

SMEs DIGITALIZATION READINESS: SHARIA FINTECH FRAMEWORK USING QUADRUPLE HELIX PERCEIVES

Mahyarni Mahyarni^{a*} and Okfalisa Okfalisa^b

^a*Department of Management, Universitas Islam Negeri Sultan Syarif Kasim Riau, HR Soebrantas Street KM 15, Indonesia*

^b*Department of Informatics Engineering, Universitas Islam Negeri Sultan Syarif Kasim Riau, HR Soebrantas Street KM 15, Indonesia*

(Received 12 June 2023; accepted 15 August 2023)

Abstract

The role of Quadruple Helix in promoting the development of digitizing SMEs highlights the significant contribution of Sharia fintech as a new challenge to sustainably and creatively face the Covid-19 disruption. This paper developed a framework of SME's Digitalization Readiness in Supporting Sharia Fintech to scrutinize the quadruple Helix perceptions and the success of digitalization. Furthermore, a Fuzzy-AHP approach is applied to analyze the significant weight of Quadruple Helix interaction and distinguish between universities, industry, communities, and government. This creates the basis of a sustainable corporate sector through the consideration of Information Technology (IT), economy, and Sharia within business activity, transaction, marketing, management, micro- environment, and macro-environment, circumscribed into 24 sub-indicators. This study found that university academicians view business activity as the most significant indication for gauging the digitization readiness of small and medium-sized enterprises (SMEs) based on Sharia fintech. It is followed by marketing, transaction, management, micro, and macro environment. Meanwhile, the other sectors including industry, communities, and government discerned marketing as the deliberation of the SMEs' Sharia-based success digitalization. This framework stimulates and synergizes an integrated works, innovation, economic growth, productivity, technology, knowledge, and skills of Quadruple Helix roles in facing the competitive advantages of digital era with concerning on the Sharia values. The prioritized analysis and recommendation from this framework admit as a guidance tool for Quadruple Helix in decision making and strategic policies in achieving the success of the digital transformation.

Keywords: sharia fintech, quadruple helix, fuzzy-ahp, small medium enterprises, digital transformation

* Corresponding author: Mahyarni@uin-suska.ac.id

1. INTRODUCTION

Digital readiness is an organization's capability to take a chance on large-scale initiatives, processes, or transformation activities and information and communication technology (Garzoni et al., 2020). Digitalization creates new challenges and opportunities for substantial gains with the entire industry value chain process (Tripathi & Gupta, 2021). It promises better connectivity and readily available information that supports the emerging intelligent manufacturing platform to improve the production performance and enhance the enterprise's flexibility, agility, and responsiveness to internal and external disturbances. This is achieved through leveraging of technology automation, cloud computing, augmented reality, additive manufacturing, big data analytics, and the Internet of Things (IoT). However, digitalization readiness should include the massive changes in organizational workforce factors to match up the technological advancement and behavioral factors dealing with human resources competence, skills, and environment changes to support routine business activities (Bag et al., 2020), instead of technological (Tripathi & Gupta, 2021).

Previous studies analyzed the various models and frameworks to measure the digitalization readiness level or index (Pingali et al., 2023). The Capability Maturity Model (CMM) described the five levels of software development process including initial, repeatable, defined, competent, and efficient (Ariffin & Ahmad, 2021). CMM measured the organizational performance based on the activities and actors involved in the software project team. Construction Engineering Readiness Assessment Model (CERAM) provides the

assessment tool by considering the process and technological elements within eight focus attributes in the upper part, such as client, process, team formation and development, the team within the organization, management system, project standards, agility, and strategy deployment. Meanwhile, attributes of technology elements, integration services, information sharing services, coordination services, and communication services were analyzed (Li & Tuunanen, 2022). CERAM measures the maturity level based on the linear manner of software project management activity. Pingali et al. (2023) produced a tool model for measuring SMEs' digitalization readiness. However, it failed to promote digital transformation in organizations and suggests the need for proper prioritization analysis in achieving success. Built a digitalization readiness measurement model under General Practitioner Information System (GPIS), and new IT/IS Capability Evaluation (NICE) involves technology experts as industry assessors (Lou et al., 2020).

