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Knowledge management strategies for enhancing competitiveness: Case studies of Applied Bachelor of Manufacturing Engineering Programs at a manufacturing polytechnic

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ABSTRACT

Knowledge management has a crucial role in higher education institutions to achieve competitive advantages, spur innovation, and adapt to changes that occur in the industry. In the Applied Bachelor of Manufacturing Engineering Program at a polytechnic, the application of good knowledge management significantly improves the professionalism and ability of the graduates. However, the program faces demographic challenges: more than half of its teachers are aged 50 and over, and the results of the Internal Quality Audit (AMI) show that its competitiveness is still low. This issue raises concerns about the loss of core knowledge as well as the sustainability of undocumented knowledge transfer. This study aims to find these obscure areas as well as design a knowledge management strategy by combining AMI methods and Knowledge Management Capability Assessment (KMCA) to assess the state of the organization. Actor analysis was carried out using Interpretive Structural Modeling (ISM), and strategy priorities were prepared using the Analytical Hierarchy Process (AHP) Method, which involved 12 experts (from academia and practitioners). The results of the KMCA assessment indicate that the organization's current capabilities are 2.5 out of 5, confirming the high uncertainty arising from knowledge management systems that still depend on individuals. Based on the weighting of AHP, this study proposes four main strategies io mitigate these uncertainties: (1) the development of integrated digital platforms to support higher education management (51.3%), (2) increasing the integration of industrial knowledge (51.7%), (3) optimizing local knowledge (49.9%), and (4) implementing community-based knowledge management strategies (50.6%). As a follow-up, future research should focus on developing evaluation models to assess the effectiveness of digital platforms and on exploring the use of knowledge to align curriculum with industry needs.

ABSTRAK

Manajemen pengetahuan merupakan aset yang krusial untuk mencapai keunggulan kompetitif, mendukung inovasi, dan merespons dinamika industri di institusi pendidikan tinggi. Dalam Program Sarjana Terapan Teknik Manufaktur di sebuah politeknik manufaktur, praktik ini sangat penting untuk meningkatkan profesionalisme dan kompetensi lulusan. Namun, program ini menghadapi tantangan demografis dengan lebih dari 50% staf pengajar berusia di atas 50 tahun, serta temuan Audit Mutu Internal (AMI) yang mengindikasikan rendahnya tingkat daya saing. Kondisi ini memicu ketidakpastian terkait keberlanjutan transfer pengetahuan tacit serta hilangnya aset intelektual inti. Penelitian ini bertujuan untuk mengidentifikasi area ketidakjelasan tersebut dan merancang strategi manajemen pengetahuan dengan mengintegrasikan metode AMI dan Knowledge Management Capability Assessment (KMCA) untuk menilai status organisasi. Analisis aktor dilakukan melalui Interpretive Structural Modeling (ISM), serta prioritasi strategi menggunakan metode Analytical Hierarchy Process (AHP) dengan melibatkan 12 responden pakar (akademisi dan praktisi). Hasil penilaian KMCA menunjukkan kapabilitas organisasi saat ini berada pada skor 2,5 dari skala 5 yang mengonfirmasi tingginya ketidakpastian akibat sistem pengelolaan pengetahuan yang masih bergantung pada individu. Berdasarkan pembobotan AHP, penelitian ini mengusulkan empat strategi utama secara berurutan untuk memitigasi ketidakpastian tersebut: (1) pengembangan platform digital terintegrasi guna mendukung manajemen pendidikan tinggi (51.3%), (2) peningkatan integrasi pengetahuan industri (51.7%), (3) optimalisasi pengetahuan lokal (49.9%), dan (4) implementasi strategi manajemen pengetahuan berbasis komunitas (50.6%). Sebagai tindak lanjut, penelitian di masa depan sebaiknya difokuskan pada pengembangan model evaluasi untuk mengukur efektivitas platform digital, serta eksplorasi pemanfaatan pengetahuan untuk menyelaraskan kurikulum dengan kebutuhan industri.

Keywords*:* AHP; Competitiveness; KMCA; Knowledge Management; Strategy

1. INTRODUCTION

Knowledge is an asset for organizations and individuals. Organizations that can effectively manage knowledge outperform the competition (Indarti & Dyahjatmayanti, 2022). Knowledge is an intangible resource that, when combined with tangible resources, supports the organization's competitive advantage (Sadewa et al., 2019). The source of knowledge can be tacit, owned by individuals, or explicit, expressed in formal, structured writing (Cabarcos et al., 2020).

Researchers with diverse scientific backgrounds have agreed that there has been a shift in organizational focus towards knowledge (Aleksić et al., 2019). Knowledge has become a key component for organizations to compete and excel in business (Montano et al., 2024). Knowledge management helps address the problems and challenges faced and supports the realization of competitive advantage for business organizations (Indarti & Dyahjatmayanti, 2022). In addition, knowledge management has been proven to be one of the influential aspects in achieving higher productivity and flexibility in the public and private sectors (Indarti & Dyahjatmayanti, 2022).

