Jurnal Aplikasi Bisnis dan Manajemen (JABM), Vol. 12 No.3, September 2026
Permalink/DOI: http://dx.doi.org/10.17358/jabm.12.3.795

Available online
http://journal.ipb.ac.id/index.php/jabm

STRATEGIC MODEL FOR ENHANCING DIGITAL COMPETITIVENESS OF REGIONAL WATER TESTING LABORATORIES: AN INTEGRATED SWOT-AHP-QSPM APPROACH

Desinta Riski Azhari, Ratih Amelia, Hujjatullah Fazlurrahman, Dana Azizah Rahmat*, Muhammad Fachmi

Faculty of Economics and Business, Department of Digital Business, Surabaya State University
Jl. Ketintang, Ketintang, Gayungan District, Surabaya City, East Java 60231, Indonesia

Article history:

Received
15 December 2025

Revised
12 February 2026

Accepted
15 July 2026

Available online
30 September 2026

This is an open access article under the CC BY license (https://creativecommons.org/licenses/by/4.0/)

Abstract:

Background: Access to safe drinking water continues to face global and national challenges, requiring reliable laboratory systems to ensure compliance with quality standards. In Indonesia, population growth, stricter regulatory demands, and competition among accredited laboratories highlight the need for strategic strengthening. Beyond technical competence, laboratories must improve service efficiency and digital access. In this context, digital transformation and service innovation have become critical for sustaining competitiveness, particularly for regional laboratories operating alongside private competitors.
Purpose: This study aims to identify strategic internal and external factors influencing PT XYZ Laboratory's performance, formulate development strategies using SWOT analysis, and determine priority strategies to enhance digital competitiveness and market positioning.
Design/methodology/approach: A mixed-methods case-study approach was applied over four months, integrating qualitative interviews and observations with quantitative analyses using SWOT, IE Matrix, AHP, and QSPM. Data were obtained from internal experts, customer records, digital-platform analytics, competitor benchmarking, and regulatory reviews.
Findings/Result: The IE Matrix positioned PT XYZ Laboratory in the Grow & Build quadrant, supported by strong accreditation, competitive pricing, and competent personnel. However, the analysis identified weaknesses in digital visibility, branding, and service responsiveness. QSPM results indicated that the highest strategic priority is the integration of digital marketing, website development, and a Laboratory Information Management System (LIMS) to enhance competitiveness and customer trust.
Conclusion: PT XYZ Laboratory possesses strong internal capabilities but must accelerate digital transformation to remain competitive within an increasingly crowded market. Strengthening branding, online platforms, and technology-based monitoring systems can significantly improve service quality and strategic positioning.
Originality/value (State of the art): This study provides a comprehensive strategic-management model specifically tailored for regional testing laboratories by integrating SWOT-AHP-QSPM with digital competitiveness assessment, an approach rarely applied in prior laboratory-sector research. The findings extend theoretical insights on Laboratory 4.0 readiness while offering practical guidance for policy and managerial decision-making.

Keywords: strategic management, laboratory operations, SWOT-AHP-QSPM analysis, digital transformation, water-quality testing

How to Cite:
Azhari, D. R., Amelia, R., Fazlurrahman, H., Rahmat, D. A., & Fachmi, M. (2026). Strategic model for enhancing digital competitiveness of regional water testing laboratories: An integrated SWOT-AHP-QSPM approach. *Jurnal Aplikasi Bisnis dan Manajemen*, 12(3), 795. https://doi.org/10.17358/jabm.12.3.795

* Corresponding author:
Email: danarahmat@unesa.ac.id

INTRODUCTION

Access to safe and clean water remains one of the most critical global challenges of the 21st century, as it directly affects public health, environmental sustainability, and socio-economic development. According to the WHO/UNICEF Joint Monitoring Programme (2023), approximately 2.2 billion people still lack access to safely managed drinking-water services, while 3.5 billion people remain without safely managed sanitation as of 2022. These findings align with the World Bank (2024), which emphasizes that disparities in access to clean water persist and continue to hinder global well-being.

In Indonesia, this urgency is becoming increasingly evident as the population is projected to grow from 281.6 million in 2024 to 284.4 million in 2025 (BPS, 2025). The rising demand for safe and potable water places significant pressure on water-quality testing laboratories to ensure compliance with national regulations. Regulations such as Ministry of Health Regulation No. 492/MENKES/PER/IV/2010 and Ministry of Health Regulation No. 32 of 2017. Laboratory testing plays a strategic role in detecting physical, chemical, and microbiological contaminants that pose risks to public health and the environment (Pontororing et al. 2019; Suruata et al. 2021). Strengthening laboratory systems is therefore essential for maintaining national resilience and safeguarding public health security.

Along with the increasing demand for clean-water services, the laboratory industry is also undergoing a significant transformation driven by technological advancements. Globally, the laboratory industry is undergoing a significant digital transformation driven by the Fourth Industrial Revolution. The Laboratory 4.0 concept integrating the Internet of Things (IoT), automation, and real-time data analytics has been proven to enhance accuracy, transparency, and testing efficiency (Azam & Mustafa, 2024; Narolita, 2020). The adoption of end-to-end workflows and electronic reporting further reinforces public trust in laboratory results (Jovičić & Vitkus, 2023). As a result, laboratories are increasingly required not only to provide accurate testing results but also to deliver services efficiently through digital platforms.

