ENHANCING REAL ESTATE FEASIBILITY STUDIES WITH MULTI-CRITERIA AND RISK ANALYSIS TOOLS

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Abstract

Conducting a reliable feasibility study is crucial yet challenging before starting any real estate project. This study presents a detailed case of a comprehensive feasibility assessment for a medium-scale real estate development in the Greater Jakarta area. It integrates multiple analytical tools, including the Performance Prism framework to identify key performance indicators, and the Analytic Hierarchy Process (AHP) alongside Pareto analysis to prioritize them. Financial viability was assessed through engineering economic calculations supported by Monte Carlo simulation. The base case simulation indicated a strong financial outlook, with a positive Net Present Value (NPV) and a healthy Internal Rate of Return (IRR). To test the project's resilience, five additional scenarios were analyzed for sensitivity, exploring how variations in key assumptions might affect financial outcomes. This combined approach provides a thorough evaluation by incorporating both quantitative data and qualitative insights, ensuring a balanced and robust feasibility study for the real estate project.

Keywords*: AHP; Feasibility; Monte Carlo; Performance Prism ; Real Estate*

INTRODUCTION

Property development is the process of taking a project from the initial idea all the way through to construction and final completion. It also involves managing the property throughout its life to create value and meet the project's goals. (Moorhead, Armitage, & Skitmore, 2021). This development process follows a series of steps from start to finish, i.e.: initiation, investigation and analysis of viability, acquisition, design and costing, consent and permission, commitment, implementation, and leasing/managing/disposal (Reed, 2021).

Real estate developers usually evaluate potential projects through feasibility studies and commonly used industry guidelines, taking into account capital costs, expected returns, and a personal assessment of risk (Moorhead et al., 2024). Feasibility analysis is essential for both developers and investors, acting as the foundation for determining whether a project is likely to succeed. This in-depth evaluation covers key areas such as physical conditions, legal requirements, and financial factors to confirm that a project is not only possible but also well-positioned for success (Havard, 2014; Kolbe, Greer, & Waller, 2013; Ratcliffe, Stubbs, & Keeping, 2014). At its core, the analysis helps accurately assess property value and predict profitability, supporting smart decision-making. The main aim is to refine and enhance development plans so they achieve or even surpass expected results, contributing to overall project excellence (Graaskamp, 1970).

Real estate developers today typically use industry-recognized benchmarks (also known as hurdle rates) as target returns when evaluating projects (Crosby, Devaney, & Wyatt, 2018). These hurdle rates represent the minimum acceptable return, factoring in the developer's cost of capital and an added premium to account for a subjective evaluation of project-specific (unsystematic) risk. Developers assess this through feasibility studies, which guide decision-makers in the early phases of development (Moorhead et al., 2021)**.** For a project or site acquisition to move forward, the projected profitability from these analyses must meet or surpass the firm's minimum return expectations.

Real estate developers involved in investment, development, redevelopment, rehabilitation, and consulting typically rely on general hurdle rates derived from industry norms or company-specific "rules of thumb" and benchmarks, often referred to as "hurdle rates of return" (Crosby, Devaney, & Wyatt, 2020). These company- or project-specific hurdle rates are then used to evaluate the feasibility of a project and support decision-making before any formal commitment is made in the development process.

Since the 1970s, several methods have been developed to assess project feasibility and performance. Common approaches include static residual valuation, residual (or accumulated) cash flow analysis, and discounted cash flow (DCF) analysis, which is used to calculate a project's net present value (NPV) (Guarini & Battisti, 2017). Recent developments in academic literature suggest using real options theory to value projects and incorporating Monte Carlo simulations to evaluate different scenarios and potential outcomes. However, it is unclear how widely these methods are adopted in the real estate development industry, as there is no recorded data on their usage (Galle, De Temmerman, & De Meyer, 2017).

Different stakeholders may have different views about a residential development project. Investors are mainly concerned with returns and investment risk, while consumers may pay more attention to housing quality, affordability, location, and livability. Contractors are more concerned whether the project can be built as planned and whether the requirements are practical. Previous research also found that developers, consumers, and investors may have different priorities when evaluating residential properties (Muktiwibowo & Anastasia, 2023). Therefore, looking only at financial performance may not be enough to evaluate a residential project. Considering the views of different stakeholders during the feasibility stage can provide a better understanding of the project and help identify possible problems before they affect the financial results.

The Performance Prism was originally developed to help organizations measure and manage performance. It focuses on five aspects: stakeholder satisfaction, stakeholder contribution, strategies, processes, and capabilities (Neely, Adams, & Kennerley, 2002). Although the framework was mainly used for performance measurement, the five aspects can also be useful for identifying factors that should be considered in a feasibility study. This is because the feasibility of a residential project depends not only on its expected financial returns, but also on whether the project can meet the needs of its stakeholders and can be executed as planned. Investors, consumers, contractors, and other stakeholders may have different expectations of the same project. In this study, the Performance Prism is therefore used as a general framework to identify the feasibility criteria from these different perspectives, rather than as a tool for setting KPIs. The identified criteria can then be prioritized using AHP to determine which factors are more important for the project.

After the relevant criteria have been identified, AHP can be used to determine which criteria are more important. AHP compares the criteria in pairs and uses the judgments of experts or stakeholders to calculate their relative weights (Saaty, 1987). This is useful because the criteria identified from different stakeholder perspectives may not have the same level of importance. Pareto analysis can then be used to identify the criteria with the highest overall importance and reduce the number of factors considered in the next stage of the analysis. These methods help focus the feasibility assessment on the factors that are considered most important. However, the results from AHP and Pareto analysis do not show whether the project is financially feasible. They also cannot show how changes in costs, revenues, discount rates, or other uncertain assumptions may affect the investment results. Financial analysis and risk analysis are therefore needed to provide a more complete assessment of the project.

Existing real estate feasibility studies have used financial analysis, multi-criteria decision-making, stakeholder assessment, and risk analysis, but these methods are often applied separately. There is still limited research that combines stakeholder-based criteria identification, AHP and Pareto analysis for prioritization, and Monte Carlo simulation for financial risk assessment in one feasibility study. This study addresses this gap by linking these methods in a single framework. The Performance Prism is used to identify relevant criteria from the perspectives of different stakeholders, while AHP and Pareto analysis are used to identify the most important criteria. The selected criteria are then complimented by financial feasibility analysis and Monte Carlo simulation to assess the effect of uncertainty on the project results. In this way, the study considers both stakeholder expectations and financial performance rather than treating them as separate parts of the feasibility assessment.

This approach is particularly relevant to residential development in Indonesia. The sector continues to play an important role in the economy, while developers and households still face issues related to housing demand, affordability, land prices, and access to housing finance. Indonesia's real estate sector contributed about IDR 505.46 trillion to GDP in 2023 (Siahaan, 2024). At the same time, housing affordability remains a concern, particularly for lower-income households, and access to housing finance can be more difficult for informal-sector workers. High land prices also create challenges for developers, especially smaller firms (Siahaan, 2025). These conditions make it important to assess a residential project from several perspectives before a large investment is made.

