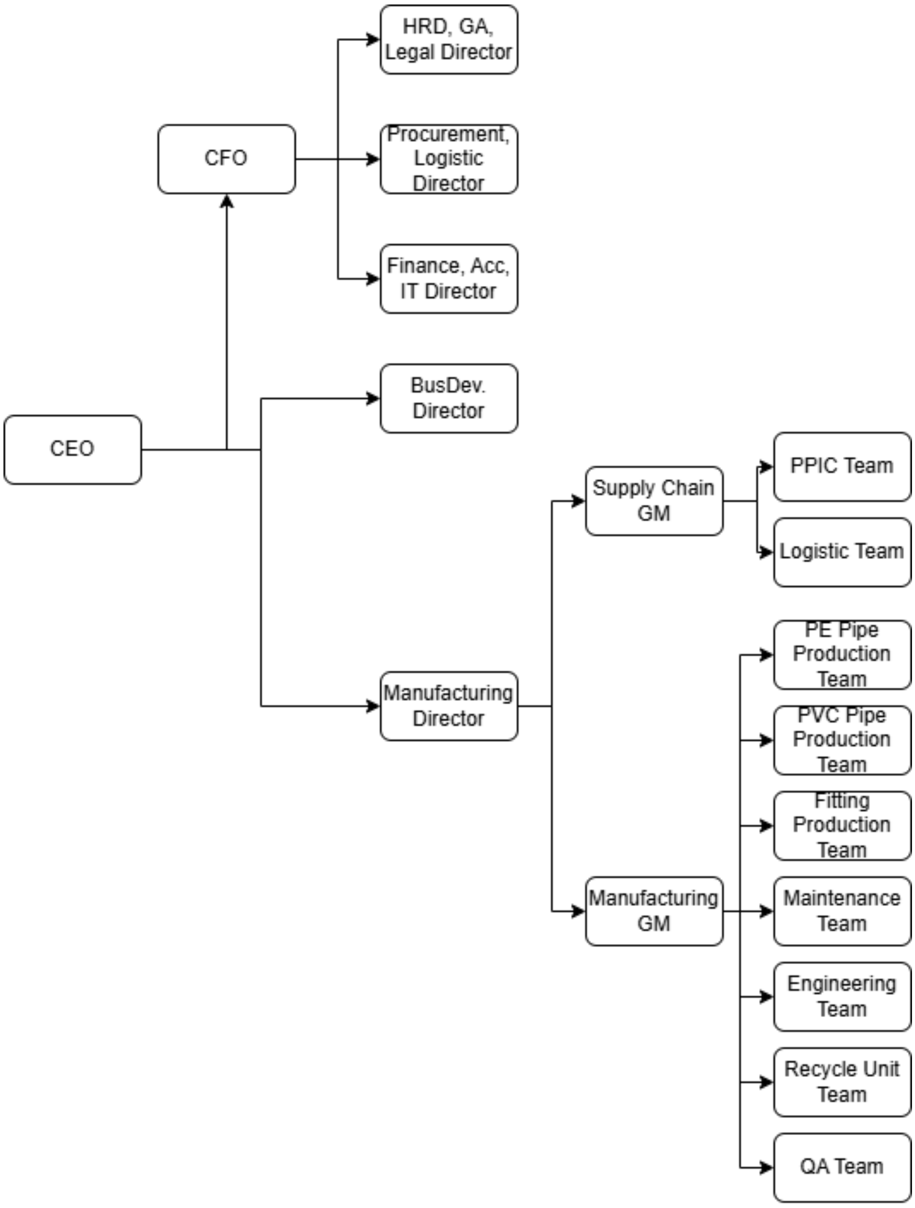

Figure I.2. Sentra Pipa Nusantara Organization Chart

PT Sentra Pipa Nusantara has a functional organizational structure that separates corporate-level and operational-level responsibilities. At the top level, the company is led by the CEO, who is responsible for setting the overall strategic direction of the company. The CEO oversees several key managerial functions, including the Chief Financial Officer, the Director of Business Development, and the Director of Manufacturing. This structure reflects the company's emphasis on finance, business development, and manufacturing as important pillars in implementing long-term operational and growth strategies. The manufacturing function is coordinated by the Manufacturing Director and is supported by managerial roles related to supply chain and manufacturing operations. The Supply Chain General Manager is responsible for material planning, goods flow management, production scheduling through Production Planning and Inventory Control, and logistics coordination. Meanwhile, the Manufacturing General Manager leads production activities and ensures the achievement of quality, capacity, and efficiency targets.

Although this study does not focus on machine utilization or detailed production operations, the organizational structure remains relevant because the decision to transition from import to in-house production or contract manufacturing requires cross-functional coordination. In this thesis, the key stakeholders are Management, Accounting, Purchasing, Procurement, Sales, R&D, Production, and Legal. The Director of Business Development and Research & Development acts as the problem owner and validates the sensitivity analysis and the managerial reasonableness of the final weighted scoring matrix, after which the validated recommendation is escalated to the CEO, who holds the authority for the final go/no-go decision; Accounting supports net selling price, import cost, landed cost, exchange-rate basis, import duty, and material price references; Purchasing supports mold cost estimate and tooling references; Procurement supports the indicative contract manufacturing scenario, contract fee logic, MOQ assumption, and tooling arrangement; Sales supports field and customer acceptance considerations; R&D supports product specification and design consideration; Production supports reject rate, manufacturability, and implementation readiness; and Legal supports preliminary intellectual property confirmation.

Products

PT Sentra Pipa Nusantara has a comprehensive product portfolio in the piping industry, covering various types of pipes and fittings for residential, commercial, industrial, and large-scale infrastructure applications. The company's main pipe products include PE pipes, PVC pipes, and PP-R pipes, each designed to meet relevant national and international quality standards. PE pipes are widely used for clean water distribution networks, irrigation systems, cable protection, and underground utility applications due to their flexibility and durability. PVC pipes are one of the company's core products and are commonly used for clean water, wastewater, sanitation, and public installation applications. PP-R pipes are primarily used for hot and cold-water piping systems in domestic and industrial sectors due to their thermal resistance.

In addition to pipes, the company also produces various types of fittings as essential components in piping connection systems. Injection Molded PE fittings and Injection Molded PVC fittings are produced using injection molding machines. Segmented PE fittings are manufactured through a fabrication process using PE pipe sections formed according to technical requirements, making them suitable for large-diameter applications or special connection configurations. Handmade PVC fittings are produced manually using fabrication techniques, allowing the company to provide connection shapes that cannot be produced through conventional molds.

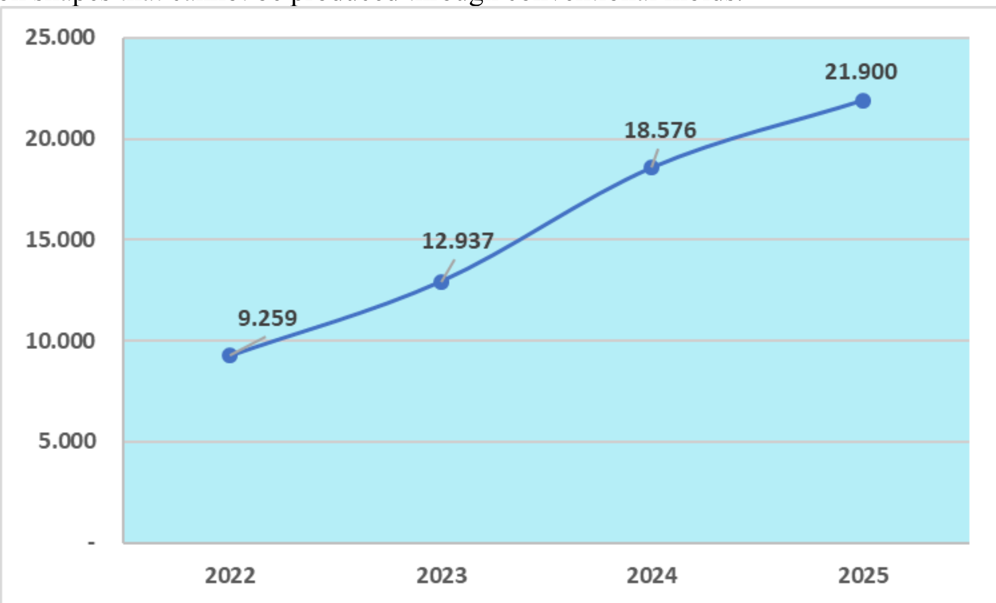

Figure I.3. Sales History of Clamp Saddle 63 mm x 1 1/4" (2022-2025)

Business Issue

The main business issue in this study is the limited opportunity to improve unit margin and product control under the current import-based sourcing model for the clamp saddle 63 mm x 1 1/4". At present, PT Sentra Pipa Nusantara purchases the product as a finished good from a third-party Malaysian brand and sells it in the domestic market. This model is operationally simple because the company does not need to prepare mold investment, production resources, direct labour, internal manufacturing processes, or local production quality-control setup. However, the model also limits the company's ability to control product cost and develop its own product identity. The final import cost is influenced by supplier CIF price, exchange rate movement, customs clearance, domestic logistics, and other landed-cost components. In addition, product specification and brand ownership remain controlled by the external supplier.

Based on internal cost information from accounting and the actual net selling price currently applied by the company, the current import-based clamp saddle model generates approximately 20% markup over cost, equivalent to 16.7% gross margin on net selling price. This margin is used as a baseline benchmark for evaluating whether in-house production or contract manufacturing can provide margin improvement. This issue is also supported by a formal internal management direction. Based on the company's Minutes of Meeting, management mandates a feasibility analysis for selected clamp saddle products by evaluating in-house production and contract manufacturing alternatives. Therefore, the selection of these clamp saddle products is mandatory and justified by management direction, rather than derived from a general product screening process. This also explains why the study does not conduct Pareto analysis across all company products.

The alternative strategy is to evaluate whether the company should continue importing the existing product or transition to own-brand clamp saddle products through in-house production or contract manufacturing. In-house production may provide greater control over cost, quality, and product design, but it requires investment in mold, tooling, production preparation, and operational readiness. Contract manufacturing may provide a middle option by allowing own-brand production with lower operational burden than in-house production, although it still requires vendor capability, quality control, and possible tooling investment.

The issue is not that importing is automatically unfavorable. Import may remain the most reasonable option if in-house production or contract manufacturing does not generate sufficient margin improvement, requires excessive investment, or creates implementation risk. Therefore, this study compares the three alternatives objectively using a structured feasibility analysis. The key stakeholders involved in this business issue are Management, Accounting, Purchasing, Procurement, Sales, R&D, Production, and Legal. These stakeholders provide the data and judgement required for the analysis: Accounting supports selling price and cost inputs, Purchasing and Procurement support mold and contract manufacturing assumptions, Sales supports field/customer acceptance, R&D and Production support technical and implementation feasibility, Legal supports preliminary IP consideration, and the Director of Business Development and Research & Development, as the problem owner, validates the sensitivity analysis and the final weighted scoring matrix before the validated recommendation is escalated to the CEO for the final go/no-go decision.

This study is important because it provides an initial decision-support analysis before the company commits to investment, supplier development, or product transition. Without a structured comparison, the company may select a production strategy based only on assumptions, which may lead to suboptimal margin improvement or unnecessary investment. Therefore, this thesis aims to provide a calculation-based feasibility recommendation that can be used for further internal evaluation.

Research Questions and Research Objectives

Based on the business issue described in the previous section, this study formulates the following research questions and research objectives.

Research Questions

This study aims to answer the following research questions:

- How do import, in-house production, and contract manufacturing alternatives compare in terms of unit cost and unit margin against the net selling price?
- How sensitive are the alternatives to changes in selected key cost drivers?
- Which production strategy should be recommended to support profitability improvement for PT Sentra Pipa Nusantara?

Research Objectives

The objectives of this study are:

- To compare import, in-house production, and contract manufacturing alternatives in terms of unit cost and unit margin against the net selling price.
- To evaluate the sensitivity of each alternative to selected key cost drivers.
- To recommend the most feasible production strategy to support profitability improvement for PT Sentra Pipa Nusantara based on a weighted multi-criteria feasibility assessment.

Research Scope and Limitation

This section defines the boundaries of the study by stating the research scope and acknowledging the research limitations.

Research Scope

- This study focuses on clamp saddle 63 mm x 1 1/4".
- The study compares three production strategy alternatives: import, in-house production, and contract manufacturing .
- The main analysis focuses on unit cost and unit margin. In this study, unit margin is defined as the difference between net selling price and unit cost.
- Sensitivity analysis is limited to selected key cost drivers that directly affect the calculation, such as material price, exchange rate, contract manufacturing fee, reject rate, and mold or tooling investment.

Research Limitation

- This study is limited to preliminary feasibility analysis based on unit cost, unit margin, sensitivity analysis, and a weighted multi-criteria feasibility assessment. It does not represent a final commercial go or no-go decision.
- This study does not conduct sales forecasting, revenue projection, market share estimation, or sales scenario analysis.

- This study does not conduct full financial investment appraisal such as Net Present Value, Internal Rate of Return, discounted cash flow analysis, or detailed payback modelling. Mold and tooling cost are treated as cost components for unit cost comparison based on available assumptions and company data.
- Product quality improvement is limited to preliminary design consideration and does not include detailed engineering design, laboratory testing, or field performance validation.
- Intellectual property consideration is limited to preliminary design awareness and does not constitute formal legal opinion, patent search, or industrial design clearance.
- The actual company name, supplier identity, vendor quotations, and confidential cost data are disguised or presented in a limited manner due to confidentiality requirements.

Literature Review

Theoretical Foundation

Import Product

Import-based sourcing is a production strategy under which a company purchases finished goods from an overseas supplier and resells them in the domestic market. In this study, the import alternative represents the current sourcing model of PT Sentra Pipa Nusantara, where the clamp saddle product is purchased as a finished good from an overseas supplier. This alternative is operationally simple because PT SPN does not need to invest in mold, tooling, production resources, or local manufacturing setup. However, Christopher (2016) explains that global sourcing may involve additional cost and risk factors, such as transportation cost, exchange-rate fluctuation, longer lead time, inventory requirement, quality issues, and supply-chain disruption.

Therefore, the import alternative should be evaluated using Total Landed Cost rather than supplier invoice price only. Pumpe and Vallée (2017) define Total Landed Cost as the total cost associated with obtaining a product, including transportation, inventory, administration, customs, risk and damage, handling, and packaging. Monczka et al. (2009) also emphasize that international purchasing requires buyers to consider cost elements beyond purchase price, such as transportation, customs duty, insurance, port handling, customs broker fees, taxes, payment and currency-related costs, and inventory carrying cost. The general cost components considered in the import alternative are summarised in Table II.1.

Table II.1. General Cost Components of the Import Alternative

Cost Component	General Description
Supplier invoice price	Unit price contracted with overseas supplier under chosen Incoterm (e.g., FOB, CIF, DAP)
International freight & insurance	Sea or air freight, container surcharges, marine insurance (excluded if Incoterm already covers them)
Import duty	Tariff applied on customs value, determined by Harmonized System classification and applicable trade agreement
Domestic taxes on import	Value-added tax and other import-related taxes applied by the destination country
Customs clearance, brokerage & port handling	Forwarder fees, document handling, customs broker fees, port handling
Inland transportation	Transportation from port of entry to buyer's facility

In the context of PT SPN, the import alternative offers lower implementation complexity, but it also exposes the company to landed-cost components, exchange-rate movement, logistics and customs-related costs, and limited control over supplier-owned product specification and brand. Therefore, import is treated as the current baseline alternative in this thesis.

In-House Production

In-house production is the alternative under which a firm manufactures the product internally using its own equipment, tooling, labour, and management systems. In managerial cost accounting, manufacturing cost is commonly classified into direct material, direct manufacturing labour, and manufacturing overhead. Manufacturing overhead includes indirect manufacturing costs that cannot be directly traced to a specific unit, such as indirect materials, indirect labour, utilities, maintenance, depreciation, and other factory-related support costs (Datar & Rajan, 2021; Garrison et al., 2018). For this study, this classification is relevant because the in-house alternative requires PT Sentra Pipa Nusantara to estimate the cost of resin, direct production labour, utilities, overhead, packaging, and product-specific tooling. For injection-moulded plastic products, the cost build-up also depends on process-related variables. Kazmer et al. (2023) model the economic cost of injection molding by considering machine cost, mold cost, material cost, energy cost, labour cost, processing time, and production quantity. Their analysis also shows that the economic attractiveness of injection molding is strongly affected by mold cost, labour cost, and part size. Therefore, the in-house unit-cost build-up in this study includes the variables summarised in Table II.2.