Competition in Indonesia's laboratory-testing industry has intensified due to the increasing number of service providers offering similar testing services. Data from the National Accreditation Committee (KAN, 2025) indicate that 94 medical laboratories, 1,573 testing laboratories, and 382 calibration laboratories are accredited. Major laboratories such as Sucofindo, Envilab, and Genau have integrated digital marketing initiatives and branding ecosystems as part of their strategies to expand market share. However, many regional laboratories still struggle with limited resources, weak branding, and low digital visibility. This gap illustrates a digital divide that limits competitiveness even among laboratories that are technically competent and accredited.

This situation is evident in PT XYZ Laboratory. Although the laboratory holds KAN accreditation (LP-552-IDN) and ISO/IEC 17025:2017 certification and offers competitive testing fees, it continues to face challenges in expanding its market reach. Limited use of social media, the absence of a dedicated website, and insufficient customer testimonials as social proof weaken its competitive positioning (Ardella, 2024). Meanwhile, external factors such as regulatory changes and evolving KAN data-recording requirements necessitate more responsive digital systems, including IoT-based temperature and humidity monitoring, which has been shown to improve recording accuracy by up to 98 percent (Susantok et al. 2025). Additionally, the integration of web-based Laboratory Information Management Systems (LIMS) enhances accuracy, scheduling, and operational accountability (Dalimunthe et al. 2023).

Beyond external pressures, laboratory competitiveness is also shaped by internal factors such as customer relations, service quality, and personnel competence. Service quality, speed, and testing accuracy play central roles in improving customer satisfaction and loyalty (Harun Al Rasyid, 2017). The use of information technology has been proven to strengthen customer relationships and enhance service competitiveness (Harun Al Rasyid, 2017). Theoretically, this study contributes to the literature on digital competitiveness within the public-service sector. Practically, it offers guidance for regional laboratories seeking to develop sustainable competitive advantages in the era of Industry 4.0.

The increasing demand for clean-water services, together with intensified competition and accelerated digital transformation, makes strategic planning both timely and necessary for laboratory organizations. Previous studies have employed strategic tools such as SWOT, IFAS-EFAS, and AHP to formulate organizational

development strategies (Mulyadi et al. 2020; Sidiq et al. 2024). However, most of these studies remain focused on operational efficiency and service quality, with limited attention to digital marketing, branding, and strategic positioning as key dimensions of competitiveness. This limitation highlights the need for a more comprehensive and integrative problem-solving approach in the digital era.

To address these challenges, this study adopts an integrated strategic analysis approach by combining SWOT analysis, IE Matrix, the Analytic Hierarchy Process (AHP), and the Quantitative Strategic Planning Matrix (QSPM). SWOT analysis is used to identify internal strengths and weaknesses as well as external opportunities and threats. Subsequently, AHP is applied to assign relative weights to each strategic factor through pairwise comparisons, ensuring consistency and objectivity in decision-making. Finally, QSPM is employed to evaluate and prioritize alternative strategies based on their overall attractiveness scores. This sequential approach enables the identification of strategic priorities for enhancing digital competitiveness and strengthening market positioning through an in-depth case-study analysis. The research design integrating SWOT, IE Matrix, AHP, and QSPM.

Based on the background, research gap, and problem-solving approach described above, this study aims to achieve the following objectives: Identify internal and external factors that influence the performance of PT XYZ Laboratory; Formulate alternative development strategies using SWOT analysis; Determine priority strategies to enhance digital competitiveness and strengthen the market position of regional testing laboratories.

METHODS

This study was conducted at PT XYZ Laboratory in Surabaya over a four-month period from June to October 2025. Research activities included data collection, processing, analysis, and report preparation. The laboratory was selected due to its strategic role in ensuring drinking-water quality and its increasing competition with private laboratories. This study utilized both primary and secondary data. Primary and secondary data were collected to support a comprehensive strategic assessment.

Data collection was carried out using both primary and secondary data sources. Primary data were obtained through direct observation, in-depth interviews with internal stakeholders, and expert questionnaires. Secondary data included financial reports, customer databases, Google Reviews, social media insights, and customer-satisfaction surveys involving 279 respondents. All data sources were triangulated to ensure validity and to enable comparisons with practices applied by private laboratories. A non-probability expert-sampling technique was employed, involving five internal experts aged 32-47 years, each with 2-13 years of experience in the water-quality testing industry. Expert selection was based on competence, strategic understanding, and professional experience (Tuan & Canh, 2022). The expert-sampling technique was selected due to the strategic nature of the analysis, which requires informed managerial judgment rather than statistical generalization.

A mixed-methods approach employing a case-study design was used, integrating qualitative analyses (interviews and observations) with quantitative analyses (SWOT, IE Matrix, AHP, and QSPM). This combination provided a comprehensive understanding of the laboratory's strategic position across internal performance, market conditions, and strategic priorities (Mulyadi et al. 2020). The integration of SWOT, IE Matrix, AHP, and QSPM enables a structured transition from qualitative strategic diagnosis to quantitative decision-making, thereby reducing subjectivity in strategy formulation. Similar methodological integrations have proven effective in prior studies (Diep et al. 2025; Li & Zhang, 2025). The SWOT analysis was used to identify internal and external strategic factors, the IE Matrix to determine the laboratory's strategic position, AHP to assign priority weights based on expert judgment, and QSPM to evaluate and rank strategic alternatives.

The framework of thought in this study is presented in the form of a data-analysis flow that illustrates the sequential stages of strategic formulation, from problem identification to strategic-solution development. The framework provides a structured guide for integrating qualitative and quantitative analyses in developing business strategies for laboratory testing services. The sequential stages of data analysis are illustrated in Figure 1.

