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A Study on the Dimensions of ERP in Taiwan's Information Industry Using the Fuzzy Delphi Method

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Abstract *— The information technology industry is placing increasing emphasis on the adoption of Enterprise Resource Planning (ERP) systems. In recent years, fuzzy decision analysis has been widely applied as an effective tool across multiple research fields, demonstrating strong practical value. In the pursuit of sustainable operation and development within the IT industry, introducing the core concept of "vitality" is crucial, as it determines whether an enterprise can achieve long-term, stable growth and maintain market competitiveness. Looking back, the efforts made by enterprises to enhance productivity and strengthen organizational competitiveness have, to some extent, revealed the driving forces behind corporate progress and upward development. However, these efforts are still insufficient to fully explain the true source of enterprise vitality—a core dynamic that fundamentally drives sustainable operations and maintains intrinsic vitality. In today's fiercely competitive and rapidly changing market environment, the competitive advantage of the IT industry increasingly hinges on the successful implementation of ERP systems and scientific enterprise management models. Based on this, this study will delve into the correlation between ERP application and enterprise vitality construction in the IT industry, as well as practical pathways, aiming to provide valuable insights for enterprises to enhance their sustainable development capabilities.*

Keywords *— Fuzzy Delphi Method (FDM); Enterprise Resource Planning (ERP); Business Management; Vitality*

I. INTRODUCTION

Past efforts by enterprises to improve productivity and enhance organizational competitiveness seem to only explain the forward and upward driving forces of enterprises to a certain extent, but cannot fully explain the source of true vitality, which lies in promoting the vitality of sustainable operation. In today's highly competitive environment, where market demands shift rapidly and customer expectations soar, the competitive advantage of the information industry depends on whether it has implemented Enterprise Resource Planning (ERP). ERP systems, with their integrated suite of modules for finance, human resources, supply chain management, and customer relationship management, streamline workflows, eliminate data silos, and provide real-time insights into operational performance. By centralizing data

and automating routine tasks, these systems reduce errors, cut down on manual processing time, and enable more informed decision-making. For instance, a manufacturing firm in the information sector can use ERP to track inventory levels in real time, ensuring that raw materials are available when needed without overstocking, thus optimizing cash flow and reducing waste. Similarly, the finance module automates invoicing and expense tracking, allowing financial teams to focus on strategic analysis rather than tedious paperwork. In an industry where speed and agility are critical, ERP not only enhances efficiency but also fosters collaboration across departments, breaking down traditional barriers and creating a more cohesive organizational culture. This integration of processes and data is what truly fuels sustainable operation, as it allows enterprises to adapt quickly to market changes, maintain high service quality, and consistently deliver value to stakeholders, thereby sustaining their competitive edge in the long run.

Therefore, delving into the topic of Enterprise Resource Planning (ERP) implementation in the information industry forms the core motivation of this study. In recent years, fuzzy decision analysis, as a methodology capable of effectively addressing uncertainty in complex scenarios, has been widely applied across multiple research fields, with the Fuzzy Delphi Method (FDM) being particularly prominent. Leveraging its unique advantages, this method adeptly handles the inherent fuzziness and subjectivity in expert judgment, providing a more scientific basis for decision-making. Since 1995, scholars such as Chang et al. (1995) have been dedicated to the innovation and development of the Fuzzy Delphi Method, proposing various improved models. These models each have their own focus, all aimed at solving complex decision-making challenges characterized by high uncertainty, imprecise data, and conflicting viewpoints.

Given this, this study has decided to adopt the decision-making framework of the Fuzzy Delphi Method to systematically identify, construct, and prioritize the key driving factors influencing the successful implementation of ERP systems in Taiwan's dynamic information industry. By incorporating fuzzy logic, this method effectively integrates valuable insights from experts across different fields, consolidating seemingly disparate viewpoints into a consensus. Its core objective is to precisely distill a series of critical variables, such as the adequacy of organizational readiness, the compatibility and advancement of technological infrastructure, the robustness of employee training systems, and the alignment of goals among various stakeholders. Through in-depth analysis and weighting of these variables, this study aims to provide a solid theoretical foundation and practical guidance for enterprises in formulating strategic plans for ERP implementation.

