Jurnal
Manajemen
Teknologi

Jurnal Manajemen Teknologi, 25(1), 2026,1-21
Available online at http://journal.sbm.itb.ac.id

Vendor Selection System in the System Integration Company PT. VISINIAGA in Surabaya using the Analytic Hierarchy Process (AHP) Method

Lewi Supranata Kristianto, Hermeindito*, and Timotius Febry Christian
School of Business Management, Universitas Ciputra Surabaya, Indonesia

Abstract. *This study aims to identify criteria for selecting system integrator vendors for PT. Visiniaga. Theoretically, the study contributes by adapting AHP to the ICT system integration context, offering a structured evaluation approach that aligns with project-specific requirements in ICT industry. Practically, the AHP-based model supports improved decision-making, reduces subjectivity, and enhances transparency and consistency in vendor selection to identify the best vendors, essential in competitive ICT markets. The samples for this study are PT Visiniaga vendor subcontractors for a period of 1 year in 2023. The AHP method is a structured decision-making approach that uses pairwise comparisons of weighted criteria and sub-criteria based on weighted criteria to derive priority weights for criteria and sub-criteria, assigning relative importance based on expert judgment from owner PT. Visiniaga and ensuring consistency through calculating a Consistency Ratio (CR). The key criteria identified include Price, Service Quality, Timeliness of Installation, and Support, with Price being the most influential factor, accounting for 58.5% of the total weight. AHP is important to be more efficient to get competitive in intense industrial competition.*

Keywords: *ICT, AHP, system integration, efficiency, structured decisions*

How to Cite: *Kristianto, L.S., Hermeindito, and Christian, T.F. (2026). Vendor Selection System in the System Integration Company PT. VISINIAGA in Surabaya using the Analytic Hierarchy Process (AHP) Method. Jurnal Manajemen Teknologi, 25(1), 1-21. doi: 10.12695/jmt.2026.25.1.1*

*Corresponding author. Email: hermeindito@ciputra.ac.id
Received: May 30th, 2024; Revision: May 20th, 2025; Accepted: June 17th, 2025
Print ISSN: 1412-1700; Online ISSN: 2089-7928. DOI: http://dx.doi.org/ 10.12695/jmt.2026.25.1.1
This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
Published by Unit Research and Knowledge- School of Business and Management-Institut Teknologi Bandung

Introduction

The study proposes a new evaluation process with the Analytic Hierarchy Process (AHP) model to address challenges faced by PT. Visiniaga in vendor subcontractors' selection system. Over time, the Information and Communication Technology (ICT) industry has experienced significant developments that have brought rapid changes in the business operational systems of various industries (OECD, 2019). The ICT integration system industry plays a vital role in the current era of increasingly widespread digitalization, where companies and educational institutions depend on ICT systems to ensure operations run smoothly and well (OECD, 2019). The future will depend heavily on data concepts and technological advances, as endpoint devices will communicate with each other through the internet and using data networks, thereby reducing human participation in the process (Porter & Heppelmann, 2015).

Selecting the optimal vendor in the ICT system integration domain involves navigating multiple, often conflicting, qualitative and quantitative criteria. While various Multi-Criteria Decision-Making (MCDM) methods exist, such as TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) (Hwang & Yoon, 1981) or simple weighted scoring, also known as the Weighted Sum Model (WSM) (Fishburn, 1967; Triantaphyllou, 2000), they may not fully capture the hierarchical nature of the decision problem or the subjective nuances inherent in expert judgments within this industry. For instance, while TOPSIS is effective for ranking alternatives based on distance to ideal solutions, it can be less intuitive for structuring complex criteria interdependencies. Simple weighted scoring, on the other hand, often struggles with systematic weight elicitation and consistency verification.

Given these considerations, this study employs the Analytic Hierarchy Process (AHP) method, as it is particularly well-suited for the vendor selection complexities faced by PT. Visiniaga. Developed by Saaty (1993), AHP excels at decomposing complex multi-factor problems into a manageable hierarchy, encompassing the goal, criteria, sub-criteria (if applicable), and alternatives. Its core strength lies in the use of pairwise comparisons, which allows for the systematic determination of relative importance for both tangible and intangible criteria, a critical aspect in ICT vendor assessment. Furthermore, AHP's ability to calculate a Consistency Ratio (CR) ensures the reliability of expert judgments (Saaty, 2008), making the decision-making process more robust, transparent, and easier to evaluate compared to other MCDM approaches for this specific context.

Installing structured cabling infrastructure in ICT systems can increase, secure, and higher data traffic rates. The need for structured cabling systems has increased significantly due to data growth caused by Internet of Things (IoT) devices (Javed et al., 2018), increased automation in business and production processes within companies, demands for tighter competition, and the value of time efficiency. The rise of the sector is driving the demand for structured cabling. The significant increase in demand for technology, cloud, and data storage, as well as market expansion, may contribute to the development of the global data and communications technology business.

The business continues to grow and invest in data communications infrastructure (Koot & Wijnhoven, 2021). Structured cabling is a crucial component of data communications infrastructure. Establishing the foundation of a communications system necessitates the construction and ongoing maintenance of structured cabling across all industrial sectorsAs shown in Figure 1, the demand for copper cables and fiber optics is projected to rise primarily driven by the rapid expansion of the telecommunications and information technology sectors. Key factors contributing to this surge include the growing internet penetration, digital transformation across various industries, and ongoing smart city initiatives.

Figure 1.
Structured Cabling Market

The escalating need for higher bandwidth capacity, particularly for video streaming services, online gaming, and cloud-based applications, is significantly boosting the adoption of infrastructure for data networks including copper cable and fiber optics.

The competitive nature of the industry necessitates that PT. Visiniaga designs an effective vendor subcontractor's selection system to maintain competitiveness in the rapidly evolving industrial landscape of system integration. This will be addressed using the Analytic Hierarchy Process (AHP) method, which provides a structured, multi-criteria decision-making framework. Initially, six main factors were considered for vendor selection: price, service quality, timeliness of installation, service and support, team capability, and completeness of installation tools. However, Team Capability and Completeness of Installation Tools can be easily supplemented through third-party resources. Team Capability, while a vendor subcontractor lacks sufficient skilled personnel, they can hire temporary or contract-based professionals for specific projects. This makes the factor less critical for long-term vendor evaluation, as subcontractors can flexibly adjust their workforce as needed. Completeness of Installation Tools, vendors can rent or lease tools if they do not own them, reducing the significance of this criterion in vendor evaluation. The availability of tools does not necessarily reflect vendor competence, as the right tools can be procured externally when needed. Consequently, the final selection model includes four key factors: price, service quality, timeliness of installation, and support. These were selected due to their direct and critical impact on the operations and success of an ICT system integrator like PT. Visiniaga.

The price criterion as ICT system integrators must deliver solutions that offer significant value, balancing initial acquisition costs with the long-term total cost of ownership (TCO)—an aspect crucial for sophisticated and evolving technological systems—while also maintaining competitiveness in project bids (Tavana et al., 2021). The service quality criterion is paramount, directly influencing the functionality, reliability, and overall performance of the final integrated ICT solution delivered to clients, thereby significantly impacting PT. Visiniaga's professional reputation and client satisfaction levels (Parasuraman et al., 1985; Asubonteng et al., 1996).