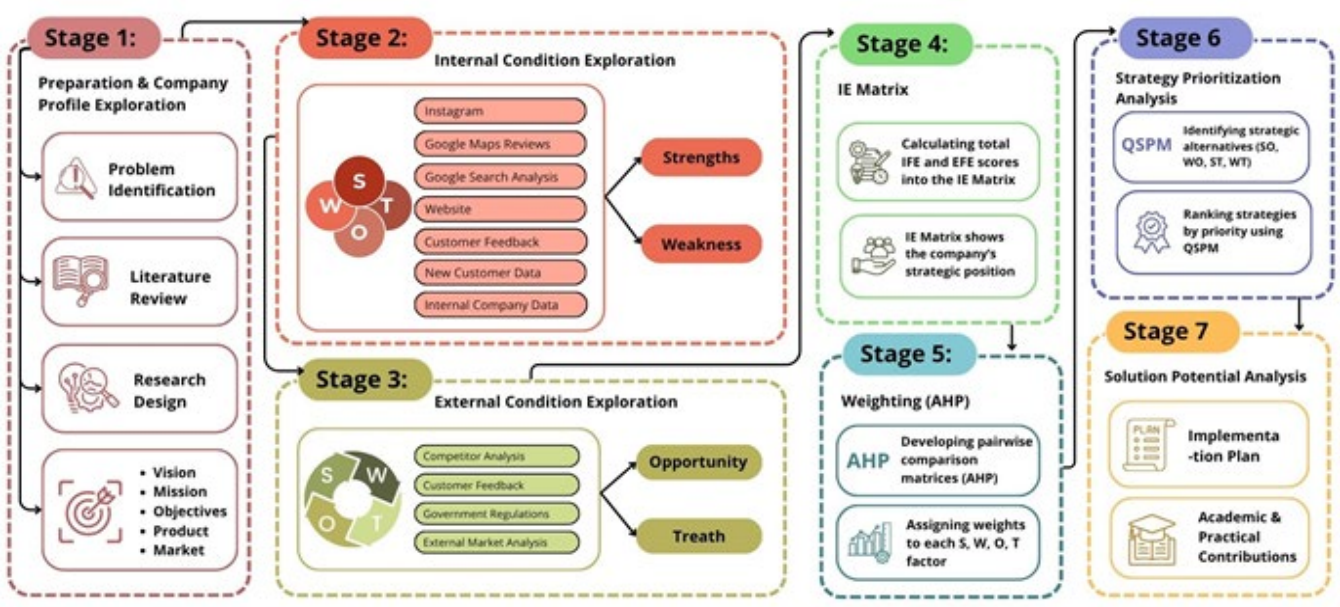


Figure 1. Sequential data analysis flow for strategic formulation using SWOT–AHP–QSPM at PT XYZ Laboratory

Stage 1: Preparation and Exploration of Company Profile

The initial phase involved identifying research problems, reviewing relevant literature, and constructing the research framework. The company's vision, mission, objectives, and market position were analyzed as the foundation for strategic assessment (Aisyah et al. 2024; Mulyadi et al. 2020).

Stage 2: Exploration of Internal Conditions

Internal analysis was conducted by identifying strengths and weaknesses. These findings were then used to formulate internal factors within the SWOT framework (Vitasari, 2021).

Stage 3: Exploration of External Conditions

External analysis was carried out by identifying opportunities and threats through competitor benchmarking, customer feedback, regulatory assessment, and reviews of macroeconomic conditions. This stage provided a comprehensive overview of the external environment influencing the organization's strategic direction.

Stage 4: IE Matrix Analysis (Internal-External)

The Internal-External (IE) Matrix was constructed by combining the weighted scores of internal (IFE) and external (EFE) factors. Based on the total IFE scores (x-axis) and EFE scores (y-axis), the organization's position was mapped into one of nine strategic cells, classified into three main strategy groups: growth/build, stability/hold & maintain, or retrenchment/harvest. The placement within a specific quadrant served as the basis for determining the most appropriate strategic alternatives for the company (Ben-Abdallah et al. 2022; Sibarani & Djunita Pasaribu, 2024).

Stage 5: Weighting Using the Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was applied to determine the relative importance of each SWOT factor using a pairwise comparison matrix. This method generates quantitative weights for each factor, providing an objective foundation for establishing strategic priorities (Jati et al. 2023). To ensure consistency in factor weighting, the Consistency Ratio (CR) was calculated. An assessment is considered consistent when CR ≤ 10 percent. (Diep et al. 2025).

Stage 6: Determination of Strategic Priorities Using the Quantitative Strategic Planning Matrix (QSPM)

The Quantitative Strategic Planning Matrix (QSPM) method was used to evaluate and rank strategic alternatives (SO, WO, ST, WT) objectively based on their level of attractiveness. Each internal and external factor listed in the IFE and EFE matrices was assigned an Attractiveness Score (AS) ranging from 1 to 4 by expert evaluators, where 1 (not attractive),

2 (less attractive), 3 (moderately attractive), and 4 (highly attractive). These scores were multiplied by the corresponding factor weights to obtain the Total Attractiveness Score (TAS) (Prananto et al. 2025).

Stage 7: Solution Analysis

The final stage integrates all research findings into implementable strategic solutions. The results provide practical recommendations for strengthening laboratory competitiveness, contributing to the strategic-management literature through the application of the integrated SWOT-AHP-QSPM model.

RESULTS

Stage 1: Preparation and Exploration of Company Profile

PT XYZ's laboratory operates as a service unit specializing in water quality testing in accordance with national and international regulatory standards. It fulfills a dual function: supporting the company's primary water service operations and generating alternative revenue through analytical testing services offered to the public and industrial sectors.