Ultimately, this study hopes that, through the aforementioned efforts, the implementation of ERP systems can closely align with the actual operational conditions of enterprises, sensitively respond to rapidly changing market demands, and remain highly consistent with the long-term sustainable growth goals of enterprises. This not only helps enhance the core competitiveness of Taiwan's information industry enterprises in an increasingly fierce market competition environment but also injects them with sustained vitality and innovative momentum. This is the fundamental motivation and value driving the in-depth development of this study.

II. LITERATURE REVIEWS

2.1 Enterprise Resource Planning

The concept of ERP was formally introduced in 1990 by the renowned American management consulting firm Gartner Group Inc. and quickly gained widespread adoption and application among various enterprises globally. At its core, an ERP system deeply integrates key business areas within an enterprise, including finance, accounting, procurement, production, logistics, material management, transportation, and human resource management. This integration not only effectively reduces the costs of cross-departmental collaboration

but also significantly enhances the speed, accuracy, and overall efficiency of information flow. For example, under traditional management models, the production department might take days to receive relevant material information after the procurement department places an order. In contrast, an ERP system enables real-time data sharing, ensuring that purchase orders, inventory status, production plans, and other critical information are instantly synchronized across departments, and thereby avoiding production delays or inventory overstock caused by information lag.

From a strategic perspective of enterprise management, ERP systems emphasize cross-system functional integration, interdepartmental collaboration, and cross-regional business consolidation. For instance, a multinational corporation with multiple production bases and overseas subsidiaries can use an ERP system to achieve unified global order management, real-time inventory allocation, and centralized financial data accounting, breaking down geographical and departmental barriers. Therefore, ERP is essentially an online data processing system with real-time data processing capabilities and a highly integrated architecture, enabling instant consolidation and unified management of all operational functions across an enterprise. Its interface typically features intuitive data dashboards, allowing managers to monitor key performance indicators—such as sales performance, production progress, inventory levels, and financial status—in real time through charts and reports. This facilitates rapid decision-making, optimizes resource allocation, and enhances the enterprise's core competitiveness.

Academic research has extensively studied how ERP systems impact organizational performance. Findings clearly demonstrate a significant positive correlation between successful ERP implementation and operational performance, with this empirical conclusion exhibiting strong robustness across different industries, enterprise sizes, and economic environments. In the early stages of digital transformation among Taiwanese enterprises, disparities in the pace of IT adoption led some companies to implement standalone information systems. However, these systems were often isolated applications at the departmental or business-line level, resulting in a lack of effective horizontal integration, severe data silos, and inefficient information flow. This directly fueled the demand for ERP systems, which emphasize comprehensive information integration and highly coordinated workflows.

Within the functional modules of an ERP system, the Sales and Distribution (SD) module falls under logistics management. This module covers the entire sales process—from order receipt, demand forecasting, sales quotations, and contract signing to shipment scheduling, transportation management, invoicing, and customer service—as well as closely related aspects such as inventory management and procurement coordination. Its primary goal is to reduce operational costs by optimizing order processing, minimizing inventory overstock, and shortening delivery cycles while enhancing overall efficiency by improving order fulfillment rates and customer satisfaction.

Regarding customer satisfaction research, Oliver (1981) posited that customer satisfaction is a subjective emotional response arising from a specific transaction, primarily driven by the sense of surprise or delight experienced during product acquisition or purchase. This emotion may stem from positive evaluations of product performance exceeding expectations or the warmth felt due to attentive service. Bolton and Drew (1991) further elaborated that customer satisfaction is a subjective emotional assessment formed after purchasing a product or service, where the gap between expectations and perceived performance is a key determinant. When actual experiences significantly surpass expectations, customers experience strong satisfaction and delight; conversely, unmet expectations may lead to disappointment or dissatisfaction. Notably, customers are highly value-oriented, where "value" refers to their comprehensive evaluation of the outcomes received relative to their inputs—not only

monetary costs but also time, effort, and other intangible investments. Outcomes encompass product functionality, service quality, brand reputation, and other dimensions. Through careful weighing, customers judge overall value to form their final conclusion on satisfaction.