Table II.2. General Cost Variables of the In-House Production Alternative

Cost Variable	Definition
Direct material	Raw material consumed per unit (e.g., polymer resin in injection moulding)
Direct labour	Operator and QC labour directly attributable to production
Variable manufacturing overhead	Utilities, consumables, machine maintenance scaling with output
Fixed manufacturing overhead	Rent, supervision, equipment depreciation within installed capacity
Mold and tooling investment	Capital expenditure for product-specific tooling, allocated to unit cost via depreciation method
Packaging and ancillary	Per-unit materials beyond the primary moulded part (packaging, assembly parts)
Reject / scrap rate	Estimated proportion of output that does not meet specification and increases the effective cost per good unit
Cycle time	Time required per production cycle, determining output rate per machine-hour

Mold and tooling investment requires specific treatment because it is incurred upfront but supports multiple units of production. Following the cost allocation and unit-cost logic in managerial cost accounting, this study allocates tooling cost to unit cost based on the expected useful production output rather than charging the full investment to one production period (Datar & Rajan, 2021; Kazmer et al., 2023). Strategically, in-house production offers greater internal control over manufacturing activities and product development decisions. Friedrich et al. (2022) show that firms may prefer in-house governance when they want to protect intellectual property, retain or develop internal competencies, and build internal learning. In the context of PT Sentra Pipa Nusantara, these arguments are relevant because the own-brand clamp saddle initiative requires control over product specification, tooling commitment, and future design improvement. However, the in-house alternative also exposes the company to tooling investment risk, capacity utilisation risk, production yield risk, and direct exposure to raw-material price changes.

Contract Manufacturing

Contract manufacturing is a sourcing alternative in which a firm delegates the physical production process to an external manufacturing partner while retaining responsibility for product specification, brand positioning, and market distribution. In this study, contract manufacturing refers to the indicative makloon alternative for PT Sentra Pipa Nusantara's own-brand clamp saddle product. This alternative differs from import because the product is intended to be sold under PT SPN's own brand, and it differs from in-house production because the manufacturing activity is performed by an external party.

In the broader outsourcing literature, outsourcing refers to the transfer of a firm's value-chain activity to an independent provider, from whom the firm procures intermediate or finished goods or services (Lahiri et al., 2022). Lahiri et al. (2022) found that outsourcing has a positive average relationship with firm performance, particularly when the outsourced activity is non-core. This supports the relevance of contract manufacturing as an alternative that may allow PT SPN to access external production capability without fully internalising production assets and operational routines. From a cost perspective, contract manufacturing can be structured according to how production and material responsibilities are allocated between the principal and the manufacturing partner. In toll manufacturing, the principal provides raw materials, while the external manufacturer provides processing facilities and receives a tolling or processing fee (Arora & Hasan, 2020). Therefore, in this thesis, the contract manufacturing cost model is based on the indicative makloon scenario obtained from internal consultation, including the assumptions on material supply, conversion fee, tooling commitment, and related supporting costs. However, contract manufacturing also creates managerial risks. The company must manage coordination, quality control, supplier dependency, and contractual commitment with the external partner. Friedrich et al. (2022) show that make-or-buy decisions should consider governance issues such as intellectual property protection, core-competence retention, internal learning, and dependency on external partners.

Sensitivity Analysis for Key Cost Drivers

A unit cost and margin comparison calculated at a single point in time provides only a base-case view of the relative position of the alternatives. Because several cost inputs may change or may differ from their initial estimates, the base-case comparison should be supplemented by sensitivity analysis. Datar and Rajan (2021) describe sensitivity analysis as a “what-if” technique used to examine how an outcome changes when predicted data are not achieved or when an underlying assumption changes. Similarly, Brigham and Ehrhardt (2008) explain that sensitivity analysis changes one input variable from the base case while holding other variables constant in order to observe how sensitive the decision outcome is to that variable. In this study, sensitivity analysis is used as a supporting tool to test the robustness of the unit cost and unit margin comparison. This is consistent with the managerial accounting view that changes in cost assumptions can affect operating results (Datar & Rajan, 2021). It is also consistent with financial decision analysis, where sensitivity analysis helps identify which assumptions have the greatest influence on the result and therefore require managerial attention (Brigham & Ehrhardt, 2008). Since this thesis does not conduct full NPV, IRR, or sales forecasting analysis, the sensitivity analysis is limited to the effect of selected cost-driver movements on unit cost and unit margin.

The selection of cost drivers is based on the cost structure of each production strategy alternative. For the import alternative, Pumpe and Vallée (2017) emphasise that Total Landed Cost includes supply-chain-related cost elements that may affect the true cost of international sourcing. For the in-house production alternative, Kazmer et al. (2023) show that injection-moulding cost analysis is influenced by process and production-related inputs, including tooling, material, labour, processing time, and production quantity. Therefore, this study applies sensitivity analysis only to cost drivers that are directly relevant to the import, in-house production, and contract manufacturing cost models.

Multi-Criteria Feasibility Assessment

Production strategy decisions should not rely only on cost and margin because sourcing decisions also involve operational, strategic, and supply-related considerations. Cánez et al. (2000) developed a make-or-buy framework to structure the relevant factors in such decisions, while Platts et al. (2002) further operationalised the framework through multi-attribute decision-making. Their process evaluates make-or-buy alternatives across several areas, including technology and manufacturing processes, cost, supply chain management and logistics, and support systems. This view is consistent with more recent sourcing literature. Saputro et al. (2022) reviewed supplier selection studies and showed that supplier selection methods should be linked to the decision context, the available data, the selection criteria, and the solution approach. Medina-Serrano et al. (2020) also support the use of a structured make-or-buy framework combined with multi- criteria decision analysis to help decision makers evaluate sourcing alternatives more systematically. Based on these arguments, this study uses a weighted scoring matrix, also referred to as the Simple Additive Weighting method, to combine quantitative and qualitative considerations into one transparent assessment. This method is suitable for a preliminary feasibility study because it allows the criteria and weights to be proposed on a defensible analytical basis and then validated by the decision owner, rather than requiring large-scale multi-respondent weighting.

Quality and Intellectual Property Considerations

Quality and intellectual property are important considerations in evaluating the feasibility of alternative production strategies. In this study, product quality is treated as a minimum requirement because all alternatives, whether import, in-house production, or contract manufacturing, must meet PT SPN’s acceptable product specification and field application requirements. ISO 17885:2021 specifies requirements and test methods for mechanical fittings used in plastic pressure piping systems (International Organization for Standardization, 2021). Therefore, quality compliance is treated as a mandatory baseline requirement and is not used as a separate differentiating criterion in the weighted scoring assessment. Intellectual property consideration remains relevant because the in-house production and contract manufacturing alternatives involve own-brand product development. In Indonesia, product shape and appearance may be relevant to industrial design protection under Undang-Undang Nomor 31 Tahun 2000 tentang Desain Industri (Republic of Indonesia, 2000). Friedrich et al. (2022) also show that make-or-buy decisions may be influenced by intellectual property concerns, core competencies, learning, and dependency on external partners. Therefore, this study includes intellectual property consideration as one of the weighted feasibility criteria. The IP review in this thesis is limited to preliminary screening through the PDKI database and internal legal consultation, and does not replace a formal legal opinion.

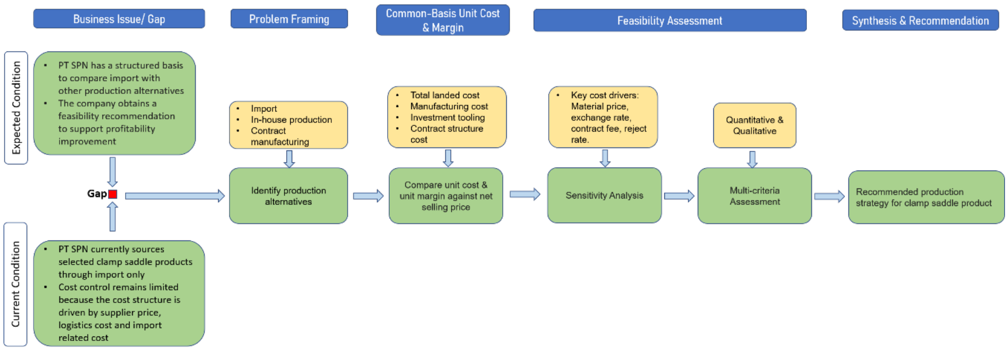

Figure II.1. Conceptual Framework Diagram

The conceptual framework begins by identifying the gap between the current and expected conditions of PT Sentra Pipa Nusantara. The current condition shows that clamp saddle 63 mm x 1 1/4" is sourced through an import-based model, which limits the company's control over product cost, brand ownership, and product flexibility. The expected condition is a structured decision basis that enables the company to compare import, in-house production, and contract manufacturing alternatives in relation to profitability improvement. This gap is translated into an analytical framework that begins with problem framing, where the three production strategy alternatives are defined. Each alternative is then converted into a common basis of comparison through unit cost and unit margin analysis. The import alternative is assessed through landed cost components, the in-house alternative through manufacturing cost decomposition and tooling burden, and the contract manufacturing alternative through an indicative contract manufacturing scenario, contract fee logic, MOQ assumption and tooling arrangement. The result of this unit economic comparison is further tested through sensitivity analysis on selected key cost drivers, including material price, exchange rate, contract manufacturing fee, reject rate, and tooling investment. Finally, the quantitative findings are integrated with qualitative considerations through a multi-criteria feasibility assessment. The criteria used in this assessment are comparative unit cost and margin, sensitivity robustness, investment or MOQ commitment, implementation readiness, vendor dependency, market and customer acceptance, and intellectual property consideration. The final weighted scoring matrix is validated by the Director of Business Development and Research & Development as the problem owner to confirm its managerial reasonableness as preliminary feasibility decision support, after which the validated recommendation is escalated to the CEO, who holds the authority for the final go/no-go decision.

Research Methodology
Research Design

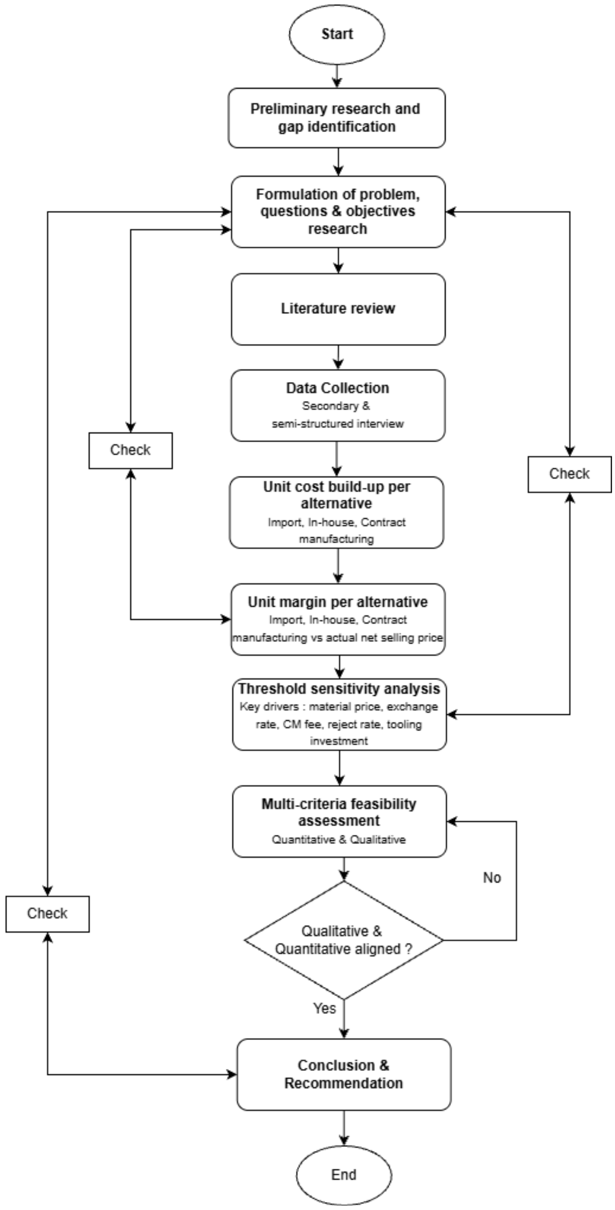

Figure III.1 Research Methodology Flowchart

The research methodology begins with preliminary research and gap identification to understand the main business issue related to the current import-based clamp saddle product. At this stage, the company context is observed, the Minutes of Meeting that mandates the feasibility analysis is reviewed, and the margin and brand-control gap under the current import-based clamp saddle model is identified. These findings are then translated into the formulation of the problem, research questions, and research objectives, where the business issue is formalised, the three production strategy alternatives namely: import, in-house production, and contract manufacturing which are defined, and the research scope and limitations are set. After the research direction is defined, a targeted literature review is conducted to establish the theoretical foundation for the analytical framework, covering total landed cost, manufacturing cost decomposition, contract manufacturing economics, sensitivity analysis, and multi-criteria feasibility assessment.

The next stage is data collection, which uses internal company data, archival documents, and semi-structured interviews with relevant functional representatives. The collected data are then used to build the unit cost for each alternative. After the unit cost is calculated, the unit margin is obtained by comparing each alternative's unit cost with the actual net selling price. This stage is checked against RQ1 to ensure that the analysis answers the comparison of unit cost and unit margin among the three alternatives. After the unit margin comparison is completed, threshold sensitivity analysis is conducted on the key cost drivers, including material price, exchange rate, contract manufacturing fee, reject rate, and tooling investment. This stage is checked against RQ2 to ensure that the analysis explains how sensitive each alternative is to changes in selected cost drivers. The results of the quantitative analysis are then combined with qualitative considerations through a multi-criteria feasibility assessment. The weighted assessment uses the criteria defined from the research questions, research objectives, theoretical foundation, and business issue priority, and applies a 1–5 score for each criterion. The flow includes a decision point, "Qualitative and Quantitative aligned?", to verify whether the qualitative assessment supports the quantitative results. If the results are not aligned, the process returns to the multi-criteria feasibility assessment for re-evaluation. If the results are aligned, the process continues to the conclusion and recommendation. The final weighted scoring matrix, including the criteria, weights, scoring rationale, final score, and recommended alternative, is validated by the Director of Business Development and Research & Development as the problem owner. This validation confirms managerial reasonableness for preliminary feasibility decision support; the validated recommendation is then escalated to the CEO, who holds the authority for the final commercial go/no-go decision.

Data Collection Method

This research uses both primary and secondary data to support the evaluation of alternative production strategies for the clamp saddle 63 mm x 1 1/4" product. Primary data were collected through semi-structured interviews and internal consultations with relevant functional representatives, including Accounting, Purchasing, Procurement, Sales, R&D, Legal, Production, and Management, with the Director of Business Development and Research & Development acting as the problem owner. Secondary data were obtained from internal company documents and archival records. In addition, several analytical assumptions were used for variables that were not available as actual historical records, particularly the indicative contract manufacturing scenario. These assumptions were treated as scenario-based inputs and were validated through internal consultation and sensitivity analysis to maintain the reliability of the methodology.

Primary Data

Primary data in this research refer to information obtained directly through semi-structured interviews and internal consultations conducted for the purpose of this research. The interviews were used to obtain confidential cost inputs, clarify calculation assumptions, validate the feasibility of each alternative, and identify non-financial considerations that could not be fully captured from documents alone and support the final validation of the weighted scoring matrix. To protect confidentiality, the informants are identified only by function or department, not by personal name.

The primary data sources and the information obtained from each function are summarised in Table III.1. The semi-structured interview protocol, which contains the main questions used to guide the interviews and internal consultations, is provided in Appendix A. These interviews support the unit cost build-up, unit margin comparison, sensitivity analysis, and comparative feasibility assessment used in the study.

Table III.1 Summary of Primary Data Sources, Information Obtained, and Use in the Analysis

No.	Interview / Internal Consultation Source	Data and Information Obtained	Use in the Analysis
1	Accounting Representative	Actual net selling price; import cost records; supplier CIF-based cost reference; landed cost components, including freight, customs clearance, forwarding, trucking, import duty, and exchange-rate basis; material price references; and input for relevant threshold sensitivity ranges.	Forms the basis for the import landed cost calculation, net selling price comparison, material cost input for the in-house alternative, and sensitivity analysis on exchange rate and material price.
2	Purchasing Representative	Mold cost estimate; tooling ownership assumption; purchasing reference for tooling and supporting components; input for threshold sensitivity on mold investment	Supports the in-house tooling burden calculation and sensitivity analysis on tooling investment
3	Procurement	input for the indicative contract manufacturing	Supports the contract manufacturing unit cost

No.	Interview / Internal Consultation Source	Data and Information Obtained	Use in the Analysis
		scenario, including contract fee logic, MOQ assumption, and tooling arrangement; input for threshold sensitivity on contract manufacturing fee.	scenario and sensitivity analysis on contract manufacturing fee.
4	Sales Representative	Customer feedback & constraints related to existing imported product and design needs to improve field competitiveness	Support the qualitative feasibility assessment, especially in assessing customer acceptance, field suitability, and potential improvement value.
5	R&D Representative	Product specification, estimated product weight, material requirement, cavity design, estimated cycle time, component requirements such as bolt, nut, rubber seal, and insert, and preliminary product design considerations.	Supports the in-house manufacturing cost decomposition, technical feasibility assessment, and comparison of product-control implications across alternatives.
6	Production Representative	Reject rate assumption, production-readiness consideration, process risk, quality-control requirement, and preliminary assessment of manufacturability.	Supports the effective unit cost calculation, sensitivity analysis on reject rate, and qualitative feasibility assessment for the in-house and contract manufacturing alternatives.
7	Legal Representative	Preliminary intellectual property confirmation and design-awareness input related to potential own-brand clamp saddle development.	Supports the qualitative feasibility assessment, especially the intellectual property consideration criterion.
8	Director of Business Development and R&D (Problem Owner)	Validation of the sensitivity analysis and the final weighted scoring matrix, including the criteria, weights, scoring rationale, final score, and recommended alternative.	Confirms the managerial reasonableness of the assessment as preliminary feasibility decision support; the validated recommendation is then escalated to the CEO, who holds the final go/no-go decision authority.

