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Enhancing ASEAN Competitiveness in Indonesia's Halal F&B Industry: Comparative AHP-ANP Analysis of SMEs and Large Enterprises

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ABSTRACT

This research explores the distinctions in strategic competitiveness between large enterprises and small and medium-sized enterprises (SMEs) within Indonesia's halal food and beverage sector, specifically in the context of the ASEAN market, through a comparative Analytical Hierarchy Process–Analytical Network Process (AHP–ANP) methodology. Although Indonesia possesses significant demographic advantages, its participation in global halal exports remains relatively modest. The analysis reveals that SMEs regard regulatory adherence as the most crucial element of competitiveness, highlighting the necessity for more streamlined certification and regulatory frameworks. In contrast, large enterprises concentrate on market expansion, focusing on understanding consumer preferences, differentiating halal offerings, and ensuring alignment with global benchmarks. Both SMEs and larger firms acknowledge the importance of product innovation and supply chain efficiency in enhancing competitive capabilities. Technological advancements, including blockchain-based traceability and digital marketing tools, are gaining prominence across the sector; however, their implementation is notably more advanced among large enterprises. The findings indicate that policy interventions should aim to simplify halal certification processes and encourage technology adoption among SMEs, whereas larger firms should prioritise branding strategies and international market penetration. By systematically ranking strategic priorities, this study contributes to the existing body of knowledge on halal industry competitiveness and offers differentiated policy and managerial recommendations based on enterprise scale. Prospective studies are encouraged to build upon this framework through longitudinal and multi-country investigations.

1. Introduction

The global halal industry has evolved into a major economic sector encompassing food and beverage, cosmetics, pharmaceuticals, tourism, and finance. Its expansion is fuelled by the growing global Muslim population, alongside increasing demand from non-Muslim consumers for products aligned with hygienic, high-quality, and ethically sound production standards. Estimates by Azam and

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Abdullah [7] and DinarStandard & Thomson Reuters [43] placed the industry's value at approximately USD 1.4 trillion in 2017, with projections indicating an increase to USD 2.6 trillion by 2024. Technological advancements, particularly blockchain and e-commerce, have significantly enhanced transparency and trust throughout halal supply chains [30; 35]. Nonetheless, the sector remains subject to complex regulatory and certification requirements, which necessitate strict compliance with halal and thayyib standards to safeguard product integrity and ensure international market access [10; 14].

Against this backdrop, Indonesia, which hosts a Muslim population of approximately 231 million—equivalent to 87.2% of its total population [42]—holds considerable potential to assume a leading role in the halal economy. Despite this demographic advantage, the country's share in global halal exports is limited to just 3.4% [41]. Domestic consumption patterns further reinforce the importance of halal certification, with studies showing that more than 85% of consumers in Indonesia prioritise halal credentials when selecting meat products [6]. Structurally, the national economy is largely driven by SMEs, which represent 99.99% of all business entities and provide employment for 97% of the workforce [41]. However, despite their centrality, SMEs face considerable challenges in obtaining halal certification. These include financial constraints, limited technical expertise, and underutilisation of Islamic financial instruments [14; 36].

In contrast, countries such as Malaysia and Thailand have achieved greater success in establishing competitive halal sectors at the regional level, owing to the implementation of standardised certification regimes and technological integration [17]. Indonesia, by comparison, has struggled with fragmented policy implementation and inconsistent technological adoption strategies [18; 32]. Although some initiatives have introduced blockchain-based platforms to enhance product traceability [39], these efforts have not been systematically incorporated into national development frameworks [15]. Moreover, prior research often isolates specific issues, such as halal certification or consumer preferences, rather than examining the interconnections among regulatory, market, and technological dimensions within an integrated competitiveness model [2; 14].

A closer examination of the halal food and beverage (F&B) sector further reveals its inherent complexity. Major product categories include halal-certified meat, poultry, and seafood, collectively accounting for over half of the global halal food market. Additional categories span dairy products, grains, bakery and confectionery goods, halal-compliant beverages, fresh produce, and halal supplements. This broad sectoral composition involves enterprises of varying sizes, from micro and small businesses to international conglomerates.

Despite the strategic relevance of this sector, existing literature exhibits several methodological gaps. A predominant reliance on qualitative or case-specific studies has hindered the development of structured, quantitative models such as the Analytic Hierarchy Process (AHP) and the Analytic Network Process (ANP) [2; 38]. As a result, there remains limited prioritization of competitiveness determinants, and insufficient exploration of how regulatory frameworks, market conditions, and technological advancements interact. Although comparative analyses acknowledge Indonesia's relative underperformance within the region [17], they rarely offer comprehensive strategies to address these shortcomings. In addition, while discussions around technological tools like blockchain emphasize their role in improving transparency, their integration into broader national halal strategies is often lacking [15; 39].

To bridge these research gaps, this study proposes a structured evaluation of competitiveness within Indonesia's halal F&B sector using an integrated AHP–ANP framework. The study aims first to assess and map the current state of competitiveness among Indonesian halal F&B firms, highlighting variations between SMEs and large enterprises. Secondly, it seeks to develop strategic recommendations tailored to the unique capacities and challenges of businesses across different scales. The AHP technique is employed to structure and prioritise competitiveness factors hierarchically, while

ANP is used to identify the interdependencies among these factors, thereby providing a comprehensive and dynamic assessment.

Although AHP and ANP have previously been utilized in halal industry research, their application in systematically modelling competitiveness within Indonesia's halal F&B context remains limited. Notably, few comparative studies have explored the differentiated strategic imperatives of SMEs and large enterprises within an integrated regulatory, market, and technological framework. By combining qualitative thematic insights with quantitative prioritization, this study establishes a robust, data-driven model designed to enhance the competitiveness of enterprises of all sizes and to support Indonesia's advancement within the ASEAN halal economic landscape.

The research is driven by the following central question: What are the principal strategic competitiveness factors that distinguish SMEs from large enterprises in Indonesia's halal F&B sector, and how can these insights be leveraged to formulate targeted enterprise and policy-level interventions?

To address this inquiry, the study pursues three core objectives: (1) to identify and rank the primary competitiveness factors shaping Indonesia's halal F&B sector, (2) to compare strategic priorities between SMEs and large enterprises operating within the industry, and (3) to develop practical recommendations aimed at improving competitiveness at both the firm and policy levels. This is accomplished through an integrated methodological design, applying AHP to define the hierarchical structure of competitiveness factors and ANP to analyze the interrelations among these elements. This dual-method approach offers a comprehensive and nuanced understanding of competitiveness across enterprise scales.

2. Literature Review

2.1 Challenges and Opportunities in Indonesia's Halal F&B Competitiveness

Indonesia's halal F&B industry demonstrates considerable promise, largely due to its substantial Muslim demographic and the growing awareness of halal standards among consumers. With Muslims comprising 87.2 percent of the national population [42], the country benefits from a strong domestic market foundation. Despite this, Indonesia accounts for only 3.4 percent of global halal exports [41]. A primary hindrance to enhanced export performance lies in the fragmented regulatory framework and the intricate nature of the certification process. The absence of standardized guidelines, the presence of overlapping institutional mandates, and the limited accessibility of certification services continue to restrict broader market participation, particularly for SMEs [14; 39].

While larger enterprises generally possess the capacity to comply with prevailing halal regulations, SMEs frequently encounter barriers stemming from inadequate financial resources, insufficient technological infrastructure, and limited operational capabilities. These constraints collectively reduce their competitiveness within the sector [5; 18]. Although the domestic market remains promising—given the country's substantial Muslim population base [42]—the broader expansion of Indonesia's halal F&B industry on the international stage is impeded by regulatory inconsistencies and the challenges associated with certification. The lack of harmonised standards, the multiplicity of institutional functions, and the procedural burden of certification remain persistent obstacles for both SMEs and, to a lesser extent, large enterprises [14; 39]. While larger firms are generally better positioned to comply with current halal standards, SMEs continue to struggle due to limited financial access, underdeveloped technological capabilities, and operational inefficiencies, thereby constraining their ability to compete effectively [5; 18].

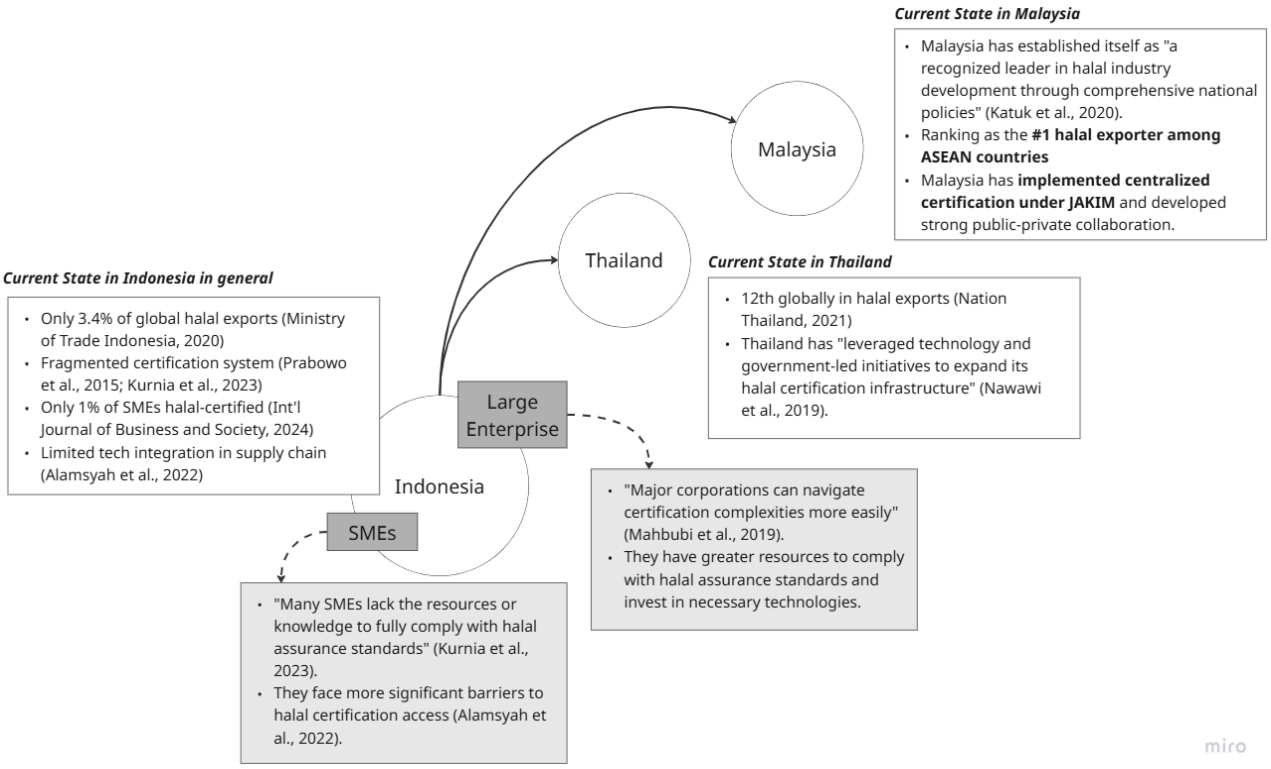

Fig.1: Competitive Positioning of Halal Industry in ASEAN Countries (Author Analysis)

