Strategic Business Diversification and Competitive Positioning in Railway Infrastructure Maintenance

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ABSTRACT

The growth of the national railway industry, the expansion of rail networks, and the increasing safety standards have driven the need for more modern, integrated, and sustainable railway infrastructure maintenance services. These conditions create opportunities to diversify into the railway infrastructure maintenance business. This study aims to formulate appropriate strategies for the company to enter the industry competitively. The research uses a descriptive qualitative approach supported by quantitative analysis. This research integrates the PESTLE framework, Porter's five forces, VRIO, SWOT–TOWS, and the quantitative strategic planning matrix. Data were collected through expert interviews, questionnaires, and document analysis. The results show that the track maintenance industry has high entry barriers, significant dependence on OEMs, strong buyer power, and complex technological and certification requirements. However, opportunities emerge through long-term Public-Private Partnership (PPP) contracts, urban/HSR projects, maintenance digitalization, and technical specialization in track and slab-track segments. The priority strategies derived include forming OEM alliances, strengthening equipment capacity, establishing an internal certification academy, and adopting predictive maintenance to improve tender scores and SLA performance. These findings provide strategic direction to expand its portfolio and strengthen competitiveness in the railway maintenance sector.

Keywords*: Competitive Strategy, Entry Barriers, Infrastructure Maintenance, Predictive Maintenance, Resource-Based View.*

INTRODUCTION

Indonesia's railway industry has experienced significant development over the past decade in line with the growing demand for safe, efficient, and sustainable mass transportation. The National Railway Master Plan (*Rencana Induk Perkeretaapian Nasional*/RIPNas) 2030 projects an expansion of the rail network to 12,100 km as well as a substantial increase in passenger and freight transport volume, requiring high-quality operation and maintenance systems. These needs underscore that, following Kljaić et al. (2023), the success of rail network development must be accompanied by the capacity to provide modern, standardized, and sustainable infrastructure maintenance as a key prerequisite for safety and service reliability.

In line with the expansion of the network, business opportunities in railway infrastructure maintenance are becoming increasingly significant, especially since urban operators such as Light Rail Transit (LRT) Jakarta and Mass Rapid Transit (MRT) Jakarta began opening track-maintenance tenders in 2023. The involvement of third parties such as PT Thamrin Citra Mulia (TCM), which won the maintenance contract for LRT Jakarta, demonstrates that domestic enterprises now have competitive space within

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this ecosystem. Such collaborative models align with the findings of Rahman et al. (2018), which indicate that partnerships with private entities enhance cost efficiency, service quality, and transparency in railway operations. These opportunities are reinforced by the national regulatory framework. Law Number 23 of 2007 provides legitimacy for business entities to engage in the development, maintenance, and operation of railway infrastructure, as long as they meet technical competency and certification requirements. The Regulation of the Minister of Transportation Number 21 of 2023 and Regulation of the Minister of Transportation Number 23 of 2023 further emphasize competency standards for infrastructure inspection and maintenance personnel, while Regulation of the Minister of Transportation Number 7 of 2022 sets specific provisions for high-speed rail lines.

Beyond regulatory factors, global technological dynamics are driving a transformation in the rail maintenance sector toward data-driven and artificial intelligence–based systems. The integration of technologies such as IoT, predictive analytics, and machine learning has been proven to enhance damage detection accuracy, reduce downtime, and strengthen operational safety (Balcı et al., 2021; Zomer et al., 2021; Larese et al., 2025). However, the implementation of these technologies in Indonesia still faces challenges, including limited automated inspection infrastructure and a shortage of experts proficient in advanced technologies (Kurniawan, 2020; Yudariansyah et al., 2023).

In this expanding business context, PT Wijaya Karya Beton Tbk (WIKA Beton) stands out as a company with strong potential to enter the railway infrastructure maintenance sector. As Indonesia's largest precast concrete producer with extensive experience providing critical components such as sleepers, girders, and track structures for LRT, MRT, and KAI networks, WIKA Beton possesses a relevant competency base. However, the company's financial performance shows considerable volatility during the 2020–2024 period, reflecting its heavy dependence on conventional construction projects that are vulnerable to external fluctuations (Muhammad & Rahadi, 2023; Lestari & Erdiana, 2025). This condition reinforces the urgency for a diversification strategy toward business lines that generate recurring and more sustainable income.

Although numerous studies on WIKA Beton have addressed internal dimensions such as financial performance, human resources, organizational culture, marketing, and risk management (Hamzah & Sumiati, 2020; Sugiyanti & Ferdian, 2020; Muhammad & Rahadi, 2023). However, none have yet investigated the company's diversification into the railway infrastructure maintenance sector. This indicates an important knowledge gap between industry needs and the available academic literature. Therefore, this study was conducted to formulate an appropriate strategy for WIKA Beton to enter and compete in the railway infrastructure maintenance business in Indonesia.

The rapid expansion of Indonesia's railway network has created increasing opportunities in the railway infrastructure maintenance sector, making it crucial for companies to evaluate their readiness to enter this growing market. This research aims to comprehensively analyze the internal and external factors that influence PT Wijaya Karya Beton Tbk's readiness to engage in railway track maintenance. Based on the evaluation of the industrial environment and the company's capabilities, the study seeks to formulate strategic alternatives that are relevant and feasible. The research identifies priority strategies that can support business diversification and strengthen the company's competitive position in the railway maintenance industry.

LITERATURE REVIEW

Business Strategy Concept and Porter's Five Forces Analysis

Business strategy serves as the central framework that guides an organization in achieving its long-term objectives by effectively managing resources, aligning with the external environment, and creating competitive advantages (Rachma et al., 2024; Wildanika et al., 2024). The formulation of a business strategy is critical in addressing the dynamics of the external environment, especially in the context of globalization and rapid technological advancements. By doing so, companies are able to anticipate shifts in the market, manage potential risks, and capitalize on emerging opportunities in a structured and strategic manner. In contemporary management practice, business strategy involves a comprehensive process that includes analyzing both internal and external environments, establishing the organization's vision and mission, defining strategic goals, and identifying sources of competitive advantage.