2.2 Business Management

Business management refers to the discipline of effectively coordinating, controlling, and making decisions regarding the entire operational processes, management, and strategic planning of organizations, enterprises, or other commercial entities. According to Amis, J. M., Mair, J., & Munir, K. A. (2020), business management encompasses multiple functions and domains, including financial management, marketing management, human resource management, operations management, strategic management, and information technology management. The core objective is to enhance enterprise efficiency, competitiveness, and sustainable development capabilities through scientific management methods.

Early business management primarily focused on basic operational functions, emphasizing production efficiency and the optimization of organizational structures. Szentes (2005) proposed competitiveness measurement methods, including products and services, laying the foundation for enterprise performance evaluation. As business complexity increased, business management gradually evolved into a systematic framework. Schuman et al. (2005) introduced the Asset Life Cycle Management (ALCM) model, integrating general project management frameworks, systems engineering, and operational reliability concepts, effectively addressing efficiency issues in process industries. Agrawal, N. et al. (2024) noted that with the rapid development of globalization and information technology, the scope of business management has expanded to include transnational operations management, e-commerce management, and enterprise resource planning (ERP) integration.

Research indicates that modern business management has achieved deep integration with ERP systems. ERP systems integrate internal financial, accounting, procurement, production, logistics, materials, transportation, and human resource management within enterprises, not only reducing integration costs across departments but also improving the efficiency and accuracy of information transmission. From a business management perspective, ERP emphasizes cross-system functionality, interdepartmental coordination, and cross-regional integration, serving as an online data processing system with real-time and integrated processing capabilities. José Eugenio (2020) proposed a simplified Analytic Hierarchy Process (AHP) application method, enhancing the appeal of AHP in business applications by calculating the priority of a set of criteria. This decision-support tool significantly improves the scientific precision of business management. Modern business management is moving toward a more intelligent, data-driven direction, with increasingly close integration with information technology, providing robust managerial support for sustainable enterprise development.

2.3 Fuzzy Delphi Method

Liang et al. (2003) adopt the efficiency concept to assess and analyze the business performance of organizations, for example, integration evaluation of banks or financial holding companies and performance evaluation of research and development programs. Liang et al. (2003) proposed a process capability index for measuring the operation performance of banks' industries, which considers factors such as transaction processing speed, error rates in customer account management, and the timeliness of loan approval processes, providing a quantitative framework to gauge how well banking operations meet predefined quality standards. There is a new insight for the service quality of banks' operations, focusing on intangible aspects like customer satisfaction with digital banking interfaces, responsiveness of customer service representatives during peak hours, and the clarity of financial product information provided to clients.

The Fuzzy Delphi Method (FDM) is a semi-structured expert interview method that begins

by searching for relevant literature on a specific topic to initially summarize the questions, ensuring that the inquiry covers all critical dimensions of the subject matter. Then, based on the knowledge and experience of experts in the relevant field, opinions are offered on the questions, and the degree of consensus among the expert group is analyzed using fuzzy logic to handle uncertainties and vagueness in expert judgments. To formally implement the FDM, a suitable expert group of 10-15 scholars needs to be selected, comprising individuals with deep expertise in banking operations, financial management, and service quality assessment, each bringing unique perspectives shaped by years of industry practice and academic research. Each expert independently provides feedback on specific topics, such as key performance indicators for bank efficiency or critical success factors in service delivery, through structured questionnaires that allow for degrees of agreement (e.g., strongly agree, agree, neutral, disagree, strongly disagree) represented as fuzzy numbers. After collection and analysis, the consistency or differences in the expert group's responses to each question are confirmed using statistical techniques to aggregate fuzzy opinions, identifying areas of strong consensus and those requiring further discussion. The implementation process may involve multiple rounds as needed to gradually reach a consensus among the experts, with revised questions and feedback shared in subsequent iterations until a stable set of criteria or indices is established.