The analysis began with an examination of PT XYZ's vision and mission. The company envisions itself as a modern drinking water provider, supported by a mission emphasizing financial transparency for community welfare, fostering water-conscious behavior, delivering efficient and sustainable services, and cultivating a work environment grounded in integrity and achievement. Although these statements align with community needs and local development priorities, they remain broad and oriented toward PT XYZ as a whole. Therefore, the testing laboratory must translate the parent company's vision and mission into more specific operational objectives.

The laboratory's operational goal is to provide water quality testing services that prioritize speed, precision, and accuracy, executed by certified professionals in accordance with ISO/IEC 17025:2017. This objective aligns with current sectoral demands and demonstrates the company's commitment to strengthening its competitiveness in the testing services industry.

Stage 2 and 3: Internal and External Environmental Analysis

Internal environmental factors were examined using multiple data sources, including PT XYZ's. The findings identified six strengths (Table 1) that support the laboratory's operational performance. However, five weaknesses were also identified, particularly in areas related to service quality enhancement and digital adaptation. These conditions suggest that although the laboratory has a solid operational foundation, further internal improvements are necessary to enhance competitiveness and sustain service excellence.

The external environmental analysis was conducted by examining competitor dynamics, government regulations, market trends, and customer feedback. Competition with private laboratories has intensified, particularly with the presence of well-established testing service providers that are widely recognized by the public. Government regulations related to water quality standards and laboratory accreditation are also becoming increasingly stringent, requiring PT XYZ Laboratory to continuously adapt to regulatory developments. On the other hand, substantial opportunities are emerging as public awareness regarding the importance of water quality increases, accompanied by growing demand for testing services from industries, hospitals, and the public sector. Based on this analysis, five key opportunities were identified, as summarized in Table 2. The identified internal and external factors were subsequently weighted using the Analytic Hierarchy Process (AHP). The resulting weights were then incorporated into the IFAS and EFAS matrix.

Stage 4: Internal-External (IE) Matrix Analysis

The internal and external factors identified were evaluated using the IFAS and EFAS matrices. The assessment process involved assigning weights using AHP and ratings to each strategic factor. The weights indicate the level of importance of each factor to the laboratory, while the ratings reflect the laboratory's ability to respond to them. The rating scale ranged from 1 to 4, where 1 indicates a major weakness, 2 a minor weakness, 3 a minor strength, and 4 a major strength (Mulyadi et al. 2020).

Table 1. Internal Factor Evaluation Summary (IFAS) of PT XYZ laboratory including strength and weakness scores

Internal Strategic Factors				
Code	IFAS	Weight	Rating	Score
Strength (S)				
S1	Legal and official credibility accredited by KAN LP-552-IDN and compliant with ISO 17025:2017.	0.1587	4	0.6346
S2	Rates offered are more affordable than private laboratories.	0.1053	3.2	0.3371
S3	The laboratory serves a wide range of sectors, including the food & beverage industry, hotels, manufacturing, schools, clinics, and students.	0.0759	3	0.2277
S4	The laboratory possesses competent, professional, and experienced laboratory staff in the field of water quality.	0.1203	3.4	0.4092
S5	The results are accurate and reliable, meeting standards and professional requirements.	0.1270	3.4	0.4318
S6	Significant revenue growth from 2018 to 2024.	0.0838	3.2	0.2680
Weakness (W)				
W1	Not well known outside of its regular customer base.	0.1085	2.6	0.2821
W2	Registration and test results are often still manual, and lab results are not yet digital.	0.0517	1.8	0.0930
W3	Does not have its own website, only listed on the general company's website, resulting in incomplete service information and losing out to competitors.	0.0382	1.4	0.0535
W4	Weak digital branding and positioning, based on Instagram feeds that are inconsistent in posting and lack testimonials.	0.0474	2.2	0.1042
W5	Real-time customer response service performance through digital media is not yet optimal.	0.0833	2	0.1666
	TOTAL IFAS			3.0077

Table 2. External Factor Evaluation Summary (EFAS) of PT XYZ Laboratory Including Opportunity and Threat Scores

External Strategic Factors				
Code	EFAS	Weight	Rating	Score
Opportunity (O)				
O1	There is a requirement for water quality testing for industries (F&B, hotels, clinics, schools).	0.1193	3.8	0.4534
O2	Can work with universities, schools, and companies for CSR & research programs.	0.1063	2.6	0.2765
O3	The local industrial market, such as restaurants and hotels in the area, requires affordable routine water testing services.	0.1623	3	0.4868
O4	The increasing trend of digitalization: consumers are more likely to search for services via Instagram, Google, and online reviews.	0.1170	2.4	0.2808
O5	Support for collaboration with educational institutions for student research and practice.	0.1401	2.6	0.3642
Threats (T)				
T1	New government policies regarding laboratory quality standards may increase operational burdens and require rapid adjustments.	0.0913	2	0.1825
T2	Competitors already have their own websites and stronger branding.	0.0737	2.4	0.1769
T3	Advances in digital technology, including laboratory automation and online platforms, could pose a threat if does not adapt quickly.	0.0847	2.2	0.1863
T4	Customer expectations (speed, transparency, service digitalization).	0.1053	2.6	0.2739
	TOTAL EFAS			2.6813

The calculated IFAS score of 3.0077 and EFAS score of 2.6813 place PT XYZ in Cell IV of the Internal-External (IE) Matrix. Cell IV corresponds to the Grow & Build category, indicating a strategic position characterized by strong internal capabilities and moderate external attractiveness. This position suggests that PT XYZ has the capacity to leverage its technical advantages while actively pursuing market opportunities through growth-oriented strategies. The position of PT XYZ Laboratory within the Internal–External (IE) Matrix is illustrated in Figure 3.