According to Barney and Hesterly (2008), business strategy not only entails long-term planning but also requires ongoing implementation and evaluation to adapt effectively to changes in the external environment. Achieving sustainable competitive advantage demands the development of unique capabilities in resource management, continuous innovation, and agile decision-making that respond to market fluctuations. In practice, a well-formulated business strategy must provide clear guidance, prioritize critical initiatives, and foster innovation to address evolving industry trends. Organizations that consistently design and execute their business strategies effectively are better equipped to face competition, mitigate risks, and achieve long-term growth and sustainability even amid market uncertainties.

Competitive Positioning and Industry Environment

Competitive positioning refers to how a company places itself within an industry in order to achieve sustainable competitive advantage (Porter, 1980). Porter emphasizes that a firm's competitive position is determined by the choice of generic strategies, namely cost leadership, differentiation, or focus, which must be aligned with the industry structure and market characteristics. These strategic choices not only reflect a company's orientation toward cost efficiency and value creation but also indicate how the firm differentiates itself from competitors in meeting customer needs.

In the railway infrastructure maintenance industry, which is capital-intensive, technology-driven, and strictly regulated, competitive positioning is crucial in determining a company's success in winning project tenders and maintaining long-term contracts (Ahi & Yildiz, 2018). Companies are required not only to be cost-efficient but also to excel in service quality, operational safety, regulatory compliance, and technological innovation. Therefore, a clear competitive position influences stakeholder perceptions, including those of government authorities, railway operators, and business partners. To analyze the external environment and strengthen the understanding of competitive position, Porter's Five Forces is applied to map the intensity of competition, the bargaining power of suppliers and buyers, the threat of new entrants, and the threat of substitute products or services (Porter, 1980). This analysis helps companies assess industry attractiveness and identify strategic pressures that affect profitability and long-term business sustainability.

Strategic Analysis Framework for Business Diversification

Strategic analysis for business diversification in railway infrastructure maintenance requires an integrated framework that captures both external environmental dynamics and internal organizational capabilities. One widely used tool to analyze the external environment is Political, Economic, Social, Technological, Environmental, and Legal (PESTEL), which examines political, economic, social, technological, legal, and environmental factors affecting organizational performance (Yüksel, 2012; Gupta, 2013). Political and legal dimensions are particularly relevant in the railway sector due to strong regulatory involvement, while technological and environmental aspects increasingly shape sustainable and safety-oriented infrastructure maintenance. Through PESTEL, firms can identify opportunities and risks arising from external forces and adapt their long-term strategies accordingly, especially in highly regulated and capital-intensive industries such as railways and construction.

Complementing external analysis, the Resource-Based View (RBV) emphasizes the strategic importance of internal resources and capabilities as determinants of sustainable competitive advantage (Barney, 1991). RBV argues that superior performance is not only driven by market conditions but also by unique firm-specific resources such as technical expertise, organizational culture, reputation, and strategic partnerships. To evaluate whether these resources can generate sustainable advantage, the Value, Rarity, Imitability, Organization (VRIO) framework is applied, where only resources meeting all four criteria can become sources of long-term competitiveness (Barney & Hesterly, 2008).

To operationalize strategic positioning, the Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) matrices systematically assess internal strengths and weaknesses as well as external opportunities and threats through weighted and rated factors (David et al., 2023). Their combination produces the Internal–External (IE) Matrix, which guides strategic directions such as growth, stability, or retrenchment. This approach is effective in identifying growth strategies for firms with strong internal capacities in high-opportunity environments (Suhendah, 2022). Strategic formulation is further strengthened through SWOT and TOWS analyses, translating environmental and internal assessments into actionable alternatives, while the Quantitative Strategic Planning Matrix (QSPM) allows objective, data-driven selection of the most feasible strategy (Wheelen & Hunger, 1995).

RESEARCH METHODS

This study adopts a multiphase mixed-method design that sequentially integrates qualitative and quantitative approaches to produce a comprehensive and valid analysis (Creswell & Creswell, 2018; David et al., 2023). The qualitative phase examines the company's external and internal environment using PESTLE and Porter's Five Forces for external factors and RBV–VRIO for internal factors, based on data from literature review, documentation, and in-depth interviews with management, practitioners, regulators, and industry experts. The qualitative findings are then processed through SWOT and TOWS frameworks to formulate strategic alternatives, which are validated by experts. Subsequently, the quantitative phase applies the QSPM, where an expert panel assigns weights and scores to prioritize the most appropriate strategies for PT Wijaya Karya Beton Tbk in entering the railway infrastructure maintenance business. The research was conducted at PT Wijaya Karya Beton Tbk during 2024–2025, involving directors and academics in strategic assessments. This design enables data triangulation, enhances validity, and generates reliable and applicable strategic recommendations to support the company's business diversification.

This study uses purposive sampling to select respondents based on expertise, experience, and relevance to the research focus (Etikan et al., 2016). For macro-level PESTLE analysis, four experts from regulators, industry associations, and academia (DJKA, MASKA, an economics lecturer, and a law lecturer) were involved. Meso-level analysis using Porter's Five Forces included five key industry institutions: DJKA (Infrastructure Division), PT KAI, LRT Jakarta, MRT Jakarta, and PT KCIC. Internal analysis with the RBV–VRIO framework involved three PT Wijaya Karya Beton Tbk board members, while strategy formulation (SWOT/TOWS) and prioritization (QSPM) engaged a panel of seven: three board members and four external experts from the PESTLE stage. This composition ensured a balanced combination of academic, regulatory, practical, and internal management perspectives for objective and contextually relevant strategic analysis.

This study uses primary data from in-depth interviews, focused discussions, and expert validation questionnaires for VRIO, SWOT, and QSPM analyses, alongside secondary data from company reports, RIPNas 2030, Ministry of Transportation regulations, academic publications, and industry reports. Primary data were collected through semi-structured interviews, expert questionnaires assessing IFE/EFE, VRIO, and QSPM scores, and document analysis of policies, financial reports, and industry information. Experts were purposively selected based on their expertise, experience, and relevance, including representatives from DJKA, MASKA, and academics in economics and law, to provide balanced regulatory, practical, and academic perspectives for strategy validation and formulation (Etikan et al., 2016).