Chang et al. (2000) developed a new fuzzy Delphi method (FDM) to be used in managerial talent assessment for a company located in Taiwan, integrating fuzzy statistics to model the imprecise nature of human judgment in evaluating leadership qualities, problem-solving skills, and adaptability, and employing the technique of a conjugate gradient search to fit membership functions, which may be derived for fuzzy forecasts of employee performance potential and career progression. Liang and Hsieh (2005) also developed an ability index by using FDM for training in banks' industry, focusing on identifying core competencies required for roles such as risk management analysts and customer relationship managers, with the index incorporating fuzzy evaluations of training effectiveness, skill acquisition rates, and the alignment of training programs with evolving industry demands.

III. METHODOLOGY

1.1 Structure of ERP

This study employed comprehensive questionnaires to initially identify preliminary dimensions, followed by the integration of expert questionnaires and rigorous ethical and legal methodologies to pinpoint the core dimensions of enterprise resource planning (ERP) within the information industry. These identified dimensions encompass a holistic framework, specifically including: organizational management strategy, which involves aligning ERP systems with overarching corporate governance, leadership structures, and operational workflows; business strategy, focusing on how ERP supports competitive positioning, market expansion, and operational efficiency through integrated process management; customer relationship management strategy, designed to enhance customer engagement, streamline order processing, and improve service delivery through centralized data access and personalized interaction tools; vendor specification strategy, ensuring that ERP systems meet stringent technical requirements, compatibility standards, and compliance with industry-specific regulations when integrating third-party software or hardware; and financial planning strategy, which enables accurate budgeting, cost tracking, financial reporting, and risk management through real-time data integration across accounting, procurement, and inventory modules. The ERP Process, as visually represented and detailed in Figure 1, illustrates the sequential and interconnected flow of these strategic dimensions, highlighting how each component contributes to the seamless operation and optimization of enterprise resources in the dynamic landscape of the information industry.

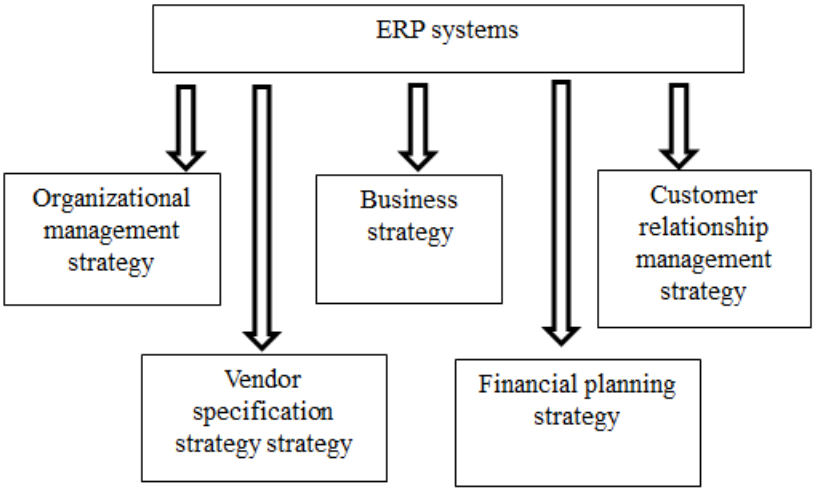

Fig.1 ERP Process

Chang and Lee (1995) refined this process by applying the Original Defuzzification Method (OM), a technique that converts fuzzy sets—representing vague or imprecise data such as subjective evaluations of candidate skills, experience, and cultural fit—into crisp numerical values, ensuring that the weight distribution of each factor in the ERP was both precise and reflective of expert judgment. This fuzzy decision system not only streamlined the candidate selection process by systematically aggregating and prioritizing multifaceted criteria but also ensured that the chosen individuals aligned with the bank's strategic goals of fostering a workforce capable of ERP development, thereby enhancing the likelihood of successful system implementation and long-term organizational effectiveness.