Building Information Modeling (BIM) measures organizational maturity associated with technology readiness. This model is inflexible, limited to BIM companies, and far from the standard for measuring SME digitalization readiness. Shehzad et al. (2021) and Schuh et al. (2021) produced Acatech Industry 4.0 Maturity Index to guide the companies' technological, organizational, and cultural transformation of resources, information systems, culture, and organizational structure. Moreover, Gürdür et al. (2019) enhanced the Acatech maturity level by studying the role of data analytical capabilities in the Swedish industry. The analytical data readiness considered the current scale situation of the organization

roles to meet the large companies in the field of telecommunication and manufacturing domain in Sweden. Lou et al. (2020) found the e-readiness on the construction (ERiC) framework as an alternative measurement tool conducted by increasing organizational awareness of supporting the digital economy. This framework is specifically designed for the Construction Industry (CI) with case studies in the United Kingdom.

Throughout the time, Tripathi and Gupta (2021) identified a workforce readiness index for the digitalization of logistics processes in industry 4.0 (Tripathi & Gupta, 2021). This framework has been successfully implemented in Indian logistics companies to analyze their position, gaps, and identify potential areas for improvement. Furthermore, Ghobakhloo and Iranmanesh (2021) developed a strategic guideline for manufacturing SMEs in fulfilling the requirements of digital transformation success. Small manufacturers need to pay attention to the change management and digitalization strategic planning capability to reach a certain degree of information, digital, operations, and cyber maturity. Okfalisa et al. (2021) have successfully built a measurement model for the digitalization readiness of SMEs by considering aspects of economic activity such as business, transactions, management, marketing, micro-environment, and macro-environment. Readiness of the Information Technology (IT) aspect is also a concern as it measures the performance of IT culture, competence, finance, and infrastructure (Okfalisa et al., 2021).

SMEs' digitalization readiness is a prerequisite for assuring readiness in Sharia, economy, and IT perspectives transformation achievement. The lack of Sharia intention to measure digitalization's maturity level grows

into a new challenge for the readiness model (Voza et al., 2022). Okfalisa et al. (2021) explored the role of Sharia in each component deeply. The barriers to SMEs' success identified are lack of knowledge and expertise related to the business, lack of capital financial support, the limitation of commercial banks' assistance, the complexity of regulations and government bureaucratic, such as the certification assurance (Indonesian National Standard for halal product), business license, equity, and human resources, competitiveness, commercial systems, innovation, government readiness, market possibilities, creativity, export prospects, business owner resistance and sustainability, local market awareness, women empowerment, internet and digital transformation, finance, admission, productivity, and infrastructure (Abdullah et al., 2023). These roadblocks provide evaluation of the obstacles posed by Sharia engagement in their business activities and supply chain.

The Quadruple Helix innovation model emphasizes the cooperation of four elements, namely local government as public authorities, industry, university, and education system. User community concerned with the integrated mechanism of innovation, economic growth, and productivity, as well as high technology, knowledge, and skill management of creative and innovative goods and services constitute new economic output (Moore et al, 2022). The Quadruple helix concept has been successfully proven to synergize the role of stakeholders in SMEs. Rosyadi et al. (2020) studied the involvement of multi-stakeholders in assisting the creative sector business. Roman et al. (2020) adopted the quadruple helix innovation theory by leveraging environmental affection to

overcome the economic development restriction. The Quadruple helix concept can integrate the care and assistance of previously separate components. Sharia banking is one of the issues devoted to the capital distribution and financing of small and medium-sized enterprises. However, the Covid-19 pandemic administers the disruption of the services for SMEs, unacceptable loans, reduced investment, weak market fragmentation, unfavorable regulations, unclear prospects of banking mergers, and inappropriate functionality of Sharia fintech management and support (Hassan et al., 2020). The emergence of various new start-up products accelerates the effectiveness and efficiency of SMEs' digitalization business (Syarifuddin et al., 2021). To support these, the fintech should pay attention to several factors, including the regulation, licensing, monitoring and supervision, customer protection, high risk of malware attacks, the legality of online loans, limited range of activities, lack of understanding of Shariah fintech, e-governance improvement, accounting, and Sharia audit, lacking scrutiny by Bank Indonesia (BI) and Financial Services Authority (OJK) (Rusydia, 2018). Moreover, the Council of Indonesia Ulama (Majelis Ulama Indonesia-MUI) has issued a fatwa related to Sharia Fintech. This strengthens the understanding of the technology-based financing services. However, the lack of ability and knowledge in empowering SME assistance, ineffective SME assistance, and the emergence of new start-up products frustrated the development and prioritization of the proper digital business model strategy (Hassan et al., 2020).