RESULTS

Competitive Structure and Industry Attraction of Railway Infrastructure

Table 1 indicates that the threat of new entrants in the railway infrastructure maintenance business is at a low–moderate level due to high entry barriers arising from layered regulations, complex technical requirements, and substantial investment needs for specialized equipment. Although transparent e-procurement processes, increasing demand driven by RIPNas, and the expansion of urban and HSR projects open opportunities for new players, the entry space remains very limited because major operators delegate most maintenance work to in-house units or specific state-owned enterprises through make-or-buy mechanisms.

Table 1. Strategic Factor Analysis for Entering the Railway Infrastructure Maintenance Business

Sub-Theme	Opportunities	Threats
High entry barriers from regulation, technology, and an oligopsonistic market structure	E-procurement access & rising RIPNas/urban/HSR demand	Complex regulations, high CAPEX, limited HR, OEM dependence, thin margins, make-or-buy
Entry lock-in due to layered regulation, specialized assets, limited certified HR, and OEM dependence	Technical specialization allows differentiation	Licensing strictness, high CAPEX, limited HR, thin margins, OEM dominance
Specialist & PPP-based entry patterns constrained by prequalification and OEM requirements	Transparent e-procurement favors technically ready entrants	Strong in-house operators, strict PQ, OEM reliance, aggressive price competition
Regulation as a multi-layer entry filter and compliance gate	Clear quality standards & e-procurement improve credibility	Thin margins and potential SOE assignments limit competition
WIKA beton's potential niche: Track/building specialization, OEM alliances, and certified workforce	Continuous demand from track/building & slab track under RIPNas	Lack of specialization, OEM partnerships, and certified HR create barriers
Polarized supplier structure: commodities vs. specialized OEM technologies	Commodity substitution lowers supplier power	OEMs dominate as price-makers, raising costs
High dependency on proprietary OEM components with limited substitution	Multi-sourcing for commodities reduces costs & ensures supply	Full OEM dependency creates cost & SLA risks
Strategic supplier dominance as price-makers	OEM alliances provide lifecycle support & value-added services	Supplier quasi-monopolies suppress margins, reduce flexibility
Dual procurement logic: transparent e-procurement vs. single-brand OEM lock-in	E-procurement widens access, promotes competition	Single-brand OEM dependency limits options, increases costs
Market access conditioned by alliances and professional certification	OEM alliances accelerate tech transfer & tender success	Lack of alliances increases performance & SLA risks
Oligopsony with highly concentrated buyers	RIPNas expansion creates opportunities for large, multi-year contracts	Few buyers with high bargaining power limit negotiation
Strong buyer power from price caps, thin margins, and strict SLA/KPI	KPI/SLA requirements encourage innovation & efficiency	Margins squeezed, risk of service commoditization
Formal contracting via tender, KPI, and SLA-based evaluation	Transparent tenders & performance evaluation open access	Strict KPI/SLA standards increase financial/reputational risks
Rising demand for technology-based value-added and predictive maintenance services	Predictive maintenance & certification provide a competitive edge	Vendors without tech differentiation are relegated to low-margin subcontracting
Substitution through operator insourcing and digital/material innovation	Digitalization & material innovation enable specialized, tech-based services	Traditional manpower-based services lose relevance
Shift toward preventive–predictive maintenance using data, AI, and IoT	Move up the value chain, become RailTech partners	Routine work volume decreases, traditional margins eroded

Sub-Theme	Opportunities	Threats
RailTech positioning requires OEM, data, and IP Access	Upstream decision-making adds value for OEM-partnered vendors	Lack of OEM access or data traps vendors in low-margin work
Concentrated competition dominated by BUMN and OEM ecosystems (urban & HSR)	Alliances with BUMN/OEMs & specialization in urban/HSR/slab track	Dominance of strong players increases rivalry, limits maneuverability
Competition through formal e-procurement, availability contracts, and OEM-Based capability	KPI/SLA-based tenders provide objective access for prepared entrants	Technical/OEM requirements reduce independence, create complex coopetition
Key success factors: Competitive pricing, certified & HSE-compliant workforce, OEM access, PdM/IoT	OEM alliances, certified HR, and PdM/IoT increase tender scores	Without OEM/support, certifications, chances are low; thin margins are insufficient
Growing RIPNas–Urban–HSR market with intensifying rivalry and limited players	RIPNas & urban/HSR expansion enable multi-year contracts & regional niches	High exit barriers, thin margins, and sustained rivalry create price pressure

Entry barriers in railway infrastructure maintenance are driven by limited certified personnel, strong dependence on Original Equipment Manufacturers (OEMs) for critical inspection and maintenance, and thin contract margins that reduce attractiveness for new entrants (Okirie et al., 2024). New players typically enter through specialist niches, such as track and building maintenance, slab track systems, or inspection services, provided they meet strict prequalification and offer technical differentiation. For WIKA Beton, this implies opportunities through specialization and technical alliances, contingent on regulatory compliance and partnerships with OEMs and operators. The supplier structure creates asymmetric bargaining power: while commodity materials allow multi-sourcing, OEMs with proprietary technologies act as price-makers, compressing margins and increasing performance risks, making strategic OEM partnerships essential (David, 2014). The market is an oligopsony with few dominant buyers, where regulated prices, thin margins, and strict Key Performance Indicators/ Service Level Agreements (KPIs/SLAs) sustain strong buyer power despite opportunities from RIPNas-driven long-term contracts (Profillidis, 2022). Technological substitution is rising as smart sensors, data analytics, and PdM enable high-value RailTech services, while conventional labor-based models face declining relevance and higher SLA risks without access to data, IP, and OEM support.