Alongside regulatory developments, the integration of technology represents both a pressing concern and a vital opportunity for the halal F&B sector. Technologies such as blockchain-enabled traceability systems have the potential to significantly enhance supply chain transparency and reinforce consumer trust. However, their implementation within Indonesia's halal F&B industry remains uneven [39]. A large proportion of SMEs lack the financial means and digital readiness to adopt and manage these advanced supply chain technologies. Strengthening the digital preparedness of SMEs and ensuring that their supply chains are interoperable with the broader regional halal ecosystem could substantially improve their competitive standing. Achieving this requires a combination of coherent regulatory reforms, improved collaboration among institutional stakeholders, and targeted technological support. Furthermore, for Indonesia to play a more prominent role in the ASEAN halal economy, it is essential to accelerate regional integration efforts. This involves harmonizing cross-border regulatory policies and building the specific capabilities of SMEs, thereby positioning the halal F&B industry for enhanced regional and global competitiveness.

2.2 Multi-Criteria Methods

Multi-criteria decision-making (MCDM) approaches provide structured frameworks for evaluating complex decision contexts involving numerous interrelated elements. Among these, AHP and ANP are particularly effective for analyzing strategic competitiveness, as they facilitate the prioritization of key factors while accounting for the interdependencies that exist among them. These methods have been applied in studies focusing on halal supply chains and competitiveness [4]. Beyond the halal industry, ANP has demonstrated broad applicability in a range of policy domains, including energy planning [19], educational strategy formulation [16], urban and regional planning [29], supply chain agility [21], and risk management.

In alignment with the study's objectives, AHP is employed to construct a hierarchical ranking of essential competitiveness factors, while ANP enhances the evaluation by capturing the interconnections among regulatory, market, and technological elements. This combined methodology

enables a thorough and adaptive assessment of competitiveness for both SMEs and large enterprises within Indonesia's halal F&B industry. A comparative overview of selected MCDM techniques is presented in Appendix A to ensure methodological transparency.

Table 1
AHP and ANP in the Research Context

Aspect	AHP	ANP
Role in Decision Process	Provides initial prioritization by structuring criteria hierarchically.	Refines the analysis by considering interdependencies among criteria.
Strength	Simplifies complex problems into a clear, structured hierarchy.	Captures feedback and dynamic relationships for a more realistic model.
Limitation	Ignores mutual influences among factors.	More complex modelling requiring expertise and detailed data.
How They Complement Each Other	AHP helps define and prioritize main factors; serves as a foundation for ANP modelling.	ANP builds on AHP results to model complex interrelations, leading to more robust insights.

2.3 Porter's Frameworks for Competitive Analysis

Porter's Diamond Model and Five Forces framework provide valuable perspectives for a structural analysis of competitiveness in Indonesia's halal F&B industry can be effectively interpreted through the application of strategic frameworks. The Diamond Model points to robust domestic demand, largely attributed to the country's substantial Muslim population. However, it also reveals structural deficiencies in key supporting sectors, including halal logistics and innovation infrastructure [23].

Porter's Five Forces framework further illuminates critical market dynamics. Intensifying competition is compelling firms to improve operational efficiency, invest in brand development, and adopt digital technologies to maintain their market positions [24]. Supplier power remains constrained due to stringent halal compliance requirements, necessitating the development of resilient and halal-compliant supply chains [35]. Simultaneously, consumer bargaining power is rising, as buyers increasingly demand greater transparency and stronger assurance mechanisms [40]. While the threat of product substitutes currently remains low, emerging dietary trends, such as increased interest in plant-based alternatives, could influence future market behaviour [34].

Taken together, these strategic frameworks underscore the urgency of strengthening institutional support, fostering innovation, and fully leveraging the potential of SMEs. Addressing these areas is essential for enhancing the competitiveness of Indonesia's halal F&B sector in the domestic market.

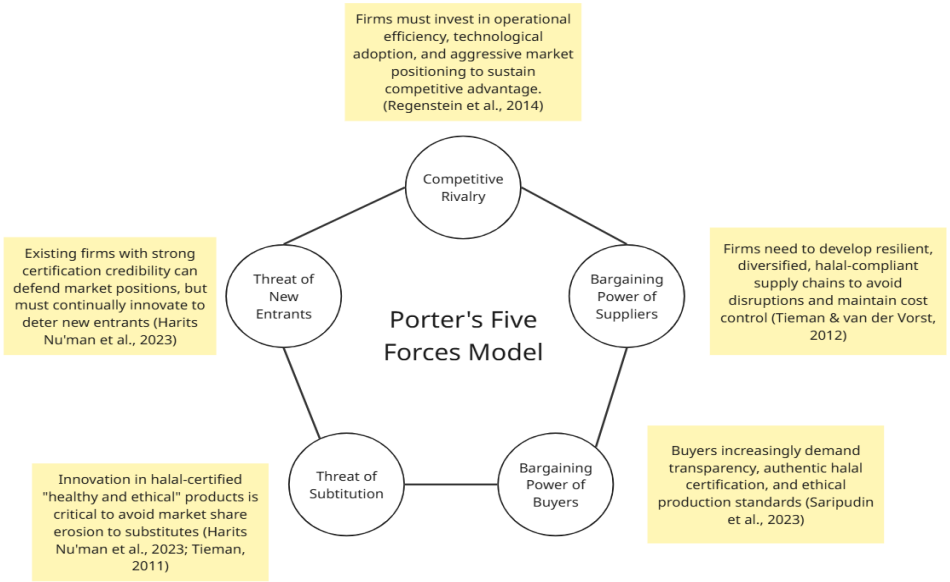

Fig.2: Porter's Diamond in Halal in F&B Industries (Author Analysis)

3. Methodology

This study adopts an MCDM framework that sequentially applies AHP followed by ANP to rank the competitiveness factors relevant to Indonesia's halal F&B industry within the ASEAN market. The identification of evaluation criteria is guided by an extensive review of existing literature and expert consultation, enabling comprehensive coverage of potential factors [26; 31].

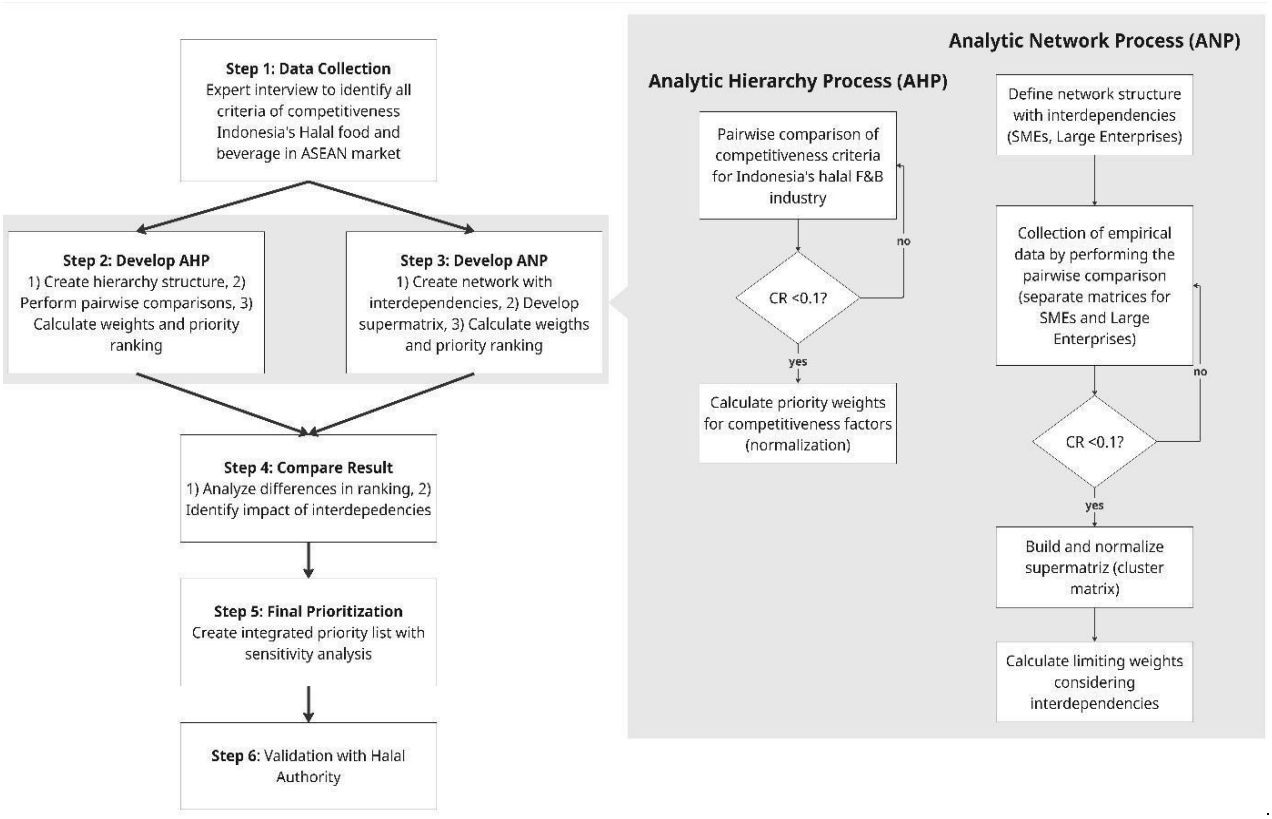

Fig.3: Research Design

AHP is selected for its effectiveness in decomposing complex decision problems into a hierarchical structure and producing prioritized rankings through pairwise comparisons [26]. However, since many competitiveness factors are interdependent rather than isolated, ANP is integrated to model these relationships more accurately and to provide a refined assessment framework [16; 29]. Comparing the results derived from AHP and ANP facilitates a deeper understanding of how interdependencies influence prioritization outcomes, thereby enhancing the robustness of strategic insights. Finally, a systematic sensitivity analysis is conducted to validate the prioritization outputs, ensuring that the resulting recommendations target areas supported by the strongest data and minimal decision bias.