Secondary Data

The secondary data were collected from internal company documents, internal archival records, academic references, standards, and relevant regulatory or institutional publications. These data were used to complement the primary data and to ensure that the analysis was grounded in both company-specific evidence and relevant theoretical foundations. The secondary data sources used in this study are summarised in Table III.2

Table III.2 Secondary Data Sources and Information Used

No.	Secondary Data Source	Data and Information Used	Use in the Study
1	Minutes of Meeting on Clamp Saddle Feasibility Analysis	Management direction requiring feasibility analysis for the clamp saddle product by evaluating in-house production and contract manufacturing alternatives.	Supports the business issue, problem formulation, and justification for selecting the clamp saddle product as the focus of the study.
2	Company Profile and Organization Structure	Company overview, business scope, product portfolio, organizational structure, and relevant functional roles.	Supports the case background, stakeholder identification, and explanation of cross-functional involvement in the study.
3	Product Documentation of Existing Imported Clamp Saddle	Existing product documentation, product image, current third-party brand context, and product application information.	Supports the product context and the explanation of the current import-based business model.
4	Internal Sales History Record	Sales volume history of clamp saddle 63 mm x 1 1/4" from 2022 to 2025.	Supports product relevance, historical demand context, and the managerial rationale for conducting the feasibility analysis.
5	Standards, Regulations, and Institutional Publications	Relevant references such as plastic piping fitting standards, industrial design regulation, and intellectual property references.	Supports the quality and intellectual property considerations included in the feasibility assessment.

Assumption Treatment

The contract manufacturing alternative is treated as an indicative contract manufacturing scenario. This means that the scenario represents a realistic vendor-based option developed from Procurement input and internal assumptions, but it should not be interpreted as a final binding vendor quotation unless later confirmed by formal quotation documents. Similarly, reject rate and selected operational assumptions are treated as planning assumptions and are tested through sensitivity analysis. The criteria and initial weights used in the multi-criteria feasibility assessment are also treated as researcher-proposed analytical inputs based on the research questions, research objectives, theoretical foundation, and business issue priority. The final weighted scoring matrix is validated by the Director of Business Development and Research & Development as the problem owner to avoid overstating the certainty of the recommendation.

Data Analysis Method

The analysis is organised into three connected components. The first is the unit cost and unit margin analysis, in which the import, in-house production, and contract-manufacturing alternatives are evaluated within a single integrated analytical procedure rather than in separate per-alternative sub-procedures; this is because the comparison is meaningful only when all three alternatives are reduced to the same per-unit basis and compared against the same actual net selling price. The second component is the threshold sensitivity analysis, which tests how changes in selected key cost drivers affect the relative attractiveness of each alternative. The third component is the multi-criteria feasibility assessment, which integrates the quantitative results with qualitative criteria through a weighted scoring matrix. The final score is calculated as the sum of each criterion weight multiplied by the score of each alternative. The final matrix is used to support the recommendation for RQ3; the validated recommendation is then escalated to the CEO, who holds the authority for the final commercial go/no-go decision.

Unit Cost and Margin Analysis

Unit cost and unit margin analysis is used to answer RQ1 by comparing the cost and profitability of the three alternatives on the same per-unit basis. The import alternative is calculated using the total landed cost approach because the product is currently purchased as a finished good from an overseas supplier. The in-house production alternative is calculated using manufacturing cost components, while the contract manufacturing alternative is calculated using an indicative contract manufacturing scenario.

The unit cost of the import alternative is calculated as follows:

UC_import = CIF supplier price + import duty + customs clearance cost + inland logistics cost (III.1)

The unit cost of the in-house production alternative is calculated as follows:

UC_in-house = direct material cost + direct labour cost + electricity cost + manufacturing overhead + tooling allocation + packaging cost (III.2)

Tooling allocation is calculated by allocating the mold and tooling investment over the expected useful production output. This treatment is consistent with injection-molding cost analysis, where mold cost contribution can be expressed on a per-part basis by dividing mold cost by the target production quantity (Kazmer et al., 2023).

The unit cost of the contract manufacturing alternative is calculated as follows:

UC_CM = contract manufacturing fee + material, accessories & packaging cost + inbound and outbound logistics cost (III.3)

To maintain comparability across the three alternatives, each unit cost is expressed on an effective per-acceptable-unit basis by dividing the gross unit cost by one minus the target reject rate, because rejected output still consumes material and processing cost. The target reject rate is provided by the Production representative and is also tested in the threshold sensitivity analysis.

After the unit cost of each alternative is calculated, the unit margin and margin ratio are calculated using the following formula:

Unit margin_i = NSP − UC_i (III.4)

Markup over cost_i = (NSP - UC_i) / UC_i x 100% (III.5a)

Gross margin on NSP_i = (NSP - UC_i) / NSP x 100% (III.5b)

where NSP is the actual net selling price, UC_i is the unit cost of each alternative, Unit margin_i is the unit margin of each alternative, Markup over cost_i reflects the company's internal cost-plus margin convention, Gross margin on NSP_i is the gross-margin ratio of each alternative. This calculation shows which alternative provides the highest margin improvement compared with the current import-based model.

Threshold Sensitivity Analysis

In this research, the key variables tested are material price, exchange rate, contract manufacturing fee, reject rate, and tooling investment. The sensitivity range (%) is determined based on internal interview and consultation inputs while keeping other variables constant. If the ranking of alternatives changes significantly under sensitivity testing, the recommendation must be interpreted with caution. If the preferred alternative remains superior under the sensitivity range, the alternative is considered more robust.

Multi-Criteria Feasibility Assessment

The multi-criteria feasibility assessment is conducted using a weighted scoring matrix, which follows the logic of the Simple Additive Weighting method. This method is selected because it converts each criterion score and weight into a comparable final score, allowing quantitative results and qualitative feasibility considerations to be assessed within one transparent framework. This approach is consistent with Platts et al. (2002), who used weighting and rating to combine multiple make-or-buy factors into an overall multi-attribute recommendation. The criteria and initial weights are proposed by the researcher based on the research questions, research objectives, theoretical foundation, and business issue priority. Seven criteria are used: (1) comparative unit cost and margin, (2) sensitivity robustness, (3) investment/MOQ commitment, (4) implementation readiness, (5) vendor dependency, (6) market and customer acceptance, and (7) intellectual property consideration.

Quantitative criteria, namely comparative unit cost and margin, sensitivity robustness, and investment/MOQ commitment, are scored using calculated outputs from the unit-cost, sensitivity, and commitment analyses. Comparative unit cost and margin is scored using min-max normalisation where a higher margin is more favourable. Investment/MOQ commitment is scored using an inverted min-max scale where a lower commitment is more favourable. Sensitivity robustness is calculated from rank performance and cost stability, as described below. This directional treatment ensures that a higher score always represents a more favourable position across all criteria. The robustness of each alternative is determined by two measurable components obtained from the scenario runs: its rank performance (whether the alternative consistently retains a low-cost position across all scenarios) and its cost stability (how little its unit cost changes when each cost driver is shifted to its low and high case).

The rank performance is expressed as a Rank Value, which converts the alternative's consistent cost ranking across the scenario runs into a normalised value between 0 and 1 using Rank Value = (N − rank + 1) ÷ N, where N is the number of alternatives (here N = 3) and rank is the alternative's cost rank (1 = lowest unit cost). Accordingly, an alternative that is consistently ranked first receives a Rank Value of 1.00.

The cost stability is computed from the spread of the unit cost across all scenarios using Formula III.6:

Stability = 1 − [(Max unit cost − Min unit cost) ÷ Base unit cost] (III.6)

where Base, Min, and Max unit cost are the base-case, lowest, and highest unit cost of the alternative observed across all sensitivity scenarios. A smaller cost spread produces a Stability value closer to 1, indicating a more stable and therefore more robust cost position. The two components are then combined into a Robustness Index and rescaled to the 1–5 scale used in the assessment, following Formula III.7:

Robustness Score = 1 + 4 × (Rank Value × Stability) (III.7)

Qualitative criteria, such as implementation readiness, vendor dependency, market and customer acceptance, and intellectual property consideration, are scored using rubric-based assessment with clearly defined scoring anchors.

The final score of each alternative is then calculated as the sum of the weighted scores across all criteria:

Final Score_i = Σ (Weight_j × Score_ij) (III.8)

where Final Score_i is the total weighted score of alternative i, Weight_j is the weight of criterion j, and Score_ij is the score of alternative i on criterion j.

After the weighted scoring matrix is completed, the overall assessment, including the criteria, weights, scoring rationale, final score, and recommended alternative, is validated by the Director of Business Development and Research & Development as the problem owner. This validation is conducted to confirm that the assessment is managerially reasonable for preliminary feasibility decision support; the validated recommendation is then escalated to the CEO, who holds the authority for the final commercial go/no-go decision.

Results and Discussion

This chapter presents the results and discussion of the feasibility analysis for the clamp saddle 63 mm × 1¼" product, following the analytical framework established in Chapter II and the methodology defined in Chapter III. It first presents the analysis of the three alternatives through unit cost, unit margin, sensitivity, and multi-criteria feasibility assessment. It then translates the analytical output into a business solution and concludes with an implementation plan and justification. This structure follows the project-thesis guidance that Chapter IV should contain Analysis, Business Solution, and Implementation Plan & Justification.

Analysis

The analysis begins from the confirmed data inputs collected from the relevant company functions and applies the unit cost formulas (Formula III.1 to III.3), the unit margin formulas (Formula III.4 and III.5), the threshold sensitivity procedure, and the weighted scoring matrix (Formula III.8). The objective of this subchapter is to convert the company data into clear analytical points that answer the three research questions: the comparative unit cost and unit margin (RQ1), the sensitivity of each alternative to key cost drivers (RQ2), and the most feasible strategy based on a multi-criteria assessment (RQ3). Each set of results is presented through tables and figures and is interpreted in narrative form, and the analytical points are consolidated into an output summary at the end of the subchapter.

Confirmed Data Inputs & Demand Context

Primary data were obtained through semi-structured interviews and internal consultations with the Accounting, Purchasing, Procurement, Sales, R&D, Production, Legal, and Management functions, while secondary data were drawn from internal cost records, the import landed-cost sheet, the product drawing and bill of materials, the sales history, and the Minutes of Meeting that mandated the feasibility study. To preserve confidentiality, informants are identified only by function, and selected figures are presented on a disguised or rounded basis. The key confirmed parameters that drive the calculations are summarised in Table IV.1; these values form the single source of truth used consistently across the unit cost, sensitivity, and scoring analysis.

Table IV.1. Confirmed Key Parameters Used in the Chapter IV Analysis

Parameter	Confirmed value	Unit / basis	Source
Net selling price (NSP)	41,166	Rp/unit (before VAT, cost-plus markup)	Accounting
Annual sales volume (2025)	21,900	units/year	Sales / Accounting
Import CIF supplier price	1.98	USD/unit (Incoterm CIF)	Accounting
Exchange rate (costing basis)	17,100	Rp/USD	Accounting
Import duty	0	% (Form D ATIGA)	Accounting
Units per import shipment	20,000	units/shipment	Import record
The customs clearance, port handling & documentation costs	Rp 7,486,533	Per shipment	Import record
The inland trucking cost	Rp 1,449,580	Per shipment	Import record
Resin material price (PP)	28,000	Rp/kg	Accounting
Manufacturing overhead cost	371	Rp/unit	Accounting
Electricity cost	1287.7	Rp/unit	Accounting
Body weight (incl. 15% runner)	210.69	grams/unit	R&D
Cavity / cycle time	2 / 281	cavity / seconds	R&D
Accessories (bolt, nut, seal, reinforce)	9,425	Rp/unit	Purchasing
Packaging	375	Rp/unit	Purchasing
Mould cost (all-in, incl. jig)	130,000,000	Rp	Purchasing
Mould useful life (technical)	500,000	shots	Purchasing
Reject rate, in-house (max)	2.5	%	Production
Operator per shift / assembly time	1 / 40	person / seconds	Production
Makloon (tolling) fee	8,746	Rp/unit	Procurement
CM total commitment / batch MOQ	200,000 / 5,000	units	Procurement
CM logistics (inbound + outbound)	400	Rp/unit	Procurement
Markup over cost minimal / investment limit	20% / 300,000,000	% / Rp	Management

The relevance of the study is reinforced by the demand context. As shown in Figure IV.1, the sales volume of clamp saddle 63 mm × 1¼” grew consistently from 9,259 units in 2022 to 21,900 units in 2025, a compound annual growth rate of approximately 33%. This sustained and growing volume indicates that the product has become an increasingly relevant item in the company’s fitting portfolio and provides a stable production base for evaluating own-brand alternatives, although in line with the research limitations (Chapter I) the study does not perform sales forecasting and treats volume only as the basis for the units-of-production and per-shipment conversions.

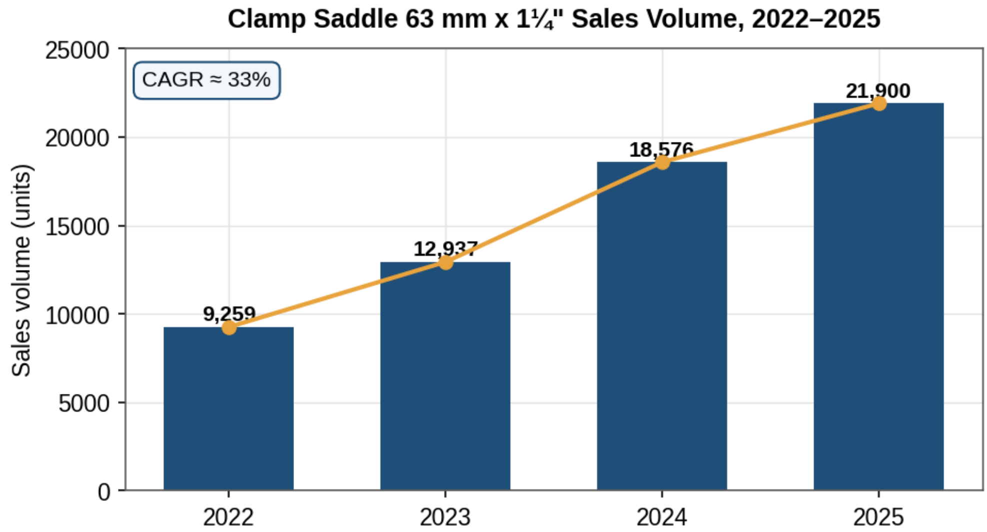

Figure IV.1. Sales Volume of Clamp Saddle 63 mm × 1¼", 2022–2025

Unit Cost Analysis

The unit cost of each alternative is calculated using the formulas defined in Chapter III. The import alternative is calculated using the total landed cost approach (Formula III.1) because the product is purchased as a finished good; the in-house alternative is calculated from the manufacturing cost components (Formula III.2); and the contract manufacturing alternative is calculated from the indicative tolling scenario (Formula III.3). Two confirmed accounting treatments are applied consistently to keep the comparison fair: The import duty is treated as 0% because the imported product is supported by a valid Form D Certificate of Origin under the ATIGA preferential tariff scheme. Form D confirms that the product originates from an ASEAN member country. Therefore, as the clamp saddle product is imported from Malaysia, it is eligible for 0% import duty in the landed cost calculation & the import value-added tax and Article 22 income tax are recoverable (creditable) and are therefore treated as a working-capital cash-flow item rather than a unit cost component (Accounting, personal communication, 2026).

Import. The import unit cost is dominated by the CIF supplier price, converted from $1.98 at the costing exchange rate of Rp 17,100, giving Rp 33,858 per unit. The customs clearance, port handling, and documentation costs of Rp 7,486,533 represent the portion of import-related costs allocated specifically to the clamp saddle product after being apportioned from the overall import shipment. Similarly, the inland trucking cost of Rp 1,449,580 represents the trucking cost portion allocated to the clamp saddle product. These allocated costs are then divided by the 20,000 clamp saddle units, resulting in Rp 374.33 per unit for customs-related costs and Rp 72.48 per unit for inland trucking. With duty at 0% and freight already embedded in the CIF term, the resulting import unit cost is Rp 34,305 per unit, as detailed in Table IV.2 and Figure IV.2.