Lack of knowledge in managing and utilizing the right Product of Shariah Fintech

under the condition of SMEs' digitalization readiness inhibits the success and sustainability of the transformation. The understanding of the condition and significant priority level has a strong influence in determining the loan assistance of peer to peer (P2P), digital shariah finance, electronic aggregator, and digital management risk.

Advancing SMEs' digitalization readiness Model by Okfalisa et al (2021) with deep exploration and emphasizing on the role of quadruple helix and Sharia fintech grows into new novelty for this research in order to embark the successful of SMEs digitalization business based on Sharia. The research question states how's to develop a Sharia Fintech framework for SME's Digitalization Readiness based on the Quadruple Helix perceptions and how's the Quadruple Helix concerns on the significant contribution of this framework. Herein, twenty-four indicators from six constructs were qualitatively analyzed and confirmed through the conceptual Sharia Fintech framework development. Hence, the Decision Support System (DSS) Fuzzy-AHP approach is adopted in order to quantitatively identified the significant contribution of each indicator and constructs within the framework by emphasizing on the Quadruple Helix perceives and concerns towards the successful of SMEs digital readiness in supporting Sharia fintech. Therefore, the role of Quadruple Helix on SMEs digitalization readiness will be more optimal explored to bring about the success and sustain of Sharia Fintech transformation.

2. REVIEW OF LITERATURE

2.1. Conceptual Model Development

The conceptual model is developed by referring to the literature reviews and then strengthened through interviews with SME stakeholders from academicians, governments, marketplace actor, SME owners, investors, and the council of Indonesian Ulama as Quadruple Helix in charges. The systematic reviews were conducted by identifying 110 papers published on Sharia Fintech, SMEs Digitalization Readiness issues and models, and the role of Quadruple Helix between 2003-2021. It was conducted using 87 specifications from Scopus journals and 23 from proceedings conferences. The analysis was performed using Atlas.ti 9 Software Packages by limiting the discussion to inclusion and exclusion criteria. Furthermore, it reviewed the Sharia digitalization readiness assessment model from the Quadruple Helix's perspective, which perceives the assessment into economic and IT platforms (Okfalisa et al., 2022) as depicted at Figure 1. Meanwhile, the interviews were conducted in accordance with Table 1 regarding the possible indicators and sub-indicators for gauging SME preparedness in Sharia perceives. To overcome the restriction of community interaction and breaking down the Covid-19 spread, Fintech emerges as an alternative solution in ensuring the sustainability of the business economic activity. Fintech inclines as information and financial technology tools in providing financial services at affordable costs, user-friendliness, and ease of transaction procedures (Syed et al., 2021; Hassan et al., 2020). In the Sharia context, a fintech grows into economic digitization

platform that provides financial services and assistance following Islamic Sharia regulation (Hassan et al., 2020).

Recently, Sharia finance has had a great opportunity in conquering financial problems after Covid-19. The perception of Sharia finance prohibits interest rates (*riba*), presumes the money as a transaction medium instead of a commodity, and guarantees no financial transactions without asset revitalization. Thus, Sharia finance boots the conceiving of financial system freedom based on profit and loss. Sharia finance services utilize and adapt the customer demands as a community financial tool, including Zakat, Qardh-Al Hasan, Sadaqa, Mudaraba, Islamic Microfinance, Sukuk, and Waqf (Hassan et al., 2020). However, the Covid-19 crashes into several challenges for Sharia finance as well as fintech, including market fragmentation due to limited travel and communication (Ozili, 2020); reduced investment and income, particularly in Sharia Microfinance and SMEs; high dependence on government assistance; zero cash owing to the delay of Equated Monthly Installment (EMI) payment; negative implications of liquidity need; and uncertainty of business merger. Hence, these encourage Sharia Fintech to administer such financial innovation services through the engagement of Sharia financial institutions and the banking system (Syed et al., 2021; Hassan et al., 2020).