The timeliness of installation criterion is especially critical in the project-driven and often time-sensitive ICT environment; delays by a vendor during the installation phase can trigger cascading disruptions to overall project schedules, potentially leading to contractual penalties and damaging crucial client relationships for the system integrator (Ho et al., 2010). Finally, the support criterion from vendors is indispensable, encompassing responsive technical assistance, effective problem resolution, and proactive maintenance services. Such support is essential for ensuring the operational continuity and effective lifecycle management of the complex integrated ICT systems that PT. Visiniaga designs, implements, and maintains for its diverse clients (Ellram et al., 2007; Haksever & Moussourakis, 2008)..

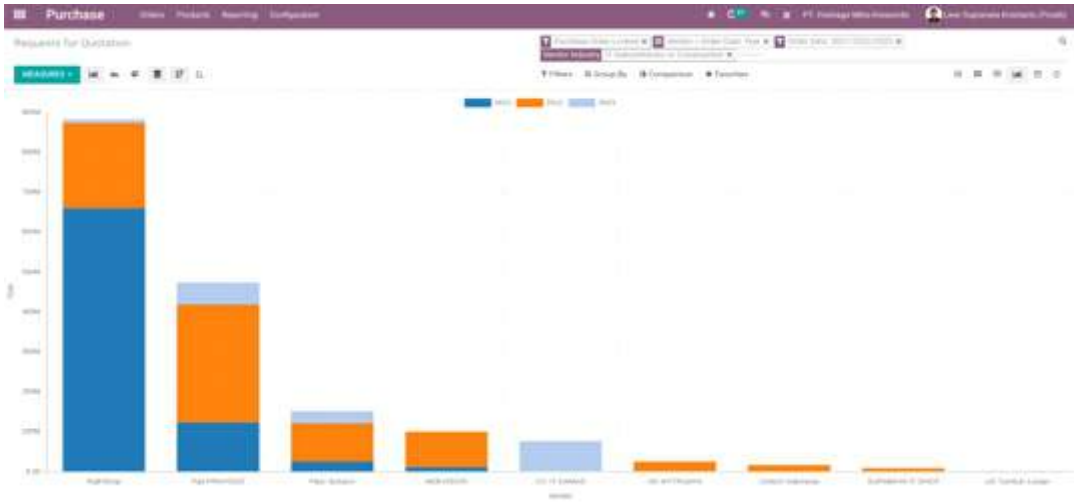

Figure 2.
Vendor Subcontractors Purchase Distribution Level 2021-2023

Figure 2 illustrates the purchase levels of subcontractor vendors engaged by PT. Visiniaga over the period 2021-2023, reflecting the evolving vendor selection process. In 2021, PT. Visiniaga's historical approach to vendor selection has evolved from relying predominantly on established relationships with one or two vendors in 2021 to engage with multiple subcontractors by 2022. This approach, heavily reliant on long-term relationships and past collaborations, resulted in limited vendor diversity, potentially increasing costs and reducing competitiveness in the procurement process.

By 2022, PT. Visiniaga expanded the number of vendors, balancing purchases across multiple subcontractors. This shift suggests an effort to diversify vendors based on price, service quality, timeliness of installation, and support. However, despite this diversification, the vendor selection remained inconsistent, as there was no clear framework for evaluating vendors systematically for the time being.

The AHP method, as proposed in this study, aims to develop a vendor selection model using the Analytic Hierarchy Process (AHP) method to improve decision-making, reduce subjectivity, and ensure a structured approach in selecting vendors based on multiple weighted criteria. As Figure 2 illustrates, without a robust vendor evaluation system, vendor selection often depends on proximity and historical collaborations, leading to potential inefficiencies and missed cost-saving opportunities.

With AHP, PT. Visiniaga can achieve a more objective, transparent, and data-driven vendor

selection process, ensuring that procurement decisions optimize cost efficiency, service quality, and project success while maintaining a competitive supplier ecosystem.

Supplier selection is one of the problems in decision-making that are difficult to undertake and requires data analysis across various factors (Avila et al., 2012; Tsai et al., 2010). Therefore, choosing suitable suppliers and conducting performance analysis correctly is strategically important for companies (Dagdeviren & Eraslan, 2008). Using a decision-making system allows companies to speed up the decision-selection process (Gorry & Scott Morton, 1971). Decision-making is a structured method for dealing with a problem. The structured approach involves a deep understanding of the essence of the problem at hand and collecting facts and data related to the problem.

One of several methods that can assist the decision-selection process is the Analytic Hierarchy Process (AHP) (Saaty, 2008). AHP is a reliable, systematic, and powerful technique for obtaining and measuring subjective assessments in Multi-Criteria Decision Making (MCDM) (Tavana, Soltanifar, & Santos-Arteaga, 2021). The AHP method has often been used in various fields to support decision-making (Saaty, 1993; Ho et al., 2010), including in the vendor selection process. This method allows decision-makers to consider various criteria simultaneously and identify the most suitable vendor subcontractors for PT. Visiniaga's projects

This study aims to achieve the following objectives:

1. Building the key selection criteria for evaluating vendors at PT. Visiniaga and assess their significance in decision-making (Saaty, 2008).
2. Create a structured AHP-based vendor selection framework that facilitates an objective and transparent assessment of subcontractors (Tavana et al., 2021).
3. Examine the impact of AHP implementation in improving vendor selection by reducing subjective judgment and enhancing procurement transparency (Saaty, 2008; Ho et al., 2010).
4. Provide strategic recommendations on adopting AHP implementation for vendor subcontractors' selection, increasing cost efficiency, and improving PT. Visiniaga's competitive advantage in the industry (Dagdeviren & Eraslan, 2008).

This study focuses exclusively on vendor selection for System Integration company, projects within PT. Visiniaga and evaluates subcontractors engaged by the company over a one-year period (2023). It does not propose vendor selection for support material, equipment or software solutions. Additionally, in AHP, the weight determination in pairwise comparisons relies on expert judgment from PT. Visiniaga's management, which, despite the consistency ratio (CR) validation, may introduce potential biases.

Literature Review

Procurement Process

Procurement refers to the process of purchasing goods and services in the supply chain (Chopra & Meindl, 2007). Lysons & Farrington (2020) define it as the activities involved in obtaining goods, services, and work required by organizations from external organizations. Therefore, procurement is important for cost optimization, supplier relationship management, quality of resources, and the availability of resources.

Baily et al. (2004) point out that the traditional approach to purchasing as a transactional activity has transitioned into developing mutual relations between suppliers and buyers. The focus of such mutualistic relationships is on value co-creation — usually involving either technology or tools — where both entities contribute elements of trust and support to increase value beyond basic economic transactions.

System Integrator

System integration is the process of integrating components, elements, or subsystems to achieve a unified system capability (Lysons & Farrington, 2020). They focus on integrating separate subsystems into successful integrated systems, which may include either hardware or software or the result of both. Failure to integrate new systems properly can lead to higher costs, inadequate services, waste of resources, harm to humans or property, or negative impact on other systems or the environment.

According to Hobday (2000), system integrators are "firms who create distinct complex products by assembling a considerable number of complementary elements into larger product systems." During the same time, Hildrum (2009) lightly uses the terminology to describe organizations that build large integrated networks leveraging commercially available telecommunications network technologies.

Supplier Selection

To produce quality products at low cost (Alifatin, 2016), a supplier that meets the company criteria is needed. Supplier selection is the most significant of the procurement process steps, and appropriate supplier choice has an impact on company competitiveness. Choosing inappropriate suppliers can lead to losses in company performance (Taherdoost & Brard, 2019).