Stage 5: Weighting with the Analytic Hierarchy Process (AHP)

The next stage involved constructing a hierarchy that incorporates SWOT factors and their subcomponents, followed by pairwise comparisons using a 1-9 importance scale where 1 indicates equal importance and 9 indicates absolute dominance of one factor over another. This process generated priority weights, as shown in Table 3, which were subsequently used to derive strategy rankings through the QSPM. These results enable the laboratory to make more structured and objective decisions regarding the most effective strategic actions. This study applied two distinct AHP-based weighting schemes for different analytical purposes. The first weighting scheme was employed to construct the IFAS and EFAS matrices, where internal factors (strengths and weaknesses) and external factors (opportunities and threats) were normalized within their respective matrices to determine the organization's strategic position using the IE Matrix. The second weighting scheme was applied within the SWOT–AHP framework, where strengths, weaknesses, opportunities, and threats were evaluated separately. The resulting combination weights were subsequently used as inputs in the QSPM to prioritize alternative strategies. This separation ensures methodological consistency between strategic positioning and strategy prioritization stages.

Based on the weight analysis derived from the SWOT-AHP model for PT XYZ Laboratory, the prioritization of strategic factors is as follows: strengths > opportunities > weaknesses > threats. This indicates that the laboratory's internal advantages are more dominant than its weaknesses. Subsequently, strategic alternatives were developed using the TOWS matrix to conceptually identify four groups of strategies: SO (maxi–maxi), ST (maxi-mini), WO (mini-maxi), and WT (mini-mini). Table 4 presents the formulated strategic alternatives.

Stage 6: Strategy Prioritization Using the Quantitative Strategic Planning Matrix (QSPM)

To determine strategic priorities, the Quantitative Strategic Planning Matrix (QSPM) was employed. This method integrates SWOT factors as vertical indicators and alternative strategies as horizontal indicators. Each factor is evaluated based on its Attractiveness Score (AS), and the Total Attractiveness Score (TAS) is calculated to determine implementation priority.

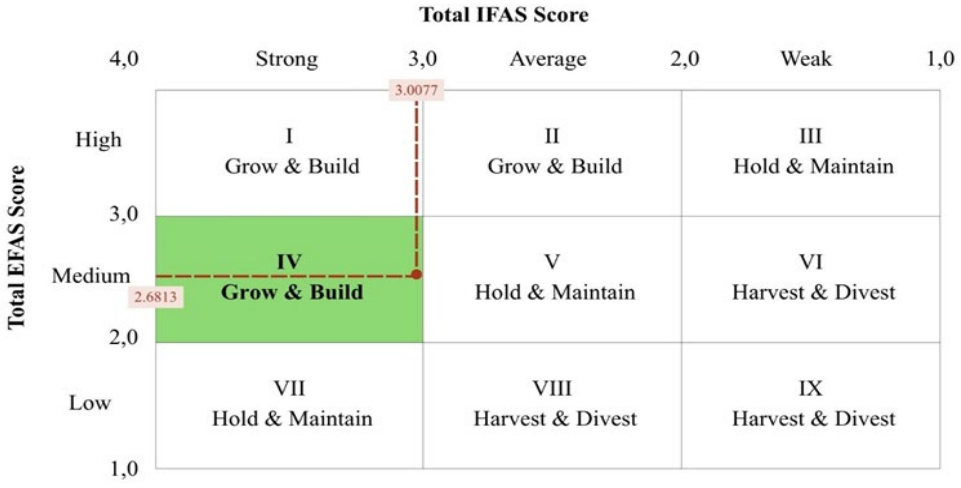


Figure 3. Position of PT XYZ Laboratory in the Internal–External (IE) Matrix Based on IFAS and EFAS Scores

Table 3. Global Weight Scores of SWOT Categories Based on AHP Analysis

Criterion layer	Weight within group	Indicator layer	Weight within group	Combination weight
Strengths	0.3910	S1	0.2791	0.1091
		S2	0.1480	0.0579
		S3	0.1063	0.0416
		S4	0.1280	0.0500
		S5	0.1731	0.0677
		S6	0.1655	0.0647
Weaknesses	0.1158	W1	0.3315	0.0384
		W2	0.1766	0.0205
		W3	0.1275	0.0148
		W4	0.1565	0.0181
		W5	0.2079	0.0241
Opportunities	0.3838	O1	0.2162	0.0830
		O2	0.1161	0.0446
		O3	0.2020	0.0775
		O4	0.2405	0.0923
		O5	0.2251	0.0864
Threats	0.1094	T1	0.41507	0.0454
		T2	0.23112	0.0253
		T3	0.17662	0.0193
		T4	0.17719	0.0194

Based on the QSPM results as shown in Table 5, the highest-priority strategy is strengthening digital-based promotion to enhance market penetration. This is followed by developing a digital registration and results system for industrial and academic segments, improving digital branding, emphasizing competitive pricing and broad segmentation to address competition, and developing digital service innovations to remain aligned with technological trends.

Stage 7: Solution Analysis

Based on the weighting results derived from the SWOT-AHP model for PT XYZ Laboratory, the strategy integrating internal strengths and external opportunities (SO) emerges as the most optimal approach for sustainable laboratory development. This strategy leverages existing opportunities while maximizing the laboratory's internal advantages, including official accreditation, competitive service fees, professional laboratory personnel, and accurate, reliable test results. In practice, the SO strategy emphasizes strengthening digital-based promotion to expand market penetration by capitalizing on ongoing digitalization trends and the increasing industrial demand for routine water quality testing.