Knowledge management is one option organizations can use to develop a competitive advantage focused on human resources (Rehman et al., 2022). Knowledge management has been shown to significantly influence an organization's ability to develop innovation strategies and foster organizational learning (Abdi et al., 2018). Knowledge management is the process of collecting, organizing, and distributing knowledge to enhance an organization's competitive advantage (Montano et al., 2024).

Knowledge management can help map the flow of knowledge by integrating the processes of knowledge discovery, creation, capture, and sharing, with the results stored in a knowledge storage model (Indarti & Dyahjatmayanti, 2022). Thus, knowledge can be reused and used as learning materials for teachers and students (Richter et al., 2023). So that organizations can identify the strengths that support the knowledge management program and the shortcomings that need improvement (Inkinen, 2016).

Many organizations have adopted knowledge management, from both small and medium organizations to large-scale organizations, including educational organizations in developing research and innovation to improve the quality of learning (Indarti & Dyahjatmayanti, 2022). Knowledge management helps educational organizations innovate by optimizing the use of knowledge to achieve organizational excellence (Iqbal, 2021). Educational organizations should be successful and supportive examples in advancing learning and teaching because, within institutional activities, knowledge is created, disseminated, and the learning process occurs (Tan, 2016).

Competitive advantage increases when knowledge as intellectual capital is managed within an organization (Rehman et al., 2022). Knowledge, as an organization's intellectual capital, can facilitate activities and generate revenue by leveraging critical resources to maintain performance, thereby effectively enhancing the organization's knowledge assets (Mehralian et al., 2018). Thus, competitive advantage is sustained through unique, rare, and non-replicable knowledge resources, enabling organizations to manage their knowledge assets better (Montano et al., 2024).

Knowledge management not only drives high innovation performance but also develops the organization's competitive advantage (Lee, 2018). For an organization to compete, it depends on its ability to consistently expand its product capabilities, rather than on having assets and resources alone (Azeem et al., 2021). Organizations should have strong knowledge management skills to develop and support work practices and routines, thereby gaining a competitive advantage in dynamic, fast-moving markets (Lee, 2018). Knowledge management provides companies with an opportunity to innovate and respond more quickly to changes in market conditions, as well as to achieve a sustainable competitive advantage (Lee, 2018). Knowledge management practices have been shown to impact competitive advantage across various organizations significantly (Montano et al., 2024).

The application of knowledge management in educational organizations has different goals from the application in other organizations (Galgotia & Lakshmi, 2022). The main goal of knowledge management in educational institutions is to form cognitive competencies (Indarti & Dyahjatmayanti, 2022). The cognitive revolution is a concept aimed at improving the quality of education, with students taking the initiative to carry out a project and instructors involved through knowledge and experiential management (Sadewa et al., 2019). Knowledge and experiment management play a role in capturing change and transforming it into information to be reused in an innovation-oriented process (Sadewa et al., 2019).

The development of teaching in vocational education applies the production-based learning (PBL) method, integrating real industrial practices into academic activities so that teachers and students experience the real conditions of the industrial process (Lizunkov et al., 2020). The assessment of the learning process in vocational education institutions is based on student competence (Yusop et al., 2022). The required competency criteria can be provided by the industry and captured in industrial projects carried out in PBL (Kipper et al., 2021). PBL is a source of knowledge used to develop competencies in each process for both students and teachers (Crespí et al., 2022).

Proper knowledge management needs to be implemented within PBL to capture existing knowledge and reuse it for product development in general and competencies in particular (Boelt et al., 2022). For knowledge management to be applied effectively and aligned with institutional goals, assessments must be conducted to determine appropriate tools (Meher & Mishra, 2019). Manufacturing education is needed to enhance the competitive advantage of the manufacturing industry. Manufacturing educational institutions are expected to produce a well-trained workforce. Expertise is expected to contribute to the sustainability of the manufacturing industry sector in the future. Based on this, manufacturing education plays an important role in supporting the competitive advantage of the manufacturing industry sector (Sikora et al., 2023).

The manufacturing industry for developing countries is one of the pillars of economic growth (Wan et al., 2022). The demand for workers with competencies aligned with the manufacturing industry's expectations remains very high (Chongvilaivan & Hur, 2019). Educational development strategies to meet the needs of global industries are needed through collaboration between educational institutions and industry, as well as through skill development aligned with industry needs (Bilderback & Thompson, 2025). Engineering vocational education plays a role in preparing a workforce ready to work in industry. Vocational education prepares students for the world of work, so vocational institutions are expected to harmonize formal education with workplace realities (Yoto et al., 2024). Furthermore, the holistic skill education concept is used to maintain the quality of vocational education (Chan, 2024). The concept comprises six steps: mapping student abilities, approaching students, implementing the learning process, testing student competencies, evaluation, and final assessment of the teaching and learning process (Strom & Viesca, 2021).

Another approach used in vocational higher education is competence-based education (CBT), in which skills, attitudes, and values are determined and directed through a specific learning process in accordance with competency standards (Chen et al., 2024). The quality of learning is expected to improve by providing students with regular input at each stage of the learning process (Cai et al., 2023). CBT assessments are conducted according to industry-specific criteria or standards, so the assessment results must align with process-based performance criteria (Ponomariovienė et al., 2025). In Technical and Vocational Education and Training (TVET), five areas are the focus: information technology, culture, communication, organizational process planning, and strengthening human resources (Owais et al., 2020).