3.1 Research Design

AHP is a structured MCDM approach developed by Saaty [26] to simplify complex decision-making challenges by organizing them into a hierarchical structure of objectives, criteria, and alternatives. Using a nine-point scale that encompasses both qualitative and quantitative judgements, AHP enables decision-makers to assign priorities based on expert evaluations and empirical insights [44; 48]. Judgement aggregation is performed through the geometric mean, and the reliability of comparisons is verified using a consistency ratio (CR), with an acceptable threshold set at 0.1 [26]. The central purpose of AHP lies in its capacity to transform intricate decision issues into manageable components, facilitating logical and objective prioritization.

Building upon this, ANP expands the capabilities of AHP by capturing the interdependencies and feedback loops among elements within a decision system, thereby representing them in a network structure. This method considers both inter- and intra-criterion relationships, necessitating the construction of a supermatrix to determine final priority weights [21; 27]. The identification of interdependencies among criterion groups was informed by literature synthesis and validated through semi-structured interviews with industry experts, who refined the dependency structure to ensure it accurately reflected real-world industry dynamics. Figure 3 visually depicts the resulting network of interrelationships. Pairwise comparison matrices were developed separately for SMEs and large enterprises, allowing the model to accommodate divergent strategic orientations and operational characteristics based on enterprise size.

This network-based modelling approach was further adapted by tailoring the pairwise comparison process to reflect the distinct strategic priorities and resource capacities of SMEs and large enterprises. Following the construction of the model, a weighted limit supermatrix was created using Super Decisions software. The software also normalized the supermatrix in each iteration, maintaining column stochasticity, while convergence was evaluated by monitoring the stability of priority vectors across iterations, according to diagnostic standards outlined for convergence [27].

Internal validity was confirmed through the calculation of consistency ratios to assess the coherence of expert judgements. Sensitivity analysis was conducted using Monte Carlo simulation to evaluate the resilience of ANP results under varying input conditions. To enhance external validity, consultations were undertaken with representatives from Indonesia's halal certification authority. These discussions ensured that the model aligned with current regulatory frameworks and improved the contextual relevance of the findings [11]. Additionally, expert input was sought to validate the interdependency structure of the ANP model, ensuring its consistency with both regulatory priorities and industry practices.

3.2 Data Collection

The qualitative data used in this study were derived from interviews with a total of twenty-two participants, comprising representatives from both large-scale enterprises and SMEs operating within Indonesia's halal F&B sector. These interviews aimed to explore competitiveness in relation to halal-certified ingredients. The large enterprise group consisted of seven senior executives from leading national and multinational firms headquartered in Jakarta, covering product categories such as instant food, dairy, beverages, snacks, and cosmetics. In parallel, the SME group included fifteen respondents from various regions, including Jakarta, Bandung, Yogyakarta, Surabaya, Medan, Makassar, and other major urban centers. This group represented a diverse range of halal F&B offerings, such as traditional snacks, bakery goods, herbal beverages, processed meat products, and milk substitutes.

A purposive sampling strategy was employed to capture a representative variation in production capacity, product diversity, and national market reach within the halal sector. This approach aligns with qualitative research conventions that prioritise the relevance and richness of data over random selection [12]. Appendix B presents a detailed profile of the interviewees, classified by business cluster, organizational role, product category, geographic location, production volume, and market share.

To enhance the validity and reliability of the findings, a consensus validation phase was conducted upon the completion of data collection. This process involved collaboration with officials from Indonesia's halal certification authority to confirm the accuracy and regulatory relevance of the identified criteria and sub-criteria. The purpose of this step was to ensure that the thematic insights were in full alignment with existing halal regulatory frameworks, industry norms, and strategic objectives. Consultation with the certification body also served as a triangulation measure, reinforcing the credibility of the qualitative analysis by reducing researcher bias and improving the generalisability

of the results. This practice reflects established qualitative research standards that emphasize stakeholder validation and methodological robustness [11].

4. Results

4.1 Model Development

4.1.1 Criteria and Sub-Criteria Hierarchy

The selection of criteria and sub-criteria in this study was derived through a structured qualitative process, specifically using thematic analysis of interview data collected from key stakeholders within Indonesia's halal F&B industry, encompassing both large enterprises and SMEs. Employing an inductive approach, the interview analysis led to the identification of six primary dimensions: regulatory frameworks, market development, product innovation, supply chain optimization, stakeholder engagement, and technology infrastructure. Each primary criterion was further divided into sub-criteria, which were informed by strategic concerns and recurring themes articulated by participants. Representative statements were utilized to elaborate and validate the emergence of each sub-criterion. Table 2 outlines the hierarchical structure of these elements, providing definitions, the number of participants referring to each item, exemplary quotations, and the frequency of mention across the interview dataset. This systematic construction aims to bridge the gap between theoretical prioritization frameworks and the practical challenges and expectations identified by industry practitioners.

The criteria and sub-criteria were developed based on a comprehensive thematic interpretation of the interview data. As summarized in Table 2, six overarching categories were distilled: Regulatory Framework and Compliance, Market Development, Product Innovation and Quality, Supply Chain Optimization, Stakeholder Engagement, and Technology and Infrastructure [1; 38]. These categories were subsequently refined into more specific sub-criteria, each substantiated by participant observations, illustrative excerpts, and occurrence frequencies to ensure both conceptual soundness and empirical relevance. The hierarchical structure reflects the multidimensional nature of competitiveness in the halal sector, integrating regulatory, market, innovation, operational, collaborative, and technological considerations. The interrelationships between criteria and sub-criteria were then mapped using AHP, as illustrated in Figure 4, which demonstrates the interconnected strategic factors influencing Indonesia's competitiveness in the ASEAN halal market [16].

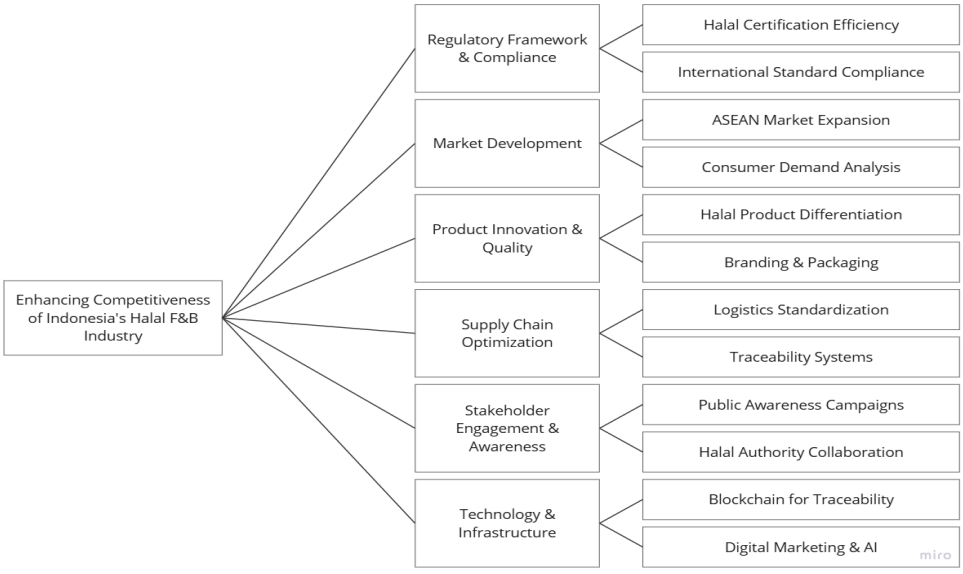

Fig.4. AHP Model with Relevant Categories

Table 2

Criteria and Sub-criteria Hierarchy

Criteria	Sub Criteria	Definition	Participants	Quotation	Occurrence
Regulatory Framework & Compliance (C1)	Certification Efficiency (C1.1)	Processing Time and Cost Optimization; Digital Certification Implementation	8	"Fast certification will open more export opportunities." (Company A) / "Shorter certification times increase SME competitiveness." (Company C)	17
	Standards Harmonization (C1.2)	ASEAN Standards Alignment; International Standards Compliance	6	"Standardizing ASEAN halal rules is crucial for regional trade." (Company D) / "Lack of harmonized standards complicates exports." (Company B)	14
	Regulatory Governance (C1.3)	Enforcement Effectiveness; Institutional Capacity	7	Strong governance ensures certification credibility." (Company E) / "Weak enforcement damages halal trust." (Company G)	13
Market Development (C2)	Consumer Outreach (C2.1)	Domestic Market Penetration; International Market Access	9	"Indonesian halal products must expand into global markets." (SME C) / "Without global branding, halal products remain local." (SME D)	18
	Branding Strategy (C2.2)	Nation Branding Initiatives; Product Differentiation	7	"We need strong national branding to boost halal reputation." (SME F) / "Branding halal products will open premium markets." (SME H)	15
	Export Facilitation (C2.3)	Market Entry Programs; Trade Agreement Utilization	6	“Export facilitation is key to halal SMEs competing internationally." (SME B) / "Support for trade agreements can boost halal exports." (SME I)	14
Product Innovation & Quality (C3)	Product Development (C3.1)	R&D Capabilities; New Product Introduction Rate	8	"Continuous R&D drives halal innovation leadership." (Academic Expert E)	16
	Quality Assurance (C3.2)	Certification Standards; Quality Control Systems	6	"Halal quality must meet both religious and global standards." (Halal Auditor B)	13
	Value Addition (C3.3)	Premium Product Development; Functional Benefits Enhancement	5	"Adding functional benefits can enhance halal product appeal." (SME M) / "Functional foods offer new halal market segments." (SME O)	12
Supply Chain Optimization (C4)	Logistics Management (C4.1)	Halal-Dedicated Transport; Contamination Prevention Systems	7	"Dedicated halal logistics minimizes contamination risks." (SME J) / "Halal logistics infrastructure needs urgent investment." (SME L)	15
	Traceability Implementation (C4.2)	Blockchain Integration; Supply Chain Transparency	8	"Blockchain can assure halal integrity end-to-end." (Company F) / "Traceability strengthens consumer halal confidence." (SME K)	16
	Supplier Network (C4.3)	Certified Supplier Availability; Supply Chain Integration Level	6	"Reliable certified suppliers strengthen halal supply chains." (Company G) / "Limited certified suppliers create bottlenecks." (SME A)	13
Stakeholder Engagement (C5)	Industry Collaboration (C5.1)	Inter-Firm Cooperation; Industry Association Strength	7	"Industry partnerships accelerate halal sector competitiveness." (Company C) / "Collaborative ecosystems benefit halal SMEs." (SME N)	12
	Government Support (C5.2)	Policy Alignment; Incentive Programs	6	"Government incentives can stimulate halal SME growth." (SME G) / "Aligned	13