Competition is moderate to high and dominated by a few core players, particularly state-owned enterprises and OEM-linked firms with full access to standards, data, and advanced technologies. Although this creates strong entry barriers, growth from RIPNas, urban rail, and high-speed rail opens space for niche strategies and alliances, especially in slab track, urban systems, and PdM services. Tender competition is KPI/SLA-driven, favoring vendors with certified personnel, technological readiness, and OEM backing; hence, technology differentiation, certification, and strategic partnerships are critical for sustainable positioning (Cabigiosu, 2022). Politically, government policy in Table 2 offers both stability and risk: network expansion, mandatory operating-worthiness, and supportive PPP regulations create long-term demand, yet high reliance on state budgets, regulated margins (≤10%), strict standards, and complex permitting impose fiscal and administrative constraints, requiring strong compliance capability and risk-mitigation strategies.

Table 2. Strategic External Factors Affecting the Railway Infrastructure Maintenance Industry

Theme	Opportunities	Threats
Government Policy	Market expansion & operating mandates	Dependence on the State Budget (*Anggaran Pendapatan dan Belanja Negara*/APBN) & fiscal risks
Regulations & Third-Party Support	Legal certainty enables bankable PPP	Low margins (≤10%), strict regulations, contract risks

Theme	Opportunities	Threats
Regulatory & Bureaucratic Barriers	Competitive advantage via compliance & tender mastery	High entry barriers, tender failure, and complex compliance
Long-Term Market Prospects	Market growth, backlog reduction, stable PPP contracts	APBN reliance, backlog & cash flow risks
Macroeconomic Impacts	GDP growth drives demand, and PPP stabilizes the market	Inflation, currency depreciation, and high interest rates
Financing & Investment	Performance-based PPP creates long-term bankable projects	Limited APBN margins, SLA penalties, capital, and certified personnel required
Public Expectations & Reputation	Value-added services enhance reliability & image	Reputation decline, SLA penalties if safety standards are not met
Urbanization & Modern Mobility	Urban growth opens maintenance opportunities	High operational frequency may cause delays & backlogs
Human Resources & Competence	Certification & vocational programs improve quality	Staff shortages raise costs, slow execution, and SLA risks
Digitalization & Failure Prediction	Predictive maintenance boosts efficiency & tech niches	Limited equipment, immature data integration, OEM standards risk failure
Industry Readiness	Digital adoption enables predictive & SLA-based contracts	Slow adoption, margin loss, high OEM costs
Technology Standards & Integration	Standardization improves safety & tech integration	Limited certified workforce, high certification costs, audit risk failure
Procurement & Tender Mechanisms	Clear tender pathways ensure access & transparency	High administrative burden, certified personnel required
Legal Clarity & Safety Standards	Regulations improve predictability & cost transparency	Complex implementation, needs qualified personnel
Legal Risk & Compliance	SLA & insurance reduce business risk	High liability, sanctions, APBN margin limits, errors
Compliance & License to Operate	Compliance with B3 & ESG strengthens reputation	High costs, legal risks if mismanaged
Environmental Regulation & ESG	Clear standards enhance credibility & trust	Operational constraints may cause contract deviations
Green Maintenance & ESG	Eco-materials & energy efficiency offer ESG differentiation	Extra costs, strict audits challenge limited workforce/systems

The economic, social, technological, legal, and environmental dimensions indicate that railway infrastructure maintenance has strong long-term prospects driven by network expansion, growing assets, maintenance backlogs, and multi-year APBN and PPP contracts supported by macroeconomic stability, but faces pressures from reliance on state budgets, inflation, exchange rates, high interest rates, thin margins (~10%), SLA penalties, capital intensity, and shortages of certified personnel (Malakhova et al., 2022; Roy et al., 2024). Digital transformation through IoT, drones, robotics, and predictive maintenance creates efficiency gains and specialization opportunities, yet is constrained by network readiness, OEM standards, certification, and implementation risks, while strict procurement rules, KPIs/SLAs, liability, and administrative burdens raise entry barriers (Ali et al., 2023). Environmental requirements on B3 handling, material traceability, and ESG reporting enable compliance and green differentiation but add cost and competency challenges that may affect performance against contractual targets (Le-Dain et al., 2023).

The analysis of the EFE in Table 3 shows that the external landscape offers substantial opportunities for the company, as the external environment provides several high-weighted opportunities that can drive corporate growth. The most influential factor is regulatory certainty and the PPP (*Kerjasama Pemerintah dan Badan Usaha*/KPBU) mandate, which has a score of 0.271, indicating a stable market and strong legal support for private sector participation in railway projects. Furthermore, economic growth and the expansion of railway infrastructure also receive a score of 0.271, thereby increasing the demand for maintenance services sustainably and ensuring a predictable revenue stream.

Table 3. External Factor Evaluation (EFE) Results Analysis

Type	External Key Factors	Weight	Rating	Weighted Score
Opportunity	Regulatory certainty & PPP mandate	0.068	4	0.272
	Economic growth & railway expansion	0.068	4	0.272
	Value-added maintenance & safety standards	0.065	4	0.260
	Predictive maintenance & digitalization	0.068	4	0.272
	Transparent regulations & insurance	0.058	3	0.174
	Rising ESG standards	0.058	3	0.174
	Open e-procurement & technical specialization	0.063	4	0.252
	Material diversification & OEM alliances	0.058	3	0.174
	RIPNAS growth & multi-year contracts	0.065	4	0.260
	Digitalization & new design standards	0.063	4	0.252
	Defined market & alliance opportunities	0.060	3	0.180
Total Opportunities				2.534
Threat	Fiscal dependence & strict regulations	0.028	2	0.056
	Inflation, currency volatility & low margins	0.030	2	0.060
	Shortage of certified personnel	0.023	1	0.023
	OEM dependence & high costs	0.030	2	0.060
	Regulatory complexity & admin burdens	0.028	2	0.056
	Environmental compliance costs & risks	0.030	2	0.060
	Licensing, CAPEX & limited HR	0.023	1	0.023
	Dominant OEMs limit margins & SLA flexibility	0.030	2	0.060
	Buyer bargaining power	0.028	2	0.056
	Low-margin manual work & limited data access	0.030	2	0.060
	Intense rivalry & high exit barriers	0.030	2	0.060
Total Threats				0.571
Total EFE Score				3.105

The adoption of predictive maintenance and network digitalization receives the same score (0.271), offering cost efficiency, enhanced safety, and technological differentiation that can serve as key selling points. Lastly, alliances with OEMs that provide lifecycle support and technology transfer have a score of 0.251, enabling improved tender scores and providing access to up-to-date equipment and performance data. The combination of these four factors creates an external climate that strongly supports the expansion of digital services, the securing of long-term contracts, and the utilization of strategic partnerships to increase railway maintenance market share.