In Indonesia, education in the manufacturing sector is the responsibility of the Directorate General of Vocational Higher Education, which is under the supervision of the Ministry of Education,

Culture, Research, and Technology. Vocational higher education is one of the higher education models designed to meet industry needs for skilled human resources ready to work in their fields. In vocational higher education, production-based learning (PBL) is an alternative model for students to develop knowledge, skills, and attitudes during the learning process (Kolmos et al., 2021). The results of the PBL model indicate that graduates who are prepared to enter real working conditions, develop critical thinking, and adopt attitudes and responsibilities towards their work can support competency development (Lizunkov et al., 2020). Cooperation between academics and industry is an important strategy because implementing real-world industry practices in academic activities supports continuous learning and ensures the development of human resources (Lee, 2018).

However, the output of vocational higher education institutions has also not been as expected due to limited resources and the quality of educators (Lazić et al., 2021). It can be improved by knowledge management-based human resource development (Malik et al., 2020). Knowledge management in education differs from that in other fields. The main goal of knowledge management in education is professionalism or maturity, as manifested in students' competencies and personal identity (Jain & Gupta, 2019). Therefore, it is necessary to undergo a cognitive revolution, placing knowledge management as a macro-strategy within the process (Ortiz et al., 2023). The implementation of knowledge management spurs students to enrich their thinking and problem-solving skills, thereby improving the quality of education (Ayasrah et al., 2024).

The Applied Undergraduate Program in Manufacturing Engineering at a manufacturing polytechnic serves a critical national role. Currently, it faces substantial internal challenges that threaten its long-term competitiveness. The 2023 Internal Quality Audit (AMI) identified deficiencies in innovation and highlighted the lack of a formal knowledge-sharing system. Demographic factors compound these issues, as more than 50% of academic staff are aged 50 years or older. Without systematic intervention, there is a considerable risk of losing important tacit knowledge when these staff members retire. Therefore, the capture and management of these intellectual assets are urgently needed to prevent a decline in graduates' competence and to maintain sustainable alignment with industry needs.

Despite the urgent need, most of the Knowledge Management (KM) research in higher education does not focus on public vocational education institutions in developing countries (Adhikari & Shrestha, 2023). Earlier studies have not combined quality audits, capability assessments, and decision-making models into a single framework to address uncertainties arising from knowledge loss (Fahadha, Maarif, et al., 2025; Quarchioni et al., 2022). This research is designing a knowledge management strategy fit for the program. The questions of this study are: (1) How to evaluate due to knowledge loss by utilizing the results of the Internal Quality Audit (AMI) and the Knowledge Management Capability Assessment (KMCA) simultaneously? (2) How can Interpretive Structural Modeling (ISM) and Analytic Hierarchy Process (AHP) determine key stakeholder priorities and knowledge management strategies for enhancing competitiveness? The study integrates several research methods into the AMI-KMCA-ISM-AHP framework. The study also contributes to the field of knowledge management by providing clear guidance for academic leaders to improve operations, protect critical knowledge, and connect vocational education to industry needs in an integrated manner.

2. LITERATURE REVIEW

2.1 Knowledge Management as Strategic Organizational Capitals

Knowledge is defined as the result of understanding gained through experiences or structured learning processes (Hauke, 2019). Individuals who have knowledge personalize subjectively, so that knowledge has uniqueness, usefulness, accuracy, and value (Obrenovic et al., 2022). Knowledge

is an intangible resource that, when combined with real resources, enhances an organization's competitive advantage (Fahadha et al., 2025). Knowledge is also based on data and information and is always tied to humans. Individuals construct it and represent beliefs about causal relationships (Dudyrev et al., 2022).

Knowledge has been considered the most valuable intangible capital for organizations to create value, drive innovation, and stay adaptive (Durst et al., 2023; Pellegrini et al., 2020). As strategic capital, knowledge is embedded in daily routines and practices and resides in team members' skills and thinking (Bergh et al., 2025; Gamble, 2020). Tacit knowledge gained from personal experience, intuition, and skills is at the core of an organization's intellectual capital (Adhikari & Shrestha, 2023; Ghlichlee et al., 2024). When organizations face demographic changes, such as an aging workforce, the risk of tacit knowledge loss underscores the need for knowledge management to treat knowledge as valuable capital (Fahadha et al., 2025).

Knowledge management takes systematic steps to create, capture, share, and utilize both tacit and explicit knowledge, thereby preventing knowledge loss and increasing productivity (Souza et al., 2022). Models such as SECI (Socialization, Externalization, Combination, and Internalization) facilitate the transformation of individual expertise into shared organizational knowledge (Cerchione et al., 2024). Strategic knowledge management is the key to staying resilient and supporting continuous learning (Umar et al., 2021).