Based on this context, this study examines the use of Performance Prism, AHP, Pareto analysis, engineering economic analysis, and Monte Carlo simulation in assessing the feasibility of a residential development project. The study considers three main stakeholder groups (i.e. investors, consumers, and contractors) to identify and prioritize the most important performance indicators. It then evaluates the financial feasibility of the proposed project and examines how uncertainty in key assumptions affects the financial results. The framework is applied to a 43-hectare medium-scale residential project in the Greater Jakarta area consisting of three types of affordable housing units. The case shows how stakeholder priorities and financial uncertainty can be considered together when evaluating a residential development project.

LITERATURE REVIEW

Feasibility Study for a New Property Development Project

Feasibility analysis in a real estate and property development project assesses whether a project meets the minimum required criteria and, if it does, helps determine whether to proceed—and if so, when to begin (Mayer & Sommerville, 2002). While it includes a financial evaluation, it also covers other key components such as an executive summary, market research, key project drivers, cost estimates, site photos and maps, financing details, planning approvals, estimated property value, and risk analysis (Rowley, Costello, Higgins, & Phibbs, 2014). The analysis also involves examining how changes in individual factors affect the outcome (sensitivity analysis), reviewing risks in the most favorable version of the plan, applying risk management strategies, and confirming the project's feasibility for all involved parties (Miles, Netherton, & Schmitz, 2015).

For those actively involved in property development, the appraisal process is more than just a routine task—it's a vital step in confirming a project's financial feasibility for all stakeholders. This process involves carefully determining the highest price that can be offered for a development site, helping to protect the developer's financial interests. It also includes a thorough analysis of proposed development plans to estimate potential profit or loss, which is key to assessing whether the project is viable. Appraisals also allow developers to explore different project scenarios, test key assumptions, and evaluate associated risks. These evaluations are essential tools for managing risk and are crucial when seeking funding, whether through loans or investor capital (Havard, 2013; Havard, 2014).

Market analysis is a crucial part of property and real estate development appraisals, leading to the estimation of a property's net operating income (NOI) over a set period. At this stage, developers must invest additional capital into the project, requiring a careful review of when expenses and income will occur, as well as the roles of debt and equity financing. This is also when developers face what's known as "hurt money"—the initial investment that cannot be recovered unless the project goes ahead. This concept emphasizes the financial risk involved in the early phases of development, though early costs like design work and consultant fees are typically low, making it easier to walk away from a project without significant losses (Baum & Crosby, 2008; Kahr & Thomsett, 2006).

Completing a feasibility analysis requires estimating input costs, the length of the project, the effect of financing costs over time, and calculating both the residual value and the present value (PV) of expected profits (Moorhead et al., 2022). Although the calculations involved—often done using specialized feasibility software—can be complex, the main goal is straightforward: to assess whether the projected profits are sufficient in light of the risks involved, ultimately supporting the decision on whether to proceed with the project or not (Havard, 2013; Isaac & O'Leary, 2013).

The most cited benchmark in real estate development decision-making is the cash-based measure known as MDC (Minimum Development Criteria) or ROC (Return on Cost) (Crosby et al., 2018). There's a direct link between the level of perceived risk and the required MDC—higher project risk leads to a higher MDC threshold that must be met before moving beyond the early planning stages (Reed, 2021). This metric is straightforward to calculate and useful for comparing or ranking different projects. However, it doesn't fully account for more complex income and expense patterns over longer periods or the time value of money (Isaac, O'Leary, & Daley, 2016). As a result, with the rise of more advanced tools like spreadsheets and specialized feasibility software, developers increasingly rely on more sophisticated return-based metrics such as Discounted Cash Flow (DCF), NPV, IRR, and Equity IRR in their decision-making (Isaac et al., 2016).

Net Present Value (NPV) is a key metric in real estate investment decisions. It represents the present value (PV) of a project's future net cash flows minus the PV of the initial investment, such as the cost of acquiring the property (Ross et al., 2014). While NPV and IRR are not hurdle rates themselves, they are often compared to target returns to evaluate whether a project meets the required financial benchmarks. These assessments become more complex when factoring in construction timelines, loan structures, and the different risks at each stage of development (Geltner, Miller, Clayton, & Eichholtz, 2007; T. Havard, 2013).

Real estate projects typically require large upfront investments, and the costs vary across different development phases (Geltner et al., 2007). Research by Brealey, Myers, & Marcus, (2007) suggests that NPV is a better hurdle rate than IRR for real estate decisions. However, Hutchinson et al. found that IRR is the most commonly used hurdle rate among European firms, with NPV ranking fourth (Hutchison et al., 2017). In Australia, a study of Queensland developers found NPV to be the third most popular financial metric (Costello & Preller, 2010). These findings highlight that feasibility analysis in property development is usually tailored to individual projects, rather than following a portfolio-based investment strategy like those used by fund managers (Moorhead et al., 2024)

The Internal Rate of Return (IRR) estimates a project's potential profitability by identifying the discount rate that sets the NPV of all future cash flows to zero. It becomes a hurdle rate when a target IRR (TIRR) is defined, indicating the minimum return expected from the project (Costello & Preller, 2010). In Australia, both IRR and MDC (Minimum Development Criteria or Return on Cost) are commonly used for speculative developments. This aligns with findings by Crosby et al., who noted that UK developers typically prioritize profit on cost, with IRR as a secondary measure (Crosby et al., 2020).

Research by Hutchinson et al. and Coleman et al. showed that many developers determine IRR using a risk-free rate plus a risk premium, rather than strictly following traditional financial theory. Interestingly, studies have found that for UK development projects, longer-term developments often yield lower IRRs, which seems to contradict the expected correlation between higher risk and higher return (Crosby et al., 2018). This is largely due to the methods used in calculating residual land value and the timing of project expenses.

Crosby et al. (2018) suggest that developers might be applying IRR and other time value of money metrics in ways not commonly discussed in academic finance literature. (Hutchison et al., 2017). Approaches to setting risk premiums range from simple "rules of thumb" to more complex models and pro-forma analysis, often lacking standard textbook foundations. It's expected that similar patterns would emerge among Australian real estate developers, echoing Crosby et al.'s findings (2018). A notable insight from Hutchinson et al. (2017) is that 80% of surveyed respondents apply specific hurdle rates tailored to each individual project or investment.

Developers are typically provided with a minimum financial benchmark (known as a hurdle rate) such as a required minimum profit, profit per unit or per square meter, or a minimum project size or revenue threshold. Surveys of real estate developers (Costello & Preller, 2010; Hutchison et al., 2017) have shown that many also rely on other straightforward financial metrics in their evaluations.

Performance Prism

The Performance Prism was developed by Neely and Kennerley in 2001. This framework approaches performance management by focusing first on the needs of key stakeholders, aiming to support long-term sustainability. It is known for being both systematic and rigorous, while also allowing for ongoing improvements (Yu & Zhu, 2011). It is a modern measurement framework created to help organizations choose the most appropriate performance indicators. It offers a broad and thorough approach that tackles important business concerns relevant to a wide range of organizations, including both for-profit and non-profit entities. Unlike other frameworks, it prompts managers to ask essential questions and carefully consider the connections between different measures, encouraging a deeper understanding of performance (Neely, Adams & Crowe, 2001).