Criteria	Sub Criteria	Definition	Participants	Quotation	Occurrence
				policies can fast-track halal sector development." (SME D)	
	Religious Authority Involvement (C5.3)	Scholar Consultation Mechanisms; Certification Body Credibility	5	"Religious scholars safeguard halal integrity at the core." (Company E) / "Involving ulama ensures halal certification legitimacy." (Company A)	11
Technology & Infrastructure (C6)	Digital Technology (C6.1)	E-Commerce Platform Adoption; Digital Marketing Capabilities	8	"Digital marketing amplifies halal brand reach effectively." (SME C) / "Online presence is critical for halal SME success." (SME B)	17
	Production Facilities (C6.2)	Modern Equipment Availability; Facility Certification Status	7	"Modern production facilities are essential for halal certification." (Company B) / "Outdated facilities limit halal certification potential." (Company G)	14
	Information Systems (C6.3)	Data Analytics Implementation; Digital Integration Level	6	"Data-driven systems improve halal traceability and efficiency." (SME E) / "Integrated IT systems support halal compliance tracking." (SME M)	13

4.2 AHP Result

The AHP findings highlight clear differences in strategic priorities between large enterprises and SMEs within Indonesia's halal F&B industry. As detailed in Table 3, large enterprises assign the highest importance to Market Development (25%), with particular emphasis on consumer demand analysis (9.3%) and halal product differentiation (8.5%). This prioritization indicates a strong strategic focus on increasing market share at both national and regional levels, supported by well-established branding and innovation capacities. In addition, Regulatory Framework and Compliance is also considered highly significant (23%), especially regarding fulfilling international standard requirements (8.5%), reflecting these firms' preparedness to access broader ASEAN and global markets. The considerable weighting attributed to Product Innovation and Quality (21%) further illustrates the priority placed on technological advancement, standardization of logistics, and implementation of traceability mechanisms aimed at improving operational efficiency and enhancing brand reliability [3; 13].

Table 3

AHP Result in Large Enterprises

Main Criteria	Weight (%)	Sub-Criteria	Local Weight (%)	Global Weight (%)
Market Development	25%	Consumer Demand Analysis	37%	9.3%
		Halal Product Differentiation	34%	8.5%
		Branding & Packaging	29%	7.2%
Regulatory Framework & Compliance	23.0%	Halal Certification Efficiency	33%	7.6%
		International Standard Compliance	37%	8.5%
		ASEAN Market Expansion	30%	6.9%
Product Innovation & Quality	21.0%	Logistics Standardization	35%	7.4%
		Traceability Systems	33%	6.9%
		Block chain for Traceability	32%	6.7%
Supply Chain Optimization	15.0%	Public Awareness Campaigns	38%	5.7%
		Halal Authority Collaboration	32%	4.8%
		Supplier Network Development	30%	4.5%
Stakeholder Engagement & Awareness	10.0%	Government Support Programs	58%	5.8%
		Industry Collaboration Initiatives	42%	4.2%
Technology & Infrastructure	6.0%	Digital Marketing & AI Adoption	60%	3.6%
		Information Systems for Traceability	40%	2.4%

In contrast, the AHP analysis for SMEs, as outlined in Table 4, underscores a stronger emphasis on navigating regulatory challenges, with Regulatory Framework and Compliance emerging as the most critical factor (26%). Within this dimension, halal certification efficiency (11.7%) and adherence to international standards (7.8%) stand out as the most influential sub-criteria. These findings reflect the persistent regulatory barriers SMEs encounter, aligning with previous research that points to limited resources and procedural intricacies as significant constraints to accessing halal certification and entering regional export markets [14; 49]. While Market Development (22%) is also acknowledged as important, it ranks below compliance-related concerns, indicating that although SMEs recognize the potential for market expansion, regulatory legitimacy remains a more pressing challenge. Additionally, SMEs exhibit considerable attention to Supply Chain Optimization (18%), suggesting an increasing awareness of the need to integrate halal logistics and supplier networks, despite ongoing limitations in terms of financial and operational capacity [13].

The divergence in strategic priorities between large enterprises and SMEs can be attributed to fundamental structural differences, including financial resources, organizational development, and the ability to navigate regulatory systems. Large firms possess financial flexibility to invest in branding, product innovation, and compliance with evolving global standards. In contrast, SMEs, often constrained by limited funding and technical capacity, tend to prioritise certification access as a primary strategy for market entry and growth. Recent research also highlights that global trends such as digital transformation and the increasing standardization of halal practices have widened the competitiveness gap between large and small firms. This growing disparity underscores the urgent need for targeted policy interventions and capacity-building initiatives to ensure that SMEs are equipped to compete and thrive within the halal economy [13].

Table 4
AHP Result in SMEs

Main Criteria	Weight (%)	Sub-Criteria	Local Weight (%)	Global Weight (%)
Regulatory Framework & Compliance	26.0%	Halal Certification Efficiency	45%	11.7%
		International Standard Compliance	30%	7.8%
		ASEAN Market Expansion	25%	7.8%
Market Development	22.0%	Consumer Demand Analysis	36%	7.9%
		Halal Product Differentiation	34%	7.5%
		Branding & Packaging	30%	6.6%
Product Innovation & Quality	17.5%	Logistics Standardization	35%	6.1%
		Traceability Systems	33%	5.8%
		Blockchain for Traceability	32%	5.6%
Supply Chain Optimization	18.0%	Public Awareness Campaigns	41%	7.4%
		Halal Authority Collaboration	34%	6.1%
		Supplier Network Development	25%	4.5%
Stakeholder Engagement & Awareness	10.0%	Government Support Programs	58%	5.8%
		Industry Collaboration Initiatives	42%	4.2%
Technology & Infrastructure	6.5%	Digital Marketing & AI Adoption	62%	4.0%
		Information Systems for Traceability	38%	2.5%

4.3 ANP Result

The ANP assessment provides a more dynamic representation of strategic priorities among both large enterprises and SMEs operating within Indonesia's halal F&B sector. As outlined in Table 5, Market Development emerges as the most influential dimension for large enterprises (27.0%), with specific focus on consumer demand analysis (10.2%) and halal product differentiation (9.3%). This highlights a strategic reorientation towards exploiting new domestic and regional market prospects,

wherein branding and packaging innovation also carry substantial significance (7.5%). Regulatory Framework and Compliance continue to hold strategic weight (22.5%), particularly in relation to adherence to international standards (8.7%), reflecting the broader aim of enhancing competitiveness in global markets. Notably, considerable emphasis is also placed on Product Innovation and Quality (20.0%), with traceability mechanisms (7.5%) and blockchain integration (6.8%) identified as key enablers. These findings illustrate the increasing reliance of large firms on technological solutions to ensure halal assurance and operational visibility, aligning with recent developments in halal logistics and certification literature [13].

Table 5
ANP Result in Large Enterprises

Main Criteria	Weight (%)	Sub-Criteria	Normalized Weight (%)
Market Development	27.0%	Consumer Demand Analysis	10.2%
		Halal Product Differentiation	9.3%
		Branding & Packaging	7.5%
Regulatory Framework & Compliance	22.5%	International Standard Compliance	8.7%
		Halal Certification Efficiency	7.8%
		ASEAN Market Expansion	6.0%
Product Innovation & Quality	20.0%	Traceability Systems	7.5%
		Blockchain for Traceability	6.8%
		Logistics Standardization	5.7%
Supply Chain Optimization	15.3%	Public Awareness Campaigns	6.0%
		Halal Authority Collaboration	5.0%
		Supplier Network Development	4.5%
Technology & Infrastructure	9.0%	Digital Marketing & AI Adoption	5.5%
		Information Systems for Traceability	3.5%
Stakeholder Engagement & Awareness	6.0%	Government Support Programs	3.8%
		Industry Collaboration Initiatives	2.2%

In contrast, SMEs reveal a distinctly different set of strategic priorities, as reflected in Table 6. Regulatory Framework and Compliance is the most prominent dimension, receiving a weight of 28.5%, with halal certification efficiency (13.2%) identified as the most influential sub-factor. This highlights the continued impact of regulatory constraints, which remain the principal obstacle for SMEs. These findings align with previous research suggesting that smaller firms are disproportionately burdened by the complexity and expense of certification procedures [14]. Although Market Development ranks as the second-highest priority (23.0%), its relative importance is diminished by SMEs' limited capacity to navigate regulatory processes, which must first be addressed before broader market participation becomes feasible. Supply Chain Optimisation and Product Innovation also receive notable emphasis (16.0% and 18.5% respectively), suggesting that SMEs increasingly recognise the importance of enhancing product quality and establishing reliable logistics systems. However, their progress in these areas remains hampered by operational constraints and resource limitations [13; 49].

These findings underscore a fundamental divergence in competitive strategies between large enterprises and SMEs. While larger firms are primarily oriented towards market-driven innovation and fulfilling halal requirements on a global scale—facilitated by their integration of advanced technologies—SMEs remain predominantly focused on overcoming regulatory barriers that hinder their access to such opportunities. This strategic disparity calls for differentiated policy responses. Specifically, initiatives aimed at simplifying halal certification procedures and establishing dedicated digital infrastructure for SMEs in Malaysia could significantly enhance their competitive positioning [13]. Furthermore, fostering stronger collaboration among governmental bodies, halal regulatory

institutions, industry leaders, and trade associations would help bridge existing compliance and capability gaps. Such efforts are essential to advancing a more inclusive and sustainable development trajectory for Indonesia's halal F&B sector within the ASEAN economic landscape.