2.2 Knowledge Management Implementation in Vocational Higher Education

The implementation of knowledge management in vocational higher education is just as important as its implementation in other business organizations. The principle of knowledge management, when implemented in education, improves the quality of the academic learning process (Fahadha et al., 2025). Vocational colleges that implement knowledge management are better able to improve the quality of student learning and of graduation (Flek & Ugnich, 2024). The implementation of knowledge management in vocational education focuses on the tools used and on opportunities for members to engage in knowledge creation and sharing (Sahibzada et al., 2022). To ensure effective implementation, vocational education institutions must be able to demonstrate challenges, especially in information technology, organizational culture, communication, process planning, and systematic team member utilization (Fahadha et al., 2025).

The traditional educational model produces the educational process by providing a theory of reflection (Fahadha et al., 2025). In traditional education, the image is not formed; rather, it is passed down from generation to generation with little change required (Fahadha et al., 2025). It supports the view that cognitive processes should be constructive rather than merely reflective, because knowledge is not only related to the surrounding world, objects, and processes, but must also be a constructive unit. It makes the knowledge development process more dynamic. Knowledge management highlights the dynamics and rapid changes in the process, enabling people to focus on the future rather than just the present (Fahadha et al., 2025). Knowledge management can also be used as a learning strategy by developing active learner initiatives that trigger quality improvement (Fahadha et al., 2025).

The development of a knowledge management model for structured vocational higher education, including internal and external organizational factors, the readiness of the organization's knowledge management infrastructure, learning systems, and knowledge flows, is an important factor that must be integrated. In addition, it is necessary to measure the current level of organizational knowledge management to identify strengths that can support the knowledge management program and shortcomings that must be corrected in the next program (Sadewa et al., 2019). This model can help map the flow of knowledge by integrating the processes of knowledge discovery, knowledge

creation, knowledge capturing, and knowledge sharing, the results of which are stored in a knowledge storage model so that they can be reused and used as learning materials for teachers and students. The maturity of knowledge management is associated with high vocational education performance. The key factors that influence high performance are processes, knowledge management, leadership, people, and knowledge management outcomes. In addition, collaboration between team members in vocational universities should also be improved, especially in knowledge sharing.

2.3 Driving Competitive Advantage through the Integration of AMI, KMCA, ISM, and AHP

Unique and hard-to-replicate resources, such as the Resource-Based View (RBV), demonstrate that intellectual capital is the key to achieving a competitive advantage (Satar et al., 2025; Varadarajan, 2023). Effective management of organizational knowledge capital, especially in vocational higher education, will stimulate innovation, respond to change, and provide better educational services (Arsawan et al., 2022; Bagna et al., 2024).

A comprehensive framework is needed to achieve a knowledge-based competitive advantage. This study examines how the integration of AMI, Knowledge Management Capability Assessment (KMCA), Interpretive Structural Modeling (ISM), and Analytic Hierarchy Process (AHP) simultaneously plays a key role in improving organizational competitiveness. First, AMI helps identify problems, such as the risk of losing important knowledge when the lecturer retires. Second, KMCA serves as a basis for evaluating institutional maturity across people, processes, technology, and strategic alignment (Sahibzada et al., 2023). Third, Interpretive Structural Modeling (ISM) analyzes the relationships between actors in complex systems (Kumar & Goel, 2022). This method aims to identify the actors with the greatest influence and to evaluate how they relate to one another (Alawamleh et al., 2023).

AHP serves as a strategic decision-making tool by transforming the capability gaps identified by KMCA and AMI into priorities for knowledge management strategies based on interactions among actors (Djajasoedarma et al., 2020). When these four frameworks are combined, organizations can protect intellectual capital and implement interventions in accordance with pre-set priorities. This approach helps achieve sustainable competitive advantage (Bergh et al., 2025; Pónusz et al., 2020). The integrative conceptual framework of this study, shown in Figure 1, explains how inputs from AMI and KMCA are processed through ISM and AHP to generate strategic priorities to increase competitive advantage.

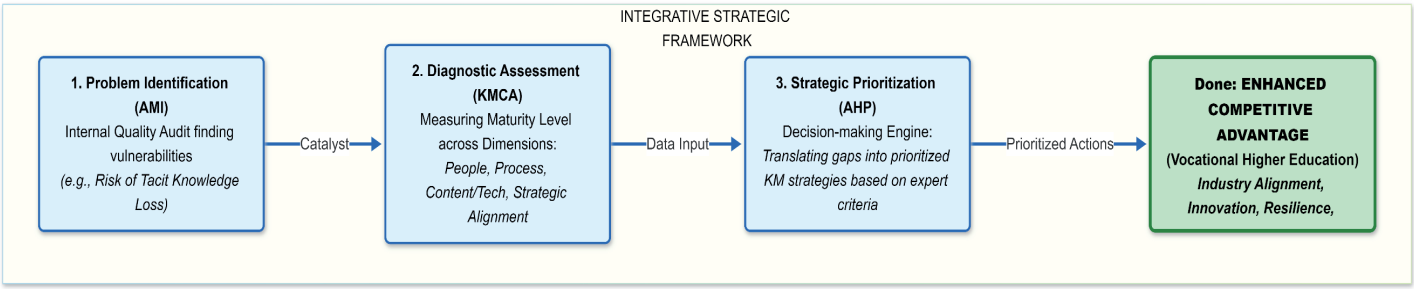

Figure 1. Creating knowledge-based competitive advantage in vocational higher education based on a conceptual framework that integrates AMI, KMCA, ISM, and AHP