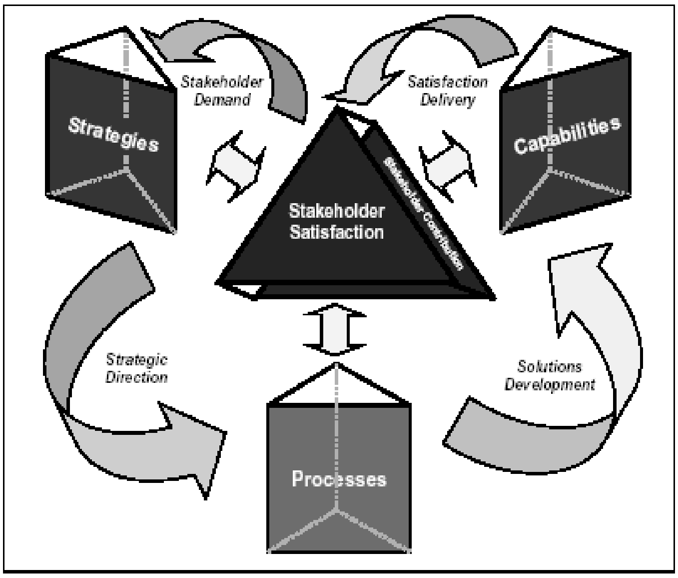

Figure 1. Performance Prism Framework

According to Neely (2007) when designing a Performance Measurement System (PMS) using the Performance Prism, businesses must address five key questions, as PMS serves as a tool for delivering value to stakeholders (Neely & Adams, 2001), (a) Who are the business's key stakeholders, and what are their needs? (Stakeholder identification); (b) What strategies should be implemented to meet those needs? (Strategy), (c) What critical processes are necessary to support these strategies? (Processes); (d) What capabilities are required to manage these processes effectively? (Capabilities); (e) What contributions are expected from stakeholders in return? (Stakeholder contribution).

These five questions form the five dimensions of the Performance Prism. Answering them helps define the necessary performance measures and indicators. These dimensions reflect overall organizational performance and should be seen as interconnected and holistic, as illustrated in Figure 1 (Kennerley & Neely, 2003).

While the Performance Prism has been applied in various studies, such as those by (Akgun & Oztas, 2017; Oey, Jourdan, & Kwo, 2022; Rompho, 2015; Yu & Zhu, 2011) , its adoption remains limited despite its structured and adaptable nature. Nevertheless, compared to other performance measurement system such as the Balanced Scorecard, the Performance Prism approach offers several advantages, one of which is its ability to identify a broader range of stakeholders. These include owners and investors, suppliers, customers, employees, the government, and the surrounding community. In contrast, the Balanced Scorecard tends to focus more narrowly on stakeholders from the perspectives of shareholders and customers only.

Monte Carlo Simulation

Monte Carlo (MC) simulation is a powerful modelling tool that generates various outcomes using an appropriate forecasting model. It aids in assessing risk and uncertainty in predictions (Singh, Parmar & Kumar, 2025). It was introduced in 1949 by American mathematicians John Von Neumann and Stanislav Ulam, is a group of methods designed to tackle complex—though often deterministic—problems by incorporating random sampling. The word "Simulation" refers to the process of generating a large number of random variables (André, Nwosu, & Sunday, 2022). It has been widely used in conjunction with forecasting methodologies to address inherent stochastic nature (André et al., 2022; Arnaut-Berilo, Zaimovic, & Turbo-Merdan, 2017; Singh et al., 2025).

In recent years, one of the most critical aspects of project management has been risk management. A project manager must identify, analyse, and assess probabilities to mitigate risks that may arise in a complex project. This is essential to help the project manager address issues that may occur during project execution and to support the successful completion of the project (Kwak & Ingall, 2007). One of the most frequently used and applied risk management methods in the field is the Monte Carlo simulation. Over the past few decades, this technique has been widely used to simulate various mathematical and scientific scenarios. However, it is not yet considered a perfect method for accurately representing future realities.

According to (Kwak & Ingall, 2007) Monte Carlo simulation is generally used in risk management processes to quantify financial risks in an investment or project. This method allows project managers to determine alternative schedules, reserve costs, or both, in order to anticipate the worst-case scenarios that may occur during the project lifecycle. It has proven effective in risk management, especially in complex fields such as biology, engineering, geophysics, computing, finance, and the social sciences.

Rubinstein and Kroese, (2016) stated that Monte Carlo simulation and investment feasibility analysis are two distinct yet complementary concepts in the context of investment decision-making. Feasibility analysis focuses on providing an overall picture of the potential success of an investment project based on various aspects such as environmental, economic, and others. On the other hand, Monte Carlo focuses more on the risks that may arise from the investment project, such as market fluctuations, rising raw material prices, and more. By applying Monte Carlo simulation to investment feasibility analysis, more accurate results can be obtained that reflect real-world conditions. Additionally, the best and worst possible outcomes of the investment can be simulated, leading to more accurate investment decisions.

RESEARCH METHOD

The study is a cross-sectional investigation that combines qualitative and quantitative methods. It consists of three major elements (see also Figure 2), as follows, (a) The first section applies the Performance Prism framework to identify performance indicators relevant to feasibility studies. This is explained through a systematic breakdown of the prism's five elements—satisfaction, contribution, strategy, process, and capability. The analysis is conducted from the viewpoints of three key stakeholders: investors, customers, and suppliers, who are considered important for the project. For each stakeholder group, we consulted five experts representing their perspectives; (b) The second stage involved shortlisting the performance indicators identified in the previous stage using the Analytic Hierarchy Process (AHP). A total of 30 respondents with relevant project experience participated in the AHP assessment. The questionnaire was completed online under the guidance of the researcher. During the questionnaire process, the consistency ratio (CR) was checked for each respondent. When the CR exceeded 0.10, the respondent was asked to review and revise the relevant pairwise comparisons until an acceptable level of consistency was achieved. After each revision, the resulting priority weights were also reviewed with the respondent to confirm that they were reasonable and reflected their judgment. These steps were conducted directly during the data collection process, so no separate record was retained of the initial CR values or the number of revisions made by each respondent. The analysis therefore used the final pairwise comparison matrices and their resulting weights; (c) The results of the Pareto analysis were further examined. The quantitative aspects were analyzed using engineering economics methods by calculating the net present value (NPV) and internal rate of return (IRR) as forecast metrics for the project's budget. These calculations were simulated using Monte Carlo methods to account for the probabilistic nature of certain growth parameters within the budget components.