Sharia banking adopts 5C prudence principles that call to mind in credit policies, credit quality assessment procedures, and the professionalism and integrity of credit foundation. According to Okfalisa et al. (2022), five principles figure out the character of prospective vagabond; the capacity of customers credit payment; the customers' capitalization; the customer

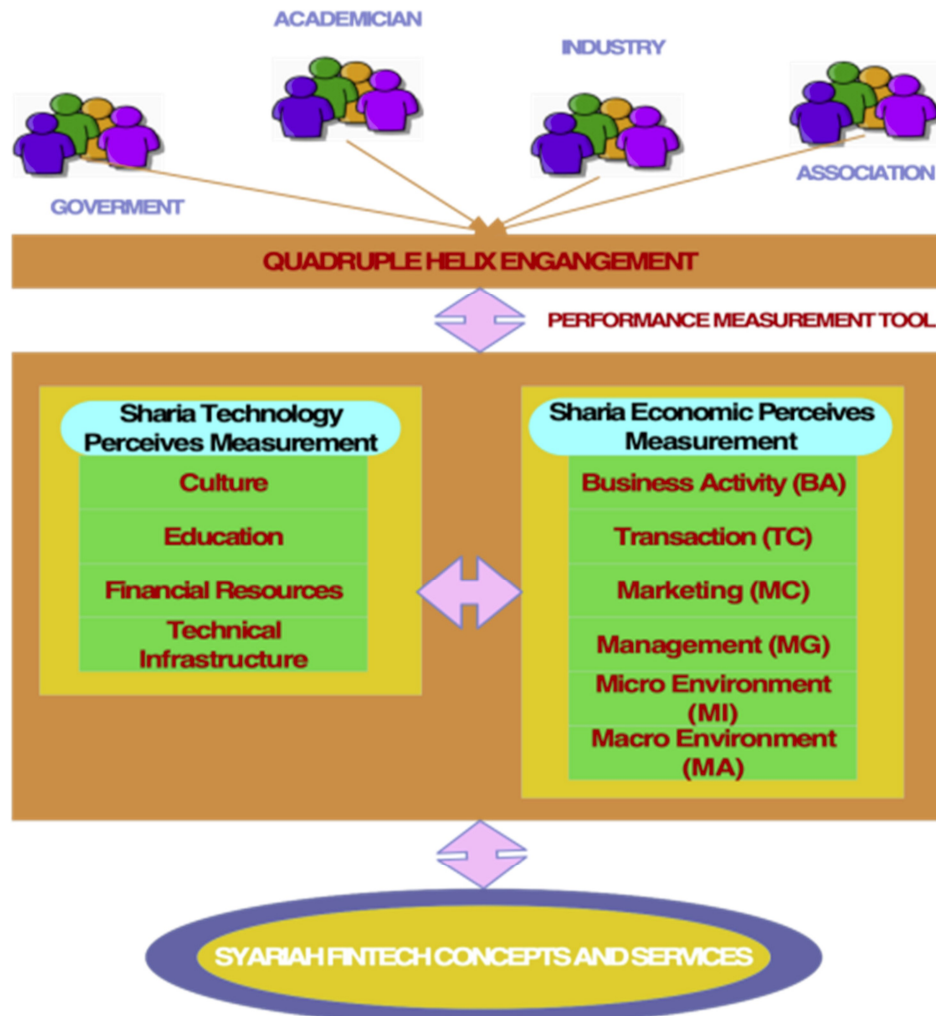


Figure 1. Conceptual model of SMEs digitalization readiness in supporting sharia fintech

collateral guarantee physically and non-physically; the customer sustain and economic condition. This 5C concept grows into the Sharia fintech consideration in providing the credits based on SMEs' digitalization preparedness.

These above are proven that digital transformation enhances and maximize SME business performance. However, since the ICT investment in transformation requires great intention and financial hazard, infrastructure, operational management, digital acceptance, and digital learning,

skills, abilities, and competencies, the measuring SMEs' digitalization readiness emerges as a solution in avoiding the various possible failures of digitization. Understanding the degree of digitization and servitization enforces the SMEs addressed to the right digital solutions, optimal business strategies, business models, and effective technology adoption (Paschou et al., 2018).