3.2 Pearson's correlation analysis method process

Pearson's correlation analysis was employed to ascertain whether a significant correlation existed between information pertaining to enterprise resource planning (ERP) and enterprise management practices. Building upon the comprehensive literature review and meticulously designed research framework outlined in the study, this investigation utilized Pearson's correlation analysis to dissect the various dimensions of ERP systems, thereby revealing the interrelationships among these critical components. To quantify the responses, a five-point Likert scale was integrated into the questionnaire, allowing participants to express their level of agreement or disagreement with each statement, ranging from 'Strongly Disagree' to 'Strongly Agree'. The primary focus of the study was on individuals employed within the information technology sector in Taiwan, a region known for its dynamic tech industry and widespread adoption of advanced business systems. In an effort to ensure a broad and representative sample, the study intentionally did not impose restrictions based on gender, occupation, or educational attainment, thus inviting participation from a diverse array of professionals, including software developers, IT consultants, system administrators, and business analysts, thereby enhancing the generalizability and practical relevance of the findings.

Convenience sampling was adopted as the data collection method, with questionnaires distributed through multiple channels to maximize accessibility: online platforms such as Google Forms, physical paper copies disseminated at industry conferences and tech meetups, and digital outreach via social media networks, messaging applications, and personal referrals from existing contacts. Prior to completing the questionnaire, participants were clearly informed about the research objectives, the principle of anonymity ensuring their identities

would remain confidential, and the inclusion of detailed research instructions alongside consent clauses, emphasizing voluntary participation without any coercion. A total of 452 questionnaires were successfully collected, providing a robust dataset for subsequent statistical analysis. Following collection, rigorous screening was conducted to identify and exclude incomplete or obviously invalid responses, such as those with uniform answers across all items or those lacking essential demographic information, ensuring that only high-quality, valid questionnaires were retained for use as the foundation of the research analysis.

3.3 Fuzzy Delphi Method process

This study employed an expert questionnaire to carry out a Fuzzy Delphi Method analysis, a structured approach designed to gather and synthesize expert opinions while accounting for uncertainty and vagueness in judgments. The panel of experts comprised five senior executives from the information industry, individuals with extensive leadership experience and deep insights into the sector's evolving landscape, including emerging technologies, market trends, and operational challenges. Two iterative rounds of consultation were conducted to refine and converge on a consensus, with each round building upon the feedback and revised inputs from the previous one to ensure robustness and alignment among the experts. The specific criteria for selecting these experts were stringent: they were required to possess not only professional knowledge and hands-on experience in information-related fields—such as software development, data management, cybersecurity, or telecommunications—but also held a bachelor's degree or higher academic qualification, ensuring a foundation of formal education complemented by practical expertise. This careful selection process aimed to assemble a panel capable of providing well-informed, nuanced perspectives that would underpin the validity and reliability of the Fuzzy Delphi Method analysis outcomes.