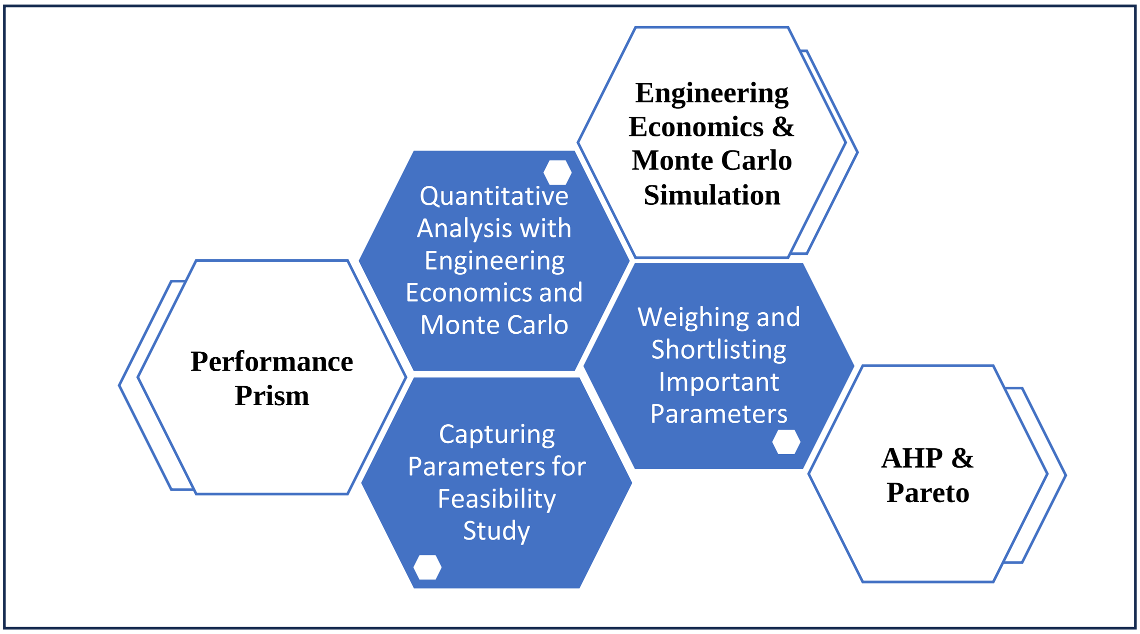

Figure 2. Summary of Proposed Methodology

RESULTS AND DISCUSSION

Capturing The Required Performance Indicators with Performance Prism

For the Performance Prism analysis, the expert panel was divided into three stakeholder groups: investors, consumers, and contractors. The experts were purposively selected based on their direct involvement in the case project and their previous professional experience. The investor group consisted of five senior employees from the project developer, holding positions from manager to director, with 10–30 years of experience. The consumer group comprised five experts, including senior marketing professionals and experienced consumers aged 30–50 years, with 5–20 years of experience. The contractor group consisted of five senior employees from the project contractor, holding positions from manager to director, aged over 30 years, and with more than 10 years of experience. This three-group composition helped ensure that the Performance Prism assessment included perspectives from the key stakeholders involved in the studied project.

Figure 3 summarizes the potential performance indicators needed for a feasibility study of a real estate complex, as identified by three stakeholder groups. The investor stakeholders identified 15 performance indicators, while customers and suppliers suggested an additional 18 and 15 indicators, respectively. As anticipated, investors emphasized financial indicators such as NPV, IRR, and payback period. Given the inherent risks associated with these financial indicators, we decided to conduct a more detailed analysis through a seven-year cash flow simulation incorporating probabilistic growth using Monte Carlo simulation.

From the customer’s perspective, some performance indicators are focused on service aspects, such as B1.1 Building Quality, B1.2 Service Quality, B1.3 Strategic Location, and B1.4 Competitive Pricing, which in turn influence B2.1 Customer Loyalty and B1.2 Repurchase Decisions. Achieving these outcomes requires attention to additional indicators, from B3.1 to B5.4. Similarly, suppliers provide a different viewpoint on key performance indicators, including C1.2 Long-Term Relationships, C1.3 Clear Contracts, and C1.4 Consistent Product Demand. These depend on factors like C2.1 Building Quality, C2.2 Price Stability, and C2.3 Timely Execution, along with several other indicators related to strategy, processes, and the capabilities of the project and its team.

In summary, the Performance Prism approach helps us develop a comprehensive set of performance indicators needed to evaluate the feasibility of a new real estate complex. Its five dimensions enable a systematic and interconnected development of these indicators. By involving multiple stakeholders, each with their own prism, we gain a complete and well-rounded view by seeing the project from various angles and perspectives.

Prioritization with AHP & Shortlisting with Pareto

We then involved 30 respondents with relevant knowledge and experience in the property industry to assign weights to the performance indicators (PIs) identified in the previous stages using the Analytic Hierarchy Process (AHP). Pairwise comparisons were conducted at each level of the hierarchy to obtain a global weight for each PI. The individual global weights from the 30 respondents were then combined using the geometric mean. An online calculator was used to support the pairwise comparison process.