Table IV.2. Import Unit Cost Build-up (Formula III.1)

Cost component (Formula III.1)	Basis	Rp/unit
CIF supplier price	USD 1.98 × Rp 17,100	33,858.00
Import duty	0% (Form D ATIGA)	0.00
Customs clearance / forwarding	Rp 7,486,533 ÷ 20,000	374.33
Inland trucking	Rp 1,449,580 ÷ 20,000	72.48
Freight & insurance	included in CIF term	0.00
Unit cost — Import		34,304.81

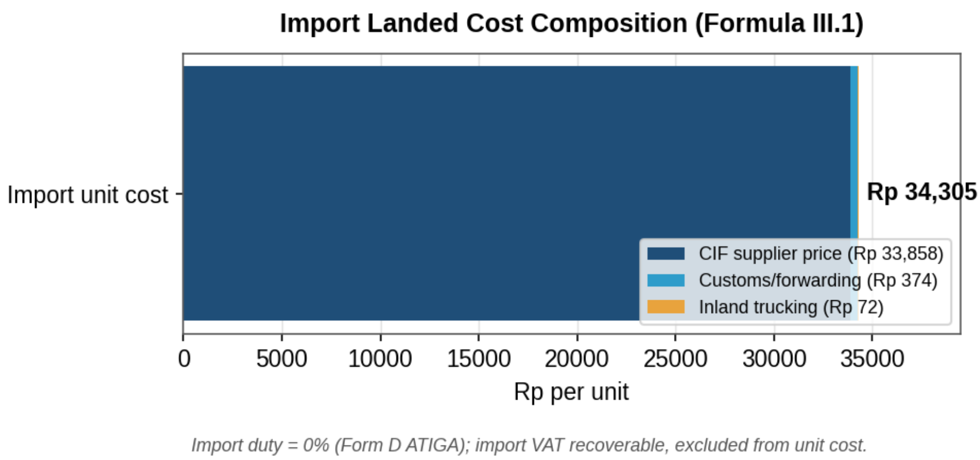

Figure IV.2. Import Landed Cost Composition

In-house production. The in-house unit cost is built from material, accessories, conversion labour, manufacturing overhead, tooling allocation, and packaging. Based on the product design from the R&D team, the estimated product weight is 210.69 grams of PP resin (including 15% runner allowance) at a price of Rp 28,000 per kilogram; divided by the production yield (1 - reject rate), where a production reject rate of 2.5% results in a material cost of Rp 6,051 per unit. The accessory set (four bolt-and-nut pairs, one seal, and one metal reinforcement) adds Rp 9,425 per unit. With two cavities and a 281-second cycle time, the effective good output is approximately 25 units per hour and the direct-labour rate is derived from the monthly minimum wage converted into a per-second rate using the statutory 40-hour working week (Government of Indonesia, 2021), so the moulding labour (1 operator) is Rp 1,192 and the assembly labour for a 40-second manual operation (1 operator) is Rp 331 per unit. After adjusting for the reject allowance, electricity and fixed overhead contribute Rp 1,321 and Rp 381 per unit, respectively. The fixed overhead component already covers machine depreciation and maintenance costs. The mould investment of Rp 130,000,000 (already includes jig and modification needs if required) is allocated using the units of production method over its technical life of 500,000 shots across two cavities at the production yield, contributing only Rp 133 per unit. Adding packaging of Rp 375 yields an in-house unit cost of Rp 19,208 per unit (Table IV.3, Figure IV.3).

Table IV.3. In-house Unit Cost Build-up (Formula III.2)

Cost component (Formula III.2)	Basis	Rp/unit
Direct material (PP, incl. runner)	(210.69 g ÷ 1000 × Rp 28,000) ÷ (1 – reject rate)	6,050.58
Accessories (bolt, nut, seal, reinforce)	per bill of materials	9,425.00
Moulding labour	wage rate ÷ good output	1,192.05
Assembly labour	40 second × labour rate/second	330.90
Electricity	per unit ÷ (1 – reject rate)	1,320.72
Fixed overhead	per unit ÷ (1 – reject rate)	380.51
Tooling allocation (units-of-production)	130,000,000 ÷ (500,000 × 2 × 0.975)	133.33
Packaging	per unit	375.00
Unit cost — In-house		19,208.10

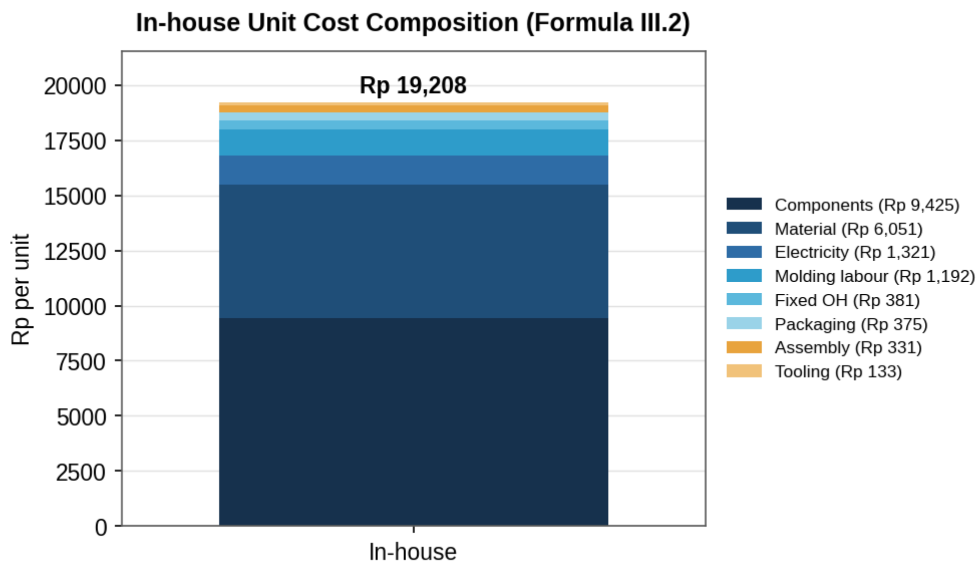

Figure IV.3. In-house Unit Cost Composition

Contract manufacturing. The contract manufacturing alternative is structured as a tolling (makloon) arrangement in which PT SPN supplies the PP resin, accessories, and packaging while the vendor performs the injection moulding and assembly. This structure is deliberately chosen to keep quality under PT SPN control. The tolling fee of Rp 8,746 per unit already embeds the vendor's mould depreciation, so no separate tooling investment is charged to PT SPN; the mould is owned by the vendor during production and is returned to PT SPN once the committed quantity is fulfilled (Procurement, personal communication, 2026). Because the vendor bears any reject above 1%, PT SPN cost the resin with a 1% allowance spare, giving a PT SPN-supplied material-and-packaging cost of Rp 15,759 per unit. Adding inbound and outbound logistics of Rp 400 per unit produces a contract manufacturing unit cost of Rp 24,905 per unit (Table IV.4, Figure IV.4).

Table IV.4. Contract Manufacturing Unit Cost Build-up (Formula III.3)

Cost component (Formula III.3)	Basis	Rp/unit
Makloon (tolling) fee	vendor; incl. mould depreciation	8,746.00
Material + packaging (PT SPN-supplied)	resin (+1% allowance spare) + accessories + packaging	15,758.91
Inbound + outbound logistics	PT SPN-CM Vendor	400.00
Unit cost — Contract manufacturing		24,904.91

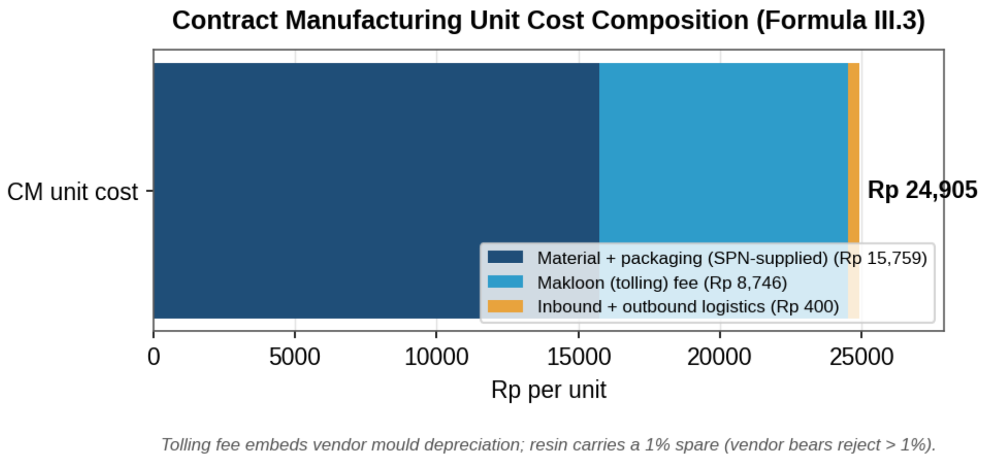

Figure IV.4. Contract Manufacturing Unit Cost Composition

Comparison. Figure IV.5 compares the three-unit costs against the net selling price. In-house production is the lowest-cost alternative at Rp 19,208 per unit, followed by contract manufacturing at Rp 24,905, with import the highest at Rp 34,305. Relative to the import baseline, in-house production reduces the unit cost by Rp 15,097 (about 44%) and contract manufacturing by Rp 9,400 (about 27%). Import is more expensive because the purchase price includes the overseas supplier's margin, freight cost, and exchange-rate exposure. Contract manufacturing is lower than import, but it still includes the vendor's margin through the tolling fee. In-house production is the most cost-efficient option because the company avoids both the overseas supplier's margin and the contract manufacturer's margin.

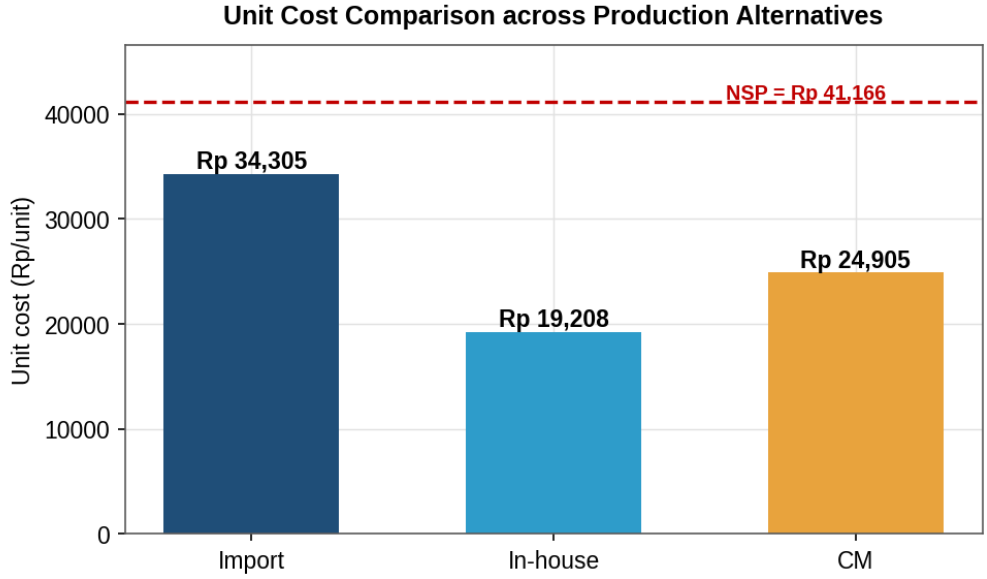

Figure IV.5. Unit Cost Comparison across Production Alternatives

Unit Margin Analysis

Following Formula III.4, the unit margin is the difference between the NSP and the unit cost of each alternative. A note on the margin convention is required for consistency with Chapters I and III. PT SPN prices on a cost-plus basis: the NSP is set as a markup over the cost of goods sold (HPP), and the company tracks and targets margin as a markup over cost rather than as a percentage of the selling price (Accounting and Management, personal communication, 2026). Accordingly, the headline margin ratio in this study is reported on a markup-over-cost basis, under which the current import baseline equals exactly 20% which is consistent with the approximate baseline stated in Chapter I and with the 20% threshold set by management. For completeness and transparency, the gross margin relative to NSP (Formula III.5) is also reported alongside it.

Table IV.5. Unit Cost, Unit Margin, and Margin Ratio against NSP of Rp 41,166 (Formulas III.4–III.5)

Alternative	Unit cost (Rp)	Unit margin (Rp)	Markup over cost	Gross margin on NSP
Import	34,304.81	6,861.19	20.0%	16.7%
In-house	19,208.10	21,957.90	114.3%	53.3%
Contract manufacturing	24,904.91	16,261.09	65.3%	39.5%

As visualised in Figure IV.6 and Figure IV.7, in-house production delivers by far the highest unit margin of Rp 21,958 per unit (a 114.3% markup over cost, or 53.3% of NSP), contract manufacturing is intermediate at Rp 16,261 (65.3% markup, 39.5% of NSP), and import is the lowest at Rp 6,861 (20.0% markup, 16.7% of NSP). Both own-brand alternatives clear the 20% markup target, whereas import only meets it at the threshold. The unit cost saving relative to import (Figure IV.8) translates directly into margin improvement of Rp 15,097 per unit for in-house and Rp 9,400 for contract manufacturing. In response to RQ1, the analysis compares the import, in-house production, and contract manufacturing alternatives in terms of unit cost and unit margin against the net selling price. The results show that in-house production provides the most favorable cost and margin position, as it generates the lowest unit cost and the highest unit margin among the three alternatives. Contract manufacturing ranks as the second-best option, while the current import-based model results in the lowest margin performance.

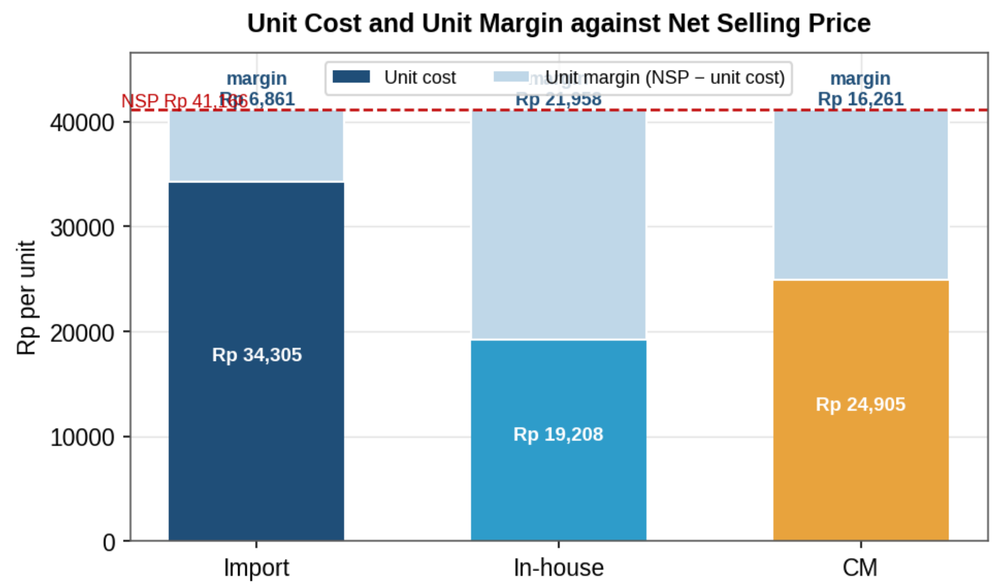

Figure IV.6. Unit Cost and Unit Margin against Net Selling Price

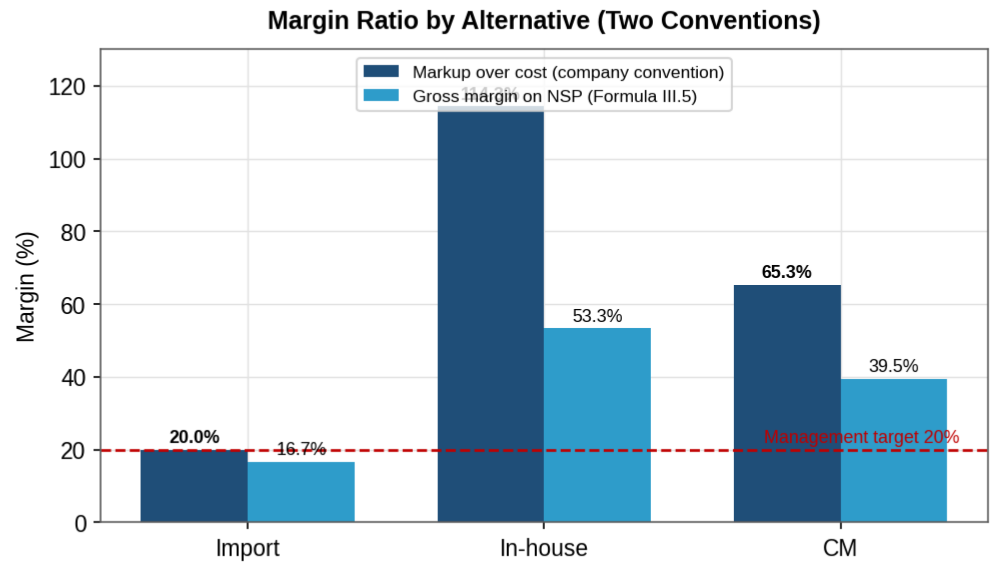

Figure IV.7. Margin Ratio by Alternative (Markup over Cost and Gross Margin on NSP)