Table 6
ANP Result in SMEs

Main Criteria	Weight (%)	Sub-Criteria	Normalized Weight (%)
Regulatory Framework & Compliance	28.5%	International Standard Compliance	13.2%
		Halal Certification Efficiency	8.5%
		ASEAN Market Expansion	6.8%
Market Development	23.0%	Consumer Demand Analysis	8.8%
		Halal Product Differentiation	7.9%
		Branding & Packaging	6.3%
Product Innovation & Quality	18.5%	Traceability Systems	7.4%
		Block chain for Traceability	6.2%
		Logistics Standardization	4.9%
Supply Chain Optimization	16.0%	Public Awareness Campaigns	6.5%
		Halal Authority Collaboration	5.8%
		Supplier Network Development	5.2%
Technology & Infrastructure	8.0%	Digital Marketing & AI Adoption	4.6%
		Information Systems for Traceability	3.4%
Stakeholder Engagement & Awareness	6.0%	Government Support Programs	3.8%
		Industry Collaboration Initiatives	2.2%

4.4 Comparison of AHP and ANP Results

The comparative analysis between AHP and ANP results reveals notable shifts in the prioritization of strategic criteria among large enterprises. As illustrated in Table 7, Regulatory Framework and Compliance displays a marked increase in relative importance, with a coefficient value of K = 1.08. This suggests that once interdependencies are accounted for, regulatory considerations assume a more influential role than initially perceived. A similar, albeit modest, rise is observed in Supply Chain Optimization (K = 1.02), reflecting an enhanced appreciation of logistics and traceability mechanisms in reinforcing halal assurance frameworks. In contrast, both Market Development and Product Innovation exhibit slight reductions in prioritization. While these areas remain relevant, their relative impact appears diminished considering the complex interrelations with regulatory and operational factors. Of note is the substantial rise in Stakeholder Engagement (K = 1.50), indicating that collaborative dynamics involving regulators, industry actors, and support institutions become increasingly critical when interlinkages are integrated into the strategic framework. On the other hand, Technology Infrastructure shows a considerable decline (K = 0.60), suggesting that although digitalization is still valued, it is viewed more as a supporting element rather than a central driver of competitiveness among larger enterprises [13].

Table 7
Criteria Group Level Comparison in Large Enterprises

Criteria Group	**AHP Weight (%)**	**ANP Weight (%)**	**Coefficient K**	**Key Observation**
Regulatory Framework	25.0	27.0	1.08	Notably Higher in ANP
Market Development	23.0	22.5	0.97	Slightly Lower in ANP
Product Innovation	21.0	20.0	0.97	Slightly Lower in ANP
Supply Chain Optimization	15.0	15.3	1.02	Slightly Higher in ANP
Stakeholder Engagement	6.0	9.0	1.50	Notably Higher in ANP
Technology Infrastructure	10.0	6.0	0.60	Significantly Lower in ANP

For SMEs, the shifts in prioritization present a distinct pattern, as illustrated in Table 8. Regulatory Framework and Compliance retain its leading position with a higher weight (coefficient K = 1.10), reinforcing the view that regulatory constraints and certification challenges become even more pronounced when interdependencies are incorporated. Slight increases in Market Development and Product Innovation further suggest that SMEs are progressively acknowledging the importance of aligning their products with changing market preferences while striving to innovate within their resource limitations [13; 14]. By contrast, Supply Chain Optimization experiences a modest decline (coefficient K = 0.89), which may be attributed to the prioritization of resolving certification-related issues before investing in broader supply chain improvements. Noteworthy is the significant drop in Stakeholder Engagement (coefficient K = 0.60), indicating that SMEs, constrained by limited capacity, are less able to participate in collaborative industry efforts unless supported through targeted institutional mechanisms. In contrast, Technology Infrastructure registers a substantial increase (coefficient K = 1.23), highlighting the growing strategic relevance of digital solutions—such as e-commerce platforms, blockchain-enabled traceability, and digital marketing—as tools through which SMEs can bypass traditional barriers and enhance their market competitiveness [13; 39].

Table 8
Criteria Group Level Comparison in SMEs

Criteria Group	AHP Weight (%)	ANP Weight (%)	Coefficient K	Key Observation
Regulatory Framework	26.0	28.5	1.10	Slightly Higher in ANP
Market Development	22.0	23.0	1.05	Slightly Higher in ANP
Product Innovation	17.5	18.5	1.06	Slightly Higher in ANP
Supply Chain Optimization	18.0	16.0	0.89	Slightly Lower in ANP
Stakeholder Engagement	10.0	6.0	0.60	Slightly Lower in ANP
Technology Infrastructure	6.5	8.0	1.23	Notably Higher in ANP

To further illustrate the strategic divergence, the radar chart depicted in Figure 5 demonstrates a clear differentiation in orientation between SMEs and large enterprises in the development of the halal industry. Both groups assign the highest importance to Regulatory Framework and Compliance (28.5% for SMEs and 27.0% for large enterprises), indicating a shared recognition of regulatory complexity as a critical barrier. However, SMEs place greater emphasis on Technology Infrastructure (8.0% compared to 6.0%), reflecting their pressing need to adopt digital tools such as e-commerce platforms, blockchain traceability, and online marketing to navigate certification challenges and expand market access [9; 46].

In contrast, large enterprises exhibit stronger prioritization of Stakeholder Engagement (9.0% versus 6.0%), capitalizing on their well-established networks and resource advantages to build cooperative ties with regulatory bodies and industry peers [9; 25]. The variance in perspectives on digitalisation reveals that SMEs view technology as a strategic necessity for closing competitiveness gaps, while large enterprises perceive it primarily as an operational support tool rather than a core competitive asset [2; 33]. Extensive literature confirms that SMEs often contend with financial and structural limitations, thus depending heavily on innovative digital solutions and institutional support to overcome market entry and certification hurdles [22; 47]. These findings underscore the importance of differentiated policy responses: SMEs require strengthened digital infrastructure and simplified certification systems, whereas large firms benefit more from enhanced stakeholder coordination and cross-industry collaboration mechanisms [20; 37].

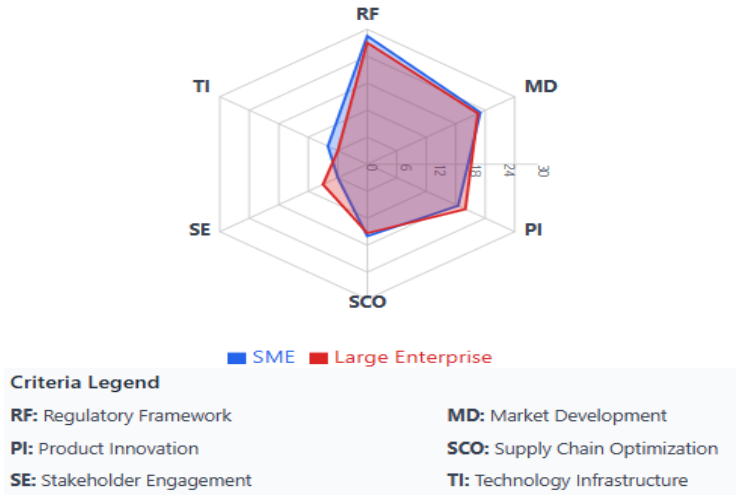

Fig.5: Radar Chart Comparison of SME and Large Enterprise

4.5 Sensitivity Analysis

4.5.1 Weight Perturbation Analysis

The final prioritization was established through a weight perturbation analysis, wherein the initial priority weights of the six principal criteria were systematically adjusted by ±10 percent and ±20 percent. This process involved incrementally increasing or decreasing each individual criterion's weight while proportionally redistributing the remaining weights to maintain consistency within the model. Subsequently, the ANP model was recalculated under each adjusted scenario to examine the sensitivity of the resulting rankings [16].

Across all perturbation cases, Regulatory Framework (C1) consistently retained its position as the highest-ranked criterion, indicating its structural dominance and stability within the overall competitiveness framework. However, ranking fluctuations between Market Development (C2) and Product Innovation (C3) were noted in approximately 28 percent of the tested scenarios, suggesting these dimensions are more susceptible to changes in initial weight assumptions. This outcome implies that while market access and innovation are indeed strategic components, their prioritization is more sensitive to shifts in external conditions. Therefore, regulatory improvements should not occur in isolation from broader strategic initiatives, particularly those related to market development and innovation, as competitive priorities may fluctuate in response to evolving environmental dynamics.

4.5.2 Monte Carlo Simulation

To enhance the robustness of the prioritization outcomes, a Monte Carlo simulation comprising 1,000 iterations was conducted, introducing random variations of up to 15 percent in the weights assigned to each criterion. For both versions of the ANP model, the strategic rankings were recalculated based on these adjusted weights, enabling an assessment of the sensitivity of the results to input uncertainties [16].

The simulation results revealed that Regulatory Reform (S1) maintained its top position in 94.8 percent of the iterations, reaffirming its structural stability and strategic centrality across fluctuating conditions. In contrast, Supply Chain Standardization (S2) and Market Development (S3) exhibited greater volatility, retaining their rankings in only 72.3 percent and 69.1 percent of the simulations, respectively. This variability indicates a higher susceptibility of these strategies to shifts in stakeholder preferences or changes in external environmental factors. The findings suggest that while regulatory initiatives form a consistent and foundational pillar of competitiveness, interventions related to supply chain efficiency and market expansion require adaptive implementation strategies, aligned with

evolving market demands and stakeholder expectations.

4.5.3 Consistency Ratio Validation

The objectivity of expert evaluations was validated by the Consistency Ratio (CR) values for all pairwise comparison matrices, each remaining below the 10 percent threshold in the initial measurements. This process involved assessing the internal consistency of judgments by confirming that the principal eigenvalue approximated the matrix size, following Saaty's criteria for acceptable levels of inconsistency [26].