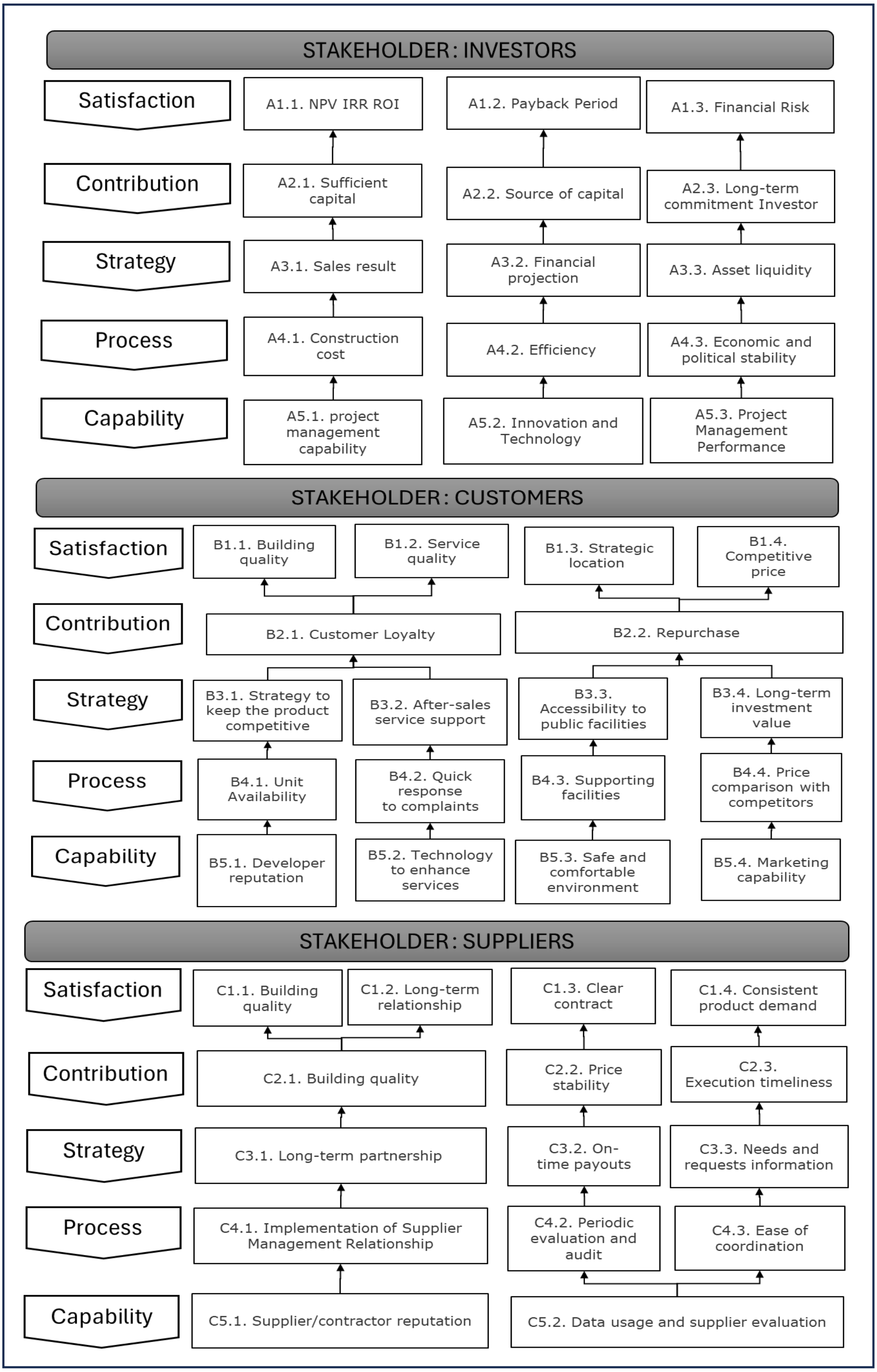

Figure 3. Summary of Performance Prism

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During the questionnaire, the consistency ratio (CR) was checked for each respondent. When the CR exceeded 0.10, the respondent was asked to review and revise the relevant pairwise comparisons. The resulting weights were also checked with the respondent to ensure that they were reasonable and reflected their judgment. The final AHP weights were then used for Pareto analysis to identify the most important PIs.

The AHP respondents were different from the expert panel used for the Performance Prism analysis. They were purposively selected based on their direct involvement in, or familiarity with, the property industry. The 30 respondents represented three main stakeholder groups: 10 investors, 14 consumers, and 6 suppliers/contractors. Their professional backgrounds included developers, contractors, entrepreneurs, civil servants, and other property-related professionals. In terms of age, 43.3% were 20-30 years old, 6.7% were 31-50 years old, and 50.0% were above 50 years old. Regarding work experience, 56.7% had more than seven years of experience, 36.7% had 4-7 years, and 6.6% had 0-3 years. This composition provided different perspectives across stakeholder groups and levels of professional experience for evaluating the residential development criteria using AHP.

The detail AHP global weight and CR by respondents is displayed in Table 1, while the summary can be seen in Table 2.

From the Pareto analysis, we shortlisted the following 17 PIs as the most important ones and upon which the project should concentrate on with the following observation, for the shortlisted financial-related performance indicators (PIs), specifically A1.1, A2.1, A1.2, A4.1, A1.3, and A3.2, we conducted a more in-depth analysis using an engineering economics cash flow evaluation over a 7-year period. To account for uncertainty and variability in cost and revenue projections, we used Monte Carlo simulation to model the growth of certain parameters. Table 2 summarizes the results of the base case Monte Carlo simulation, showing an Internal Rate of Return (IRR) of 17.6% and a Net Present Value (NPV) of 12,729,469,451 Rupiah, indicating a financially feasible and attractive investment. A detailed explanation of the analysis is provided in the following section.

In addition to financial factors, project stakeholders must also consider other key shortlisted elements such as B.1.1 and C.1.1, which relate to building quality, but can significantly impact others, like customer loyalty (B.2.1). Attention should also be given to project management capability (A.5.1), service quality (B.1.2), innovation and technology (A.5.2), and strategic location (B.1.3), as these elements influence sales performance (A.3.1) and operational efficiency (A.4.2), which in turn affect financial outcomes. Furthermore, having a reliable source of capital (A.2.2) and long-term investor commitment (A.2.3) also contribute to the project's overall financial success.

Engineering Economics with Monte Carlo

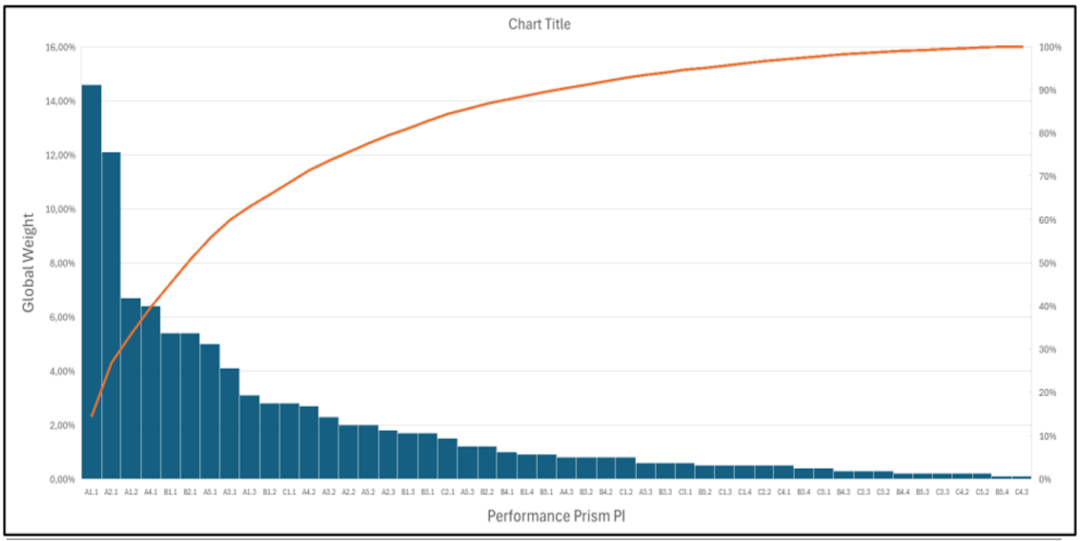
Table 3 presents the assumptions used in the Monte Carlo analysis. The growth assumptions for each cash flow component were based on current conditions in the Indonesian real estate market and discussions with the project stakeholders. A triangular distribution was used for the variables included in the simulation. The minimum, most likely, and maximum values were used to represent the possible range of growth for each variable.