3. METHOD

This research took place in the Applied Undergraduate Program in Manufacturing Engineering at a manufacturing polytechnic from January to December 2024. The study used both qualitative and quantitative descriptive methods to provide a thorough and relevant analysis. Primary data were collected through direct observation of academic and administrative activities, structured and semi-structured interviews, and open- and closed-ended questionnaires. Using these methods helped the researchers find patterns in the data and understand stakeholder views in detail. Secondary data were collected through a thorough review of Scopus- and Sinta-indexed journals, scholarly books, and various institutional records, such as accreditation documents, internal quality assurance (SPMI) reports, strategic plans, and results from internal academic audits. This data integration results in more accurate evaluations, thus strengthening the validity and reliability of the findings.

This study uses purposive sampling, selecting respondents directly involved in knowledge management and strategic decision-making in organizations. The study included 12 experts, including top academic leaders and administrative officials at the university and faculty levels. Consisting of the Vice Chancellor for Academic Affairs, the Dean and Vice Dean of the Faculty of Engineering (both academic and non-academic), the Head of the Academic Bureau, the Head of the Quality Assurance Institute, the Head of the Internal Supervisory Unit, and the Head of Faculty Administration Services. At the departmental level, data is collected from the Head and Secretary of the Department of Manufacturing Engineering, as well as the Coordinator of the Applied Undergraduate Program. In addition, a knowledge management expert from Astra Polytechnic contributes to the practice of integrating knowledge in vocational and industrial environments.

This study analyzes data using the Knowledge Management Capability Assessment (KMCA) model from the American Productivity and Quality Center (APQC). The KMCA is the primary framework for measuring the maturity of knowledge management across different programs. It looks at four main areas: people, processes, content-technology, and strategic alignment. It helps identify strengths and gaps in knowledge infrastructure. The study also uses Interpretive Structural Modeling (ISM), a widely used method for examining how different factors relate within complex systems (Kumar & Goel, 2022). ISM helps identify the factors that influence a situation by accounting for uncertainty and how factors depend on one another (Alawamleh et al., 2023). The process starts by identifying key factors from the literature (Sonar et al., 2020). Experts then review these factors to ensure they align with the research (Jashnabadi et al., 2023). Next, the ISM technique is used to build a structural model that links the elements, which is then checked for accuracy and usefulness (Ahmad & Qahmash, 2021). ISM is a helpful tool for policy-making and strategic planning (Warfield, 1978).

The Analytic Hierarchy Process (AHP) supports decision-making involving multiple criteria. This process involves setting goals, determining alternative strategies, and prioritizing strategies. Experts provide opinions based on consistency ratios (CRs) to ensure the results are reliable. A CR of 0.1 or lower indicates consistent results. This approach provides a strong argument for developing strategies that help organizations achieve a competitive advantage by managing knowledge effectively. It is especially important in vocational higher education, which must adapt to industry needs for long-term success. Figure 2 shows each step of the AHP process, starting with setting goals and checking the consistency ratio.