The most significant external threats each have a score of 0.055, namely fiscal dependence, which makes the company vulnerable to changes in budget policies; stringent regulations that compress margins and raise entry barriers; inflationary pressures and exchange-rate fluctuations that reduce financial space; and limitations in certified human resources, which may lead to backlogs and SLA penalties. The total threat score is 0.571, indicating a considerably significant level of external risk.

Internal Readiness, Strategic Position, and Priority Strategies of Wika Beton

The VRIO evaluation in Table 4 shows that PT Wijaya Karya Beton Tbk possesses a mix of strengths and weaknesses, reflecting uneven internal readiness to enter the railway infrastructure maintenance business. Several indicators are considered strengths, such as technical skills, project experience, cost control capability, and organizational flexibility, which are viewed as assets in responding to external challenges such as thin margins, strict regulations, and an oligopsonistic market structure. However, several weaknesses remain, particularly in technology-based innovation (BIM/Digital Twin, IoT, predictive maintenance), limited certified personnel, and the absence of strategic alliances with OEMs, all of which could weaken the company's competitiveness in a highly regulated and technology-intensive market.

Table 4. Evaluation Results Using the VRIO Framework

Dimension	Ind	V	R	I	O	Competitive Implication	Strength or Weakness
Technical Skills	KT 1	Yes	No	–	–	Competitive parity	Strength
	KT 2	Yes	No	–	–	Competitive parity	Strength
	KT 3	No	–	–	–	Competitive disadvantage	Weakness
Managerial Expertise	KM 1	Yes	No	–	–	Competitive parity	Strength
	KM 2	Yes	No	–	–	Competitive parity	Strength
	KM 3	No	–	–	–	Competitive disadvantage	Weakness
	KM 4	Yes	No	–	–	Competitive parity	Strength
Innovation Capabilities	KI 1	No	–	–	–	Competitive disadvantage	Weakness
	KI 2	No	–	–	–	Competitive disadvantage	Weakness
	KI 3	No	–	–	–	Competitive disadvantage	Weakness
Dynamic Capabilities	KD 1	Yes	No	–	–	Competitive parity	Strength
	KD 2	Yes	Yes	Yes	Yes	Sustained competitive advantage	Strength and sustainable distinctive competence
	KD 3	No	–	–	–	Competitive disadvantage	Weakness
	KD 4	Yes	No	–	–	Competitive parity	Strength
Customer Engagement	KP 1	Yes	No	–	–	Competitive parity	Strength
	KP 2	No	–	–	–	Competitive disadvantage	Weakness
	KP 3	Yes	No	–	–	Competitive parity	Strength
	KP 4	Yes	No	–	–	Competitive parity	Strength
Human Resources & Certification	SS 1	No	–	–	–	Competitive disadvantage	Weakness
	SS 2	No	–	–	–	Competitive disadvantage	Weakness
	SS 3	No	–	–	–	Competitive disadvantage	Weakness
Alliances & Strategic Networks	AJ 1	No	–	–	–	Competitive disadvantage	Weakness
	AJ 2	Yes	No	–	–	Competitive parity	Strength
	AJ 3	Yes	No	–	–	Competitive parity	Strength

The VRIO evaluation of PT Wijaya Karya Beton Tbk's internal resources shows that the company has several capabilities that are valuable and support its strategy to enter the railway infrastructure maintenance business, such as railway engineering competence, experience in strategic projects, cost-control abilities, and organizational flexibility (Meng & Sun, 2024). However, these capabilities mostly generate only competitive parity, as they are also possessed by many other players in the construction and railway industries.

On the other hand, weaknesses are quite dominant in areas such as technological innovation (BIM, digital twin, IoT, predictive maintenance), the absence of DJKA-certified or railway-skilled personnel, and the lack of formal alliances with OEMs. This condition indicates that WIKA Beton's internal strengths are not yet sufficient to fully address external pressures such as strict regulations, an oligopsonistic market structure, high supplier bargaining power, and technology- and reliability-based service level agreement (SLA) requirements. Thus, the VRIO results suggest that WIKA Beton needs to selectively strengthen its internal advantages, especially in areas of critical weakness, in order to convert external opportunities into sustainable competitive advantages.

Table 5. IFE Matrix Analysis

Type	Internal Key Factors	Weight	Rating	Weighted Score
Strenghts	Railway infrastructure engineering competencies	0.062	4	0.247
	Experience in transportation infrastructure projects	0.062	4	0.247
	Strategic planning for entering new businesses	0.053	3	0.158
	Contract management & SLA/KPI	0.062	4	0.247
	Cost control capabilities	0.053	3	0.158
	Adaptation to regulations & e-procurement tenders	0.053	3	0.158
	Organizational flexibility for cross-regional scale-up (sustainable distinctive competence)	0.053	3	0.158
	Knowledge transfer & learning culture	0.053	3	0.158
	Relationships & reputation with railway operators	0.059	4	0.237
	Client feedback & satisfaction systems	0.053	3	0.158
	Track record in strategic projects	0.059	4	0.237
	Collaboration with other state-owned enterprises (BUMN)	0.053	3	0.158
	Regional networks for PPP (KPBU) projects	0.053	3	0.158
Total Strengths				2.475
Weakness	Capacity of specialized equipment	0.025	2	0.050
	Regulatory compliance governance	0.027	2	0.055
	Adoption of BIM/Digital Twin for maintenance	0.027	2	0.055
	Implementation of IoT & AI in predictive maintenance	0.027	2	0.055
	Availability/KPBU business model	0.025	2	0.050
	Capability to integrate OEM alliances	0.027	2	0.055
	Ability to meet operators' specific requirements (work windows, safety, MTBF)	0.025	2	0.050
	Number of certified Railway Expertise personnel	0.021	1	0.021
	Human resources pipeline programs (internal academy, certification partnerships)	0.025	2	0.050
	Scarcity of HSR/urban rail talent	0.018	1	0.018
	Formal partnerships with OEMs	0.027	2	0.055
Total Weakness				0.514
Total IFE Score				2.989