Table 1. Detail AHP Calculation by Respondents

	Respondents Global Weight (%)																														
PI	Group result	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	R 11	R 12	R 13	R 14	R 15	R 16	R 17	R 18	R 19	R 20	R 21	R 22	R 23	R 24	R 25	R 26	R 27	R 28	R 29	R 30
A1.	**14.6**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	5.	5.	8.	7.	4.	11	5.	25	4	6.
A1.	**6.7**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	1.	5.	2.	9.	1.	3.	2.	4.	1.	7.
A1.	**3.1**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	1.	0.	2.	2.	1.	1	1.	5.	1.	0.
A2.	**12.1**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	5.	6.	6.	4.	9.	4.	7	8.	7.	5
A2.	**2**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	1.	0.	1.	0.	1.	0.	1.	1.	0.	0.
A2.	**1.8**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	1.	1.	1.	0.	1.	0.	1.	0.	0.	0.
A3.	**4.1**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	1.	1.	1.	1.	1.	1.	2.	3.	2.	2.
A3.	**2.3**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	1.	0.	0.	1.	0.	1.	3.	1.	0.
A3.	**0.6**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
A4.	**6.4**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	3.	5	2.	2.	4.	2.	3.	2	3.	3.
A4.	**2.7**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	1.	0.	1.	1.	1.	2.	2.	1.
A4.	**0.8**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
A5.	**5**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	1.	1.	2.	1.	4.	4.	3.	2.
A5.	**2**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	0.	0.	0.	1.	0.	2	1.	0.
A5.	**1.2**	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	0.	0.	0.	0.	0.	1.	1	0.
B1.	**5.4**	1.	1.	1.	1.	1.	10	7.	7.	7.	7	11	8.	9.	8.	9.	5.	4.	1.	7.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B1.	**2.8**	1.	1.	1.	1.	1.	3	2.	7.	3.	2.	3	5.	3.	6	3.	1.	4.	0.	2.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B1.	**1.7**	1.	1.	1.	1.	1.	1	2.	2.	3.	2.	1.	3.	1.	1.	0.	2.	1.	0.	2.	2.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B1.	**0.9**	1.	1.	1.	1.	1.	0.	1.	1.	0.	0.	0.	0.	1.	1	0.	1.	0.	0.	0.	7.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B2.	**5.4**	3.	3.	3.	3.	3.	9.	8.	6.	7.	7.	6.	3.	9	5.	8.	13	11	2	4.	1.	3.	3.	3.	3.	3.	3.	3.	2.	3.	3.
B2.	**1.2**	3.	3.	3.	3.	3.	1.	1	0.	0.	2.	1.	1.	1	2.	1.	1.	1.	0.	1.	8.	3.	3.	3.	3.	3.	3.	3.	2.	3.	3.
B3.	**1.7**	1.	1.	1.	1.	1.	1.	2	2.	1.	2.	1.	2.	2.	2.	2.	0.	1.	2.	6.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B3.	**0.8**	1.	1.	1.	1.	1.	0.	1.	0.	1.	0.	1.	0.	0.	1.	0.	0.	0.	1.	1.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B3.	**0.6**	1.	1.	1.	1.	1.	0.	0.	0.	1	0.	0.	1	0.	0.	0.	1.	0.	1.	1	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B3.	**0.4**	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	1.	3.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B4.	**1**	1.	1.	1.	1.	1.	1.	1	0.	1.	1.	1.	0.	1.	1.	0.	1.	1.	5.	1.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B4.	**0.8**	1.	1.	1.	1.	1.	0.	0.	1.	0.	0.	0.	1.	1.	0.	0.	1.	2.	1.	0.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B4.	**0.3**	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B4.	**0.2**	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B5.	**0.9**	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	0.	0.	0.	0.	0.	0.	9.	0.	1	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B5.	**0.5**	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2.	0.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B5.	**0.2**	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
B5.	**0.1**	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
C1.	**2.8**	9.	8.	9.	9.	10	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.
C1.	**0.8**	3.	2.	2.	2.	3	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.
C1.	**0.5**	1.	2.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.
C1.	**0.5**	1.	2.	1.	2	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.
C2.	**1.5**	5.	5.	5.	5.	5	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C2.	**0.5**	1.	1.	2.	1.	1.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C2.	**0.3**	1.	1.	1.	0.	0.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C3.	**0.6**	2.	2.	1.	2.	2	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C3.	**0.3**	0.	1.	1.	1.	0.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C3.	**0.2**	0.	0.	0.	0.	0.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C4.	**0.5**	1.	1.	2	1.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C4.	**0.2**	1	0.	0.	1.	1	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C4.	**0.1**	0.	0.	0.	0.	0.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	0.	2.	2.
C5.	**0.4**	1.	1.	1.	1.	1.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	1	3.	3.
C5.	**0.2**	0.	1.	0.	0.	0.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	1	3.	3.
CR	**4.9**	8.	5.	9.	9	9.	9.	6.	9.	8.	7.	7.	8.	6.	5.	6.	8.	8.	7.	9	9.	3.	7.	8	8.	8.	7.	8.	8.	4.	9.

Table 2. Aggregated Summary of AHP Calculation

	Level 1			Level 2			Global Weight
A. Stakeholder Investor	0.655	A1. Satisfaction (Investor)	0.373	A1.1	NPV IRR ROI	0.59	14.60%
				A1.2	Payback Period	0.27	6.70%
				A1.3	Financial Risk	0.12	3.10%
		A2. Contributions (Investors)	0.242	A2.1	Sufficient capital	0.76	12.10%
				A2.2	Source of capital	0.12	2.00%
				A2.3	Long-term commitment Investor	0.11	1.80%
		A3. Strategy (Investor)	0.107	A3.1	Sales result	0.58	4.10%
				A3.2	Financial projection	0.33	2.30%
				A3.3	Asset liquidity	0.09	0.60%
		A4. Process (Investor)	0.152	A4.1	Construction cost	0.64	6.40%
				A4.2	Efficiency	0.27	2.70%
				A4.3	Economic and political stability	0.08	0.80%
		A5. Ability (Investor)	0.126	A5.1	project management capability	0.60	5.00%
				A5.2	Innovation and Technology	0.24	2.00%
				A5.3	Project Management	0.14	1.20%
B. Consumer Stakeholders	0.250	B1. Satisfaction (Consumer)	0.433	B1.1	Building quality (Consumer)	0.49	5.40%
				B1.2	Service quality	0.26	2.80%
				B1.3	Strategic location	0.15	1.70%
				B1.4	Competitive price	0.08	0.90%
		B2. Contribution (Consumer)	0.263	B2.1	Customer Loyalty	0.81	5.40%
				B2.2	Repurchase	0.18	1.20%
		B3. Strategy (Consumer)	0.142	B3.1	Strategy to keep the product	0.47	1.70%
				B3.2	After-sales service support	0.23	0.80%
				B3.3	Accessibility to public facilities	0.17	0.60%
				B3.4	Long-term investment value	0.11	0.40%
		B4. Process (Consumer)	0.094	B4.1	Unit Availability	0.44	1.00%
				B4.2	Quick response to complaints	0.31	0.80%
				B4.3	Supporting facilities	0.14	0.30%
				B4.4	Price comparison with	0.09	0.20%
		B5. Ability (Consumer)	0.068	B5.1	Developer reputation	0.51	0.90%
				B5.2	Technology to enhance services	0.27	0.50%
				B5.3	Safe and comfortable	0.14	0.20%
				B5.4	Marketing capability	0.06	0.10%
C. Supplier Stakeholders	0.095	C1.Satisfaction (Supplier)	0.482	C1.1	Building quality (Supplier)	0.60	2.80%
				C1.2	Long-term relationship	0.16	0.80%
				C1.3	Clear contract	0.11	0.50%
				C1.4	Consistent product demand	0.11	0.50%
		C2. Contribution (Supplier)	0.244	C2.1	Building quality	0.64	1.50%
				C2.2	Price stability	0.20	0.50%
				C2.3	Execution timeliness	0.14	0.30%
		C3. Strategy (Supplier)	0.118	C3.1	Long-term partnership	0.55	0.60%
				C3.2	On-time payouts	0.29	0.30%
				C3.3	Needs and requests information	0.14	0.20%
		C4.Process (Supplier)	0.089	C4.1	Implementation of Supplier	0.56	0.50%
				C4.2	Periodic evaluation and audit	0.27	0.20%
				C4.3	Ease of coordination	0.16	0.10%
		C5.Capability (Supplier)	0.067	C5.1	Supplier/contractor reputation	0.65	0.40%
				C5.2	Data usage and supplier	0.34	0.20%