In Dickson (1996), criteria for supplier selection include quality, delivery, past performance, warranties and claim policies, production facilities and capacity, price, technical capability, financial position, procedural compliance, communication systems, industry reputation, desire, management and organization, operational control, service, attitude, impression, packaging ability, labor relations, geographical location, past business value, training aids, and reciprocal arrangements.

Surjasa et al. (2006) present influential supplier selection criteria and categories consisting of new supplier development criteria implemented (price, quality, delivery time, quantity, and customer care (price-quality ratio, discount opportunities, specification compliance, defect-free products, consistent quality, delivery on time, transportation management, accuracy of quantity delivered, accuracy of packaging contents, ease of contact, clear communication of questions, fast response to requests and complaints, etc.).

Decision Support System

The original name proposed for decision support systems was management decision systems (Scott Morton, Gorry, 1970). Decision support systems were developed to assist managers in dealing with semi-structured decision problems and to improve efficiency and productivity (Gorry & Scott Morton, 1971). Decision support systems were developed to assist managers in dealing with semi-structured decision problems and to improve efficiency and productivity (Gorry & Scott Morton, 1971).

Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process is a structured decision–making approach created by Thomas L. Saaty in 1973. However, AHP allows people or groups to make decisions involving multiple criteria by dividing the problem into smaller and more manageable parts. AHP provides solutions to complex decision problems by structuring criteria hierarchically and supporting consistent evaluation (Saaty, 2008; Ho et al., 2010).

AHP has been applied in diverse decision environments such as choice (one from many), prioritization/evaluation (the relative goodness of various alternatives), resource allocation (the best combinations of alternatives), benchmarking (one process against another), and quality management (the delivery of products or services that consistently meet customers' expectations) (Saaty, 2008; Ho et al., 2010).

The advantages of AHP, as mentioned in literature, are that it can handle complex situations, assess qualitative and quantitative criteria and convert complex problems into understandable models. Despite that, it has some shortcomings, such as the challenges in identifying relative weights and biased decision-making (Saaty, 2008).

The steps for supplier selection using AHP include: determining selection criteria, conducting pairwise comparisons to assess criteria importance, evaluating suppliers based on established criteria, conducting pairwise comparisons to assess suppliers against criteria, and calculating final supplier priorities (Nydick & Hill, 1992).

Within the digitally intensive e-commerce sector, which heavily relies on ICT infrastructure, Rani et al. (2021) demonstrated the use of an integrated fuzzy AHP and fuzzy TOPSIS approach for supplier selection, emphasizing criteria pertinent to dynamic operational environments. Tavana et al. (2021) proposed a hybrid fuzzy AHP-VIKOR methodology for the strategic selection of cloud service providers, highlighting the method's capacity to evaluate complex technical and service-level criteria inherent in ICT service procurement. While some studies, such as Ho et al. (2010), apply integrated AHP models in manufacturing contexts, the underlying principles of evaluating technological capabilities and service performance of suppliers often resonate with the requirements of ICT system integrators. Furthermore, the evolution of AHP is evident in its application to specialized selection contexts, such as green supplier selection, often employing advanced fuzzy extensions to handle inherent uncertainties (Rani et al., 2021). These international studies collectively affirm AHP's flexibility and enduring relevance in structuring and resolving complex selection decisions (Ho et al., 2010; Rani et al., 2021), particularly where multiple qualitative and quantitative factors, similar to those faced by PT. Visiniaga (e.g., price, service quality, timeliness of installation, and support), must be systematically evaluated.

Relevant and Non-Relevant Selection Criteria

While traditional supplier selection frameworks often include numerous criteria, research suggests that not all criteria are equally relevant in every industry context. Vendor selection criteria should be tailored to specific industry needs and organizational objectives (Dickson, 1996; Weber et al., 1991). In the context of system integration, certain criteria may be less critical due to industry-specific characteristics and operational realities.

Non-Relevant Criterion:

1. Team Capability

Team Capability is traditionally recognized as one of the critical supplier selection criteria (Choi & Hartley, 1996). In the case of system integration subcontractors, however, this is less relevant due to the flexibility with which people can mix and match. According to Rubin et al. (2008), subcontractors can easily modify their skill matrix by mixing temporary workers. According to Giunipero and Pearcy (2000), project-based industries routinely rely on vendors to provide contract-based professionals as needed to augment their permanent employees when specialized knowledge is necessary.

In industries with standardized technical requirements, the ability to temporarily access specialized talent via freelance markets is better than having a large permanent team (Beil, 2010). The global reach and the increase of the gig economy have led to a growing availability of skilled technical labour on a project basis (Aguinis & Lawal, 2013). This flexibility mitigates the need for a permanent vendor team capability assessment as temporary shifts in any workforce have become an industry normal.

2. Completeness of Installation Tools

The completeness of installation tools, while seemingly important for technical service providers, has been shown to be a poor predictor of performance quality in modern service contexts. According to Ellram et al. (2007), access to specialized equipment can be achieved through rental and leasing

arrangements, particularly for standard industry tools. Haksever and Moussourakis (2008) demonstrate that equipment ownership has become less critical in contractor selection due to the widespread availability of equipment rental services.

All technical capability should be measured by way of its methodology and knowledge, not ownership of tools (Talluri & Narasimhan, 2004). For IT service providers, Ho et al. (2010) discovered that contractors renting specialized equipment often yielded results equal to or better than those owning equipment, as they could acquire the latest technology without limitations imposed by capital investment. The spread of specialized providers of tool rental services has made equipment ownership meaningless as a distinguishing feature of supplier performance (Krause et al., 2001).

Relevant Criterion:
While criteria such as price and service quality are widely referenced in supplier selection literature, these elements hold particular significance within the ICT system integration sector. At PT. Visiniaga, competitive pricing often determines project feasibility due to strict client budgets. Additionally, timely installations and responsive support services are critical for maintaining service level agreements with clients in highly dynamic environments. The selection of appropriate vendors is pivotal for any organization, but for an IT system integrator like PT. Visiniaga, operating in the competitive Surabaya market, it is a cornerstone of operational success and strategic growth. While general supplier selection literature (e.g., Dickson, 1996; Surjasa et al., 2006) identifies a broad array of potential criteria, their specific relevance and weighting are highly dependent on the industry and organizational context (Weber et al., 1991). For PT. Visiniaga, which delivers complex ICT solutions often involving the integration of multiple hardware and software components from various subcontractors, certain criteria emerge as particularly critical due to client expectations, project complexities, market dynamics in Indonesia, and the company's aim to provide cost-effective, reliable, and timely solutions. This study identifies Price, Service Quality, Timeliness, and Support as the paramount criteria for PT. Visiniaga.

1. Price
Price is a critical factor for most purchases. Consumer price expectations and price violations are major determinants of consumer buying behaviour. Price is the money used to pay for a product or service (Kotler, 2009). In the context of contemporary ICT and digital supply chains, while initial price is a critical factor, strategic procurement approaches increasingly emphasize a broader financial evaluation. This includes considerations like Total Cost of Ownership (TCO), moving towards a more holistic view of cost that encompasses the entire lifecycle of procurement (Tavana et al., 2021). Such value-oriented perspectives are advocated to ensure long-term benefits and strategic alignment, a comprehensive outlook particularly pertinent for ICT system integrators like PT. Visiniaga. These firms must navigate the imperative of price competitiveness alongside the necessity for vendor reliability and sustained service quality in delivering complex projects.