The IFE Matrix in Table 5 shows that the company has strong internal capabilities, with a total strengths score of 2.475 versus 0.514 for weaknesses. Key strengths include engineering competencies in slab track and rail structures (0.247), experience in transportation infrastructure projects (0.247), contract management with SLA/KPI monitoring (0.247), and strong relationships with major operators (KAI, MRT, LRT, KCIC) (0.237). These strengths enable independent project execution, enhance regulatory credibility, ensure contract compliance, and open opportunities for strategic collaborations in digitalization and safety initiatives. However, the company also faces notable internal weaknesses. These include low adoption of BIM/Digital Twin, limited IoT and AI implementation in predictive maintenance, insufficient OEM integration, and the absence of formal partnerships (0.055). Additional weaknesses, such as limited specialized equipment, constrained KPBU business model capacity, and gaps in human resource pipeline programs (0.050), further restrict the company's ability to fully leverage its strengths.

The results of the IE analysis in Figure 1 show that WIKA Beton is positioned at coordinates (2.989; 3.105) in the IE Matrix, specifically in Cell II – Growth. This indicates that the company's internal readiness is adequate for scaling up, while the external dynamics fall within the high band, creating room for accelerated entry into the railway infrastructure maintenance business. This position is not merely about survival but about developing capabilities and expanding the market in a measured manner in line with the grow and build direction.

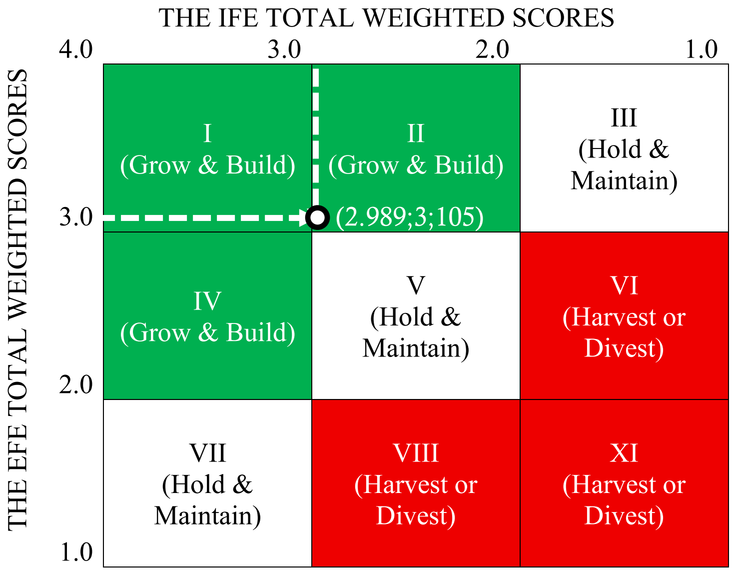

Figure 1. IE Matrix Analysis

Based on the IE analysis, WIKA Beton is positioned in Cell II – Growth. Internally, total strengths of 2.475 far exceed weaknesses of 0.514, with an IFE score of 2.989 on the threshold of "strong." Externally, an EFE score of 3.105 reflects a favorable environment where opportunities and policy support outweigh threats (Sibarani & Pasaribu, 2024). This implies the need to convert existing advantages into scalable service capacity by strengthening operational reliability and governance to consistently meet service level agreements, accelerating certifications and human resource readiness per DJKA requirements, and digitalizing processes for efficiency and predictive maintenance (Suhendah, 2022).

Disciplined risk mitigation remains crucial given margin pressures, buyer bargaining power, and OEM dominance, requiring contract management, cost control, technology partnerships, and capability building to protect profitability (Ben-Abdallah et al., 2022). The results affirm three points: WIKA Beton's internal foundation supports service scale expansion, external momentum favors growth through market penetration, service development, and network expansion (David, 2014; Pasaribu et al., 2025). Prioritizing risk-prone factors ensures balanced growth and performance sustainability. These insights underpin TOWS-based strategy formulation, leveraging high-weight factors as key levers and addressing lower-weight factors for improvement.