To further test the resilience of expert input under conditions of uncertainty, the model incorporated a ±20 percent perturbation of criterion weights. Even under these altered scenarios, 97.2 percent of simulations retained CR values within the acceptable range, thereby affirming the methodological rigour and reliability of the expert elicitation process. These results support the overall validity of the prioritization findings and confirm their robustness against moderate deviations in expert opinion or stakeholder diversity. Nevertheless, the observed variability in the ranking of Market Development and Supply Chain strategies signals the need for policymakers to maintain flexibility when adapting strategic responses, particularly in the face of shifting regulatory landscapes and dynamic market environments.

5. DISCUSSION

5.1 Priority Issues in Indonesia's Halal Industry Competitiveness

5.1.1 Priority Issues in Larger Enterprise

As shown in Figure 6, the priority matrix demonstrates that large enterprises operating within Indonesia's halal F&B sector focus predominantly on high-impact strategic areas. The most critical factors identified include Consumer Demand Analysis (10.2%), Halal Product Differentiation (9.3%), and International Standard Compliance (8.7%), all of which are positioned in the upper-right quadrant of urgency and importance. This concentrated focus reflects a strategic orientation toward meeting sophisticated consumer expectations while maintaining adherence to globally recognised certification standards, consistent with emerging market trends [13]. In contrast, elements such as Traceability Systems (7.5%), Blockchain for Traceability (6.8%), and Digital Marketing and AI Adoption (5.5%) are categorised as medium-priority enablers. These are perceived as facilitating future competitiveness rather than requiring immediate intervention. Notably, factors such as Industry Collaboration Initiatives (2.2%) appear in the lower-priority quadrant, indicating that larger firms tend to concentrate on strengthening internal capacities rather than relying on broader collaborative efforts within the industry.

From a practical standpoint, the findings indicate that large enterprises should intensify efforts to strengthen their understanding of consumer preferences and accelerate the pace of product innovation, while simultaneously maintaining rigorous halal compliance in line with international standards. Given the increasing competitive pressure from regional counterparts such as Malaysia and Thailand, enhancing product differentiation and maintaining robust certification processes are essential strategies for sustaining export growth and brand leadership within the halal sector [49]. Although technologies like traceability systems and blockchain are not currently prioritized, early investments in these areas are likely to yield long-term benefits by supporting operational resilience and enhancing brand integrity within high-value halal segments [13]. Furthermore, the relatively low prioritization of external collaboration suggests a missed opportunity to leverage collective strengths within the broader halal ecosystem. Accordingly, policy incentives aimed at encouraging stronger

partnerships between industry actors and regulatory bodies could play a pivotal role in enhancing sector-wide competitiveness soon.

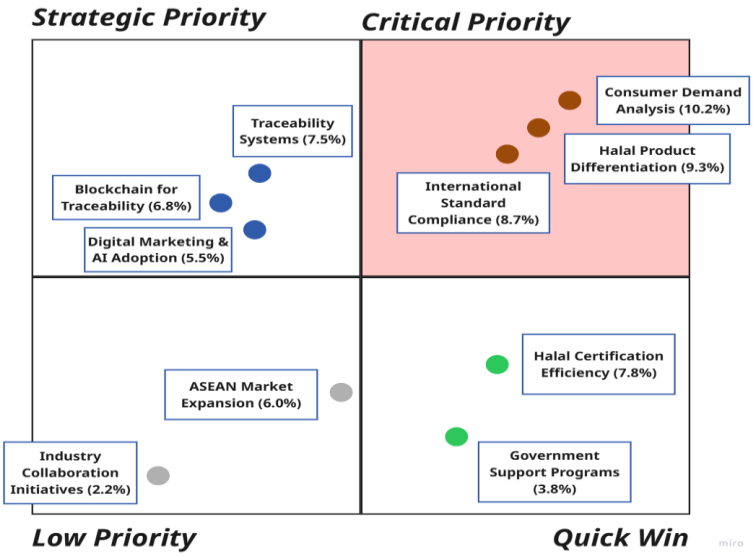

Fig.6: Priority Matrix in Large Enterprise

5.1.2 Priority Issues in SME

According to the priority matrix illustrated in Figure 7, SMEs within Indonesia's halal F&B sector place the highest emphasis on regulatory-related dimensions, with International Standard Compliance (13.2%) and Halal Certification Efficiency (8.5%) occupying the critical priority quadrant. This underscores that regulatory legitimacy remains the primary constraint limiting SMEs' access to broader markets, echoing prior findings which emphasize the substantial challenges faced in navigating complex certification frameworks [13; 14]. Additionally, Consumer Demand Analysis (8.8%) emerges as a significant concern, indicating that while SMEs acknowledge the necessity of aligning product offerings with evolving consumer preferences, their limited capacity hampers timely strategic responses. Although Traceability Systems (7.4%), Digital Marketing and AI Adoption (4.6%), and Information Systems (3.4%) are identified as important, they fall outside the critical quadrant. This suggests that resource constraints continue to limit investment in long-term technological advancement, relegating such initiatives to secondary strategic consideration.

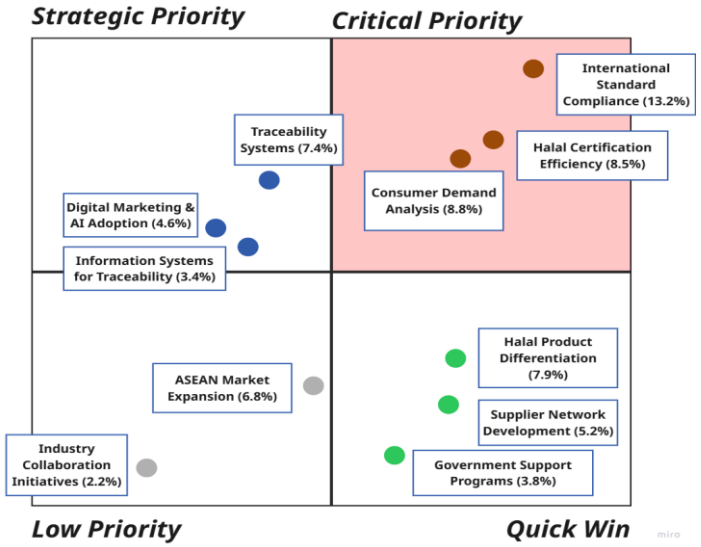

Fig.7: Priority Matrix in SMEs

From a practical standpoint, these findings underscore the need for targeted policy interventions aimed at simplifying halal certification processes and providing both financial and technical assistance to SMEs. Facilitating expedited access to certification could substantially enhance their participation in broader markets [13]. While technologies such as traceability systems and digital marketing are not currently perceived as urgent, structured capacity-building initiatives focused on digitalization could significantly strengthen SMEs' resilience and long-term competitiveness [13]. Immediate improvements can also be pursued to reinforce SMEs' foundational capabilities for easier integration into the halal supply chain. These include rapid advancements in Supplier Network Development (5.2%) and the strategic deployment of Government Support Programmes (3.8%), both of which may deliver tangible benefits in the short term.

Although many halal F&B enterprises in Indonesia have yet to prioritize traceability technologies like blockchain, their strategic value is becoming increasingly evident. Recent analyses suggest that robust traceability mechanisms could serve as a key differentiator in markets requiring cross-border certification and transparency [13; 49]. The findings of this study imply that technology adoption is often subordinated to regulatory compliance, a prioritization likely shaped by resource limitations and immediate market access challenges faced by SMEs. Similar dynamics are observed in other Muslim-majority economies with established SME sectors, such as Pakistan and Bangladesh, where regulatory barriers and fragmented certification systems remain central concerns [3; 6]. These cases reinforce the importance of integrated halal ecosystem governance.

Although stakeholder engagement received moderate attention in both the AHP and ANP analyses, it emerges as a pivotal yet underexploited mechanism for enhancing halal F&B competitiveness in Indonesia. The current policy environment reveals a lack of structured collaboration among public institutions, private actors, and religious authorities, with efforts often occurring in isolation. By contrast, Malaysia's centralized approach under JAKIM illustrates how stakeholder alignment can streamline certification procedures and promote innovation, while enhancing international brand legitimacy [17]. Developing coordinated multi-stakeholder platforms would therefore be instrumental in bridging regulatory and industry divides, improving transparency, and fostering collaborative development of norms and digital tools to close the competitiveness gaps identified in this study.

5.2 AHP versus ANP: Methodological Insights

The comparative evaluation of AHP and ANP methodologies in this study highlights notable divergences in the manner complex interrelationships within the halal industry ecosystem are measured. Echoing the findings of Jorge-García and Estruch-Guitart [16] regarding ecosystem service valuation, the results suggest that AHP may overemphasize certain criteria when they are assessed in isolation. For instance, Stakeholder Engagement and Technology Infrastructure received relatively higher weights under AHP (7.09% and 5.17% respectively) compared to their corresponding weights in ANP (5.88% and 3.45%). This discrepancy stems from AHP's reliance on a strictly hierarchical structure, which does not capture the interdependence among criteria, leading to potential overvaluation of factors not sufficiently embedded within systemic interrelations.

Conversely, ANP assigns greater significance to Supply Chain Optimization (11.87%) than AHP (10.24%), reflecting its position as a mediating factor between Market Development and Regulatory Framework. This distinction illustrates ANP's superior capacity to model interwoven dependencies, consistent with the findings of Daneshparvar et al. [45], who emphasize ANP's effectiveness in representing complex decision contexts. In the current analysis, this implies that the improvements in logistics and traceability mechanisms within the halal sector generate cascading effects throughout the ecosystem, an influence not fully captured by linear, top-down methodologies.

Importantly, both AHP and ANP identify Regulatory Framework as the highest-ranking criterion, with a coefficient of K = 1.05, demonstrating the robustness and consistency of this outcome across methodological approaches. This finding aligns with Nimawat and Gidwani [21], who reported that although weight allocations may vary between AHP and ANP, the ranking of dominant priorities tends to remain stable, particularly when the criticality of a factor is well-established. Accordingly, comparative methodological assessment not only reinforces the validity of the strategic priorities determined but also underscores the analytical value of incorporating real-world complexities and stakeholder interconnections. This is particularly relevant for fostering collaboration among large enterprises and supporting the digital transformation of SMEs within Indonesia's halal F&B sector.