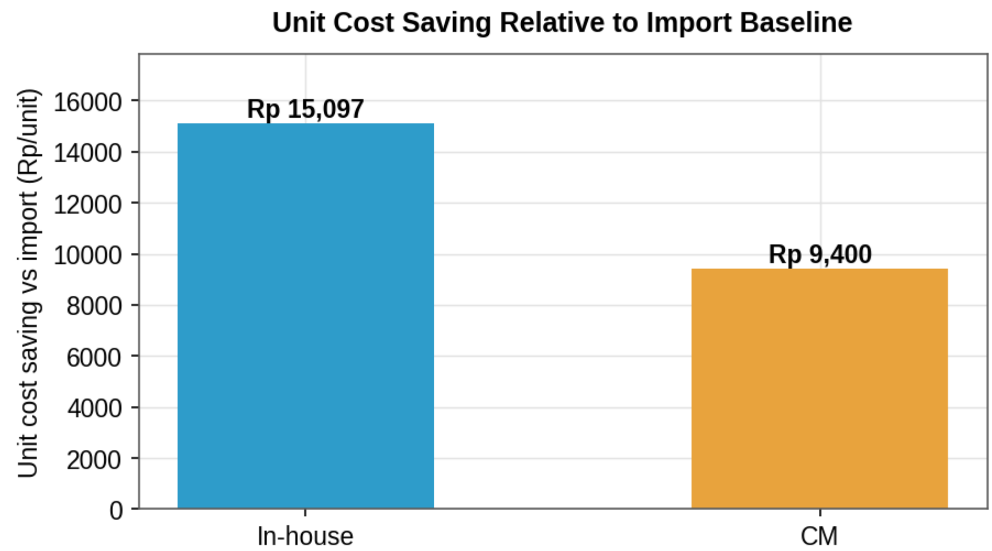

Figure IV.8. Unit Cost Saving Relative to the Import Baseline

Threshold Sensitivity Analysis

In line with Chapter III, threshold sensitivity analysis is conducted on five declared key cost drivers: material resin price, exchange rate, contract manufacturing fee, reject rate, and mould/tooling investment, while holding the other variables constant. The low and high ranges were obtained from semi-structured interviews and internal consultations, and represent realistic movement or estimation ranges for each driver. This approach follows the sensitivity analysis logic of changing one input variable from the base case to observe its effect on the result (Brigham & Ehrhardt, 2008). In this study, resin price and exchange rate represent market-driven fluctuations, while mould/tooling investment represents estimation uncertainty before investment commitment. The reject-rate range is expressed relative to the 2.5% base case used in the in-house costing.

Table IV.6. Threshold Sensitivity Input Ranges

No.	Cost driver	Alternative affected	Base case	Low case	High case	Source
1	Material price (PP resin)	In-house, CM	Rp 28,000/kg	−20% (Rp 22,400)	+20% (Rp 33,600)	Accounting
2	Exchange rate	Import	Rp 17,100/USD	−10% (Rp 15,390)	+10% (Rp 18,810)	Accounting
3	Contract manufacturing fee	CM	Rp 8,746/unit	−10% (Rp 7,871)	+10% (Rp 9,621)	Procurement
4	Reject rate	In-house	2.5%	−20% (2.0%)	+20% (3.0%)	Production
5	Mould / tooling investment	In-house	Rp 130,000,000	−5% (Rp 123.5M)	+5% (Rp 136.5M)	Purchasing

Material price (In-house & CM). The sensitivity analysis begins with resin material price because this driver directly affects the cost structure of both in-house production and contract manufacturing. As shown in Figure IV.9, a ±20% change in resin price shifts the in-house unit cost from Rp 17,998 to Rp 20,418. The same resin price movement also affects the contract manufacturing alternative, shifting its unit cost from Rp 23,713 to Rp 26,097. This indicates that resin price is a key variable for both local production alternatives. However, even under the high resin price scenario, the in-house unit cost remains below the contract manufacturing and import alternatives.

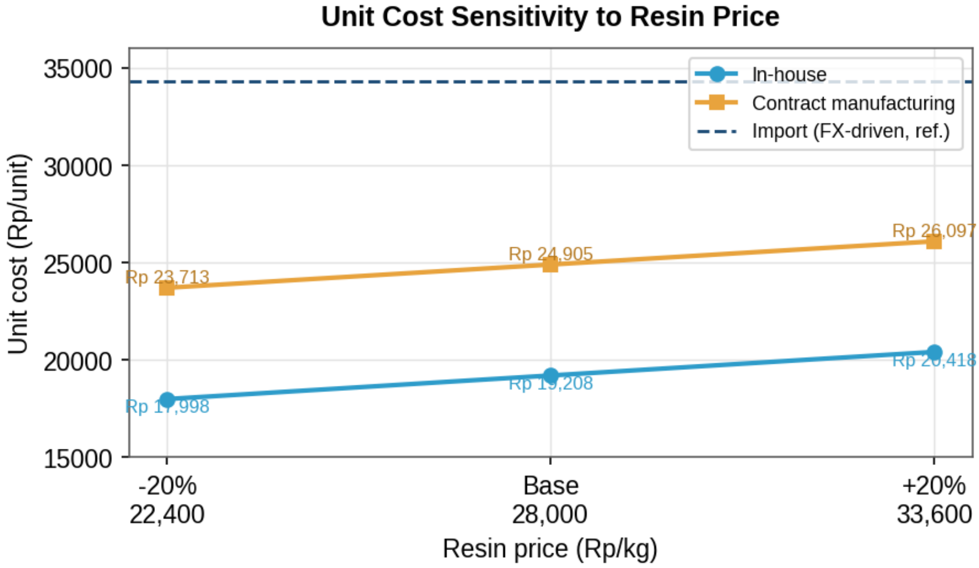

Figure IV.9. Unit Cost Sensitivity to Resin Price (In-house and CM)

Reject rate (In-house). The next sensitivity test evaluates the reject rate for the in-house production alternative. As shown in Figure IV.10, a ±20% relative change in the reject rate only shifts the in-house unit cost from Rp 19,162 to Rp 19,255. This relatively narrow movement indicates that reject rate has a limited impact on the in-house unit cost within the tested range. Although reject rate remains operationally important because it affects production yield, its cost impact is smaller than the impact of resin price.

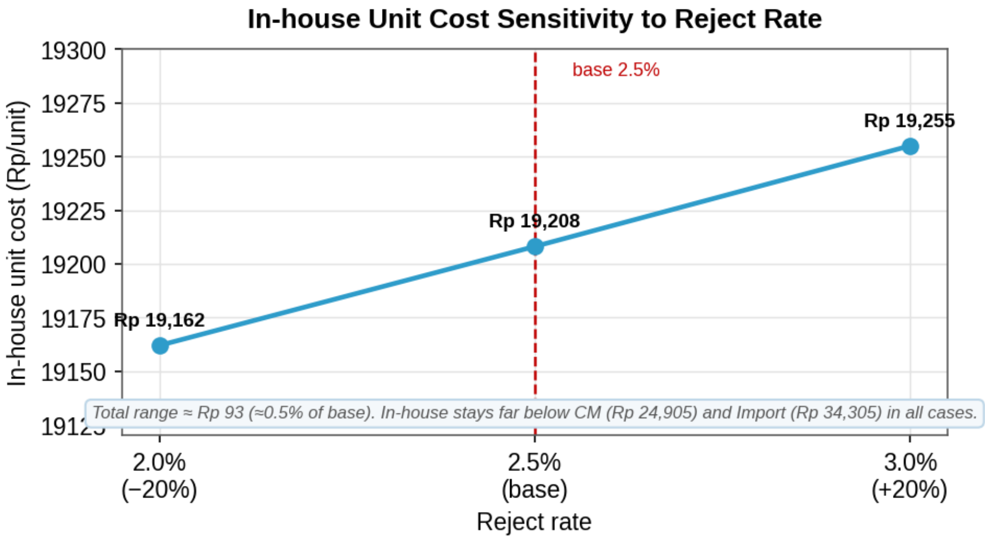

Figure IV.10. In-house Unit Cost Sensitivity to Reject Rate

Tooling investment (In-house). The in-house unit cost is the least sensitive of all to the mould (tooling) investment. Because the mould is allocated to unit cost using the units-of-production method over a technical life of 500,000 shots across two cavities. As Figure IV.11 illustrates, a ±5% change in the mould investment from Rp 123,500,000 to Rp 136,500,000 around the Rp 130,000,000 base alters the per-unit tooling allocation by only a few Rupiah, moving the in-house unit cost from Rp 19,201 to Rp 19,215, a total range of about Rp 14 per unit (less than 0.1% of the base unit cost). Therefore, within the tested range, tooling investment does not materially change the cost position of the in-house alternative.

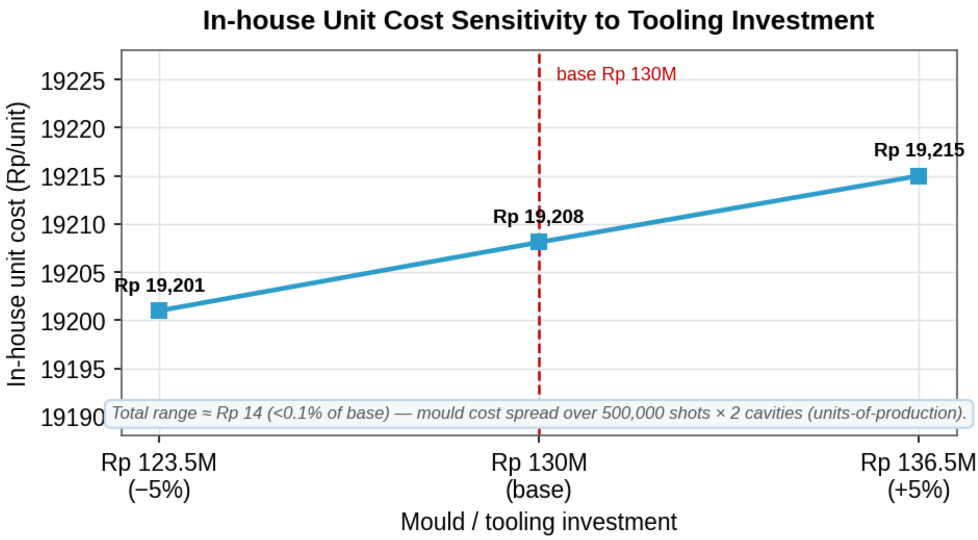

Figure IV.11. In-house Unit Cost Sensitivity to Tooling Investment

The relative importance of these three in-house cost drivers is summarised in the tornado chart in Figure IV.12. The chart confirms that resin price is the dominant driver of in-house unit cost, as its bar is substantially wider than the bars for reject rate and tooling investment. In contrast, reject rate and tooling investment have much smaller effects on the unit cost. Overall, the in-house alternative remains cost-competitive across all tested scenarios for resin price, reject rate, and tooling investment.

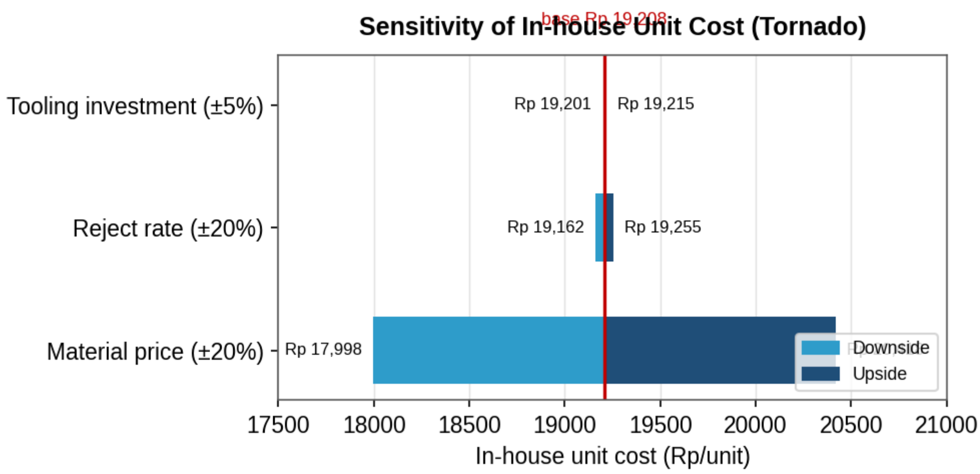

Figure IV.12. Tornado Chart — Sensitivity of In-house Unit Cost to Key Drivers

Makloon fee (CM). The analysis then continues with the contract manufacturing fee because this cost component directly reflects the external vendor's conversion charge and margin. Holding the PT SPN-supplied material and logistics constant, a ±10% change in the tolling fee from Rp 7,871 to Rp 9,621 around the Rp 8,746 base moves the contract manufacturing unit cost linearly from Rp 24,030 to Rp 25,780, a range of Rp 1,750 per unit, or about 7% of the base unit cost of Rp 24,905. Even at the upper bound of the fee, however, the contract manufacturing unit cost of Rp 25,780 remains well above the in-house unit cost of Rp 19,208 and below the import cost of Rp 34,305, so a higher tolling fee does not alter the position of contract manufacturing as the intermediate-cost alternative.

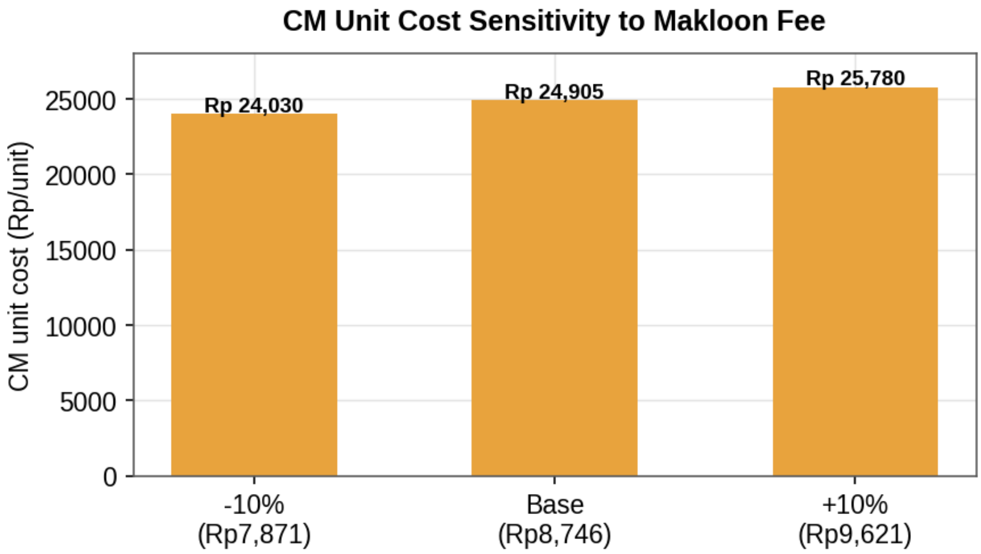

Figure IV.13. CM Unit Cost Sensitivity to the Makloon Fee

Figure IV.14 consolidates the two drivers that affect the contract manufacturing unit cost, namely the PT SPN-supplied material price and the tolling fee, into a single tornado chart that ranks them by the width of their impact. The material price, tested at ±20%, produces the wider swing, moving the contract manufacturing unit cost between Rp 23,713 and Rp 26,097 (a range of Rp 2,384), whereas the tolling fee, tested at ±10%, produces a narrower swing between Rp 24,030 and Rp 25,780 (a range of Rp 1,750). This ordering shows that, although the tolling fee is the contract-manufacturing-specific conversion charge, the cost of the PT SPN-supplied resin is the dominant source of variation in the contract manufacturing alternative, mirroring the finding for in-house production where resin price is also the leading driver. Across the full range of both drivers the contract manufacturing cost remains between the in-house and import levels, confirming that it stays the second-lowest-cost alternative under all tested movements. The reject rate, exchange rate, and tooling investment do not appear in this tornado because, under the indicative tolling structure, the vendor bears any reject above 1%, the resin is procured domestically in Rupiah, and the vendor owns the mould, so none of these drivers flows into the contract manufacturing unit cost.