Table 6. Alternative Strategies for PT Wijaya Karya Beton Tbk

Category	Alternative Strategies	Indicators
SO (Maxi–Maxi)	SO1. Secure long-term KPBU contracts	≥2 multi-year contracts, ≥25% win rate, ≤60 days mobilization
	SO2. Achieve technology differentiation through PdM & Digital Twin	≥2 pilots, ≥15% lifecycle cost reduction, ≥90% early anomaly detection
	SO3. Build OEM alliances and co-innovation	≥3 MoUs/JVs, ≥2 innovation projects, ≥5% contract value expansion
	SO4. Develop a Green Maintenance & ESG portfolio	100% projects with ESG reports, ≥20% energy savings, ≥2 contracts with green KPIs
	SO5. Establish regional hubs and technical specialization	3 operational hubs, ≤30 days mobilization, ≥75% equipment utilization, ≥30% slab track tender win rate
WO (Mini–Maxi)	WO1. Expand specialized equipment capacity	≥75% utilization across 3 regional hubs, support multi-year RIPNAS contracts
	WO2. Strengthen regulatory compliance and governance	100% tender compliance ≤72 hours, ≥95% annual audit compliance
	WO3. Accelerate digital adoption	2 digital twin pilots, ≥30% contracts using PdM/IoT by 2027
	WO4. Build a certified workforce pipeline	≥50 railway-certified engineers annually via academy & university partnerships
	WO5. Formalize OEM partnerships	MoU/JV for lifecycle support & tech transfer, +≥10 tender score points in ≥2 projects
ST (Maxi–Mini)	ST1. Implement SLA-based & margin-assured contracts	≥98% availability in ≥90% contracts, penalties <0.5% revenue
	ST2. Enhance cost efficiency	≥8% annual material savings, 10–12% project margins
	ST3. Establish an internal certification center & academy	≥50 certified engineers/year, ≥95% HSE compliance
	ST4. Form strategic partnerships with OEMs	≥3 OEMs for lifecycle support & spare parts, reduce downtime ≥20%
	ST5. Shift toward performance-based & ESG services	≥50% new contracts with green KPIs, ≥2 projects using availability-based models
WT (Mini–Mini)	WT1. Expand specialized equipment via OEM leasing/partnerships	≥75% utilization, <10% downtime
	WT2. Establish a digital compliance center	100% tender compliance, ≥95% audit pass rates
	WT3. Build internal academy & university partnerships	≥50 DJKA-certified railway engineers annually
	WT4. Form MoU/JV partnerships with OEMs	≥3 OEMs, reduce SLA risks & penalties by ≥20%
	WT5. Reorient portfolio toward availability & green maintenance	≥50% new contracts SLA/ESG-based by 2027

Table 6 shows that the SWOT and TOWS analyses generate four groups of alternative strategies for PT Wijaya Karya Beton Tbk in entering the railway infrastructure maintenance business. SO strategies leverage internal strengths and external opportunities by expanding long-term KPBU-based contracts, implementing technology differentiation through predictive maintenance and digital twin, forming OEM alliances, developing an ESG-based green maintenance portfolio, and establishing regional hubs to enhance mobilization and technical specialization. WO strategies address internal weaknesses by investing in specialized equipment, improving tender compliance systems, accelerating digital adoption, increasing certified personnel, and building OEM partnerships to strengthen technology access and tender performance (Chan & Owusu, 2022).

ST strategies use internal strengths to counter threats through SLA-based and margin-assurance contracts, multi-sourcing cost efficiency, personnel certification, and strategic OEM alliances to reduce downtime in high-tech projects. WT strategies mitigate combined weaknesses and threats by optimizing equipment via leasing schemes, enhancing compliance systems, expanding certified personnel, forming OEM partnerships, and shifting toward availability contracts and green maintenance to manage thin margins and reputational risks. These strategies provide a measurable operational framework for WIKA Beton to build competitive advantage and sustainable positioning in the railway infrastructure maintenance industry (Wibowo, 2024).

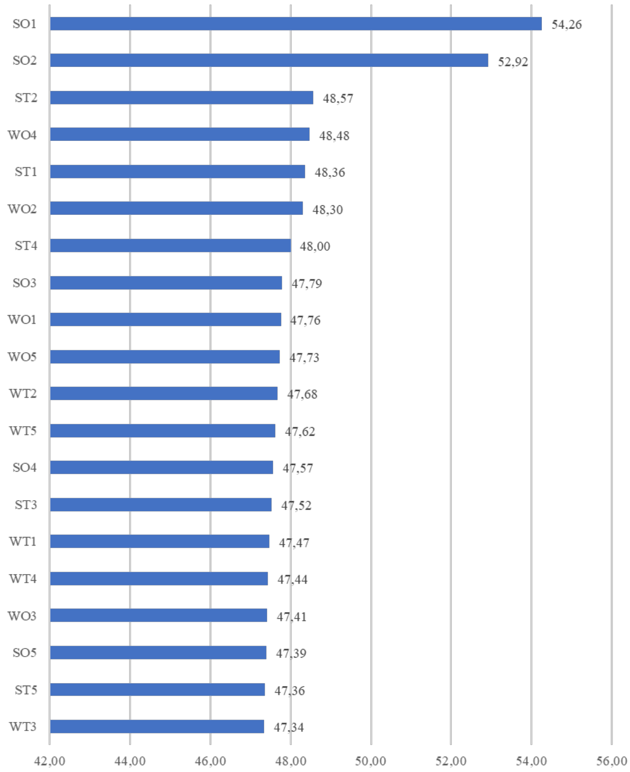

Figure 2. Results of Strategy Prioritization Using QSPM

Figure 2 shows the QSPM results, highlighting the prioritized strategies for PT Wijaya Karya Beton Tbk in entering the railway infrastructure maintenance business. The top-ranked SO1 strategy (securing long-term KPBU-based contracts, score 54.26) ensures revenue continuity and strategic positioning, supported by Law Number 23 of 2007 Articles 20–21 and aligned with national policy, consistent with Suryawati (2020) on leveraging intangible assets for sustainable advantage. SO2 (technology differentiation via predictive maintenance and digital twin, score 52.92) strengthens operational reliability and reduces lifecycle costs, leveraging existing VRIO-based engineering competencies and external opportunities (O4, O10), as reinforced by Yudariansyah et al. (2023) and Bianchi et al. (2025).

Mid-priority strategies include ST2 (cost efficiency through multi-sourcing, 48.57), addressing thin margins and OEM dependence, and WO4 (certified HR pipeline, 48.48), ensuring regulatory compliance per Law Number 23 of 2007 Articles 68–72, supported by Kurniawan (2020) and Njatrijani et al. (2024). Other strategies ST1 (SLA-based contracts), WO2 (digital compliance system), ST4 (strategic OEM partnership), and ESG-focused ST5/WT5 guide business repositioning toward performance-based, sustainable, and compliant operations, aligned with Sitorus et al. (2022), Hernowo et al. (2025), and Damián and Zamorano (2025). The QSPM results emphasize that WIKA Beton's core priorities, KPBU contracts, technological differentiation, fiscal efficiency, and HR capacity, must be urgently realized, while supporting strategies in ESG, compliance, and OEM partnerships ensure long-term sustainability and competitive positioning in the national railway sector.