This study applies fuzzy theory to describe general uncertainty problems inherent in complex decision-making scenarios, particularly those involving imprecise or vague information. The research methods consist of two main parts: a comprehensive literature review to synthesize existing knowledge and the Fuzzy Delphi Method, a structured approach to elicit expert opinions under uncertainty. The Fuzzy Delphi Method is described as follows: Fuzzy theory uses the value of the membership function, which ranges from 0 to 1, to quantify the degree of belonging of an element to a fuzzy set, thereby describing general uncertainty problems that cannot be adequately captured by crisp binary logic. Hierarchical analysis, proposed by Thomas L. Saaty, is a decision-making method that organizes complex problems into a hierarchy of criteria and alternatives, using pairwise comparisons between elements at each level to derive relative importance weights. These weights are then synthesized to determine the overall priority of each alternative, with the option possessing the highest relative weight selected as the optimal solution. Kaufmann and Gupta's (1988) Fuzzy Delphi Method builds upon this foundation by integrating triangular fuzzy numbers, which are defined by three parameters (a lower bound, a modal value, and an upper bound) to represent the fuzziness of expert judgments, allowing for a more nuanced aggregation of opinions compared to traditional Delphi techniques. This study employs questionnaires to identify preliminary dimensions relevant to the implementation of financial planning, enterprise resource planning, and customer relationship management in the information industry, and subsequently utilizes expert questionnaires combined with the Fuzzy Delphi Method to determine the weight values associated with these dimensions, ensuring that the resulting priorities account for the inherent uncertainties and subjectivity present in expert assessments. Kaufmann and Gupta's (1988) fuzzy Delphi method is based on the triangular fuzzy number, which provides a flexible framework for modeling the imprecision in expert elicitation, enhancing the robustness and reliability of the decision-making process.

$$u_a(x) = \begin{cases} 0, & x < a \\ \frac{x-a}{b-a}, & a \leqslant x \leqslant b \\ \frac{c-x}{c-b}, & b < x \leqslant c \\ 0, & x > c \end{cases} \quad (1)$$

This study uses the Original Method (OM method) proposed by Chang and Lee (1995). The larger the OM value, the higher the importance of the factor.

$$OM(O_k) = \int_{\rho^*}^{1} \varpi(w)[\eta_1(w) \times c_k(w) + \eta_2(w) \times d_k(w)]\mathrm{d}w \quad (2)$$

$$OM(Oi) = \int_{0}^{1} \{0.5w[a + w(b-a) + (1-0.5w)[c + w(c-b)]\}dw$$
$$= (6b + a + 5c)/12 \quad (3)$$

$$OM(O_j) = \int_{0}^{1} \{(1-0.5w)[a + w(b-a)] + 0.5w[c + w(c-b)]\}dw$$
$$= (6b + 5a + c)/12 \quad (4)$$

IV. ANALYSIS AND RESULTS

After years of meticulous system integration, the synergies within the information technology industry have gradually emerged, weaving a complex yet cohesive network of interconnected systems and processes. Enterprise Resource Planning (ERP) in the information technology industry has played a pivotal role in making the operational platform more complete, streamlining workflows, enhancing data accuracy, and fostering seamless communication across departments. The results of the second expert questionnaire, which gathered insights from seasoned professionals in the field, are presented in Table 1. This table serves as a critical tool for analyzing the nuances of ERP implementation in the financial sector. By delving into Table 1, we can explore the similarities and differences in the weights assigned to each aspect of ERP within five major strategic areas: organizational management strategy, which encompasses leadership alignment and cross-departmental collaboration; business strategy, focusing on aligning ERP with overarching business goals and market demands; technology strategy, involving the selection and integration of cutting-edge technologies to support ERP functionalities; vendor specification strategy, which evaluates the reliability, compatibility, and support services of potential ERP vendors; and cost-benefit strategy, assessing the financial implications and return on investment of ERP adoption.

From Table 1, it is evident that the highest weight is allocated to vendor specification strategy, highlighting the critical importance of choosing the right partner to ensure successful ERP deployment and long-term performance. Following closely behind is organizational management strategy, underscoring the need for strong internal governance and stakeholder engagement to drive ERP adoption and maximize its benefits, as shown in Table 1.

Table 2 presents a detailed examination of the correlation patterns within the customer relationship management (CRM) dimension specifically tailored to the information industry, highlighting how various CRM components interact and influence one another. To rigorously assess the strength and direction of these relationships, this study employs Pearson product-moment correlation analysis, a statistical method well-suited for measuring linear associations between continuous variables. The correlation coefficients derived from this analysis are categorized into distinct levels to interpret the nature of the relationships: coefficients below 0.10 indicate

no meaningful correlation, suggesting that the variables in question do not exhibit a significant linear association; values ranging from 0.10 to 0.35 denote low correlation, implying a weak but detectable linear relationship; coefficients between 0.36 and 0.70 represent moderate correlation, indicating a noticeable and practically relevant linear connection; those from 0.71 to 0.99 signify high correlation, reflecting a strong linear association where changes in one variable are closely mirrored by changes in the other; and finally, a coefficient above 1.00, though theoretically impossible in standard Pearson correlation (which ranges from -1 to 1), is included here as a definitional upper bound for perfect correlation, where variables would exhibit an exact linear relationship with no variability.