These findings support the proposed hypothesis that the implementation of digital transformation strategies positively contributes to strengthening the digital competitiveness and market positioning of regional water testing laboratories. The findings are also consistent with the Laboratory 4.0 perspective proposed by Jovičić and Vitkus (2023) and Azam and Mustafa (2024), which emphasize that digital integration, automation, and real-time information systems support laboratory efficiency, transparency, responsiveness, and service competitiveness. In addition, the prioritization of digital promotion, online registration systems, and digital branding aligns with previous strategic-management studies by Mulyadi et al. (2020) and Diep et al. (2025), which demonstrated that the integration of SWOT, AHP, and QSPM provides an effective framework for identifying strategic priorities and strengthening organizational competitiveness. However, this study extends prior research by specifically incorporating digital competitiveness dimensions such as online visibility, digital branding, customer responsiveness, and Laboratory Information Management Systems (LIMS) within the context of regional water testing laboratories. Therefore, the findings not only confirm previous strategic-management theories but also contribute to the growing literature on digital transformation and Laboratory 4.0 readiness in public-service laboratory sectors.

Table 4. TOWS Matrix Formulating SO, WO, ST, and WT Strategic Alternatives for PT XYZ Laboratory

	Strengths (S)	**Weaknesses (W)**
	S1. Legal and official credibility accredited by KAN LP-552-IDN and compliant with ISO 17025:2017. S2. Rates offered are more affordable than private laboratories S3. The laboratory serves a wide range of sectors, including the food & beverage industry, hotels, anufacturing, schools, clinics, and students. S4. The laboratory possesses competent, professional, and experienced laboratory staff in the field of water quality. S5. The results are accurate and reliable, meeting standards and professional requirements. S6. Significant revenue growth from 2018 to 2024	W1. Not well known outside of its regular customer base. W2. Registration and test results are often still manual, and lab results are not yet digital. W3. Does not have its own website, only listed on the general company's website, resulting in incomplete service information and losing out to competitors. W4. Weak digital branding and positioning, based on Instagram feeds that are inconsistent in posting and lack testimonials. W5. Real-time customer response service performance through digital media is not yet optimal.
Opportunities (O)	**Strategi SO**	**Strategi WO**
O1. There is a requirement for water quality testing for industries (F&B, hotels, clinics, schools). O2. Can work with universities, schools, and companies for CSR & research programs. O3. The local industrial market, such as restaurants and hotels in the area, requires affordable routine water testing services. O4. The increasing trend of consumers are more likely to search for services via Instagram, Google, and reviews O5. Support for collaboration with educational institutions for student research and practice.	SO1. Leverage official accreditation and competitive pricing to attract industrial segments that are required to conduct water-quality testing (S1, S2, O1, O3). SO2. Offer reliable and accurate testing services as a research partner for universities and schools (S4, S5, O2, O5). SO3. Increase market penetration by strengthening digital based promotional activities (S6, O4).	WO1. Develop a digital registration and results-delivery system to attract industrial and academic clients (W2, W3, O1, O2). WO2. Enhance digital branding to increase visibility among students and local industries (W4, O3, O5). WO3. Optimize customer-response performance in line with digital trends and rising consumer expectations (W5,O4).
Threats (T)	**Strategi ST**	**Strategi WT**
T1. New government policies regarding laboratory quality standards may increase operational burdens and require rapid djustments. T2. Strong competitors already have their own websites and stronger branding. T3. Advances in digital technology, including laboratory automation and online platforms, could pose a threat if does not adapt quickly. T4. Customer expectations in the market are increasingly high (speed, transparency, service digitalization).	ST1. Strengthen credibility by displaying official accreditation documents to maintain trust amid new regulatory demands (S1, S5, T1). ST2. Highlight lower pricing and broad market segmentation to compete against stronger competitors (S2, S3, T2). ST3. Develop digital-based service innovations to remain relevant with technological advancements (S4, S6, T3, T4).	WT1. Immediately build a basic website and digital service system to avoid falling further behind competitors (W2, W3, T2, T3). T2. Improve service SOPs and optimize customer responsiveness to meet rising customer expectations (W5, T4).

Table 5. Strategic Priority Ranking Based on Quantitative Strategic Planning Matrix (QSPM) Analysis for PT XYZ Laboratory

Priority	Code	Strategy	Weight
1	SO3	Increase market penetration by strengthening digital-based promotional activities	3.2382
2	WO1	Develop a digital registration and results-delivery system to attract industrial and academic clients	3.0581
3	WO2	Enhance digital branding to increase visibility among students and local industries	3.0145
4	ST2	Highlight lower pricing and broad market segmentation to compete against stronger competitors	3.0100
5	ST3	Develop digital-based service innovations to remain relevant with technological advancements	2.8934
6	WO3	Optimize customer-response performance in line with digital trends and rising consumer expectations	2.8901
7	ST1	Strengthen credibility by displaying official accreditation documents to maintain trust amid new regulatory demand	2.8579
8	SO1	Leverage official accreditation and competitive pricing to attract industrial segments that are required to conduct water-quality testing	2.7774
9	WT1	Immediately build a basic website and digital service system to avoid falling further behind competitors	2.7066
10	SO2	Offer reliable and accurate testing services as a research partner for universities and schools	2.7033
11	WT2	Improve service SOPs and optimize customer responsiveness to meet rising customer expectations	2.6613

In addition, the laboratory is encouraged to develop a digital registration and results delivery system to attract industrial and academic segments, as well as to enhance digital branding to improve visibility among university students and local industries. These initiatives align with opportunities for collaboration with universities, educational institutions, and companies through CSR programs and research partnerships. In general, the findings indicate that the laboratory's internal strengths remain more dominant than its weaknesses, while external opportunities continue to provide strong momentum for growth. By implementing the strategies prioritized through QSPM, PT XYZ Laboratory can more effectively enhance its competitiveness, expand market reach, and maintain public trust in its service quality ultimately supporting sustainable laboratory development.