The significance of such a holistic view is echoed in supplier selection literature. For instance, research by Taherdoost & Brard (2019) underscores that even when price is a dominant criterion, its assessment should be integrated with considerations of lifecycle value, risk mitigation, and vendor responsiveness. While PT. Visiniaga is highly price-conscious, strategically incorporates these broader value and TCO considerations, as highlighted by Tavana et al. (2021) for digital environments, to select vendors that offer the optimal balance for project success and client satisfaction."

2. Service Quality
Service quality was first introduced by Churchill and Surprenant (1982) and Asubonteng et al. (1996), highlighting the theory of customer satisfaction. It reflects the efficiency with which a company provides

services in line with customer requirements. Services are distinct from goods as they offer intangible, heterogeneous, and simultaneous production and consumption benefits (Parasuraman et al., 1985).

Service quality, reflecting the degree to which a delivered service aligns with customer expectations and specified requirements (Parasuraman et al., 1985; Churchill & Surprenant, 1982), is a paramount concern in the selection of vendors, especially within the ICT system integration sector where project outcomes are intricately tied to vendor performance. For an ICT system integrator like PT. Visiniaga, which architects and deploys complex technological solutions for its clients in the dynamic Surabaya market, the service quality rendered by its subcontractors is not merely a performance metric but a direct determinant of its own operational success and market reputation. The nature of system integration—melding diverse hardware, software, and network components—means that the reliability, compatibility, and performance of each element sourced from vendors are critical. As highlighted by Tavana et al. (2021) in their study on supplier selection for digital supply chains, both the intrinsic quality of products/services (such as conformity and reliability) and the service capabilities of vendors (like technical support and responsiveness) are pivotal.

3. Timeliness of Installation

Timeliness refers to responding to consumers' requests in a timely and efficient manner (Ellram et al., 2007; Haksever & Moussourakis, 2008). Installation timeliness is a capability to install properly on time.

The critical role of 'Timeliness' for PT. Visiniaga is amplified by the project-based nature of the ICT system integration industry. As highlighted by research on project procurement, delays from one vendor can have cascading negative impacts on overall project schedules and costs (Ho et al., 2010; Ellram et al., 2007). For an ICT system integrator managing multiple concurrent projects with firm client deadlines, such as PT. Visiniaga, ensuring vendor adherence to delivery schedules is paramount to maintaining project viability and client satisfaction. A delay from a single vendor or subcontractor can initiate a domino effect, leading to significant disruptions in overall project schedules, increased labor costs due to extended project durations, and potential contractual penalties for PT. Visiniaga, on cascading impacts in project procurement). Ensuring that vendors can reliably meet delivery and installation deadlines is therefore essential for PT. Visiniaga to maintain project profitability, achieve high levels of client satisfaction, and solidify its reputation as an efficient and dependable ICT solutions provider in a demanding market."

4. Support

Service and support refer to activities performed by organizations following the consumer purchase of their products. The goals are to minimize risks from using a product and maximize the value of the experience of consumption.

Post-purchase service and support, encompassing activities undertaken by vendors after product delivery or project completion, play a pivotal role in maximizing the long-term value derived from procured goods and services and mitigating operational risks (Ellram et al., 2007; Haksever & Moussourakis, 2008). In the context of ICT system integration, the criticality of ongoing vendor "Support"—which includes aspects like after-sales service, technical assistance, and vendor responsiveness—is increasingly recognized, especially for companies like PT. Visiniaga. This is underscored in recent literature on supplier selection in technology-driven environments; for example, Tavana et al. (2021) identify comprehensive service capabilities, including technical support and responsiveness, as key criteria for selecting suppliers in digital supply chains.

For PT. Visiniaga, which delivers complex and often mission-critical ICT solutions to a

diverse client in the Surabaya market, the quality and reliability of support from its vendors (subcontractors) are crucial for several reasons. Firstly, integrated ICT systems, by their nature, may require ongoing maintenance, troubleshooting, and periodic updates to ensure optimal performance and security throughout their lifecycle. The ability of PT. Visiniaga's vendors to provide prompt and effective Technical Support is essential for resolving any issues that arise post-implementation, thereby minimizing potential downtime for clients and upholding PT. Visiniaga's service commitments. Secondly, clear and efficient Communication & Coordination with vendor support teams is vital for swift problem diagnosis and resolution. Thirdly, the Response Speed of a vendor when technical issues emerge can significantly impact a client's operational continuity and their overall satisfaction with the solution provided by PT. Visiniaga. In a competitive market where long-term client relationships are key, robust vendor support enables PT. Visiniaga to ensure the sustained performance of its integrated solutions, manage client expectations effectively, and solidify its reputation as a dependable long-term ICT partner.

Research Methodology

This research approach does not use hypotheses and does not require hypothesis testing with statistical methods. This research uses Analytic Hierarchy Process (AHP) to analyse vendor selection based on expert judgment. The subject of this research is PT. Visiniaga, a system integration company located in Surabaya, East Java. Research was selected for its relevance to the research, ease of access, and availability of comprehensive data. Cooperation with the company and permissions facilitated data collection. The data collection method involves detailing the population, sample, and techniques. The research population includes relevant individuals or units. A systematic sampling process ensures diversity and avoids bias.

Data collection techniques include questionnaires, observations, and document analysis, chosen based on availability and research objectives. The process follows systematic guidelines, focusing on validity and reliability to ensure research integrity.

The delineation of pertinent vendor selection criteria for PT. Visiniaga, an ICT system integrator, was a foundational phase of this research, conducted systematically to ensure contextual relevance and methodological rigor for the subsequent Analytic Hierarchy Process (AHP) model. An initial comprehensive list of potential criteria was derived through a dual approach: firstly, an extensive review of seminal and contemporary academic literature pertaining to vendor/supplier selection (Taherdoost & Brard, 2019) and AHP applications within ICT and project-based industries; and secondly, preliminary consultations and interviews with key management personnel and the owner of PT. Visiniaga to ascertain existing evaluation practices, operational challenges, and perceived critical success factors specific to their vendor subcontractor engagements. This iterative process yielded an initial set of six potential main criteria: price, service quality, timeliness of installation, service and support, team capability, and completeness of installation tools.

Subsequently, this preliminary set of criteria underwent a rigorous screening, refinement, and validation sequence. The six criteria were presented to and deliberated upon by an expert panel composed of seven key internal stakeholders at PT. Visiniaga, representing diverse functions including Director of Operations, IT Manager, Project Management Officer, and Solution Team, who would later participate in the AHP pairwise comparisons. These structured discussions, facilitated by the researcher, assessed each criterion for its direct applicability, measurability, and criticality to PT. Visiniaga's system integration projects. Based on this expert consensus, 'Team Capability' and 'Completeness of Installation Tools' were deemed less critical as primary differentiating

factors for PT. Visiniaga's model due to the documented flexibility in sourcing these through third-party or temporary means (Ho et al., 2010). Consequently, the remaining four criteria: Price, Service Quality, Timeliness of Installation, and Support, were unanimously validated by the panel as the most impactful and directly influential for successful vendor subcontractor performance. These validated criteria and sub criteria then formed the primary level of the AHP hierarchy, structured under the overall goal of optimal vendor selection, and vendor alternatives at subsequent levels.