Table 1 Results of the Second OM Value Analysis in Enterprise Resource Planning

Factor	a	b	c	2-nd OM value
Organizational management strategy	6.83	7.89	8.65	8.12
Business strategy	5.77	7.23	8.91	7.81
Customer relationship management	5.98	7.24	8.12	7.50
Vendor specification strategy	8.11	8.42	8.68	8.50
Financial planning strategy	7.12	7.43	8.92	8.03

Table 2 Summary Table of Correlation Coefficients in ERP

		ERP performance
Organizational management strategy	Pearson	0759***
Business strategy	Pearson	0.761***
Customer relationship management	Pearson	0.793***
Vendor specification strategy	Pearson	0.722 ***
Financial planning strategy	Pearson	0.735**

*p＜0.05 **P＜0.01 ***P＜0.001

V. CONCLUSION

This study, through fuzzy logic analysis, summarizes the findings of the research and reveals the dimensions of Enterprise Resource Planning (ERP) in the IT industry. Most sub-items have an OM weight value of 7.0 or higher, a threshold that underscores their critical importance in shaping ERP priorities within this dynamic sector. This indicates that the IT industry's ERP dimensions emphasize vendor specification strategy, highlighting a strategic focus on selecting and aligning with ERP vendors whose solutions can seamlessly integrate with the fast-paced, innovation-driven nature of IT operations. Therefore, ensuring market competitiveness in the IT industry relies on ERP vendor specification strategies, as these choices directly impact operational efficiency, scalability, and the ability to adapt to rapidly evolving technological demands and customer needs. Vendor specification strategies mainly include:

1. Identifying qualified suppliers

Ensuring suppliers consistently provide products and services of appropriate quality, timeliness, quantity, and price, and identifying and improving high-risk suppliers. This process involves rigorous evaluation criteria that encompass multiple dimensions to guarantee reliability and value. Quality assessment includes detailed inspections of product specifications, material standards, and compliance with industry regulations, ensuring that goods meet or exceed predefined benchmarks for durability, performance, and safety. Timeliness is evaluated through historical data on delivery schedules, including on-time delivery rates, lead time consistency, and responsiveness to urgent orders,

which helps mitigate disruptions in the supply chain. Quantity management focuses on the supplier's ability to fulfill order volumes accurately, with minimal variance, to support production planning and inventory management without excess stockpiles or shortages. Price analysis involves comparing competitive market rates, negotiating favorable terms, and evaluating cost structures to ensure cost-effectiveness without compromising on quality or service. Additionally, identifying high-risk suppliers requires monitoring factors such as financial stability, operational capacity, geopolitical exposure, and adherence to ethical and environmental standards. Once high-risk areas are pinpointed, targeted improvement initiatives are implemented, such as collaborative quality audits, process optimization workshops, or revised contractual agreements to address gaps. Continuous monitoring through regular performance reviews, feedback loops, and key performance indicator (KPI) tracking ensures that suppliers maintain their qualifications and that improvements are sustained over time, fostering long-term partnerships built on trust and mutual success.

2. Management processes

Establishing comprehensive supplier management policies, including rigorous supplier selection criteria that assess financial stability, production capabilities, quality control systems, and ethical business practices; systematic supplier evaluation mechanisms that involve regular performance reviews based on key metrics such as on-time delivery rates, product defect levels, compliance with contractual terms, and responsiveness to customer feedback; thorough on-site verification procedures that include unannounced facility inspections to evaluate manufacturing processes, safety protocols, working conditions, and adherence to environmental regulations; and structured guidance/improvement steps that provide suppliers with detailed feedback reports, targeted training programs, and collaborative problem-solving sessions to address identified gaps, enhance operational efficiency, and ensure continuous alignment with evolving industry standards and organizational requirements, thereby guaranteeing that all suppliers consistently meet or exceed predefined quality, reliability, and sustainability benchmarks.