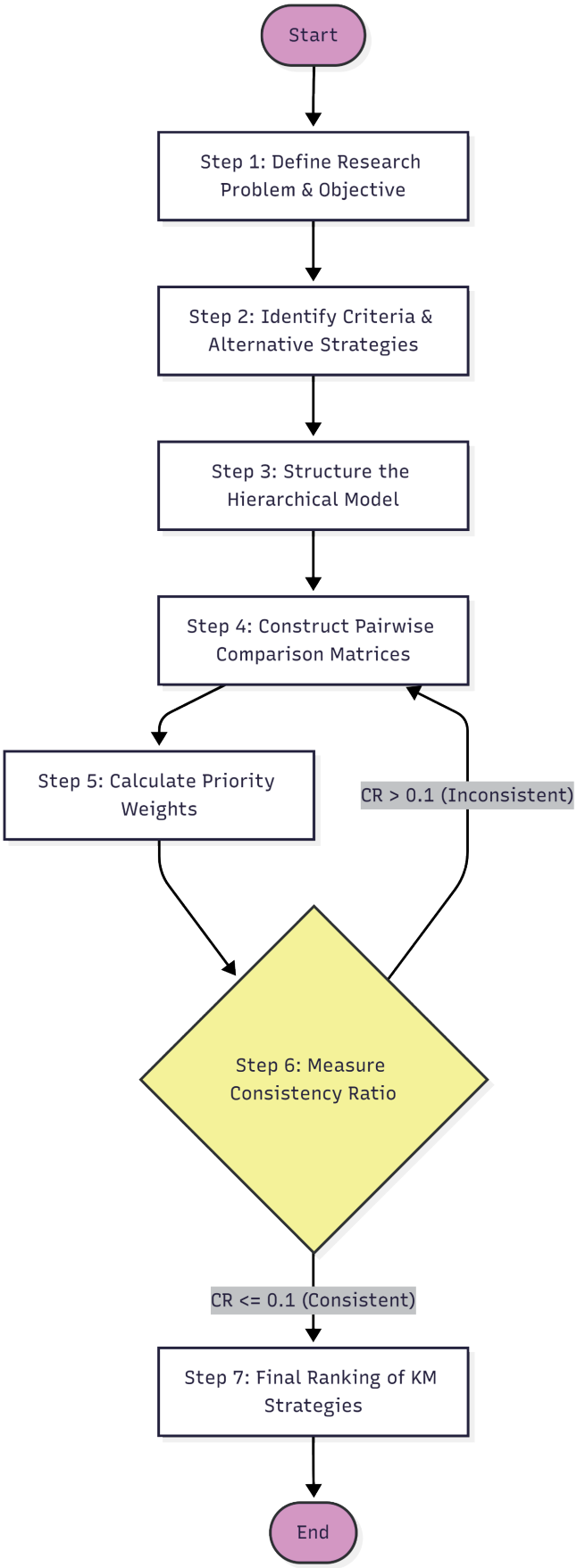

Figure 2. The Analytic Hierarchy Process (AHP) is applied to formulate the knowledge management strategy.

4. RESULTS AND DISCUSSION

4.1 Internal Quality Audit (AMI) Result

The 2023 Internal Quality Audit revealed specific performance discrepancies, particularly in the Output dimension, which scored a critical low of 1.00 (Table 1).

Table 1. AMI Scores for the 2023 audit

Aspect	Reality	Expectation	Gap
Input	3.20	3.30	–0.10
Process	2.90	3.15	–0.25
Output	1.00	3.05	–2.05
Outcome	3.10	3.20	–0.10
Impact	3.05	3.00	+0.05

Source: Processed primary data, 2025

Analysis from audits and interviews (n = 9) identified four key drivers for this deficiency: an outdated curriculum, limited lecturer capacity for active pedagogies, underutilized digital tools, and fragmented program management. These gaps create significant uncertainty about the program's ability to produce work-ready graduates aligned with Industry 4.0.

4.2 Knowledge Management Capability Assessment (KMCA) Result

To further diagnose the root causes of the AMI gaps, the KMCA was deployed. The results (Table 2) indicate an early stage of knowledge management maturity, with an overall average below the faculty standard.

Table 2. KMCA Assessment

Categories	Reality	Expectation	Gap
People	0,44	2,56	2,11
Process	0,56	2,78	2,22
Content and Technology	0,78	1,89	1,11
Strategy	0,67	2,89	2,22

Source: Processed primary data, 2025

The most pronounced gaps are in the People (0.44) and Process (0.56) dimensions. It confirms the vulnerability and uncertainty surrounding the loss of tacit knowledge, especially given the aging academic staff and the continued lack of standardization in knowledge-capture processes.

4.3 ISM-Based Actor Analysis

Mapping the structure of actors in the context of knowledge management using the Interpretive Structural Modeling (ISM) approach provides a highly valuable hierarchical framework for designing strategies to strengthen competitive advantage in vocational higher education. ISM is a methodological approach developed to identify and map the complex relationships among elements of social systems in stages, producing a logical, integrated hierarchical structure (Warfield, 1978). In this study, the mapping of the thirteen main actors involved in the knowledge system of the Manufacturing Engineering Study Program has been carried out and visualized into five levels that show the degree of influence and dependence of each actor on the system.

The actors at level 1 include Alumni (A5) and the Center for Information and Communication Technology (A11), which act as independent agents or parties with a direct impact on the implementation of knowledge strategies. Alums, as a representation of the final product of the education system, have structural strength in internal processes but are indicators of the success of the learning system implemented. On the other hand, the role of UPA ICT is technical as a provider of digital infrastructure to support knowledge management, which, although vital, does not have the power to intervene in policy.

Moving to level 2, actors such as the Quality Assurance Institute (A10) and Graduate User Stakeholders (A7) can be more responsive and representative of external needs. LPM is an entity that bridges institutional policies and quality control and plays a role in the internal audit and assessment process. Meanwhile, graduate user stakeholders provide feedback on graduates' readiness for absorption into the job market, making them important actors in the external validation mechanism of knowledge systems.

At level 3, the connecting actors between the strategic and operational levels were identified, namely Education and Laboratory Personnel (A3) and Partner Industries (A6). This role describes the function of interfacing knowledge between the internal campus ecosystem and industry's practical needs. The existence of industry as a partner shows that the success of knowledge management in vocational education cannot be separated from the direct involvement of business actors and the world of work (Etzkowitz & Zhou, 2021). The dual role is not only as a recipient of graduates, but also as a producer of new practice-based knowledge.

Furthermore, level 4 is filled by key actors in the process of creating and disseminating knowledge, such as Study Program Coordinators (A1), Lecturers (A2), Students (A4), Deans (A8), and Rectors (A9). This group can be seen as both a knowledge creator and a distributor because it participates directly in the SECI (Socialization, Externalization, Combination, Internalization) cycle (Nonaka & Ichijo, 2007). Students are not just passive learners; they actively shape and share knowledge through learning, applied research, and industry collaborations.

Level 5 is where the main group, known as the Community of Practitioners (A13), is located. This community participates in knowledge management through cooperation and learning from shared experiences. In a knowledge management system, the contribution of this kind of community is very important because it helps update knowledge, verify practices, and foster a culture of knowledge across various fields, where representatives from Level 5 serve as external influences that support vocational education policies.