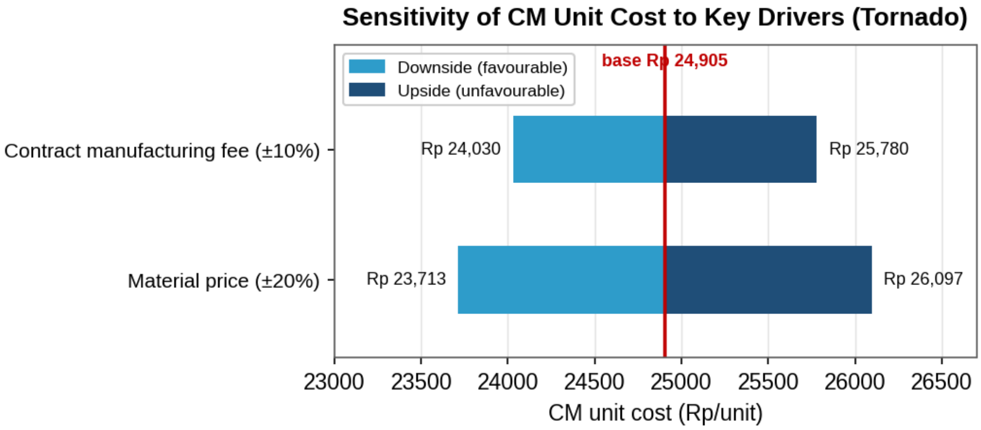

Figure IV.14. Sensitivity of CM Unit Cost to Key Drivers (Tornado)

Exchange rate (Import). Finally, the sensitivity analysis evaluates exchange rate movement for the import alternative. As shown in Figure IV.15, a ±10% change in the exchange rate shifts the import unit cost from Rp 30,919 to Rp 37,691. This confirms that exchange rate is the dominant driver of the import unit cost because the imported product is purchased from an overseas supplier. Even under the strongest Rupiah scenario, the import unit cost remains higher than the in-house and contract manufacturing alternatives. Therefore, exchange rate sensitivity reinforces the finding that the current import-based model has the weakest cost position among the three alternatives.

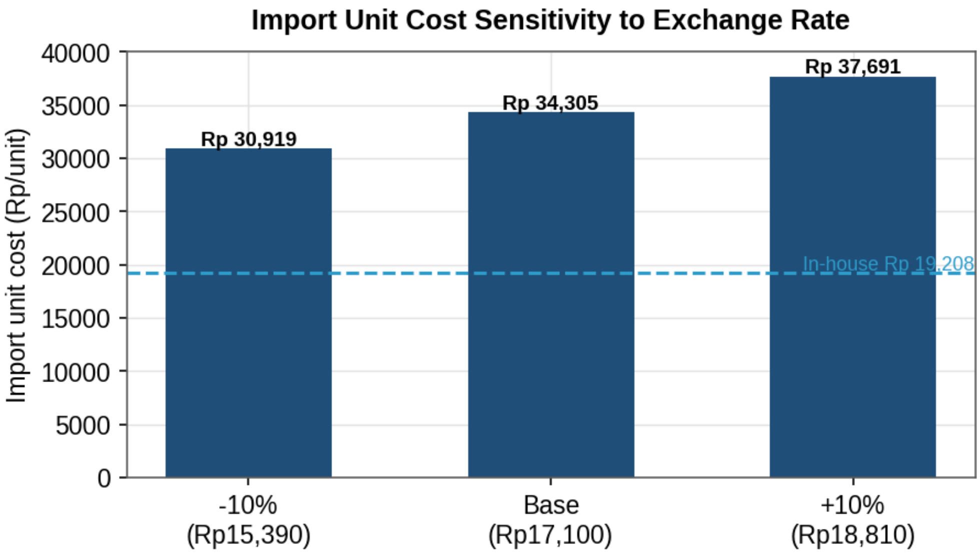

Figure IV.15. Import Unit Cost Sensitivity to Exchange Rate

To test whether the ranking is stable, the individual driver movements are consolidated into a set of scenario runs in which each driver is moved to its low and high case in turn. The results are summarised in Table IV.7. Across all eleven scenarios — the base case plus the ten single-driver shocks — in-house production remains the lowest-cost alternative without exception, and the ordering in-house < contract manufacturing < import is preserved in every scenario. Figure IV.16 illustrates this graphically: the in-house unit cost range lies entirely below the ranges of the other two alternatives, so the alternatives do not overlap under any tested movement.

Table IV.7. Scenario Runs — Unit Cost per Alternative and Lowest-cost Winner

Scenario	Import (Rp)	In-house (Rp)	CM (Rp)	Lowest cost
Base case	34,305	19,208	24,905	In-house
Resin price −20%	34,305	17,998	23,713	In-house
Resin price +20%	34,305	20,418	26,097	In-house
Exchange rate −10%	30,919	19,208	24,905	In-house
Exchange rate +10%	37,691	19,208	24,905	In-house
Makloon fee −10%	34,305	19,208	24,030	In-house

Scenario	Import (Rp)	In-house (Rp)	CM (Rp)	Lowest cost
Makloon fee +10%	34,305	19,208	25,780	In-house
Reject rate −20% (2.0%)	34,305	19,162	24,905	In-house
Reject rate +20% (3.0%)	34,305	19,255	24,905	In-house
Tooling −5%	34,305	19,201	24,905	In-house
Tooling +5%	34,305	19,215	24,905	In-house

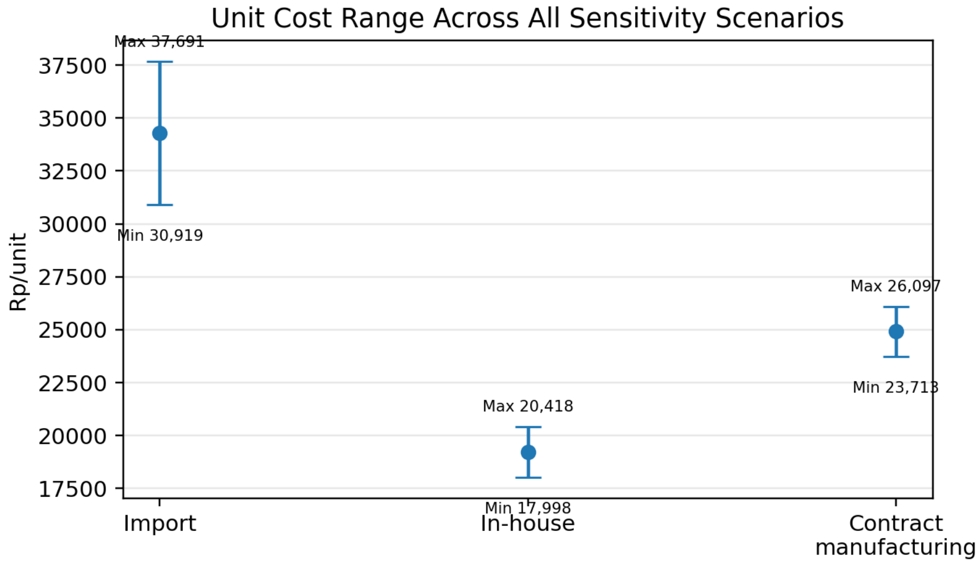

Figure IV.16. Unit Cost Range across All Sensitivity Scenarios

The sensitivity analysis shows that each alternative is affected by different key cost drivers. The import alternative is most sensitive to exchange-rate movement, while the contract manufacturing alternative is mainly affected by the contract manufacturing fee and resin price. For the in-house alternative, resin price is the dominant cost driver, whereas reject rate and tooling investment have relatively limited effects on unit cost within the tested ranges. Overall, the results indicate that in-house production remains the lowest-cost and highest-margin alternative under all tested single-driver sensitivity scenarios, followed by contract manufacturing and import.

Multi-criteria Feasibility Assessment

The quantitative results obtained in the previous subsections are integrated with qualitative considerations through a weighted scoring matrix (Simple Additive Weighting), following Formula III.8. Seven criteria are evaluated on a 1–5 scale and combined using weights that were proposed on a defensible analytical basis and validated by the Director of Business Development and Research & Development as the problem owner. Three criteria are quantitative, namely comparative unit cost and margin, sensitivity robustness, and investment/MOQ commitment and four are qualitative, namely implementation readiness, vendor dependency, market and customer acceptance, and intellectual property consideration. The quantitative criteria are scored by normalising the calculated results across the three alternatives, whereas the qualitative criteria are scored against defined rubric anchors; each criterion is explained in turn below before the scores are combined. The applied weights are 30%, 20%, 20%, 5%, 10%, 5%, and 10% respectively, summing to 100%.

Comparative unit cost and margin (quantitative, weight 30%). This criterion measures the profitability that each alternative generates against the same net selling price, using the margin results obtained in Subsection IV.1.3. Because the three alternatives differ only in scale rather than direction, the scores are obtained by min–max normalisation of the markup-over-cost margin: the alternative with the highest margin is anchored at 5, the lowest at 1, and the middle alternative is scaled proportionally using Score = 1 + 4 × (value − minimum) ÷ (maximum − minimum). Applying this to the markups of 20.0%, 114.3%, and 65.3%, in-house production scores 5.0, contract manufacturing 2.9, and import 1.0, as detailed in Table IV.8. Quantitative criteria.

Table IV.8. Comparative Cost and Margin (Min–Max Normalisation Scoring)

Alternative	Markup over cost	Normalised (x − min) ÷ (max − min)	Score = 1 + 4 × norm
Import	20.0%	0.00	1.0
In-house	114.3%	1.00	5.0
Contract manufacturing	65.3%	0.48	2.9

Sensitivity robustness (quantitative, weight 20%). This criterion is scored quantitatively from the scenario runs in Subsection IV.1.4, combining two components read directly from those results: rank performance (whether the alternative keeps a low cost rank across the scenarios) and cost stability (how little its unit cost moves when the drivers are varied). A Rank Value is computed as (n + 1 − average rank) ÷ n, with n = 3 alternatives, so an alternative ranked first in every scenario scores 1.00, one ranked second 0.67, and one ranked third 0.33. A Stability Value was calculated using Formula III.6 to measure the extent to which each alternative maintained its position across the sensitivity scenarios. The Robustness Index was then calculated using Formula III.7 by multiplying the Rank Value by the Stability Value. To make the result consistent with the 1–5 scoring scale used in the weighted multi-criteria feasibility assessment, the Robustness Index was rescaled using the following formula: Score = 1 + 4 × (Rank Value × Stability Value). Because each alternative holds the same rank in every scenario, in-house production is always first (Rank Value 1.00) with a cost spread of 12.6% (Stability 0.874), giving 1 + 4 × (1.00 × 0.874) = 4.5; contract manufacturing is always second (0.67) with the smallest spread of 9.6% (0.904), giving 3.4; and import is always third (0.33) with the widest spread of 19.7% (0.803), giving 2.1. As summarised in Table IV.9, in-house production does not receive the maximum score of 5 despite always ranking first, because its unit cost still varies by about 12.6%; a score of 4.5 therefore fairly reflects both its cost leadership and its residual cost variation.

Table IV.9. Sensitivity Robustness Scoring (Rank Value × Stability Value)

Alternative	Avg. rank	Rank Value	Base (Rp)	Min (Rp)	Max (Rp)	Spread	Stability	Index	Score
Import	3	0.33	34,305	30,919	37,691	19.7%	0.803	0.268	2.1
In-house	1	1.00	19,208	17,998	20,418	12.6%	0.874	0.874	4.5
Contract mfg	2	0.67	24,905	23,713	26,097	9.6%	0.904	0.603	3.4

The investment/MOQ commitment criterion captures the total capital and volume exposure of each alternative. For import this is the per-shipment commitment of 20,000 units at Rp 34,305 per unit (Rp 686,100,000); for in-house it is the mould investment of Rp 130,000,000; and for contract manufacturing it is the total accumulation commitment of 200,000 units at the tolling fee of Rp 8,746 per unit (Rp 1,749,200,000). Although contract manufacturing requires no upfront tooling outlay, its binding obligation to absorb 200,000 units gives it the largest commitment and therefore the lowest score (1,0) on this criterion, while in-house production carries the lowest commitment and scores highest (5,0) (Table IV.10). Notably, the in-house mould investment of Rp 130,000,000 is well within the management investment limit of Rp 300,000,000.

Table IV.10. Investment / MOQ Commitment Scoring

Alternative	Commitment basis	Commitment value (Rp)	Score (1–5, lower commitment = higher)
Import	20,000 units × Rp 34,305	686,100,000	3.6
In-house	Mould / tooling investment	130,000,000	5.0
Contract manufacturing	200,000 units × Rp 8,746	1,749,200,000	1.0

Implementation readiness (qualitative, weight 5%). Implementation readiness combines qualitative judgement with a quantitative roll-up: each alternative is first assessed against an absolute 1–5 rubric on six equally weighted sub-criteria, and the qualitative ratings are then converted to numbers and averaged into a single score for the matrix. The six sub-criteria, their per-alternative score, and the supporting notes are shown in Table IV.11. Because the rubric already expresses an absolute level of readiness, the average is used directly and is not re-normalised. The resulting scores are 4.5 for import (already operational but slow to replenish from overseas), 3.0 for in-house production (machine, material, and an established QC standard are offsetting factors, but mould trial, set-up, and QC validation remain), and 2.2 for contract manufacturing (dependent on vendor qualification, sample approval, and a pre-order lead time).

Table IV.11. Implementation Readiness Rubric Scores (Six Sub-criteria)

Sub-criterion (equal weight)	Import	In-house	CM
Process readiness	5 — already running	1 — new setup needed	1 — vendor has not made this part
Resource readiness	5 — no production resource needed	3 — machine/material likely; mould to validate	1 — vendor has the capability
Quality readiness	5 — known import quality	5 — QC standard already applied	5 — QC can be imposed on vendor
Supply / material / vendor	5 — existing supplier & logistics	2 — resin ready; accessories to confirm	2 — resin ready; accessories to confirm
Implementation / launch timeline	5 — already implemented	2 — mould trial, setup, pilot	1 — vendor deal, sample, approval
Replenishment / supply lead time	2 — overseas lead time	5 — immediate once material ready	3 — pre-order ≈ 10 days
Final readiness score (equal-weighted average)	4.5	3.0	2.2

Vendor dependency, market acceptance, and intellectual property (qualitative). The three remaining qualitative criteria, namely vendor dependency (weight 10%), market and customer acceptance (5%), and intellectual property consideration (10%). are each scored based on 1–5 rubric anchors in Table IV.12. Applying these anchors, on vendor dependency in-house production scores 5 because production is fully internal, contract manufacturing scores 3 (PT SPN can partially control quality by supplying the raw material and components, but production scheduling and detailed dimensional quality still depend on the vendor), and import scores 1 (full reliance on the overseas supplier). On market and customer acceptance, import scores 4 because the existing product is already accepted in the field, while in-house production and contract manufacturing each score 3, since the own-brand product will be accepted once it meets the required standard but may need samples and field assurance during the transition (Sales, personal communication, 2026). On intellectual property, import scores 5 because the design risk is borne by the third-party brand, and in-house production and contract manufacturing each score 4, reflecting a low residual risk: the preliminary search in PDKI, found no directly relevant trademark (the PDKI screening record is provided in Appendix B), industrial design, or patent for a compression-joint clamp saddle. However, search documentation and legal review are still required as mitigation (Legal, personal communication, 2026).

Table IV.12. Rubric Anchors for the Qualitative Criteria (1–5)

Criterion	Score 1	Score 2	Score 3	Score 4	Score 5
Vendor dependency	Highly dependent on an external party for supply, quality, and price	High dependence, partly mitigable through contract, monitoring, and communication	Moderate dependence with some mitigation in place	Low dependence; good control of spec/quality/schedule and an alternative-vendor option	Full internal control; minimal dependence
Market & customer acceptance	Very hard to accept; customer likely to reject or distrust	Low acceptance; doubts over quality, brand, or price	Neutral; needs samples, education, testing, or a better price	Fairly accepted; minor concerns but still easy to sell	Highly accepted; proven in the field, trusted, low rejection risk
Intellectual property	Very high risk; a highly relevant PDKI right could block the option	High risk; similar IP indicated; legal review and redesign needed	Moderate; no direct obstacle found but the search is still limited	Low; no directly related IP found, with documentation and review as mitigation	Very low; PDKI search documented and clear, design differentiated, NDA / ownership / registration in place

Weighted result. Multiplying each criterion score by its validated weight and summing produces the weighted multi-criteria matrix in Table IV.13. In-house production obtains the highest total weighted score of 4.60, well ahead of contract manufacturing at 2.72 and import at 2.46.