DISCUSSION

At the meso level, Porter's Five Forces indicate that Indonesia's railway infrastructure maintenance industry is highly competitive, with strong entry barriers and dependence on strategic suppliers and key buyers such as KAI, KCIC, MRT, and LRT. New entrants face multilayered regulations, high CAPEX, and limited certified personnel, while incumbents must maintain quality to prevent niche specialists from entering (Faturrahman & Belgiawan, 2022; Hanifah & Wandebori, 2025). Supplier power is polarized: general materials are substitutable, but OEMs dominate, making strategic alliances and certified HR pipelines critical. Buyers exert strong bargaining power due to regulatory margins (~±10%) and strict SLAs. Substitution threats come from insourcing, slab-track designs, and IoT/AI-based predictive maintenance, while rivalry remains high because of the SOE ecosystem, exit barriers, thin margins, and KPI/SLA expectations (Cabigiosu, 2022).

PESTLE findings show that external opportunities and risks are closely intertwined. Politically, network expansion, operational eligibility mandates, and PPP support provide strategic direction, although reliance on APBN funding and narrow regulated margins pose fiscal risks (Bou Hatoum et al., 2023; Wibowo, 2024). Multi-year APBN and PPP contracts offer revenue certainly but inflation, currency depreciation, SLA penalties, and upfront capital and certified personnel requirements require effective risk mitigation (Malakhova et al., 2022). Urbanization, rising public safety expectations, and certified workforce shortages emphasize differentiation through service quality and internal certification programs (Roy et al., 2024).

Technologically, the adoption of IoT, AI, drone/robotic inspections, and predictive maintenance enables specialization in high-precision segments such as HSR, CBTC, and slab track. Yet, heterogeneous infrastructure readiness, certification costs, and operational risks challenge implementation (Ali et al., 2023). Legally, mechanisms including LPSE, PBJ, OSS, PPP contracts, and compliance with Law Number 23 of 2007 Articles 20–23 provide procedural certainty but increase administrative burdens and liability risks. Environmental aspects, including B3 management, Environmental Impact Analysis (*Analisis Mengenai Dampak Lingkungan*/AMDAL) or Environmental Management and Monitoring Efforts (*Upaya Pengelolaan dan Pemantauan Lingkungan*/UKL-UPL), and ESG reporting, act as a license to operate and differentiation opportunity, though compliance costs remain significant (Le-Dain et al., 2023).

VRIO analysis shows that most of WIKA Beton's core resources are valuable but neither rare nor inimitable, indicating limited sustained competitive advantage. Differentiation through slab track specialization, unique process standardization, and OEM alliances is essential to create rarity and barriers to imitation (Barney, 1991; Barney & Hesterly, 2019). TOWS analysis suggests leveraging internal strengths, operational capacity, OEM networks, and digital readiness to capture external opportunities such as RIPNAS growth, ESG expectations, and PPP support. Weaknesses, including limited equipment, compliance gaps, and certified personnel shortages, require phased investment, an internal academy, and digital compliance systems (Ansoff, 1957; David et al., 2023).

These findings indicate that WIKA Beton must transition from a purely technical contractor to a strategic partner that integrates regulatory compliance, technological innovation, life-cycle cost management, and certified talent development. The strategy aligns with conceptual frameworks from Porter, PESTLE, VRIO, and TOWS, showing that competitive advantage depends on internal strengthening and adaptation to external pressures (Pamungkas & Muthohar, 2017). Immediate priorities include securing long-term PPP-based contracts as revenue anchors, in line with Law Number 23 of 2007 Articles 20–23, adopting PdM and digital twin solutions as technology differentiators, developing a pipeline of DJKA-certified personnel, and formalizing OEM partnerships for lifecycle support. Organizationally, establishing a Strategic Business Unit (SBU) for Rail Maintenance that integrates operations, engineering, HR, legal, IS, finance, and QHSE divisions ensures coordinated execution of KPI/SLA contracts, technological innovation, and regulatory compliance. Consistent implementation of these strategies ensures WIKA Beton can compete effectively, maintain regulatory adherence, and achieve sustainable positioning in the railway infrastructure maintenance sector (Porter, 1980; Grant, 2018; Barney & Hesterly, 2019).

CONCLUSION

The mapping of external and internal factors indicates that the greatest opportunities for PT Wijaya Karya Beton Tbk lie in PPP schemes, e-procurement, and sustainability-based services, while threats stem from thin margins, OEM dominance, buyer bargaining power, and strict certification requirements. Key strengths include infrastructure engineering competencies, experience in strategic projects, contract management, cost control, and networks with state-owned enterprises, whereas weaknesses are limited specialized equipment, early-stage digital adoption, and insufficient certified personnel. The IFE–EFE projection places the company in Cell II growth, indicating adequate internal readiness and favorable external dynamics for accelerated entry into rail infrastructure maintenance.

Integration through SWOT–TOWS and prioritization via QSPM generated main strategies: securing long-term contracts, technological differentiation with predictive maintenance and digital twins, efficiency through multi-sourcing, and capacity-building for certified personnel. Supporting strategies include digital compliance, OEM partnerships for lifecycle support, shifting toward availability-based and green maintenance contracts, and establishing a strategic rail maintenance business unit to enhance cross-functional coordination. Consistent implementation of these strategies will strengthen competitive positioning and ensure long-term sustainability in the national railway ecosystem.

This study is limited by its focus on strategic and operational factors, without a quantitative assessment of financial feasibility (e.g., NPV, IRR), scenario uncertainties, or broader macroeconomic variations. Data availability on certified personnel and technology adoption levels was also limited, potentially affecting the precision of strategic prioritization. Future studies could expand the analytical scope by integrating scenario planning or system dynamics to assess long-term impacts, evaluate financial feasibility through NPV, IRR, and payback period analyses, and explore competency development models for railway engineering certification to support human capital readiness. These extensions would provide a more comprehensive basis for informed diversification into the rail infrastructure maintenance sector.

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