3. Supplier risk assessment

Conducting comprehensive economic, social, and environmental risk assessments of existing suppliers, and providing tailored guidance to higher-risk suppliers. The economic risk assessment involves analyzing financial stability, including cash flow trends, debt-to-equity ratios, and exposure to market volatility, such as fluctuations in raw material prices or currency exchange rates that could impact delivery timelines and cost predictability. Social risk evaluation focuses on labor practices, including adherence to fair wage standards, safe working conditions, compliance with local labor laws, and the presence of any reported incidents of worker exploitation or discrimination. Environmental risk assessment examines a supplier's sustainability practices, such as waste management protocols, carbon footprint reduction efforts, compliance with environmental regulations regarding emissions and resource usage, and the implementation of eco-friendly production processes. For higher-risk suppliers identified through these assessments, guidance is provided in the form of actionable recommendations, such as financial restructuring support, training on improved labor practices, or technical assistance to adopt greener technologies. This guidance aims to mitigate risks, enhance supplier resilience, and align their operations with organizational sustainability and ethical sourcing goals, ensuring long-term reliability and responsible supply chain management.

REFERENCES

[1] Agrawal, N., Kotikalapudi, K. B., Kumar, N., Sahoo, P., & Pant, N. (2024). Managing diversity in the workplace: Challenges and best practices for inclusive leadership. Educational Administration: Theory and Practice, 30(5), 14415–14422.

[2] Amis, J. M., Mair, J., & Munir, K. A. (2020). The

organizational reproduction of inequality. Academy of Management Annals, 14(1), 195–230.

[3] Bolton, R. N. & Drew, J. H.(1991) , "A Multistage Model of Customers' Assessments of Service Quality and Value. Journal of consumer research, 17, 375-384.

[4] Chang, P. T., Huang, L. C., and Lin, H. J. (2000). The fuzzy Delphi method via fuzzy statistics and membership function fitting and an application to the human resources, Fuzzy Sets and Systems, 112, 511-520.

[5] Chang, P. T., and Lee, E. S. (1995). The estimation of normalized fuzzy weights, Computers and Mathematics with Applications, 29(5), 21-24.

[6] Chang, I. S., Tasuhiro, Y., Gen, M., and Tozawa, T. (1995). An efficient approach for large scale project planning based on fuzzy Delphi method, Fuzzy Sets and Systems, 76, 277-288.

[7] Kaufmann, A., and Gupta, M. M. (1988). Fuzzy mathematical model in engineering and management science, New York: North-Holland Inc.

[8] Liang, S. K., Chen, K. S., and Hung, Y. H. (2003). Measuring Banking Operation Performance by Applying a Process Capability Index. Journal of Information and Optimization Sciences, 24(2): 317-328.

[9] Liang, S. K. and Hsieh, S. Y. (2005). An examination of the professional ability index used by banks for training, using the fuzzy Delphi method. Journal of Insurance, 2(1):105-122.

[10] José Eugenio L. (2020). AHP-express: A simplified version of the analytical hierarchy process method, Methods X, 7: 100748. doi:10.1016/j.mex.2019.11.021

[11] Oliver, R. L. (1981), "Measurement and Evaluation of Satisfaction Process in Retail Settings. Journal of Retailing, 57(3), 25-48.

[12] Schuman, C. A. and Brent, A. C. (2005). Asset life cycle management: towards improving physical asset performance in the process industry, International Journal of Operations and Production Management, 25(6), 566-579.

[13] Szentes, T. (2005). Interpretations, aspects and levels, decisive factors and measuring methods of competitiveness, Society and Economy, 27(1), 5-41.