Managerial Implications

Based on the strategic analysis conducted using the SWOT-AHP-QSPM approach, strategies SO3, WO1, and WO2 demonstrate significant managerial implications for enhancing the performance and competitiveness of PT XYZ Laboratory. These strategies emphasize the critical role of digital service transformation through strengthening digital-based promotional activities to increase market penetration (SO3), developing a digital registration and results-delivery system (WO1), and enhancing digital branding to expand visibility among students and local industries (WO2). The implementation of these strategies requires management to integrate marketing and service functions into a coherent digital ecosystem. Accordingly, managerial implications include the need for adjustments in marketing policies, strategic resource allocation, and the reinforcement of the laboratory's digital identity to ensure that its internal strengths are effectively communicated to target market segments.

The implementation of strategies SO3, WO1, and WO2 has the potential to significantly enhance market reach, service efficiency, and brand image, as evidenced by prior empirical studies. The literature indicates that digital marketing exerts a significant positive effect on customer satisfaction by improving service quality and information accessibility, thereby fostering customer loyalty and favorable organizational perceptions (Ilham & Tajuddien, 2025). Furthermore, other studies have demonstrated that well-integrated digital marketing strategies contribute to increased market penetration and brand awareness, which subsequently support organizational performance growth in the digital era (Sayudin et al. 2023). Consequently, consistent implementation of these strategies may enable the laboratory to accelerate entry into new markets and

expand its client base. Conversely, failure to adopt these digital strategies may expose the laboratory to risks such as limited visibility, restricted market reach, and stagnation in building long-term relationships with industrial and academic segments. Furthermore, the integrated SWOT-AHP-QSPM framework proposed in this study may serve as a practical strategic-planning tool for managers and policymakers in designing data-driven digital transformation initiatives, strengthening Laboratory 4.0 readiness, and improving the long-term sustainability of regional public-service laboratories.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the SWOT-AHP-QSPM analysis, PT XYZ Laboratory is positioned in the Grow & Build quadrant, indicating strong internal capabilities and favorable external opportunities for development. The laboratory's key strengths include accredited testing services, competent personnel, competitive pricing, and reliable testing results, while its main challenges relate to limited digital visibility, digital branding, and service digitalization. The QSPM results identified strengthening digital-based promotion, developing digital registration and reporting systems, and enhancing digital branding as the highest-priority strategies for improving digital competitiveness and market positioning. These findings are consistent with previous studies highlighting the effectiveness of SWOT-AHP-QSPM integration in supporting organizational competitiveness and strategic development, while extending its application to digital competitiveness in regional water testing laboratories. Overall, the study demonstrates that digital transformation and strategic capability development are essential for sustaining competitiveness in the Industry 4.0 era.

Recommendations

Future studies are recommended to involve multiple laboratories in order to enhance the generalizability of the findings and enable comparative analysis across laboratories. In addition, future research should broaden data sources by incorporating external stakeholders, such as regulators and industry partners, to obtain more comprehensive and balanced perspectives. Further studies may also integrate the SWOT-AHP-QSPM framework with other quantitative approaches to empirically examine the impact of digital strategies on laboratory performance and competitiveness, as well as to evaluate the long-term effectiveness of digital strategy implementation.

This research has several limitations. First, the study was conducted on a single laboratory, limiting the generalizability of the findings. Second, the primary data relied mainly on internal experts and customers, leaving perspectives from other external stakeholders underrepresented. Lastly, the case study approach using SWOT-AHP-QSPM is context-specific and does not permit quantitative cross-laboratory comparison.

FUNDING STATEMENT: This research did not receive any specific grant from the public, commercial, or not-for-profit funding agencies.

CONFLICTS OF INTEREST: The author declares no conflict of interest.

GENERATIVE AI STATEMENT: The author declares during the preparation of this work the authors used ChatGPT in order to check grammar and polish text. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

REFERENCES

Aisyah, Siregar, F. S., Utami, W., Primarani, N. R., & Setyawati, R. (2024). Potential for science laboratory development: A SWOT analysis.. *Journal of Quality Assurance in Islamic Education (JQAIE)*, *4*(2), 95–108. https://doi.org/10.47945/jqaie.v4i2.1662

Ardella, C. (2024). Application of customer relationship management on a website. *Journal of Data Analytics, Information, and Computer Science*, *1*(1), 10–18. https://doi.org/10.59407/jdaics.v1i1.421

Azam, F., & Mustafa, A. (2024). Integrating IoT devices in Clinical Laboratories for Real-time Monitoring. *Jornal Brasileiro de Patologia e Medicina Laboratorial*, *60*(1), 39–45. https://doi.org/10.1900/JBPML.2024.60.01.006

Ben-Abdallah, R., Alshurideh, M., & Shamout, M. D. (2022). Business Development Strategy Model Using EFE, IFE, and IE Analysis in a High-Tech Company: an Empirical Study. *2022 1 Academy*

of Strategic Management Journal, *21*(2), 1–13. https://www.abacademies.org/articles/business-development-strategy-model-using-efe-ife-and-ie-analysis-in-a-hightech-company-an-empirical-study.pdf

Dalimunthe, A., Sari, A. C., Maulana, B., Syahputra, F., & Suryanto, E. D. (2023). Rancang bangun sistem informasi manajemen pengelolaan laboratorium berbasis web di sekolah menengah kejuruan. *Jurnal Teknologi Informasi & Komunikasi Dalam Pendidikan*, *10*(2), 118. https://doi.org/10.24114/jtikp.v10i2.54116

Diep, T. T., Ngoc, A. N. T., Dinh, H. V., Van, T. D., & Van, M. N. (2025). Strategies and policies for sustainable development of Vietnam's cultural industries using SWOT, AHP and QSPM approaches: A case study of the cultural tourism sector. *Decision Science Letters*, *14*(4), 909–918. https://doi.org/10.5267/j.dsl.2025.7.007

Harun Al Rasyid. (2017). Pengaruh kualitas layanan dan pemanfaatan teknologi terhadap kepuasan dan loyalitas pelanggan Go-Jek. *Jurnal Ecodemica*, *1*(2), 210–223.