Emphasizing the Sharia previews, SMEs' digitalization readiness is a prerequisite for assuring readiness in Sharia, economy, and IT perspectives transformation achievement

Table 1. Sharia compliant SMEs' digitalization readiness variables (1/2)

Sharia Economical Perceives		
No.	Criteria	Reference
1	Business activities (BA) – BA is measured based on business activities related to production, management strategy, resources, distribution, and consumer protection. Sharia is captured through the implication of the mutual trust principles, fairness, communicativeness, and honesty as an Islamic way of life within business activities.	Umeh et al., 2020; Camilleri, 2018; Li et al., 2020a; Islam & Wahab, 2021; Okfalisa et al., 2021.
2	Transaction (TC) – TC is deliberated through several digital commercial activities, including digital data transactions and infrastructure (viz., e-commerce, financial technology (Fintech), and social media as a platform for digital business purposes); digital utilization platforms for manufacturing, marketing, sales, business presentation, and strategy models determinations. The perception of Sharia is recognized through the applicative of Islamic law and <i>Akidah</i> during the digital commercial transaction process when both parties ensure the business transaction is performed with good intentions and goals following trustworthiness, keeping promises (<i>Amanah</i>), and not committing fraud.	Ilbiz & Durst, 2019; Axmann & Harmoko, 2020; Islam & Wahab, 2021; Okfalisa et al., 2021; Hassan et al., 2020.
3	Marketing (MC) – MC is defined as ideas, products, services, and the use of technology to meet market opportunities. Aspects of Sharia that are emphasized in this marketing construct regard the theological factors (<i>rabbaniyah</i> nature or divine values in upholding the enforcing Islamic law with perfect, harmony, goodness, preventing evil, realizing the truth, destroying falsehood, and disseminating benefits), ethical (within the exertion of <i>akhlaqiyyah</i> within activities that prioritizes morals and ethics), realistic (pursuing the concept of <i>al-waqi'yyah</i> in the form of marketing flexibility, Islamic sharia resilience, and humanistic (the application of <i>al-insaniyyah</i> concepts through the nature awareness of universal, controlled, balanced, far from greedy, and high social awareness).	Castagna et al., 2020; Cluley et al., 2020; Orciuoli et al., 2020; Suhendi et al., 2020; Adam et al., 2020; Islam & Wahab, 2021; Okfalisa et al., 2021.
4	Management (MG) – MG is the ability of SMEs to plan, organize, manage, control, maintain, creative and partner development and business sustainability, especially during digital transformation. Sharia perceives the above components are measured from the aspect intertwin on organizational vision and mission, guidelines and law direction, effective management promotion, supervision and coordination, communication, and transparency.	Lou et al., 2020; Yousaf et al., 2020; Wong et al., 2020; Randel et al., 2018; Islam & Wahab, 2021; Okfalisa et al., 2021.
5	Micro Environment (MI) – MI is spelled out as internal factors that directly or indirectly affect the digitalization readiness of SMEs. This include stakeholder views, marketing system, productivity, management, operational functions, technology adoption, market needs, regulation/strategy/vision, pricing and licensing. The aspects were analyzed by considering the opportunities on demand and supply of halal products, the elasticity of blessings, the Muslim consumer's behavior who preoccupy halal goods, no usury, and <i>mashlahah</i> as well monopolistic market competition.	Lou et al., 2020; Umeh et al., 2020; Karman, 2020; Musari & Fathorrazi, 2021; Okfalisa et al., 2021; Islam & Wahab, 2021;
6	Macro Environment (ME) – ME is the external boundary factors that affect SMEs' digitalization readiness, such as demography, regional economy, technology, environment, politics, government support, culture, and competitors. Sharia scrutinizes the significance of social aspects and benefits to the environment or society. For example, reducing unemployment, the balance of payments, inflation and economic growth, increasing national income, investment, saving, infaq, zakat, and alms.	Singh et al., 2021; Pal et al., 2020; Musari & Fathorrazi, 2021; Okfalisa et al., 2021; Islam & Wahab, 2021

Table 1. Sharia compliant SMEs' digitalization readiness variables (2/2)