This structure for actors shows that creating a knowledge management system for higher vocational education requires an understanding of how both internal and external participants operate and play various roles at different levels, both strategically and practically. According to the Fourth Helix Model, cooperation between universities, businesses, government agencies, and society is essential to increase the competitiveness of higher vocational education (Campanella et al., 2017). An effective knowledge management approach includes not only technology and internal guidelines, but also the full involvement and cooperation of all interested parties (Ferreira et al., 2020).

4.4 AHP Strategy Prioritization

The Knowledge Management Capability Assessment (KMCA) uses the APQC evaluation framework for People, Processes, Content, Technology, and Strategy. This evaluation relies on the knowledge of 12 professionals, including prominent academic and administrative figures from the university, as well as teaching staff. Among them are the Vice Chancellor for Academic Affairs, Deans and Vice Deans of the Faculty of Engineering (including academic and non-academic roles), Head of the Academic Bureau, Head of the Quality Assurance Institute, Head of the Internal Supervisory

Unit, and Head of Faculty Administrative Services. For information at the departmental level, data was collected from the Head and Secretary of the Department of Manufacturing Engineering, as well as the Coordinator of the Applied Bachelor of Manufacturing Engineering Program. To gain industry perspective, a knowledge management specialist from Astra Polytechnic shared insights on how knowledge is applied in real-world situations, with a focus on knowledge management standards. The demographics indicated the following statistics: educational attainment of bachelor's degree (22%), master's degree (11%), doctor's degree (67%); age brackets 30-40 (45%), 40-50 (22%), 50-65 (33%); years of service 0-5 (15%), 5-10 (22%), >10 (67%). KMCA results showed the lowest score in the People category, at 0.44, followed by the Process category, at 0.56. This score shows that knowledge management is still in its infancy. In comparison, the content and technology dimensions scored 0.78, indicating several levels of improvement in the implementation of IT-based knowledge systems.

Positive Outlooks (PO) describe five main approaches: (1) Creating an integrated digital technology system. (2) Build a system to manage industry knowledge. (3) Make technology training part of the routine. (4) Enhancing sustainable partnerships with businesses. (5) Conduct evaluations based on diversity, equity, and inclusion (DEI) standard practices. This approach emphasizes innovative thinking, emphasizing digital resources and collaboration with industry for future benefits. For Moderate Positive Scenarios (MPSs): (1) improve the integration of industry knowledge, (2) slowly adopt digital technologies, (3) improve the skills of educators, (4) organize knowledge about grants, and (5) expand understanding of different cultures. These techniques adopt more practical methods to demonstrate increased readiness and resources, but still have limitations.

In Semi-Pessimistic Scenarios (SSPs), the strategy applied is cautious and inward-focused. The main goal of this approach is to build internal strength and make effective use of local resources. The five key steps in this situation are: (1) Maximizing the use of local expertise, (2) Documenting practical knowledge, (3) Increasing organizational capacity, (4) Increasing cooperation within the organization, and (5) Expanding understanding of diversity. This overall plan aims to ensure the program runs smoothly through smart management as well as protect the critical knowledge available. In the Pessimistic Scenario (SP), this strategy mainly emphasizes the importance of high flexibility and reduced dependence on external resources. The five main strategies include: (1) making the most of available knowledge, (2) simplifying the learning process, (3) implementing community-based knowledge management, (4) choosing simpler technology solutions, and (5) raising awareness of diversity through local narratives. These actions support institutions to remain open, culturally aware, and strong, albeit with limited resources.

To handle future uncertainties such as changes in resources or technology, we implement a scenario-focused Analytics Hierarchy Process (AHP). A dozen specialists evaluated the strategy in four different institutional situations: Optimistic (SO), Semi-Optimistic (SSO), Semi-Pessimistic (SSP), and Pessimistic (SP).

Table 3. Priorities Strategies

Code	Strategy	Weight	Consistency Ratio
SO1	Designing an Integrated Digital Platform System	51.3%	5.3%
SSO1	Increasing Industry Knowledge Integration	51.7%	6.8%
SSP1	Local Knowledge Optimization	49.9%	9.7%
SP3	Community-Based Knowledge Management	50.6%	6.2%

Source: Processed primary data, 2025

The results from AHP show that under excellent conditions, the development of the Integrated Digital Platform System (SO1) has the highest priority, with a percentage of 51.3%. When things

are going well, experts argue that investing in an integrated digital infrastructure is the most appropriate option. In semi-good conditions, Enhanced Industrial Knowledge Integration (SSO1) was the most important, with a figure of 51.7%, highlighting the need for curriculum alignment with industry needs. In a slightly detrimental situation, Local Knowledge Optimization (SSP1) is the most important, with a percentage of 49.9%, showing the importance of paying attention to regional conditions when carrying out development. In adverse situations, Community-Based Knowledge Management (SP3) gets a 50.6% priority, emphasizing the importance of collaborative connectivity locally when resources are limited. A high score on the main strategy in each condition (around 50%) indicates a strong agreement among experts, although other options are also considered.