Table IV.13. Weighted Multi-criteria Feasibility Assessment Matrix (Formula III.8)

No.	Criterion	Weight	Import	InHouse	CM	Import × w	InHouse × w	CM × w
1	Comparative unit cost and margin	30%	1.0	5.0	2.9	0.30	1.50	0.88
2	Sensitivity robustness	20%	2.1	4.5	3.4	0.42	0.90	0.68
3	Investment / MOQ commitment	20%	3.6	5.0	1.0	0.72	1.00	0.20
4	Implementation readiness	5%	4.5	3.0	2.2	0.22	0.15	0.11
5	Vendor dependency	10%	1.0	5.0	3.0	0.10	0.50	0.30
6	Market & customer acceptance	5%	4.0	3.0	3.0	0.20	0.15	0.15
7	Intellectual property consideration	10%	5.0	4.0	4.0	0.50	0.40	0.40
	TOTAL	100%				2.46	4.60	2.72

The contribution of each criterion to the totals is shown in Figure IV.17. In-house production leads on the three most heavily weighted criteria (comparative cost and margin, sensitivity robustness, and investment/MOQ commitment) which together carry 70% of the weight, and its lead is driven primarily by the cost-and-margin and commitment criteria. Import accumulates most of its modest total from implementation readiness and intellectual property, while contract manufacturing draws its score mainly from cost and margin and from robustness but is held back by its high commitment.

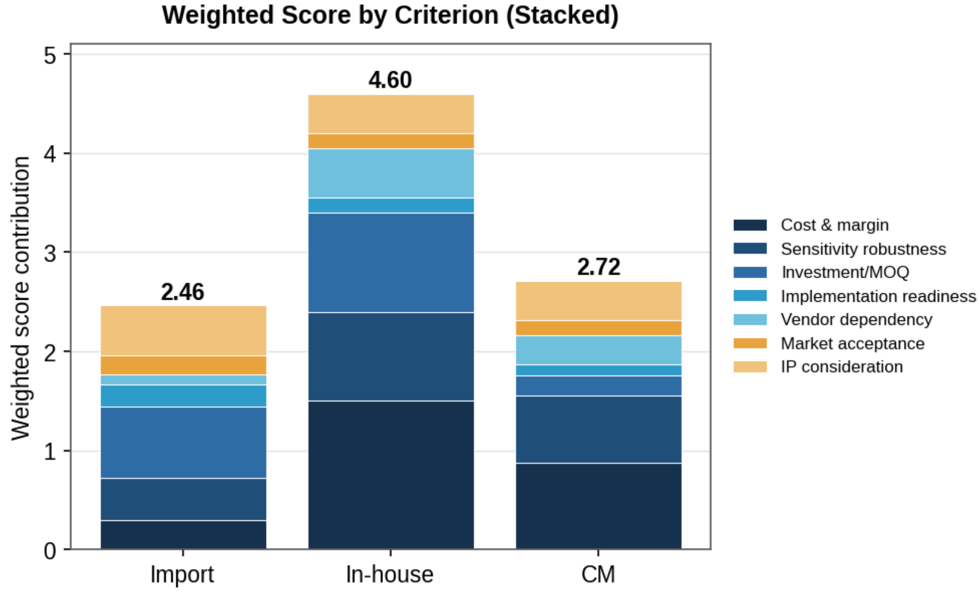

Figure IV.17. Weighted Score Contribution by Criterion

The final weighted scores are compared in Figure IV.18, which confirms a clear and decisive margin in favour of in-house production: at 4.60 it stands well above contract manufacturing (2.72) and import (2.46), and the gap is wide enough that it is not sensitive to small adjustments in the individual criterion scores. On the basis of RQ3, in-house production is therefore the most feasible production strategy. The complete assessment (criteria, weights, scoring rationale, scores, and the recommended alternative) was validated by the Director of Business Development and Research & Development as the problem owner; consistent with the methodology, this validation is decision support, and the validated recommendation is escalated to the CEO, who holds the authority for the final go/no-go decision.

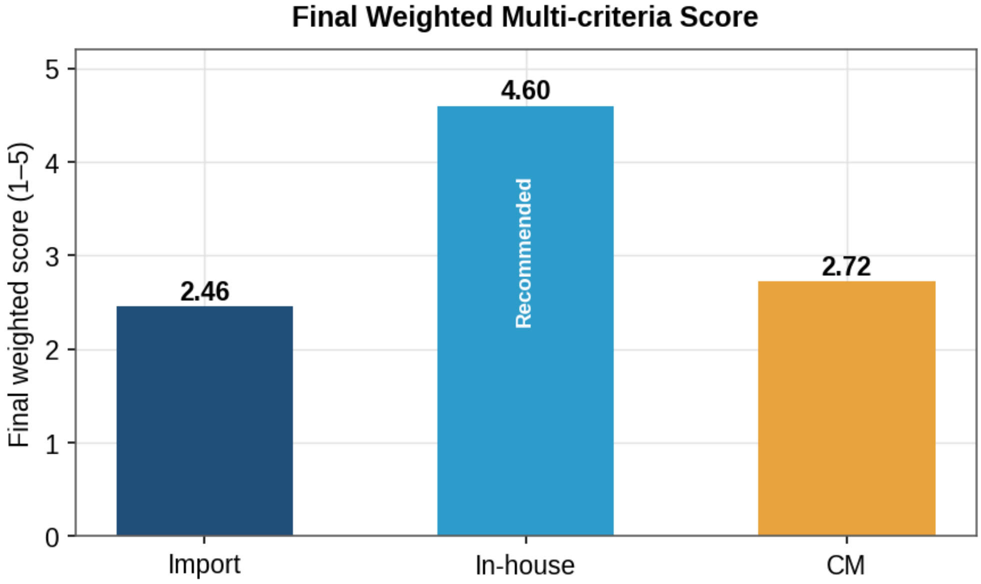

Figure IV.18. Final Weighted Multi-criteria Score by Alternative

Summary of Analysis

The analysis in Subchapter IV.1 produces the following consolidated output points, which become the basis for the business solution in Subchapter IV.2. First, on unit cost and margin (RQ1), in-house production is the lowest-cost route at Rp 19,208 per unit and yields the widest margin (Rp 21,958, a 114.3% markup over cost), ahead of contract manufacturing (Rp 24,905; Rp 16,261; 65.3%) and import (Rp 34,305; Rp 6,861; 20.0%); both own-brand routes clear the 20% management target. Second, on sensitivity (RQ2), this cost advantage is robust: in-house production remains the lowest-cost option in every one of the eleven scenarios across the five declared drivers, with resin price the dominant driver for the own-brand routes and the exchange rate for import, yet no single movement reverses the ordering. Third, on multi-criteria feasibility (RQ3), in-house production obtains the highest validated weighted score (4.60 against 2.72 for contract manufacturing and 2.46 for import) while remaining within the Rp 300 million investment limit. Fourth, the only counter-weights are import's stronger current readiness and field acceptance and contract manufacturing's lower upfront outlay, neither of which offsets the margin, robustness, and commitment advantages of in-house production.

Business Solution

Building on the analytical output, this subchapter sets out the recommended production strategy together with the product-improvement, quality, and risk-control considerations that operationalise it. The solution responds directly to the management objective of evaluating an own-brand strategy in which margin is the primary feasibility criterion.

Recommended Strategy

The recommended solution is to replace the third-party import with in-house production of an own-brand clamp saddle 63 mm × 1¼" under the PT SPN brand. In-house production is selected because it simultaneously delivers the widest margin, the most robust cost position across every tested scenario, and the lowest capital and volume commitment (Rp 130 million, within the Rp 300 million limit), while keeping full control of cost, quality, and product design and presenting only a low residual intellectual-property risk; it attains the highest validated weighted score of 4.60 out of 5.0.

Figure IV.19. Strategic Positioning of Alternatives: Margin vs Commitment

Product Improvement and Quality Baseline

The shift to an own-brand product allows one targeted, preliminary design improvement that addresses a known field complaint with the imported product, namely an excessive gap between the nut and its housing that allows the nut to shift and strip under tightening (Sales, personal communication, 2026). The proposed design tightens the nut-housing geometry to the nut dimension to remove that gap and adds a sandblast finish for appearance (R&D, personal communication, 2026). Consistent with the research scope, this is a preliminary design consideration rather than detailed engineering, and quality is treated as a mandatory baseline: every alternative, including the recommended product, must meet the applicable ISO 17885 specification verified through hydrotest quality control on production samples, which is why quality is not used as a differentiating scoring criterion. The own-brand design drawing is to be inserted as Figure IV.20.

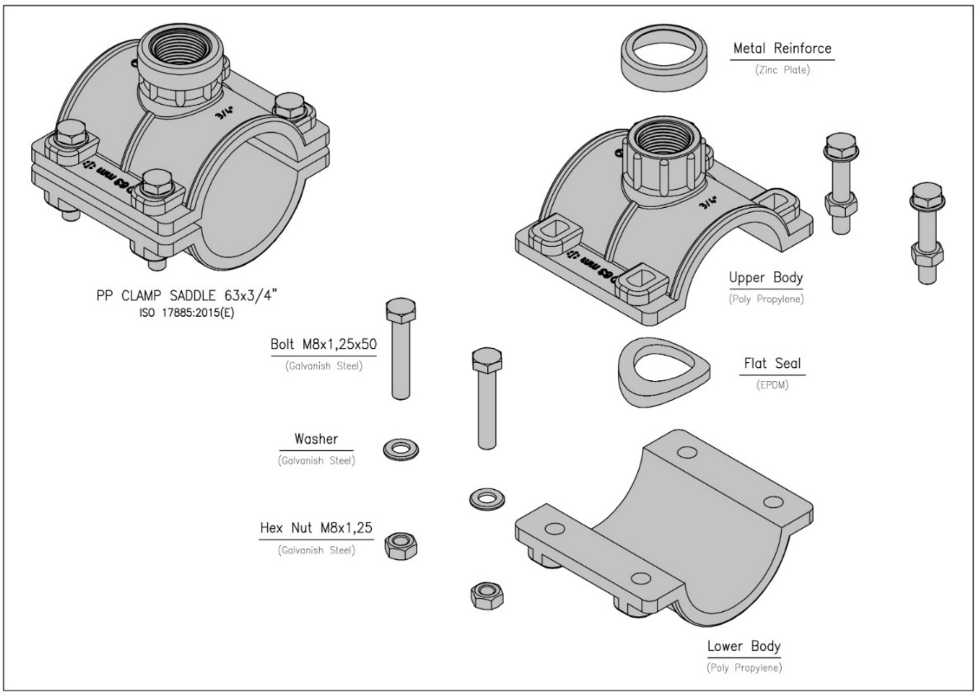

Figure IV.20. Own-brand Clamp Saddle Technical Drawing (R&D)

Risk Control and Mitigation

The principal risks of the recommended solution and their mitigations are summarised in Table IV.14. The most material exposures are the commercial transition (early returns or claims and the effort of switching customers from an established imported product), dependence on the external mould maker together with the risk of drawing leakage, and process yield; these are mitigated respectively through a piloted roll-out in the project channel with sample approval and hydrotest QC, through an NDA combined with PT SPN ownership of the mould and controlled drawing distribution, and through the 2.5% reject allowance already built into the costing together with trial validation.

Table IV.14. Key Risks and Mitigations for the Recommended Strategy

Risk area	Mitigation
Customer transition (early returns/claims; effort to switch from import)	Piloted roll-out in the project sales channel; sample approval; hydrotest QC; phased switch with field assurance
Mould-maker dependency and technical-drawing leakage	NDA; PT SPN ownership/control of the mould; controlled drawing distribution; clear ownership clause
Production yield (reject up to 2.5%)	2.5% spare costed into resin, electricity, labour, and overhead; QC sampling; trial validation before scale-up
Production capacity	Confirmed idle capacity on the existing Haitian MA3800 machine operating 24 hours across three shifts
Intellectual property exposure	PDKI screening found no relevant registration; differentiated design; option to register the PT SPN brand/design
Margin erosion from resin-price movement	Identified as the dominant driver; monitor resin price; margin remains above target across the tested ±20% range

Conditional Consideration

The solution is conditional on the in-house preparation gates being completed successfully (mould trial, QC validation, and pilot acceptance). If internal capacity becomes constrained or the mould trial is delayed, contract manufacturing is the second-best fallback: it still improves margin materially over import (Rp 16,261 versus Rp 6,861 per unit) and requires no upfront tooling outlay, at the cost of a higher per-unit price and a binding 200,000-unit commitment. Continuing to import remains the baseline only if the own-brand routes are not approved or cannot meet the quality baseline, since it is operationally simple and field-proven but improves neither margin nor product control.

Implementation Plan & Justification

This subchapter proposes an implementation plan for the recommended in-house production strategy, expressed through a 5W+1H structure and a stage-gate roadmap, and states the validation and approval authority that justifies proceeding. The plan is preliminary decision support: it defines the milestones and decision points required before the company commits to investment and product transition.

The 5W+1H elements of the implementation plan are summarised in Table IV.15. In essence, the plan is to produce the own-brand clamp saddle in-house in order to capture the highest margin and full product control, at the existing PT SPN injection-moulding facility, coordinated across the relevant functions under the problem owner, over an approximately ten-month staged timeline, executed through a sequence of approval gates.

Table IV.15. Implementation Plan — 5W+1H Summary

Element	Description
What	Produce the own-brand clamp saddle 63 mm × 1¼” in-house via injection moulding and manual assembly, replacing the third-party imported product.
Why	To capture the highest unit margin (114.3% markup versus the 20% import baseline), the most robust cost position, and the lowest commitment within the investment limit, while gaining full control of cost, quality, and design.
Where	PT SPN injection-moulding facility (Bogor), using the existing Haitian MA3800 machine; incoming QC performed at the PT SPN factory.

Element	Description
Who	R&D (design/BOM), Purchasing (mould/tooling), Production and QC (trial, hydrotest), Sales (pilot, project channel), and Legal (IP/NDA); the Director of Business Development and R&D acts as the problem owner who validates the analysis, and the CEO holds the go/no-go decision.
When	An approximately ten-month staged timeline, reflecting the four-month mould lead time plus trial, pilot, and review.
How	A stage-gate roadmap (Gate 0 to Gate 6) with explicit approval gates, incorporating the nut-housing design fix, an NDA and design-registration option, and hydrotest quality control.

The detailed stage-gate roadmap is presented in Table IV.16 and visualised as a Gantt chart in Figure IV.21. It begins with validation of the feasibility direction by the Director of Business Development and R&D as the problem owner (Gate 0), followed by the product specification and BOM freeze (Gate 1), the IP and legal safeguard review before any tooling or vendor commitment (Gate 2), mould sourcing and fabrication (Gate 3, the longest stage owing to the four-month mould lead time), trial production and sample validation with hydrotest QC (Gate 4), a pilot with selected project-channel customers (Gate 5), and a final review at which the validated recommendation is escalated to the CEO for the scale-up go/no-go decision (Gate 6).

Table IV.16. In-house Implementation Stage-Gate Roadmap

Gate	Activity / deliverable	Month	Owner	Decision / evidence
Gate 0	Validation of feasibility direction (problem owner)	1	Director of Business Dev. & R&D	Validated scoring matrix / MoM
Gate 1	Own-brand product specification and BOM freeze	1–2	R&D	Approved drawing / BOM
Gate 2	IP and legal safeguard review before commitment	2	Legal	IP note, NDA draft
Gate 3	Mould sourcing (local) and fabrication	2–7	Purchasing	Quotation, mould trial
Gate 4	Trial production and sample validation (hydrotest)	7–9	R&D / Production / QC	Trial report, QC checklist
Gate 5	Pilot sales / customer acceptance (project channel)	9–10	Sales	Customer feedback
Gate 6	Final review and scale-up decision (escalated to CEO)	10	CEO (decision)	Review meeting / MoM

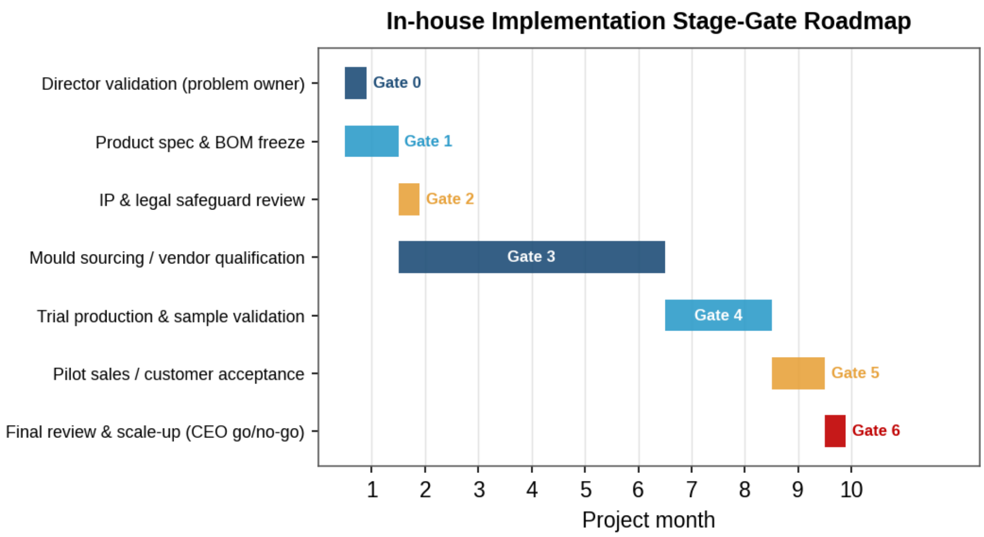

Figure IV.21. In-house Implementation Stage-Gate Roadmap

The Implementation plan is justified by the analytical results and by the validation required in the methodology. The criteria, weights, scoring rationale, sensitivity results, and recommended alternative were validated by the Director of Business Development and R&D as the problem owner, confirming that the assessment is managerially reasonable for preliminary feasibility decision support. The plan separates this validation from the final decision: each approval gate culminates in escalating the validated recommendation to the CEO, who holds the authority for the final commercial go/no-go decision. The recommendation also satisfies the stated management constraints, it exceeds the 20% margin target, falls within the Rp 300 million investment limit, and aligns with the preference for the highest-margin option which provides an evidence-based basis for proceeding to the implementation gates ahead of a final corporate decision.