	glob weight	cum glob. weigh
A1.1. NPV IRR ROI	14.60%	14.60%
A2.1. Sufficient capital	12.10%	26.70%
A1.2. Payback Period	6.70%	33.40%
A4.1. Construction cost	6.40%	39.80%
B1.1. Building quality (Consumer)	5.40%	45.20%
B2.1. Customer Loyalty	5.40%	50.60%
A5.1. project management capability	5.00%	55.60%
A3.1. Sales result	4.10%	59.70%
A1.3. Financial Risk	3.10%	62.80%
B1.2. Service quality	2.80%	65.60%
C1.1. Building quality (Supplier)	2.80%	68.40%
A4.2. Efficiency	2.70%	71.10%
A3.2. Financial projection	2.30%	73.40%
A2.2. Source of capital	2.00%	75.40%
A5.2. Innovation and Technology	2.00%	77.40%
A2.3. Long-term commitment Investor	1.80%	79.20%
B1.3. Strategic location	1.70%	80.90%

Figure 4. Summary of Pareto Analysis – Shortlisted PIs.

Table 3. Summary of Monte Carlo

	Work Elements	Monte Carlo Parameters					Annual Growth		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
		DF Type	Base Case	min	likeliest	max	Base	Simulated	2025	2026	2027	2028	2029	2030	2031	2032
	Cash Outflow															
I	**Land Acquisition**	*Triangula*	*1.0520*	*1.00*	*1.05*	*1.15*	*5%*	*5.200%*	38,807,500,	40,825,530,	42,948,500,	45,181,866,	47,531,370,	50,003,051,		
II	**Permit & Planning**															
II.1	Location Permit								6,020,000,0							
II.2	Building Permit	*Triangula*	*1.0520*	*1.00*	*1.05*	*1.10*	*5%*	*5.200%*	811,500,000	853,698,843	898,092,069	944,793,789	993,924,048	1,045,609,1	1,099,981,8	
II.3	Planning	*Triangula*	*1.1297*	*1.00*	*1.05*	*1.10*	*12,5%*	*12.972%*	591,250,000	667,949,559	754,598,923	852,488,825	963,077,437	1,088,012,0	1,229,153,8	1,388,605,0
III	**Land Preparation**															
III.1	Cut & Fill	*Triangula*	*1.0734*	*1.00*	*1.05*	*1.10*	*7%*	*7.341%*	6,756,104,0	9,065,063,0	9,730,503,6	6,266,875,4	2,242,302,9	2,406,904,1	2,583,588,1	
III.2	Infrastructure Construction (Roads, Sewerage, Electricity	*Triangula r*	*1.0738*	*1.00*	*1.05*	*1.10*	*7%*	*7.378%*		11,724,810, 629	12,589,901, 250	13,518,820, 773	14,516,278, 679	15,587,331, 930	16,737,410, 604	17,972,345, 427
III.3	Landscape	*Triangula*	*1.0703*	*1.00*	*1.05*	*1.10*	*7%*	*7.025%*		990,000,000	1,324,436,2	1,417,479,9	910,236,015	324,727,159	347,539,735	371,954,929
IV	**Housing Construction**	*Triangula*	*1.0769*	*1.00*	*1.10*	*1.15*	*7%*	*7.692%*								
IV.1	30 / 60 Subsidized									12,754,000,	38,261,972,	44,374,799,	56,890,727,	61,266,892,	38,928,013,	26,574,566,
IV.2	30 / 60 Commercial									4,016,355,0	6,179,003,2	17,301,196,	19,348,661,	20,837,004,	15,292,332,	24,165,958,
IV.3	36 / 60 Commercial									4,047,930,0	6,538,959,1	18,778,535,	20,223,023,	21,778,625,	17,590,415,	24,837,047,
	Total Housing Construction									20,818,285,	50,979,934,	80,454,531,	96,462,412,	103,882,522	71,810,760,	75,577,572,
	Total Construction Cost								**52,986,354,**	**84,945,337,**	**119,225,967**	**148,636,857**	**163,619,602**	**174,338,158**	**93,808,434,**	**95,310,478,**
V	**Overhead & Marketing**															
V.1	Office Overhead	*Triangula*	*1.0789*	*1.00*	*1.10*	*1.20*	*7%*	*7.889%*	3,600,000,0	3,884,006,7	4,190,419,1	4,521,004,5	4,877,670,0	5,262,473,2	5,677,633,8	6,125,546,8
V.2	Promotion & Sales Fee	*Triangula*	*1.0790*	*1.00*	*1.10*	*1.20*	*7%*	*7.899%*	9,334,940,1	12,590,337,	10,867,837,	8,794,683,5	3,163,113,4	3,412,955,0	3,682,530,7	3,973,399,0
V.3	Handover Cost	*Triangula*	*1.0760*	*1.00*	*1.10*	*1.20*	*7%*	*7.603%*	268,750,000	289,183,267	311,170,090	334,828,589	360,285,861	387,678,669	417,154,173	448,870,722
	Total Overhead and Marketing Cost								**13,203,690,**	**16,763,527,**	**15,369,427,**	**13,650,516,**	**8,401,069,3**	**9,063,107,0**	**9,777,318,7**	**10,547,816,**
	Cash Inflow															
VI	**House Sales**															
VI.1	30 / 60 Subsidized	*Triangula*	*1.0330*	*1.00*	*1.10*	*1.20*	*3%*	*3.302%*		25,900,000,	74,532,747,	82,916,814,	101,970,399	105,337,962	64,201,876,	42,041,490,
VI.2	30 / 60 Commercial	*Triangula*	*1.0566*	*1.00*	*1.10*	*1.20*	*5%*	*5.662%*		13,930,000,	21,026,801,	57,765,256,	63,383,652,	66,972,637,	48,224,929,	74,771,774,
VI.3	36 / 60 Commercial	*Triangula*	*1.0559*	*1.00*	*1.10*	*1.20*	*5%*	*5.589%*		12,780,000,	20,241,355,	56,993,562,	60,178,767,	63,541,983,	50,319,870,	69,662,088,
	Total House Sales									**52,610,000,**	**115,800,904**	**197,675,634**	**225,532,819**	**235,852,584**	**162,746,676**	**186,475,353**
VII.1	**Cashflow**								**-**	**-**	**-**	**35,388,259,**	**53,512,147,**	**52,451,318,**	**59,160,923,**	**80,617,058,**
VII.2	Net Present Value (NPV)								12,729,469,							
VII.3	Internal Rate Return (IRR)								17.6%							

The cost components in the cash flow include all activities ranging from land acquisition, permits, and planning, to land preparation, housing construction, and marketing-related expenses. The revenue projections are based on the sales plan set by the company under study. Certain cash flow elements, such as cut and fill work, landscaping, promotion and sales fees, show an upfront skew in cash inflow or outflow. Using 500 simulation runs, the Monte Carlo analysis produced a base case IRR of 17.6% and a NPV of 12,729,469,451 Rupiah. The distribution of these results is illustrated in Figure 5. These results indicate that the project is financially feasible under the base case assumptions.