6. Conclusion

This study systematically identified and ranked the key factors influencing competitiveness in Indonesia's halal F&B sector within the ASEAN region by applying a hybrid multi-criteria decision-making approach. The findings reveal that strengthening regulatory frameworks, expanding market access, and improving supply chain efficiency are essential to support sustained industry growth. While large enterprises tend to pursue strategic market expansion and technological innovation, SMEs continue to encounter considerable obstacles, particularly in navigating complex regulatory and certification procedures. These insights provide a meaningful contribution to halal industry literature by addressing structural competitiveness and offering practical guidance for policymakers, industry stakeholders, and scholars. Furthermore, the results highlight the rising importance of digital transformation and international standard compliance as core enablers of Indonesia's competitiveness in the regional and global halal economy. The research also contributes to the theoretical understanding of complex decision environments by illustrating how integrated modelling techniques can capture strategic interdependencies often missed by conventional hierarchical approaches. This methodological advancement improves the interpretability and robustness of prioritization outcomes in multi-actor settings. In addition, this study enhances the methodological literature on decision-making in the following ways:

It demonstrates the application of a combined decision-modelling framework to capture interconnected strategic challenges in fragmented halal ecosystems.

It offers a scalable approach that can be adapted to other halal industry contexts, particularly those characterized by significant SME participation, such as Pakistan, Bangladesh, or Turkey.

It shows how combining prioritization techniques with network-based modelling can yield deeper insights in settings where regulatory, market, and technological factors are intricately linked.

7. Limitation and Future Research

While the study employed a robust methodological framework, several limitations must be acknowledged. Firstly, the composition of the expert panel, although inclusive of representatives from large enterprises, SMEs, and halal regulatory authorities, was largely limited to the Indonesian context. This geographical concentration may constrain the generalizability of the findings across the broader ASEAN region, where regulatory environments and market dynamics may differ significantly. Secondly, the analysis employed cross-sectional data, which offers a static view of competitiveness determinants without capturing temporal shifts or trends. A longitudinal approach could yield richer insights into how strategic priorities evolve in response to regulatory or market developments.

Moreover, the research primarily adopted a supply-side perspective, focusing on the strategic and operational challenges encountered by firms and regulators. This emphasis excluded a detailed behavioral analysis of halal consumer preferences and evolving consumption patterns, which are increasingly critical in shaping market competitiveness. To address these gaps, future studies should

consider expanding the geographical scope to include benchmarking exercises with ASEAN frontrunners such as Malaysia and Thailand. Additionally, incorporating longitudinal designs would enable the monitoring of shifts in strategic importance over time. Further enhancements to competitiveness modelling could also involve the integration of emerging technological advancements, such as artificial intelligence-based traceability systems and blockchain-enabled certification protocols. These technologies offer promising avenues for improving transparency, operational efficiency, and consumer trust in halal supply chains. Lastly, future research should examine generational shifts in consumer behaviour, particularly among younger, tech-savvy Muslim populations, whose expectations and consumption habits may redefine the strategic landscape of the halal F&B sector.

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Author Contributions

All authors contributed substantially to the conception, design, analysis, and development of this paper and have approved the submitted version.

Donald Crestofel Lantu contributed to the conceptual framework, research supervision, and critical revision of the manuscript for important intellectual content.

Sri Herliana led the literature review synthesis, contributed to the data interpretation, and provided feedback on the structure and coherence of the manuscript.

Sudrajati Ratnaningtyas was involved in methodology development, data analysis, and drafting of key findings.

Mia Rosmiati contributed to the theoretical model development, reviewed the discussion section, and provided technical insights related to interdisciplinary implications.

Inayati Fadhilah Zulfa participated in data collection, preliminary analysis, and initial drafting of the manuscript.

All authors have read and agreed to the final version of the manuscript and are accountable for all aspects of the work.

Conflicts of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

[1] Ab Talib, M. S., Abdul Hamid, A. B., & Ai Chin, T. (2015). Motivations and limitations in implementing Halal food certification: a Pareto analysis. *British Food Journal*, 117(11), 2664-2705. https://doi.org/10.1108/bfj-02-2015-0055

[2] Ab Talib, M. S., Md. Sawari, S. S., Abdul Hamid, A. B., & Ai Chin, T. (2016). Emerging Halal food market: an Institutional Theory of Halal certificate implementation. *Management Research Review*, 39(9), 987-997. https://doi.org/10.1108/mrr-06-2015-0147

[3] Abd Rahman, A., Singhry, H. B., Hanafiah, M. H., & Abdul, M. (2017). Influence of perceived benefits and traceability system on the readiness for Halal Assurance System implementation among food manufacturers. *Food Control*, 73, 1318-1326.

https://doi.org/10.1016/j.foodcont.2016.10.058

[4] Aghdaie, M. H., Zolfani, S. H., & Zavadskas, E. K. (2013). Decision making in machine tool selection: An integrated approach with SWARA and COPRAS-G methods. *Engineering Economics*, 24(1), 5-17. https://doi.org/10.5755/j01.ee.24.1.2822

[5] Haqq, A. N. A., & Maftukhah, I. (2021). The influence of halal awareness, halal certification, and food ingredients on purchase intention of halal food. *Management Analysis Journal*, 10(1), 56-65. https://doi.org/10.15294/maj.v10i1.43103

[6] Ali, M. H., Tan, K. H., & Ismail, M. D. (2017). A supply chain integrity framework for halal food. *British Food Journal*, 119(1), 20-38. https://doi.org/10.1108/bfj-07-2016-0345

[7] Azam, M. S. E., & Abdullah, M. A. (2020). Global halal industry: Realities and opportunities. *International Journal of Islamic Business Ethics*, 5(1), 47-59. https://doi.org/10.30659/ijibe.5.1.47-59

[8] Behzadian, M., Kazemzadeh, R. B., Albadvi, A., & Aghdasi, M. (2010). PROMETHEE: A comprehensive literature review on methodologies and applications. *European Journal of Operational Research*, 200(1), 198-215. https://doi.org/10.1016/j.ejor.2009.01.021

[9] Camilleri, M. A. (2019). The SMEs' technology acceptance of digital media for stakeholder engagement. *Journal of Small Business and Enterprise Development*, 26(4), 504-521. https://doi.org/10.1108/jsbed-02-2018-0042

[10] Chaudry, M. M., & Riaz, M. N. (2014). Safety of Food and Beverages: Halal Food Requirements. In *Encyclopedia of Food Safety* (pp. 486-491). https://doi.org/10.1016/b978-0-12-378612-8.00400-5

[11] Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry & research design: Choosing among five approaches* (4th ed.). SAGE.

[12] Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1-4. https://doi.org/10.11648/j.ajtas.20160501.11

[13] Has-Yun Hashim, Y. Z., Ahmad, A. N., Samsudin, N., Abd Lateef, M. H., & Majlan, N. S. (2022). Evolution of Halal Research: A Bibliometric for 1996–2020. *Journal of Fatwa Management and Research*, 27(3), 1-38. https://doi.org/10.33102/jfatwa.vol27no3.443

[14] Hasan, H., Sulong, R. S., & Tanakinjal, G. H. (2020). Halal Certification Among the SMEs in Kinabalu, Sabah. *Journal of Consumer Sciences*, 5(1), 16-28. https://doi.org/10.29244/jcs.5.1.16-28

[15] Hasan, K. N. S., & Pasyah, T. (2022). Challenges of Indonesian Halal Industry in the Digital Economic Era. *Sriwijaya Law Review*, 6(2), 319-335. https://doi.org/10.28946/slrev.vol6.iss2.869.pp319-335

[16] Jorge-García, D., & Estruch-Guitart, V. (2022). Comparative analysis between AHP and ANP in prioritization of ecosystem services – A case study in a rice field area raised in the Guadalquivir marshes (Spain). *Ecological Informatics*, 70, 101739. https://doi.org/10.1016/j.ecoinf.2022.101739

[17] Katuk, N., Ku-Mahamud, K. R., Kayat, K., Abdul Hamid, M. N., Zakaria, N. H., & Purbasari, A. (2020). Halal certification for tourism marketing: The attributes and attitudes of food operators in Indonesia. *Journal of Islamic Marketing*, 12(5), 1043-1062. https://doi.org/10.1108/jima-03-2020-0068

[18] Kurnia, A., Marliyah, & Nasution, J. (2023). Development Strategy of Halal Food Industry to Enhance Consumption Activities in the Community of Medan City. *Asian Journal of Applied Business and Management*, 2(3), 337-346. https://doi.org/10.55927/ajabm.v2i3.5671

[19] Mardani, A., Jusoh, A., Zavadskas, E., Cavallaro, F., & Khalifah, Z. (2015). Sustainable and

Renewable Energy: An Overview of the Application of Multiple Criteria Decision Making Techniques and Approaches. *Sustainability*, 7(10), 13947-13984. https://doi.org/10.3390/su71013947

[20] Marjudi, S., Setik, R., Raja Lope Ahmad, R. M. T., Wan Hassan, W. A., & Md Kassim, A. A. (2023). Utilization of Business Analytics by SMEs In Halal Supply Chain Management Transactions. *JOIV: International Journal on Informatics Visualization*, 7(2), 407-417. https://doi.org/10.30630/joiv.7.2.1308

[21] Meade, L. M., & Sarkis, J. (1999). Analyzing organizational project alternatives for agile manufacturing processes: An analytical network approach. *International Journal of Production Research*, 37(2), 241-261. https://doi.org/10.1080/002075499191751

[22] Omar, C. (2013). Challenges and marketing strategies of Halal products in Malaysia. *Interdisciplinary Journal of Research in Business*, 2(12), 2046-7141.

[23] Porter, M. E. (1990). *The competitive advantage of nations*. Free Press.

[24] Regenstein, J. M., Chaudry, M. M., & Regenstein, C. E. (2003). The Kosher and Halal Food Laws. *Comprehensive Reviews in Food Science and Food Safety*, 2(3), 111-127. https://doi.org/10.1111/j.1541-4337.2003.tb00018.x

[25] Russo, A., & Perrini, F. (2009). Investigating Stakeholder Theory and Social Capital: CSR in Large Firms and SMEs. *Journal of Business Ethics*, 91(2), 207-221. https://doi.org/10.1007/s10551-009-0079-z

[26] Saaty, T. L. (1980). *The analytic hierarchy process: Planning, priority setting, resource allocation*. McGraw-Hill International Book Co.