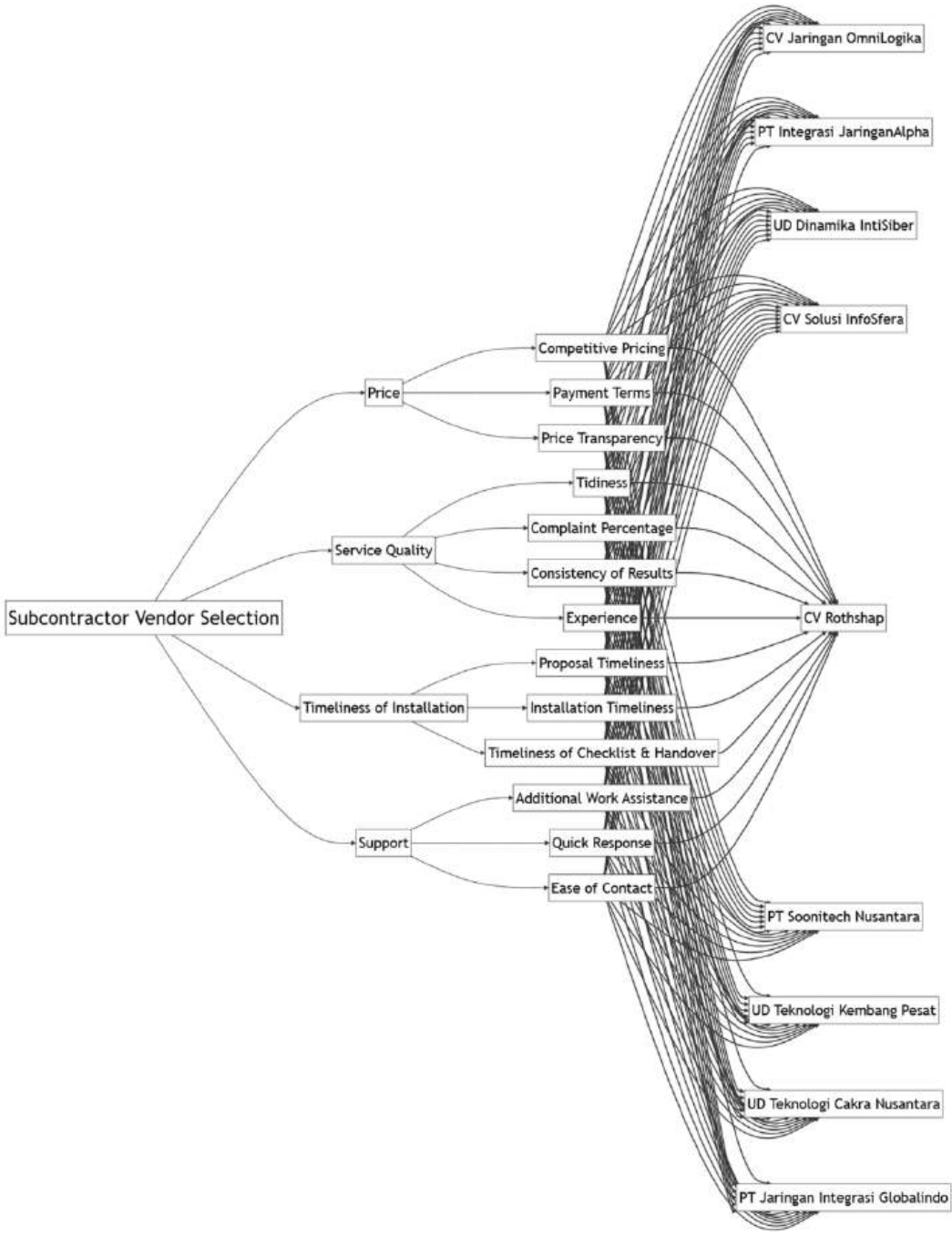

Figure 3.
AHP Model

The sampling method used in this study is purposive sampling, where samples are selected for specific purposes, thus limiting, or predefining the population under study (Sugiyono, 2018). According to Saaty, in 1993, the sample in this research adhered to applicable methods, ensuring it was representative. In applying the AHP method, the emphasis is placed on the quality of data from respondents rather than the quantity. Therefore, the AHP assessment requires respondents who are experts in their field to make decisions when selecting alternatives. The respondents in this study are individuals who understand and have an influence on the decision-making process or possess the necessary information. There is no specific formulation for the number of respondents in the AHP method, but the minimum requirement is two respondents (Saaty, 1993). Therefore, the researcher selected seven individuals holding various positions at PT. Visiniaga in Surabaya. The respondents were chosen based on critical criteria such as Price, Service Quality, Timeliness of Installation, and Support.

1. Expert 1, Director of Sales & Operations
- Aiming for a comprehensive understanding of all aspects especially Price.
- Provides strategic direction, final approval of critical vendor partnerships, and holistic risk assessment.
- Deep understanding of overall business impact of Price; strategic importance of Service Quality and long-term Support & Services for company reputation and sustainability.

2. Expert 2, IT Manager
- Aiming for Service Quality, Timeliness of Installation, and Support.
- Key contributor regarding vendor impact on operational efficiency, project profitability, and client satisfaction.
- Assessing the impact of Service Quality on project milestones, extensive practical experience with managing Timeliness of Installation, and the critical need for reliable vendor Support & Services throughout the project lifecycle.

3. Expert 3, Project Management Officer
- Aiming for Price, Service Quality and Timeliness of Installation and Support.
- Oversees vendor performance during project execution, operational cost, ensures adherence to project timelines and quality standards.
- Extensive practical experience with managing Timeliness of Installation, assessing the impact of Service Quality on project milestones, and the critical need for reliable vendor Support & Services throughout the project lifecycle.

4. Expert 4, Project Management Officer
- Aiming for Price, Service Quality and Timeliness of Installation and Support.
- Oversees vendor performance during project execution, operational cost, ensures adherence to project timelines and quality standards.
- Extensive practical experience with managing Timeliness of Installation, assessing the impact of Service Quality on project milestones, and the critical need for reliable vendor Support & Services throughout the project lifecycle.

5. Expert 5, Administration
- Aiming for Service Quality and Support.
- Monitors daily vendor activities, problem-solves project-level issues, and reports on vendor performance.
- Ground-level experience with vendor Timeliness of Installation, practical assessment of Service Quality on-site, and immediate interface for Support & Services needs during projects.

6. Expert 6, Solution & Procurement Team
- Aiming for Price, Timeliness of material
- Executes purchasing strategy, negotiates terms, manages vendor

contracts, and ensures cost-effectiveness.
- Primary expertise in Price analysis, negotiation, and market value; logistical coordination for Timeliness of Installation; and vendor relationship management for Support & Services.

7. Expert 7, Solution & Procurement Team
- Aiming for Price, Timeliness of material
- Executes purchasing strategy, negotiates terms, manages vendor contracts, and ensures cost-effectiveness.
- Primary expertise in Price analysis, negotiation, and market value; logistical coordination for Timeliness of Installation; and vendor relationship management for Support & Services.

AHP structured decision-making processes then work through vendor selection in seven steps to instilla systematic and structured approach:
1. Set the objective, as this research suggests, is critical for selecting subcontractor vendors.
2. Construct the hierarchical structure model, meaning the goal, then criteria, sub-criteria, and vendor alternatives.
3. Criterion weighting, i.e., comparison of all possible pairs of criteria, assigning relative weight to every criterion.
4. Check for consistency in pairwise comparisons through consistency ratio (CR) validation.
5. Prioritize vendors - Rate vendors against each criterion on a scale from 1-10.
6. Calculate priority vectors and define the final weight for each vendor.
7. Vendors are ranked, and the vendor with the highest priority score is selected.