Conclusion and Recommendation

This chapter crystallises the results of the analysis and interpretation in Chapter IV into concise conclusions that answer the research questions, and then sets out the managerial recommendations, limitations, and directions for further study.

Conclusion

The study set out to evaluate whether an alternative production strategy could improve the profitability of the clamp saddle 63 mm × 1¼”, which is currently sourced as a finished good under a third-party brand. Three conclusions follow, corresponding to the three research questions.

In answer to the first research question, on how the alternatives compare in unit cost and unit margin against the net selling price, the study concludes that manufacturing the product internally is the most economical route and continuing to import is the least. Reducing all three options to the same per-unit basis, in-house production carries the lowest unit cost and consequently the largest margin, contract manufacturing occupies the middle position, and import is the most expensive with the thinnest margin; both own-brand routes exceed the company’s margin expectation, whereas import only meets it at the threshold. The margin gap is substantial rather than marginal, which is what gives the subsequent recommendation its strength.

In answer to the second research question, on how sensitive the alternatives are to changes in the key cost drivers, the study concludes that the cost advantage of in-house production is robust rather than incidental. When the five declared drivers are moved across their tested ranges, in-house production remains the lowest-cost option in every scenario and the ranking of the three alternatives does not change. The drivers that matter most differ by route — the price of resin for the two own-brand options and the exchange rate for import — but none of them moves far enough to overturn the conclusion, so the recommendation does not depend on a single favourable assumption.

In answer to the third research question, on which strategy should be recommended to support profitability improvement, the study concludes that in-house production is the most feasible option once cost, margin, sensitivity, and the qualitative factors are weighed together. It records the highest weighted multi-criteria score by a clear margin, leads on the most heavily weighted criteria of cost and margin, robustness, and commitment, and stays within the company’s investment limit. Import retains an advantage only in its current operational readiness and established field acceptance, and contract manufacturing offers a lower-capital but higher-commitment middle path; neither advantage is sufficient to displace in-house production as the recommended strategy. These conclusions meet the research objectives, which were to compare the alternatives on unit cost and margin, to test their sensitivity to the key cost drivers, and to recommend the most feasible strategy through a weighted multi-criteria assessment.

Recommendation

Flowing from these conclusions, the principal recommendation to management is to proceed with a staged transition from import to in-house production of the own-brand clamp saddle, treating the present study as the decision-support basis and reserving the final commercial decision for the CEO at the end of the stage-gate process. In practical terms, the company is advised to validate the feasibility direction at the initial gate, freeze the product specification and bill of materials incorporating the nut-housing design improvement, secure the intellectual-property position through an NDA, ownership of the mould, and registration of the PT SPN brand and design, source the mould locally, and validate the product through trial production and hydrotest quality control before a pilot in the project sales channel and escalation to the CEO for the scale-up decision.

Three supporting recommendations accompany the main one. First, because the price of resin is the dominant influence on the in-house cost, the company should monitor resin prices and revisit the margin if they move materially beyond the tested range. Second, contract manufacturing should be retained as a documented fallback in case internal capacity is constrained or the mould trial is delayed, and import should be maintained only until the own-brand product has been validated, so that supply is never interrupted during the transition. Third, the same evaluation framework, namely unit-cost build-up, threshold sensitivity, and a validated weighted scoring matrix, It can be applied to other fittings currently imported, so that the clamp saddle becomes the first case of a broader own-brand and margin-improvement programme rather than an isolated decision.

The study has several limitations that should be borne in mind when acting on it. It is a preliminary feasibility analysis built on unit cost, unit margin, threshold sensitivity, and a weighted multi-criteria assessment; it does not include a full financial investment appraisal such as net present value, internal rate of return, or payback, and it does not forecast demand or model machine utilisation. The contract-manufacturing option is represented by a single indicative tolling scenario rather than a binding quotation, the product-quality and intellectual-property considerations are addressed at a preliminary level, and selected figures are disguised or rounded to protect confidentiality.

These limitations point to directions for further study. Future work could extend the analysis into a full financial appraisal of the in-house option, incorporating net present value, internal rate of return, and payback alongside a demand forecast and a capacity-utilisation analysis; it could obtain competing quotations from several contract manufacturers to test the tolling scenario; it could validate the realised unit cost, reject rate, and product quality after a pilot run against the planning assumptions used here; and it could apply the same framework across the wider fitting portfolio to prioritise the next own-brand candidates. Such studies would convert the preliminary recommendation of this thesis into a fully appraised investment decision.

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Appendix A Semi-Structured Interview Protocol by Functional Source

No.	Function/ Department	Role of informant	Guiding Interview Questions
1	Accounting	Accounting Supervisor	1. What is the current net selling price of the clamp saddle 63 mm × 1¼"?
			2. What markup over cost and gross margin does that currently yield?
			3. What is the current cost or HPP of the imported clamp saddle product price per unit, and in which currency is it invoiced?
			4. What is the supplier CIF price used in the import cost calculation?
			5. What exchange rate basis is used for the import cost calculation? and is it a spot, budget, or contractual rate?
			6. What landed cost components are included in the import cost calculation?
			7. What import duty rate applies, and does the product benefit from any preferential tariff (for example, Form D / ATIGA)?
			8. How are customs clearance, forwarding, port handling, and inland trucking costs allocated to this product?
			9. How many units are in a typical import shipment, so the per-shipment charges can be allocated per unit?
			10. Is import duty applicable to this product? If not, what is the basis for the 0% import duty treatment?
			11. Are import VAT and Article 22 income tax treated as product cost or recoverable tax items?
			12. For an in-house scenario, what PP resin price per kilogram should be used, and is it a contracted or market price?
			13. What manufacturing overhead rate per unit should be applied to in-house production?
			14. For sensitivity analysis, what realistic movement range would you expect for the exchange rate and for the resin price over the planning horizon?
			15. Are there any cost components that should be excluded to avoid double counting?
2	Purchasing	Purchasing officer	1. What is the estimated mold and tooling investment required for the in-house clamp saddle alternative, including any jig or fixture?
			2. What is the expected useful life of the mould, expressed in number of shots?
			3. What is the estimated lead time for mold fabrication?
			4. What is the purchasing reference price per unit set for the supporting components (bolt, nut, rubber seal, and metal reinforce)?
			5. Can you break the accessory cost down per component, or is only the aggregate per-unit figure available?
			6. What is the packaging cost per unit?
			7. What realistic sensitivity range should be used for mold or tooling investment?

Appendix A Semi-Structured Interview Protocol by Functional Source (continued)

No.	Function/ Department	Role of informant	Guiding Interview Questions
3	Procurement	Procurement staff	1. On what basis is the contract-manufacturing (makloon/tolling) fee per unit estimated, and what does it cover (conversion, labour, machine, vendor overhead)?
			2. What tolling fee per unit is realistic for this part given its size and cycle time?
			3. What total volume commitment and minimum order/batch quantity would a vendor typically require?
			4. Under the tolling arrangement, which party supplies the raw material and components — PT SPN or the vendor?
			5. If PT SPN supplies the material, how is reject/scrap handled — up to what percentage does the vendor absorb, and above what threshold does PT SPN bear it?
			6. What is the estimated inbound and outbound logistics cost per unit should be assumed for moving material to, and finished goods from, the vendor?
			7. What is the tooling arrangement under contract manufacturing — does PT SPN provide the mould, or does the vendor? include mold depreciation?
			8. Is there any minimum order quantity required by the vendor?
			9. Is there any total quantity commitment required under the contract manufacturing scenario?
			10. What is the expected production or delivery lead time from the vendor?
			11. What material allowance should be provided by PT SPN to the vendor?
			12. What vendor-control or quality-control mechanism should be prepared if contract manufacturing is selected?
			13. Should this scenario be treated as an indicative option or a binding quotation, and what would be needed to firm it up?
			14. What realistic sensitivity range should be used for the contract manufacturing fee?
4	Sales	Sales representative	1. How do customers currently perceive the imported clamp saddle in terms of quality, price, and field performance?
			2. What design or performance improvements have customers or the field requested that would strengthen competitiveness?
			3. If PT SPN offered an own-brand version, would customers accept it, and under what conditions?
			4. What score is reasonable for market and customer acceptance for each alternative?
5	R&D	R&D engineer	1. What is the estimated part weight for the clamp saddle body, and does that figure include the runner/sprue? What runner allowance (%) is assumed?
			2. Which resin grade is specified for the body?
			3. What is the proposed mould cavity configuration (number of cavities), and what estimated cycle time results?
			4. What components are required to complete the product ?
			5. What product design improvement is proposed compared with the existing imported product?
			6. Are there technical or dimensional standards the product must meet (for example, pressure rating, pipe compatibility)?
			7. What quality test should be conducted during trial production?
			8. How does R&D input support the comparison of product control among import, in-house production, and contract manufacturing?

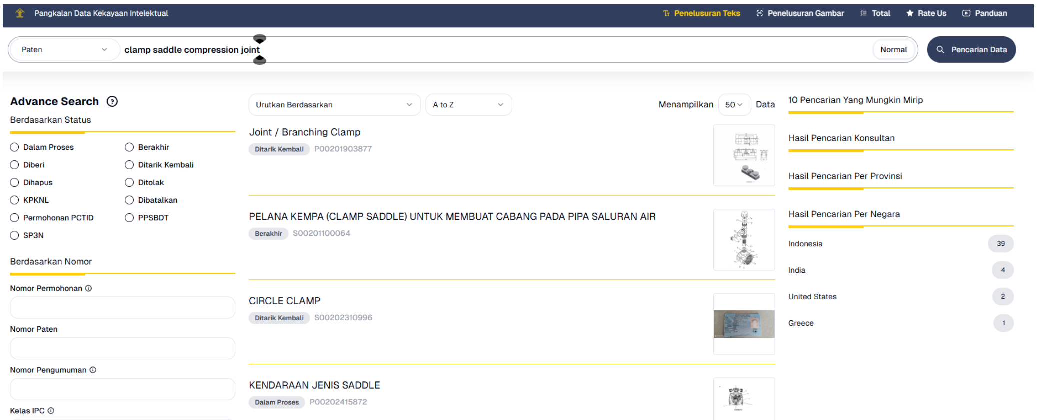
Appendix A Semi-Structured Interview Protocol by Functional Source (continued)

No.	Function/ Department	Role of informant	Guiding Interview Questions
6	Production	Production staff	1. Is the clamp saddle product technically feasible to produce using the existing production facility?
			2. Which injection molding machine is suitable for producing this product?
			3. Is there available production capacity for the in-house alternative?
			4. How many operators are required per shift to run the moulding machine, and what is the assembly time per unit for the accessories?
			5. What reject rate assumption should be used for the in-house cost calculation?
			6. What labour rate should be used to cost moulding and assembly labour?
			7. What are the main production risks during mold trial and initial production?
			8. What quality-control checks and equipment are required to meet the product specification?
			9. What preparation is needed before in-house production can be launched?
			10. What factors may affect implementation readiness for in-house production?
			11. For sensitivity analysis, what reject-rate range is plausible?
			12. What score is reasonable for implementation readiness for each alternative?
7	Legal	Legal officer	1. What intellectual property aspects should be considered before developing an own-brand clamp saddle?
			2. Which database should be used for the preliminary IP screening?
			3. What did a preliminary search in the intellectual-property database (PDKI) indicate for this product category?
			4. If PT SPN registers its own brand and design, what registration steps and documentation are required?
			5. For the contract-manufacturing option, what contractual safeguards are needed to protect PT SPN's design and data?
			6. What score is reasonable for intellectual property consideration for each alternative?
8	Management	Director of Business Development & R&D (problem owner)	1. What minimum markup over cost target should the recommended alternative achieve?
			2. What investment limit applies to any tooling or capital outlay for this product?
			3. Which criteria and relative weights do you consider appropriate for comparing the alternatives?
			4. Are the seven multi-criteria feasibility assessment criteria relevant to the decision?
			5. Do you agree with the sensitivity analysis and the final weighted scoring matrix — the scoring rationale, final scores, and recommended alternative?
			6. Is contract manufacturing acceptable as a fallback if the in-house preparation is delayed or constrained?

Appendix B Intellectual-property (PDKI) Search Documentation from PDKI Database

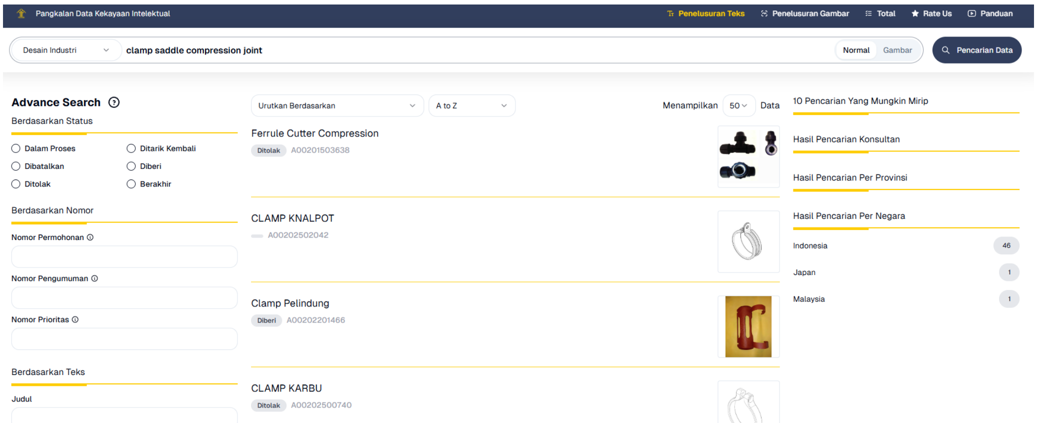
B1. Patent Search Result from PDKI Database

This section presents the screenshot of the patent search result obtained from the official PDKI database. The search was conducted to identify whether there were any registered patent records related to the clamp saddle product or similar product features under the searched keyword. Based on the displayed search result, no directly relevant patent record was identified for the searched item at the time of access.



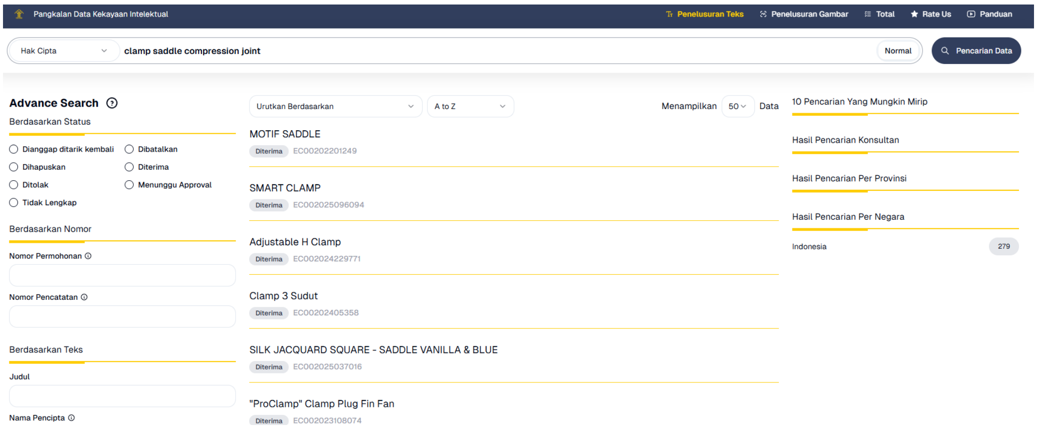
B2. Industrial Design Search Result from PDKI Database

This section presents the screenshot of the industrial design search result obtained from the official PDKI database. The search was conducted to examine whether the visual appearance, shape, or configuration of the clamp saddle product had been registered as an industrial design in Indonesia. Based on the displayed search result, no directly relevant industrial design record was identified for the searched item at the time of access.



B3. Copyright Search Result from PDKI Database

This section presents the screenshot of the copyright search result obtained from the official PDKI database. The search was conducted to review whether there were any copyrigh t records associated with the searched product name, brand reference, or related supporting materials. Based on the displayed search result, no directly relevant copyright record was identified for the searched item at the time of access.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