[27] Saaty, T. L. (2001). *The Analytic Network Process: Decision Making with Dependence and Feedback* (2nd ed.). RWS Publications.

[28] Vaidya, O. S., & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. *European Journal of Operational Research*, 169(1), 1-29. https://doi.org/10.1016/j.ijpe.2003.11.014

[29] Saaty, T. L., & Vargas, L. G. (2016). *Decision making with the analytic network process: Economic, Political, Social and Technological Applications with Benefits, Opportunities, Costs and Risks*. Springer. https://doi.org/10.1007/0-387-33987-6

[30] Secinaro, S., & Calandra, D. (2020). Halal food: Structured literature review and research agenda. *British Food Journal*, 123(1), 225-243. https://doi.org/10.1108/bfj-03-2020-0234

[31] Subramanian, N., & Ramanathan, R. (2012). A review of applications of Analytic Hierarchy Process in operations management. *International Journal of Production Economics*, 138(2), 215-241. https://doi.org/10.1016/j.ijpe.2012.03.036

[32] Sutandi, S. (2021). Policy Strategy for Halal Logistics Development in Indonesia. *Proceedings of the 1st International Conference on Science and Technology in Administration and Management Information, ICSTIAMI 2019*. http://dx.doi.org/10.4108/eai.17-7-2019.2302909

[33] Taylor, E., & Kane, K. (2005). Reducing the burden of HACCP on SMEs. *Food Control*, 16(10), 833-839. https://doi.org/10.1016/j.foodcont.2004.06.025

[34] Thompson, C., Smith, D., & Cummins, S. (2018). Food banking and food insecurity in high-income countries. *Critical Public Health*, 28(1), 1-2. https://doi.org/10.1080/09581596.2018.1440539

[35] Tieman, M., & Ghazali, M. C. (2013). Principles in halal purchasing. *Journal of Islamic Marketing*, 4(3), 281-293. https://doi.org/10.1108/JIMA-01-2012-0004

[36] Utomo, S. B., Sekaryuni, R., Widarjono, A., Tohirin, A., & Sudarsono, H. (2020). Promoting Islamic financial ecosystem to improve halal industry performance in Indonesia: A demand and supply analysis. *Journal of Islamic Marketing*, 12(5), 992-1011. https://doi.org/10.1108/jima-12-2019-0259

[37] Wijaya, L. I., Ardiansyahmiraja, B., Wicaksono, A. P., Rianawati, A., Hadi, F. S., Silalahi, M. A. R., Izharuddin, M., & Zunairoh. (2023). The impact of IT capability and organizational learning on halal food SMEs' performance. *Cogent Business & Management*, 10(3), 2264562. https://doi.org/10.1080/23311975.2023.2264562

[38] Zailani, S. H., Seva Subaramaniam, K., Iranmanesh, M., & Shaharudin, M. R. (2015). The impact of supply chain security practices on security operational performance among logistics service providers in an emerging economy. *International Journal of Physical Distribution & Logistics Management*, 45(7), 652-673. https://doi.org/10.1108/ijpdlm-12-2013-0286

[39] Zhang, A., Mankad, A., & Ariyawardana, A. (2020). Establishing confidence in food safety: Is traceability a solution in consumers' eyes? *Journal of Consumer Protection and Food Safety*, 15(2), 99-107. https://doi.org/10.1007/s00003-020-01277-y

[40] Saripudin, Rosalia, P., Putra, A. F., Sholahuddin Aldila, S., Al Adawiyah Salsabila, R. A., Azriel Azhari, M., & Yunizhar, A. (2023). Determining the Top E-Wallet In Indonesia: Applying the AHP Method to optimal financial choices. *Multiple Criteria Decision Making*, 18, 77-111.

[41] Indonesia Halal Lifestyle Centre, DinarStandard, & Bank Indonesia. (2021). *Indonesia Halal Markets Report 2021/2022*. Jakarta: Indonesia Halal Lifestyle Centre / DinarStandard. Retrieved from https://isef.co.id/wp-content/uploads/2021/10/ReportIndonesiaHalal2021_2022.pdf

[42] Pew Research Center. (2017, July 26). *U.S. Muslims concerned about their place in society, but continue to believe in the American dream: Findings from Pew Research Center's 2017 survey of U.S. Muslims*. Washington, DC: Pew Research Center. Retrieved from https://www.pewresearch.org/religion/wp-content/uploads/sites/7/2017/07/U.S.-MUSLIMS-FULL-REPORT.pdf

[43] DinarStandard & Thomson Reuters. (2018). *State of the Global Islamic Economy Report 2018/19*. Dubai: DinarStandard. Retrieved from https://islamicbankers.center/wp-content/uploads/2019/02/thomson-reuters-difc-state-of-the-islamic-economy-report-2018.pdf

[44] AlShamsi, O., & Ajmal, M. (2018). Critical factors for knowledge sharing in technology-intensive organizations: Evidence from UAE service sector. *Journal of Knowledge Management*, 22(2), 384-412. https://doi.org/10.1108/JKM-06-2017-0247

[45] Daneshparvar, B., Rasi Nezami, S., Feizi, A., & Aghlmand, R. (2022). Comparison of results of flood hazard zoning using AHP and ANP methods in GIS environment: A case study in Ardabil province, Iran. *Journal of Applied Research in Water and Wastewater*, 9(1), 1-7.

[46] Amalia, S. R., Badina, T., & Najib, M. A. (2023). Effect of Covid-19 and Firm Fundamentals on Firm Value (Empirical Study on Mining Companies Listed on the List of Sharia Securities for the Period 2017–2021). In *International Conference on Sustainability in Technological, Environmental, Law, Management, Social and Economic Matters (ICOSTELM 2022)* (pp. 104-116). Atlantis Press.

[47] Lestari, S., Bakhtiar, A., & Suliantoro, H. (2023). Green Marketing and Intention to Buy Green Product: Systematic Literature Review. *Spektrum Industri*, 21(1), 75-84.

[48] Dey, P. K., & Cheffi, W. (2013). Green supply chain performance measurement using the analytic hierarchy process: A comparative analysis of manufacturing organisations. *Production Planning & Control*, 24(8-9), 702-720. https://doi.org/10.1080/09537287.2011.642188

[49] Alqudsi, S. G., Hilman, H., & Kaliappen, N. (2022). Integrated model of entrepreneurial orientation and resource-based view theory on international performance of small and medium enterprises. *International Journal of Organizational Analysis*, 30(6), 1518-1536. https://doi.org/10.1108/IJOA-02-2021-2618

Appendix A
MCDM Methods Comparison

Method	Advantage	Disadvantage	Reference
Analytic Hierarchy Process (AHP)	Simplifies complex problems using a hierarchical structure; easy to apply and interpret; widely adopted.	Assumes independence among criteria; not suitable for highly interconnected decision environments.	[28; 42]
Analytic Network Process (ANP)	Models complex interdependencies and feedback among criteria; captures real-world decision complexities.	More complex to design and compute; requires substantial expertise in network structuring.	[16] [4]
TOPSIS (Technique for Order Preference by Similarity to Ideal Solution)	Considers both the best and worst solutions; computationally simple; intuitive ranking of alternatives.	Sensitive to the choice of normalization technique; assumes criteria independence.	[8] [8]
VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje)	Emphasizes ranking and selecting alternatives with conflicting criteria; useful for compromise solutions.	Results are sensitive to the weight assignment and decision-making strategy (group vs individual).	[24]
ELECTRE (Elimination and Choice Translating Reality)	Suitable for problems with many alternatives; considers outranking relations.	Complex method; requires threshold setting; can yield incomparability between alternatives.	[24]
PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation)	Simple preference functions; flexible; effective for ranking in multi-criteria problems.	Requires clear preference function definitions; may oversimplify criteria relationships.	[8]

Appendix B
List of Participants

No	Cluster	Initial	Responsibility Level	Location	Product	Company Size	
						Production 2024 (kTon)	National Share (%)
Semi-structured Interview							
1	Large	Company A	Senior Manager	Jakarta	Instant Food, Baby Food	1500	18%
2	Enterprise	Company B	Marketing Head	Jakarta	Snacks, Coffee	1100	12%
3		Company C	Senior Manager	Jakarta	Nutrition, Dairy	950	10%
4		Company D	Senior Manager	Jakarta	Sauces, Ice Cream, Tea	800	9%
5		Company E	Business Development Manager	Jakarta	Cosmetics, Personal Care	700	7%
6		Company F	Regulatory Affairs Officer	Jakarta	Dairy, Beverages	900	10%
7		Company G	Senior Manager	Jakarta	Dairy Products	850	9%
8	SME	SME A	Owner	Jakarta	Traditional Snacks	15	0.5%
9		SME B	Marketing Manager	Bandung	Halal Bakery Products	20	0.7%
10		SME C	Owner	Yogyakarta	Halal Beverage (Herbal Drinks)	10	0.3%
11		SME D	Production Manager	Surabaya	Halal Processed Meat	25	0.8%
12		SME F	R&D Officer	Makassar	Halal Bottled Drinks	18	0.6%
13		SME H	Owner	Palembang	Halal Traditional Cakes	16	0.5%
14		SME I	Owner	Balikpapan	Halal Seafood Processing	19	0.6%
15		SME J	Owner	Denpasar	Halal Vegan Food Products	13	0.4%
ANP and AHP							
1	Large	Company A	R&D Manager				
2	Enterprise	Company B	Marketing Head				
3		Company C	Senior Manager				

List of Participants (continued)

No	Cluster	Initial	Responsibility Level	Location	Product	Company Size	
						Production 2024 (kTon)	National Share (%)
4		Company D	QA/QC Manager				
5		Company E	Business Development Manager				
6	SME	SME B	Marketing Manager				
7		SME C	Owner				
8		SME D	Production Manager				
9		SME E	Owner	Medan	Halal Instant Spices	12	0.4%
10		SME K	Owner	Banjarmasin	Halal Sauces & Condiments	15	0.5%
Triangulation							
1	Halal Certification	P1	Director of Certification	Jakarta			
2	Body	P2	Certification Officer	Jakarta			
3	(BPJPH)	P3	Senior Halal Auditor	Jakarta			
4		P4	Halal Policy Advisor	Jakarta			
5		P5	Halal Policy Advisor	Jakarta			