4.5 Mitigating Uncertainties through AMI-KMCA-ISM Integration

The integration of AMI and KMCA points to a major problem in the program. Previous research, such as that conducted by Sahibzada et al. (2023), emphasized that information technology infrastructure is essential for knowledge management. However, the findings of this study show that relying solely on technology is not enough. Because there are important gaps in the field of Human Resources and Processes, if an organization does not have standards in knowledge management, then it will risk losing valuable knowledge. Therefore, organizations should focus first on developing a culture of knowledge sharing before making major investments in digitalization.

4.6 Strategic Implications

Prioritizing strategies that use AHP helps organizations stay competitive in an uncertain future. Unlike the old model, which did not change, this AHP method makes it easier for organizational leaders to adjust plans. In a situation where resources are abundant, experts focus on digital innovation (SO1) and industry merger (SSO1) as per the needs of the industry 4 era. 0. Building an integrated digital platform enables organizations to transform from simple industries to strategic partnerships. This is in line with the opinion of those who say that the incorporation of digital knowledge can improve the performance of institutions (Kordab et al., 2020). In situations with fewer resources and higher uncertainty, strategies begin to be geared towards internal aspects. Local Knowledge Optimization (SSP1) and Community-Based Management (SP3) are prioritized because they both demonstrate organizational resilience.

4.7 Theoretical and Practical Contributions

The strategy in designing an interconnected digital platform for the management of higher education emphasizes the importance of institutions to actively use technology to improve the quality of education. By focusing on efficiency in operations, cooperation, and appropriate curriculum development, educational institutions can provide a better learning experience for students and ensure that graduates are ready to make meaningful contributions in the workforce. This integrated and creative way strengthens the institution's position when facing challenges and opportunities in the digital age. Strategies to strengthen the incorporation of industrial knowledge in a semi-optimistic situation encourage educational institutions to actively establish solid cooperation with the industrial sector, design appropriate curricula, and use practice-based learning methods. Through planned methods and cooperation, educational institutions can improve the quality of graduates and ensure they are ready to face the challenges of the ever-changing world of work.

Local knowledge enhancement strategies show that educational institutions need to take active actions to deal with existing problems. By recognizing the skills required, creating an appropriate curriculum, and establishing good cooperation with the community, educational institutions can increase the relevance of education and ensure that graduates are prepared to make a good contribution at the local level. Planned and collaborative methods can help institutions stay flexible and thrive in an ever-changing environment. Community-based knowledge management through

collaboration with local organizations is not only able to improve the quality of education and curriculum suitability, but also make a meaningful contribution to the progress of the community and the local economy. This creates a more open and competitive educational ecosystem, as well as producing alumni who are ready to make a positive impact in the world of work.

5. CONCLUSION

This research creates a flexible knowledge management approach to reduce the danger of hidden knowledge loss and to address resource shortages. These hazards are discovered through Internal Quality Audit (AMI) and Knowledge Management Capability Assessment (KMCA). By combining the results of the AMI-KMCA with Interpretive Structure Modeling (ISM) and Process Hierarchy Analysis (AHP), the study created a comprehensive assessment model. The results of the study show that the differences that exist in Human Resources and processes must be corrected with a targeted strategy to protect intellectual assets and increase the competitiveness of vocational higher education institutions.

This study uses a technique based on scenarios in the structure of AHP. This technique helps in making choices that can vary depending on the unpredictable situations that may occur. This study found significant insights by modifying strategies according to available resources. For example, when sufficient resources are available and uncertainty is minimal, strategies prioritize outside elements, highlighting digital advancements through platforms that are strongly linked to the industry. However, as uncertainty and resource limitations increase, attention turns to things inside. In these circumstances, top priority becomes resilience-based practices, such as leveraging local knowledge from the community to help organizations stay flexible and relevant amid challenges.

Strategic mapping based on various scenarios provides more adaptive direction for organizational leaders in formulating policies without relying on just one way. In theory, this study adds insight to the knowledge management literature by presenting a flexible framework for state vocational education institutions. Further research can create a framework to evaluate success over time and measure the long-term effectiveness of those strategies. In addition, this research collects continuous input from the industry and alumni to test and improve these models so that they can be applied in practice.

DECLARATIONS

Data Availability

Fahadha, Rizqa Ula; Maárif, Muhammad Syamsul; Yulianto, Budi, 2026, "Knowledge Management Strategies for Enhancing Competitiveness: Case Studies of Applied Bachelor of Manufacturing Engineering Program at Manufacturing Polytechnic," http://hdl.handle.net/20.500.12690/RIN/KDAJIF, RIN Dataverse, V1.

CRediT (Contributor Roles Taxonomy)

Rizqa Ula Fahadha: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data Curation, Writing-Original draft preparation, Writing and Editing, and Visualization. **Muhammad Syamsul Maárif:** Methodology, Validation, Supervision. **Budi Yulianto:** Methodology, Validation, Supervision.

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Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

The use of AI or AI-assisted technologies

During the preparation of this work, the authors used Grammarly to evaluate their writing, improve readability and quality, and correct grammatical and stylistic errors. After using this tool or service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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