Sharia Economical Perceives		
No.	Criteria	Reference
7	IT-Culture–It is defined by the SMEs' socio-cultural preparedness, awareness, knowledge, creativity, attitude, satisfaction, trust, self-confidence, and behavior toward the emotional adaptation of digital technology without compromising Sharia principles in everyday life activities.	Paschou et al., 2020; Wahyuni et al., 2020; Islam & Wahab, 2021
8	IT-Education–It is exemplified as the readiness to grow the digital skills, knowledge sharing capability, creativity, and innovation in supporting technology adoption without compromising Sharia values in daily life activity.	Paschou et al., 2020; De Marco et al., 2020; Okfalisa et al., 2021; Islam & Wahab, 2021
9	IT-Financial Resources– It is designated as the readiness of SMEs' financial assets to reinforce digital technology adoption by preconditioning the availability of loans or capital assistance, grants, and resources supporting programs through training, seminars, and exhibitions without compromising Sharia values.	Peillon and Dubruc, 2019; Galligan & Mansor, 2011; Okfalisa et al., 2021; Islam & Wahab, 2021
10	IT-Infrastructure– It is related to IT infrastructure, hardware and software, standardized infrastructure, access time, speed, accuracy, and utilization to support digitalization without compromising Sharia values.	Budhiraja, 2019; Suhendi et al., 2020; Okfalisa et al., 2021; Islam & Wahab, 2021; Hassan et al., 2020

within the SMEs sector. This success factor would provide SMEs with a better opportunity to develop other drivers of digitalization success, such as resource availability, digital readiness in Sharia, managerial expertise for digital transformation, and digital sophistication of business partners (Ghobakhloo & Iranmanesh, 2021).

Figure 1 explains that the essential performance predictors that SMEs can develop from economic and IT of Sharia perceives and, as a result, gain the education regarding on the competency to perform a comprehensive digitalization readiness pre-assessment are infrastructure and finance supported as resource availability, culture digital readiness in Sharia application, and management competency for digital transformation. At present, business partners' digital maturity as well as Quadruple Helix contribution and involvement combined with digitalization readiness pre-assessment capability and digital Sharia training and education, would

confess SMEs to generate transitional success predictors of organizational change qualifications, knowledge, digital technology skills, and manufacturing digitalization strategic road-mapping (Ghobakhloo & Iranmanesh, 2021).

In nutshell, the more mature of Quadruple Helix components towards the digital readiness, the more risks minimization on the failure of SMEs digitalization. The three main dependent success factors on the right side of the industrial digital transformation as well as fintech accomplishment are cybersecurity readiness, information and digital technology capability, and operations technology preparedness, which are the most demanding and complicated achievements.

2.2. DSS Fuzzy-AHP

The Analytical Hierarchy Process (AHP) model is a popular and successful Multi-Attribute Decision Making (MADM) technique for determining the significant criteria values in project assessment. It

provides the capability to solve complex and unstructured problems into the hierarchy criteria and sub-criteria levels (Ghosh, 2023). It can tolerate decision-makers' assessments and diverse views when dealing with multiple criterion decision-making situations (Okfalisa et al., 2018; Chen et al., 2020). Additionally, it divides the decision-makers' viewpoints into 1 to 9 degrees as given preferences against alternatives preferred. The consistency of the comparison matrices reflects the decision-makers caution in launching unfinished judgments and affects the acceptably persistent indicators. Fuzzy-AHP was introduced to cope with decision-makers fuzziness and uncertainty judgments through the set numbers operation (Liu et al., 2021; Astanti et al., 2020). Therefore, the vagueness of human thoughts, human thinking style, and linguistics terms was sufficiently handled by integrating the fuzzy approach in AHP. It was utilized by Ban et al. (2020) to spell out the different perceptions of decision-makers language and variables. Lyu et al. (2020) employed Fuzzy-AHP to establish a consistent judgment matrix in a new consulting process toward an adequate risk assessment model. Meanwhile, Okfalisa et al. (2021) brought the decision support system approach to determining the priority indicators in appraising the SMEs' digitalization readiness. Abdullah et al. (2023) explained the flow activity of Fuzzy-AHP below.

The analysis is started through the structure hierarchy development of the Sharia-compliant digitalization readiness model (See Figure 2). The hierarchy showed the model construction of variables and sub-variables categorization set as criteria. Therefore, the Fuzzy-AHP analytical was operated to verify the model construction over the figuring of the pairwise matrix

comparison values, including the Consistent ratio (CR), Consistency Index (CI), and Random Index (RI). The Fuzzy transformation was neglected by following the Triangular Fuzzy Number (TFN) scale as depicted in Table 2 (Liu et al., 2021). TFN is a trapezoidal number that provides a linear mathematical model conversion using l , m , and u parameters ($l \leq m \leq u$) for weighting the fuzzy function of criteria and alternatives. Therefore, these numbers can consider a significant operation to achieve the optimum ranking results (Zavadskas et al., 2020; Hossain et al., 2021).