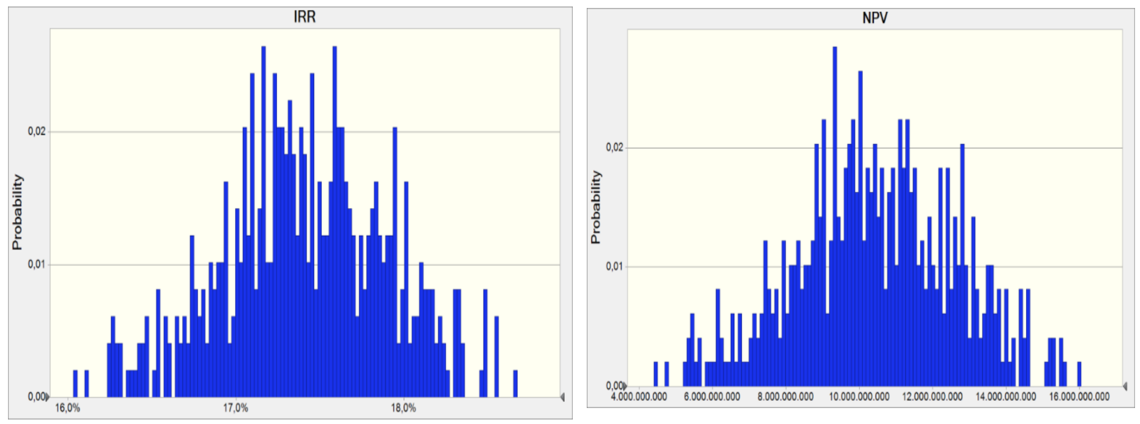


Figure 5. Result of NPV and IRR distribution function

However, the base case alone does not show how sensitive the project is to changes in costs and revenues. Therefore, five additional scenarios were examined using different combinations of minimum, most likely, and maximum growth assumptions. The results are presented in Table 4.

Table 4. Summary of Scenario

Scenario	Cost Growth	Revenue Growth	NPV (IDR)	IRR
0	Monte Carlo base case		12,729,469,451	17.6%
1	likeliest	likeliest	11,290,917,190	17.3%
2	min	max	27,506,578,916	20.4%
3	min	min	11,710,546,528	17.4%
4	max	min	(3,201,405,962)	14.3%
5	max	max	12,594,626,426	17.5%

The scenario results show that the project remains financially feasible under most of the tested conditions, with IRRs ranging from 14.3% to 20.4%. However, Scenario 4 is an important exception. Under this scenario, all cost components are assumed to grow at their maximum rates while all revenue components grow at their minimum rates. The resulting NPV becomes negative at IDR –3.20 billion, with an IRR of 14.3%. This indicates that the project is vulnerable when cost increases occur together with weak housing sales growth.

The comparison between Scenarios 3, 4, and 5 also provides some indication of the main sources of financial risk. When both costs and revenues are at their minimum levels (Scenario 3), the NPV is IDR 11.71 billion. Increasing costs to their maximum levels while keeping revenues at their minimum (Scenario 4) reduces the NPV by approximately IDR 14.91 billion (from IDR 11.71 Bio to – IDR 3.2 Bio). In contrast, increasing revenues from their minimum to maximum levels while keeping costs at their maximum (Scenario 5) increases the NPV by approximately IDR 15.80 billion (from IDR 12.59 Bio to - IDR 3.2 Bio). This suggests that changes in revenue have a slightly greater effect on NPV than changes in overall costs in the scenarios tested, although both factors have a substantial influence on project performance.

The results also suggest that maintaining housing sales is important for the financial performance of the project. At the same time, controlling construction, land preparation, land acquisition, and other development costs is necessary to avoid the combination of high costs and weak sales that occurs in Scenario 4. In practice, developers can reduce these risks by monitoring construction and land-related costs closely, controlling project spending, reviewing the sales plan regularly, and adjusting sales and marketing strategies when market demand is weaker than expected. More flexible development and sales scheduling may also help reduce the effect of unfavourable market conditions.

It should be noted that the scenario analysis evaluates the combined effects of cost and revenue assumptions rather than the influence of individual variables. Nevertheless, the results clearly show that the project becomes financially unfavorable when high-cost growth is combined with low revenue growth. This highlights the importance of maintaining effective cost control while sustaining housing sales to preserve the project's financial viability.

The findings are consistent with previous research emphasizing the importance of quantitative financial and risk analysis in real estate development. Moorhead *et al*. (2024) found that real estate developers commonly rely on financial feasibility measures, particularly IRR and development-cost-based returns, alongside qualitative risk assessments when making investment decisions. Similarly, Moorhead *et al.* (2021) reported that property developers use quantitative techniques to evaluate uncertainty and support feasibility decisions during the early stages of development. The present study further demonstrates that project viability can deteriorate substantially when unfavorable cost and revenue conditions occur simultaneously. A similar pattern was reported by Rahman, Miraj, Prasidha, & Amanda (2025) in a property-led TOD project in Greater Jakarta, where a combination of adverse conditions caused the project to become financially unfeasible. These findings suggest that real estate feasibility should be assessed not only under base-case assumptions but also under combined downside scenarios that capture the potential interaction of cost and market risks.

CONCLUSION AND SUGGESTIONS

This study developed an integrated approach to assess the feasibility of a real estate investment project by combining Performance Prism, AHP, Pareto analysis, engineering economics, and Monte Carlo simulation. The main contribution of this study is the integration of these methods to assess project feasibility from both financial and non-financial aspects. Instead of focusing only on financial indicators, the approach first identifies important performance indicators from key stakeholders and then evaluates their priorities together with the financial feasibility and project risks.

The Performance Prism helped identify the relevant performance indicators by considering stakeholder satisfaction, stakeholder contribution, strategies, processes, and capabilities. AHP and Pareto analysis were then used to prioritize these indicators and determine which areas require more attention. This shows that stakeholder-related and project performance factors can be considered together with financial measures in a real estate feasibility study.

The engineering economics analysis and Monte Carlo simulation were used to evaluate the financial feasibility of the project while considering uncertainty in costs and revenues. The results indicate that the project is financially feasible under the base-case assumptions. However, the scenario analysis shows that the project can become financially unfavourable when cost growth is high and housing sales revenue is low. This indicates that both cost control and maintaining housing sales are important for the project's financial performance. The results also suggest that non-financial indicators should not be ignored because they may indirectly affect the overall success of the project.

From a practical perspective, the integrated approach can help developers and investors identify important performance areas, prioritize their attention, and evaluate whether the project can remain financially feasible under different conditions. It can therefore be used as a supporting tool for making real estate investment decisions.

This study is limited to a cross-sectional analysis of one real estate development project and reflects the conditions and assumptions of the case studied. Therefore, the results may not be directly applicable to other projects. Future studies could apply the same approach to real estate projects with different scales, locations, and types to examine whether similar results are obtained. Future research could also compare the estimated results with actual project performance after project completion.

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