A structured interview, complemented by a questionnaire, was used for data collection against the four key elements in vendor selection:
1. Pricing
2. Service Quality
3. Timeliness of Installation
4. Support

The respondents are administered a questionnaire based on the criteria and sub-criteria established during the research. The respondents then provide answers to the questionnaire with guidance from the researcher, ensuring that no leading opinions influence their responses. The questionnaire is accessible through Google Sheets, which was prepared by the researcher and includes a scoring scale of 1 to 10 for each subcontractor company. This process ensures that the questionnaires distributed to respondents yield valid and reliable data. The data is then processed using the weights obtained from the Analytic Hierarchy Process (AHP). The outcome is a priority value assigned to each subcontractor, with the highest value indicating the most suitable subcontractor for the company to utilize. The outcome is a comprehensive ranking of vendors, aiding decision-makers in selecting the most suitable vendor on a rational, structured approach.

The AHP method aims to provide a foundation for the team to assess and select vendors in a more structured manner. Additionally, it offers a way for the company to evaluate vendors used in projects, enabling more competitive pricing and better service. The expected outcome of the AHP method is to provide weighted percentages of criteria and sub-criteria in vendor selection.

Results and Discussion

Results

The AHP analysis revealed Price criterion as the most influential criterion in PT. Visiniaga's vendor selection process, with a substantial weight of 58.5%. This pronounced emphasis likely reflects the highly competitive ICT system integration market in Surabaya, where offering cost-effective solutions is paramount for securing projects. It may also be indicative of the procurement drivers of PT. Visiniaga's

clientele, who often operate under strict budgetary constraints. This finding is consistent with numerous studies across various sectors where price frequently emerges as a key determinant in vendor selection (Deveci et al., 2020).

Supporting this observation, prior studies emphasize that in ICT project procurement, particularly in infrastructure-oriented services, decision-makers prioritize initial cost due to client cost sensitivity and minimal perceived differentiation in basic technical service levels (Ho et al., 2010; Weber et al., 1991). This aligns with perspectives in the supplier selection literature, where markets with low differentiation in core offerings tend to exhibit higher price sensitivity (Porter, 1985).. In the case of PT. Visiniaga, whose projects often involve structured cabling and integration tasks, vendors are expected to meet baseline specifications, shifting the strategic focus towards cost competitiveness.

However, this emphasis on Price criterion contrasts with some research in specialized ICT service procurement, where 'technical expertise' or 'innovation capacity' might receive greater weighting. The specific context of PT. Visiniaga, which focuses on infrastructure-oriented integration projects, may lead to a scenario where multiple vendors can meet baseline technical and quality requirements, thus elevating Price criterion as a more significant differentiator. This aligns with the perspective offered by (Saaty, 1993; Saaty, 2008), who noted that in markets with perceived low differentiation in core offerings, price sensitivity tends to increase.

While Service Quality, Timeliness of Installation, and Support criterion were recognized as critical, their comparatively lower weights suggest that these criteria act more as threshold qualifiers. Vendors are expected to meet minimum acceptable standards in these areas, with pricing emerging as the final selection lever. Practically, this underscores the importance for PT. Visiniaga to manage vendor pricing strategically without compromising baseline expectations for service and performance. Theoretically, the study extends current AHP literature by illustrating how economic pressures and market structure influence weighting preferences in vendor selection within Indonesia's ICT integration landscape.

Based on the data gathered from each questionnaire, it is found that Price criterion is the most crucial factor in determining which subcontractor is the most suitable for PT. Visiniaga. Table 1 presents an analytical breakdown of factors influencing the selection of subcontractor vendors, categorized into four main criteria: Price, Quality, Timeliness of Installation, and Support. Each criterion is assigned a Priority Vector indicating its relative importance, and each sub-factor within these criteria is assigned both a Priority Vector and a Global Priority Vector, reflecting its weight within its category and overall weight, respectively.

Price is the most significant criterion, comprising 58.50% of the overall decision-making process. Within this category, Competitive Pricing (38.49%) is the most critical sub-factor, highlighting the emphasis on obtaining the best possible prices from subcontractors. Payment Terms (16.50%) and Price Transparency (3.51%) are also important, though to a lesser extent. Service Quality is the second most important criterion, with a 14.70% weight in decision-making. Within this criterion, the Complaint Percentage (8.36%) is paramount, indicating the importance of minimizing complaints to ensure reliable performance. In contrast, Tidiness (3.48%), Consistency of Results (1.88%), and Experience (0.97%) are shown to be the least important factors.

Timeliness ranks third with a 20.30% influence on the overall decision. Installation Timeliness (9.48%) and Timeliness of Checklist and Handover (9.48%) are equally important, emphasizing the need for timely project completion and smooth transitions between subcontractors.

Table 1.
Priority Vector & Global Priority Vector of Criteria and Sub-Criteria

No.	Factors	Priority Vector	Global Priority Vector
1	Price	58.50%	
1.1	Competitive Pricing	65.80%	38.49%
1.2	Payment Terms	28.20%	16.50%
1.3	Price Transparency	6%	3.51%
2	Service Quality	14.70%	
2.1	Tidiness	23.70%	3.48%
2.2	Complaint Percentage	56.90%	8.36%
2.3	Consistency of Results	12.80%	1.88%
2.4	Experience	6.60%	0.97%
3	Timeliness of Installation	20.30%	
3.1	Proposal Timeliness	6.60%	1.34%
3.2	Installation Timeliness	46.70%	9.48%
3.3	Timeliness of Checklist and Handov	46.70%	9.48%
4	Support	6.50%	
4.1	Additional Work Assistance	42.90%	2.79%
4.2	Quick Response	42.90%	2.79%
4.3	Ease of Contact	14.20%	0.92%

Proposal Timeliness (1.34%) is less critical. Support, the least significant criterion, accounts for 6.50% of the decision-making process. Within this category, Additional Work Assistance (2.79%) and Quick Response (2.79%) are equally critical, highlighting the need to be responsive and willing to provide additional support when needed. Ease of Contact (0.92%) holds the least value.

Table 2 presents the eigenvalues, consistency index (CI), and consistency ratio (CR) for various factors influencing the selection of subcontractor vendors. They are categorized into four main criteria: Price, Service Quality, Timeliness of Installation, and Support. Price is calculated to have an eigenvalue of 0.961, Service Quality at 1.0789, Timeliness of Installation at 1.1821, and Support at 0.9134. The total CI for the main criteria combined is 0.0451, calculated to produce a CR of 0.05. As the CR is below 0.1, the weight given to each main criterion is deemed consistent.

In addition, Table 2 shows the Eigenvalue, CI, and CR of each sub-criteria in the criteria itself. Price is divided into Competitive Pricing with an eigenvalue of 0.9508, Payment Terms at 1.1746, and Price Transparency at 0.9569. The cumulative CI is 0.0412, which can be converted into a CR value of 0.071. Due to this reason, the weight of each sub-criteria is consistent. Criteria Service Quality is divided into Complaint Percentage with an eigenvalue of 1.107, Tidiness 0.9534, Consistency of Results 1.195, and Experience 0.9232. CI is processed to be 0.0595 and calculated into CR of 0.066.