Ilham, G. N., & Tajuddien, R. (2025). Systematic Literature Review: Peran Digital Marketing Dan Kualitas Layanan Terhadap Kepuasan Pelanggan. *AN NAJAH (Jurnal Pendidikan Islam dan Sosial Keagamaan)*, *4*(6), 381–387. https://journal.nabest.id/index.php/annajah

Jati, D. P., Suliyanto, Novandari, W., & Fauzi, D. R. (2023). Startup sustainability issues: an analytical hierarchy process (AHP) method and quantitative strategic planning matrix (QSPM). *Corporate and Business Strategy Review*, *4*(4), 32–42. https://doi.org/10.22495/cbsrv4i4art4

Jovičić, S., & Vitkus, D. (2023). Digital transformation towards the clinical laboratory of the future. Perspectives for the next decade. *Clinical Chemistry and Laboratory Medicine*, *61*(4), 567–569. https://doi.org/10.1515/cclm-2023-0001

Li, J., & Zhang, Q. (2025). Strategy selection for the digitization of traditional industries in Guangxi: a machine learning-enhanced SWOT-AHP approach. *Proceedings of the 2nd Guangdong-Hong Kong-Macao Greater Bay Area International Conference on Digital Economy and Artificial Intelligence, DEAI 2025*, 766–771. https://doi.org/10.1145/3745238.3745359

Mulyadi, A., Kirbrandoko, K., & Sahara, S. (2020). Pengembangan Strategi Laboratorium Uji Pt Xyz. *Jurnal Aplikasi Bisnis dan Manajemen*, *6*(1), 14–25. https://doi.org/10.17358/jabm.6.1.14

Narolita, D. (2020). Prodia: disruption in clinical laboratory service system. *International Research Journal of Management, IT and Social sciences*. https://doi.org/10.21744/irjmis.v7n1.811

Pontororing, M. E. I., Pinontoan, O. R., Sumampouw, O. J., Kesehatan, F., Universitas, M., & Ratulangi, S. (2019). Uji kualitas air bersih dari Pt. Air Manado berdasarkan parameter biologi dan fisik di Kelurahan Batu Kota Kota Manado. *Jurnal Kesmas*, *8*(6), 484–492.

Prananto, F. S., Kurniawan, E., & Nugraha, S. B. (2025). Analysis of the development potential and strategy of the Kauman Batik Village in Surakarta using Quantitative Strategic Planning Matrix (QSPM) approach. *Jurnal Pendidikan Geografi: Kajian, Teori, dan Praktek dalam Bidang Pendidikan dan Ilmu Geografi*, *30*(2), 218–236. https://doi.org/10.17977/2527-628X.1208

Sayudin, S., Kartono, K., & Curatman, A. (2023). Increasing business effectiveness through the implementation of an integrated digital marketing strategy. *Journal of World Science*, *2*(11), 1908–1913. https://doi.org/10.58344/jws.v2i11.478

Sibarani, A., & Djunita Pasaribu, R. (2024). Development strategy analysis with ife-efe-ie matrix, swot matrix and ahp at pt putra morowali sejahtera. *International Journal of Science, Technology & Management*, *5*(6), 1398–1405. https://doi.org/10.46729/ijstm.v5i6.1192

Sidiq, F., Indrawan, R. D., & Hasbullah, R. (2024). Strategi pengembangan bisnis jasa surveyor independen pada unit bisnis batubara PT XYZ. *Jurnal Aplikasi Bisnis dan Manajemen*, *10*(2), 703–715. https://doi.org/10.17358/jabm.10.2.703

Suruata, C., Sakati, S. N., Kanan, M., Balebu, D. W., & Dwicahya, B. (2021). Kualitas air bersih di Desa Pondan Kecamatan Mantoh Kabupaten Banggai Provinsi Sulawesi Tengah Tahun 2021. *Jurnal Kesmas Untika Luwuk : Public Health Journal*, *12*(2). https://doi.org/10.51888/phj.v12i2.66

Susantok, M., Wibowo, A. U. A., Akbar, M., & Rahul. (2025). Peningkatan akurasi sistem pemantauan suhu dan kelembapan pada laboratorium pengujian benih tanaman menggunakan inversi regresi linier. *Jurnal Teknologi Informasi dan*

Ilmu Komputer, *12*(1), 153–164. https://doi.org/10.25126/jtiik.2025129083

Tuan, N. H., & Canh, T. T. (2022). Integral SWOT-AHP-TOWS model for strategic agricultural development in the context of drought: a Case Study in Ninh Thuan, Vietnam. *International Journal of the Analytic Hierarchy Process*, *14*(1), 1–30. https://doi.org/10.13033/IJAHP.V14I1.890

Vitasari, P. (2021). Analysis of Internal and External Factors after Implementing the Improvement Strategy using SWOT Method. *IJEBD (International Journal of Entrepreneurship and Business Development)*, *4*(3), 334–339. https://doi.org/10.29138/ijebd.v4i3.1359