Table 2.
Reliability Test

No.	Factors	Eigenvalue	CI	CR
1	Price	0.961	0.0451	0.05
1.1	Competitive Pricing	0.9508	0.0412	0.071
1.2	Payment Terms	1.1746		
1.3	Price Transparency	0.9569		
2	Quality	1.0789		
2.1	Tidiness	1.107	0.0595	0.066
2.2	Complaint Percentage	0.9534		
2.3	Consistency of Results	1.195		
2.4	Experience	0.9232		
3	Timeliness of Installation	1.1821		
3.1	Proposal Timeliness	1	0	0
3.2	Installation Timeliness	1		
3.3	Timeliness of Checklist and Handover	1		
4	Support	0.9134		
4.1	Additional Work Assistance	1	0	0
4.2	Quick Response	1		
4.3	Ease of Contact	1		

Table 3.
Subcontractor Overall Score

No.	Subcontractor	Score
1	CV Jaringan OmniLogika	27.50%
2	PT Integrasi JaringanAlpha	52.90%
3	UD Dinamika IntiSiber	60.10%
4	CV Solusi InfoSfera	54.90%
5	CV Rothshap	56.80%
6	PT Soonitech Nusantara	50.90%
7	UD Teknologi Kembang Pesat	60.30%
8	UD Teknologi Cakra Nusantara	61.80%
9	PT Jaringan Integrasi Globalindo	62.70%

As the CR is below 0.1 it passes as a consistent value. Timeliness is broken down into Installation Timeliness, Timeliness of Checklist, and Handover and Proposal Timeliness, with every sub-criterion having an eigenvalue of 1. As the eigenvalue is 1, the CI & CR is calculated to be 0 and is determined to be consistent. Support, the least significant criterion of the decision-making process, is divided into Additional Work Assistance, Quick Response, and Ease of Contact. Similarly, every sub-criterion here has an eigenvalue of 1. CR & CR is calculated to be 0 and proven consistent. With each sub-criteria considered, it is now possible to score the subcontractor surveyed by asking the respondents to complete questionnaires. Table 3 presents the total score that every subcontractor earned from the aggregated questionnaire. It can be seen that PT Jaringan Integrasi Globalindo achieved the highest score (62.70%), followed by UD Teknologi Cakra Nusantara (61.80%) and UD Teknologi Kembang Pesat (60.30%). The data presented indicates that the three vendors are the best subcontractors to choose from in the selection process.

Discussion

This research does not merely replicate the traditional AHP framework but adapts it to address the real-world constraints and strategic procurement needs of a medium-sized system integrator operating in a rapidly evolving technological and economic landscape.

The contribution of this study is twofold. First, it introduces a practically viable AHP implementation model that distinguishes between strategic and operational decision roles. The criteria weighting—a process requiring deeper strategic insight and consistency checks—was conducted solely by the company's Owner and Director. This ensures alignment with the organization's long-term objectives. Meanwhile, the vendor performance evaluation, typically more data-intensive and operational in nature, was conducted by seven managerial staff members using a direct 1–10 rating scale.

This method is justified on the basis of efficiency, reduced cognitive bias, and alignment with AHP's flexibility for real-world decision environments, as acknowledged by Nydick and Hill (1992).

Second, this research contributes to the growing body of literature on decision support systems in emerging economies by presenting an AHP-based vendor evaluation framework that is scalable, replicable, and adaptable. The model facilitates objectivity, transparency, and traceability in vendor selection—qualities that are critical in an industry where project delays, cost overruns, and service failures are common. The model also supports the development of a structured vendor database, allowing PT. Visiniaga to continuously refine its procurement practices and build strategic vendor partnerships over time.

Therefore, the value of this study lies not in the novelty of the AHP method itself, but in its customized integration into an organizational decision-making process that reflects both theoretical rigor and practical constraints, offering actionable insights and a scalable framework for other ICT firms facing similar operational challenges

Research findings indicate that price considerations dominate the selection process for subcontractor vendors, with competitive pricing being the most crucial factor. This emphasis suggests a strong focus on cost efficiency. However, Timeliness of Installation and Service Quality are also significant, reflecting the need for reliable and timely delivery of services. Although the least weighted, Support still plays a role, particularly in the responsiveness and additional assistance subcontractors provide.

Overall, the decision-making model prioritizes cost efficiency while balancing it with the necessity for quality, timely execution, and supportive collaboration from subcontractor vendors. This approach ensures a comprehensive evaluation of potential subcontractors, considering financial and operational performance metrics.

The breakdown provides a structured framework for understanding the critical criteria influencing vendor selection. By clearly outlining the factors and their respective weights, decision-makers can make informed choices based on a comprehensive system. It also highlights the relative importance of different criteria, such as price, quality, timeliness of installation, and support. The process identifies specific sub-factors within each criterion and assigns weights to each. This allows decision-makers to identify which aspects within each category are most crucial for successful vendor selection.

Understanding the relative importance of each criterion and sub-factor enables decision-makers to allocate resources more effectively. For example, if price is determined to be the most critical factor, efforts can be directed toward negotiating competitive pricing with subcontractor vendors. By considering factors such as quality and timeliness of installation alongside price, the process helps mitigate risks associated with selecting subcontractor vendors. Prioritizing Service Quality and Timeliness of Installation reduces the likelihood of disruptions or issues during project execution.

This process suggests choosing a subcontractor with the highest suitability score is the most appropriate decision because the subcontractor will perform well with the best price or offer the best quality of work that offsets the price they ask for. The company can also alternate between subcontractors depending on the customer's priorities in their project.

It is crucial to tailor the criteria and sub-criteria to meet the specific requirements of the company, customer, and project. For the company, considering financial viability, strategic alignment, resource utilization, risk management, and sustainability are paramount. Addressing customer needs entails evaluating aspects such as product quality, customer satisfaction, value proposition, timeliness, and innovation.

Meanwhile, defining the scope, managing costs, ensuring effective communication, maintaining quality standards, and adhering to deadlines are vital for the project. By expanding and customizing these criteria and sub-criteria, decision-makers can conduct a comprehensive evaluation that accounts for all stakeholders' needs and ensures the successful execution of the project.

Study Limitations

In order to be more focused, the following limitations are taken:

1. Designing models and prototypes for vendor selection systems based on the Analytical Hierarchy Process method.
2. The vendor selection evaluation system is used internally by PT. Visiniaga to increase competitiveness and cost efficiency.

Conclusion

The criteria set for selecting the best vendor for PT. Visiniaga includes Price, Service Quality, Timeliness of Installation, and Support. Price is the most crucial criterion, weighing 58.5%, followed by Timeliness of Installation at 20.3%, Service Quality at 14.7%, and Support at 6.5%. These criteria are further divided into sub-criteria for a more detailed vendor selection process. Price is divided into Competitive Pricing (38.5%), Payment Terms (28.2%), and Price Transparency (6%). Service Quality includes Tidiness (3.5%), Complaint Percentage (8.4%), Consistency of Results (1.8%), and Experience (1%). Timeliness of Installation is divided into Proposal Timeliness (1.3%), Installation Timeliness & Speed of Checklist and Handover, each weighing 9.5%. Support includes Additional Work Assistance (0.9%), Quick Response & Ease of Contact, each with 2.8%. The consistency of these criteria and sub-criteria have been tested and proven reliable with a CR<0.01. Based on the final weights, the top vendor for PT Visiniaga will be PT Jaringan Integrasi Globalindo, with the highest score of 62.7%, followed by UD Teknologi Cakra Nusantara at 61.8% and UD

Teknologi Kembang Pesat at 60.3%. However, considering price alone, UD Teknologi Cakra Nusantara and UD Teknologi Kembang Pesat outperform PT Jaringan Integrasi Globalindo, so all three alternatives should be carefully considered.

The contributions of this research extend beyond its immediate application at PT. Visiniaga, offering substantial practical insights and an adaptable methodological framework for other Information and Communication Technology (ICT) system integration firms, notably Small and Medium-sized Enterprises (SMEs) contending with competitive market pressures. The Analytic Hierarchy Process (AHP) model, as delineated in this study, furnishes a structured, transparent, and objective approach that can be assimilated by such organizations to transition from predominantly subjective or inconsistent vendor selection paradigms. Through the systematic identification and weighting of critical performance criteria—identified herein as Price, Service Quality, Timeliness of Installation, and Support & Services—other system integrators may enhance their decision-making capabilities, potentially achieving optimized procurement costs, mitigated project risks, and improved vendor performance outcomes.

The significant weighting assigned to 'Price' within this specific case study presents a salient consideration for peer organizations, prompting a strategic calibration between cost-efficiency imperatives and the requisite thresholds for quality and service pertinent to their distinct operational contexts and client expectations. Consequently, the adoption of a systematic evaluation methodology of this nature possesses the capacity to empower analogous ICT enterprises to elevate project success rates, fortify supplier collaborations, and enhance their competitive posture within the dynamic marketplace.

The recommendations from this research are as follows:

Recommendations For The Company

1. Use this study to understand the vendor selection process. Prioritize PT Jaringan Integrasi Globalindo as the leading vendor, followed by UD Teknologi Cakra Nusantara and UD Teknologi Kembang Pesat.
2. Price should be considered to enhance profit margins and ensure Service Quality and Timeliness of Installation. Choose vendors that meet all three criteria, not just one or two.
3. Consider adding more vendors to increase project options and include them in a qualification database for future collaborations.
4. Companies in similar fields can adjust the criteria and sub-criteria from this study to fit their specific needs, as the research is reflective.

Recommendations For Future Researchers

1. Future studies should include more criteria and sub-criteria to allow for more specific weight distribution.
2. Increase the number of relevant respondents to enhance data accuracy. Ensure respondents are directly related to the research topic to maintain data relevance.
3. While this study processed nine vendors using the AHP method, this methodology can handle more vendors as needed. The same applies to criteria and sub-criteria.

Declaration

Author Contribution

All authors contributed equally as the main contributors of this paper. All authors read and approved the final paper.

Funding Statement

This research received no specific grant from any funding agency in the public. commercial, or not-for-profit sectors.

Competing Interest

The authors declare that they have no conflicts of interest to report regarding the present study.

References

Asubonteng, P., McCleary, K. J., & Swan, J. E. (1996). SERVQUAL revisited: a critical review of service quality. *Journal of Services Marketing*, 10(6), 62–81.

Avila, J. A., Gonzalez, R. P., & Ramirez, A. C. (2012). AHP-based decision support system for supplier selection. *International Journal of Production Research,* 50(14), 4041–4052.

Baily, P., Farmer, D., Crocker, B., Jessop, D., & Jones, D. (2004). *Procurement principles and management (9th ed.)*. Pearson Education.

Beil, D. R. (2010). *Supplier selection. Michigan Ross School of Business Working Paper* Series.

Choi, T. Y., & Hartley, J. L. (1996). An exploration of supplier selection practices across the supply chain. J*ournal of Operations Management,* 14(4), 333–343.

Chopra, S., & Meindl, P. (2007). *Supply chain management: Strategy, planning, and operation*. Pearson Education.

Dagdeviren, M., & Eraslan, E. (2008). Supplier selection using analytic hierarchy process and fuzzy logic. *International Journal of Business and Management,* 3(9), 144–155.

Deveci, M., Canitez, F., & Gökaşar, I. (2020). A fuzzy multi-criteria decision-making approach for supplier selection in service systems. *Expert Systems with Applications,* 150, 113281.

Dickson, G. W. (1996). An analysis of vendor selection systems and decisions. *Journal of Purchasing,* 2(1), 5–17.

Ellram, L. M., Tate, W. L., & Billington, C. (2007). Services supply management: The next frontier for improved organizational performance. *California Management Review,* 49(4), 44–66.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. American *Journal of Theoretical and Applied Statistics,* 5(1), 1–4.

Fishburn, P. C. (1967). Additive utilities with incomplete product sets: Applications to priorities and assignments. *Operations Research*, 15(3), 537–542.

Gorry, G. A., & Scott Morton, M. S. (1971). A framework for management information systems. *Sloan Management Review,* 13(1), 55–70.

Haksever, C., & Moussourakis, J. (2008). A model for evaluating service projects. *The Journal of Business and Industrial Marketing*, 23(4), 242–251.

Ho, W., Xu, X., & Dey, P. K. (2010). Multi-criteria decision making approaches for supplier evaluation and selection: A literature review. *European Journal of Operational Research,* 202(1), 16–24.

Hwang, C. L., & Yoon, K. (1981). *Multiple attribute decision making: Methods and applications*. Springer-Verlag.

Javed, M. Y., Majeed, A., & Qureshi, M. A. (2018). Role of IoT in data communication. *International Journal of Advanced Computer Science and Applications,* 9(3), 213–219.

Kotler, P. (2009). *Marketing management (13th ed.)*. Prentice Hall.

Koot, M., & Wijnhoven, F. (2021). Usage impact on the value of information systems: A data infrastructure perspective. *Information and Management*, 58(3), 103445.

Krause, D. R., Pagell, M., & Curkovic, S. (2001). Toward a measure of competitive priorities for purchasing. *Journal of Operations Management,* 19(4), 497–512.

Lysons, K., & Farrington, B. (2020). *Procurement and supply chain management (10th ed.)*. Pearson.

Nydick, R. L., & Hill, R. P. (1992). Using the analytic hierarchy process to structure the supplier selection procedure. *International Journal of Purchasing and Materials Management*, 28(2), 31–36.

OECD. (2019). *Going digital: Shaping policies, improving lives*. OECD Publishing.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing,* 49(4), 41–50.

Rani, P., Bhakar, S. S., & Sharma, R. (2021). Green supplier selection using hybrid fuzzy AHP–TOPSIS technique. *Journal of Cleaner Production,* 280, 124530.

Saaty, T. L. (1993). *Decision making for leaders: The analytic hierarchy process for decisions in a complex world*. RWS Publications.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences,* 1(1), 83–98.

Surjasa, D., et al. (2006). Supplier performance evaluation using multi-criteria. *Jurnal Teknik Industri,* 8(1), 1–10.

Taherdoost, H., & Brard, A. (2019). Analyzing the process of supplier selection criteria and methods. *Procedia Manufacturing, 32,* 1024–1034.

Tavana, M., Soltanifar, M., & Santos-Arteaga, F. J. (2021). An integrated and comprehensive fuzzy multicriteria model for supplier selection in digital supply chains. *Sustainable Operations and Computers*, 2, 12–25.

Triantaphyllou, E. (2000). *Multi-criteria decision making methods: A comparative study*. Springer.

Weber, C. A., Current, J. R., & Benton, W. C. (1991). Vendor selection criteria and methods. *European Journal of Operational Research*, 50(1), 2–18.