Next, the calculation of Fuzzy Synthesis (S_i) values was assisted by the formula in Equation (1):

$$S_i = \sum_{i=1}^m M_{gi}^j x \left[\sum_{i=1}^n \sum_{j=1}^m M_{gi}^j \right]^{-1} \quad (1)$$

S_i extent is determined by considering the synthetic values from total amount of criteria (m) transformation within TFN scale (M). It describes in (g) parameter as (l, m, u) against the pairwise matrix in rows (i) and column (j) comparison. The synthesis extent values showed that the calculation of vector value (V) defines in $M2 = (l2, m2, u2) \geq M1 = (l1, m1, u1)$ whereby $V (M2 \geq M1) = \sup[\min(\pi M1(x)), \min(\pi M2(y))]$ and

$$V(M2 \geq M1) \begin{cases} 1 \text{ if } m_2 \geq m_1 \\ 0 \text{ if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} \end{cases} \quad (2)$$

This number indicates the relative priority or weight of one criterion over another. The calculation of De-fuzzification Ordinary Value (d') for criteria numbers ($k = 1, 2, n; k \neq I$). The vector weight (W) value for each alternative (A) is calculated using the

formula at Equation (3):

$$W = (d'(A1), d'(A2), \dots, d'(An))^T. \quad (3)$$

Furthermore, the normalization value of fuzzy vector weights (W) is estimated using the formula at equation (4):

$$(A_n) = \frac{d'}{\sum_{i=1}^n d(A_n)} \quad (4)$$

whereby $W = (d(A1), d(A2), \dots, d(An))^T$ and W is a non-fuzzy number.

3. METHODOLOGY

The stages were undertaken in developing the SMEs' Digitalization Readiness in Sharia Fintech framework, including the formulation stage and the framework development stage (See Figure 3). The formulation stage was carried out by identifying phenomena, significant issues, and problems. This exploration activity was performed theoretically and surveyed through interviews. The basic scientific concepts used as references in the development of this study were Islamic banking economic. Fintech technology, and Sharia Fintech obtained through books, proceedings, or journals. A systematic literature review was attempted with the limitations of journals and conference papers under scopes in the last year. As an outcome, a construct development instrument was formed to measure the digitalization readiness of sharia-based SMEs, as shown in Table 1.

Initial interviews with several practitioners of economics, Islamic banking, and fintech technology were conducted to

strengthen hypotheses and linkage between theory and practice. The Quadruple Helix concept was applied within four respondents' components, including the government that consists of Ministry of Cooperatives and SMEs, the Ministry of Industry and Trade of SMEs cooperatives, the Integrated Business Service Center (IBSC), the Ministry of Communication and Information, and the Central and Regional Communications and Information Office (Riau Province, West Nusa Tenggara (NTB), Samarinda, and Yogyakarta). As an academicians in the field, the part domestically involved Telkom University, Universitas Islam Negeri Sultan Syarif Kasim Riau (UIN Suska Riau), Mataram University, Mulawarman University, and abroad (Taibah University, Saudi Arabia. Meanwhile, the elaborate practitioners involved the Sharia Finance and Fintech companies, Bank Indonesia, Bank Syariah Indonesia, Telkom Investors, the Financial Services Authority, Amanna/ Alami Sharia/ Qazwa, and Indonesian Ulema Council. The community parties are performed from the marketplace (Nusa Tenggara Barat Mall, Padiumkm, Wiranesia) and SMEs association. As a result, Table 1 was confirmed, the questionnaire instrument was accomplished and the conceptual revised framework was then developed.

Next, the framework development stage is then flourished in order to identify the significant factors of model development based on the perceives of Quadruple Helix's components. Herein, a quantitative analysis using Decision Support System approach is adopted. The analysis was conducted by disseminating the proposed Saaty (Li et al., 2020b) questionnaire with semi-structured interviews platform and nine priority scales for each construct and indicators. The respondents were limited to at least one top-

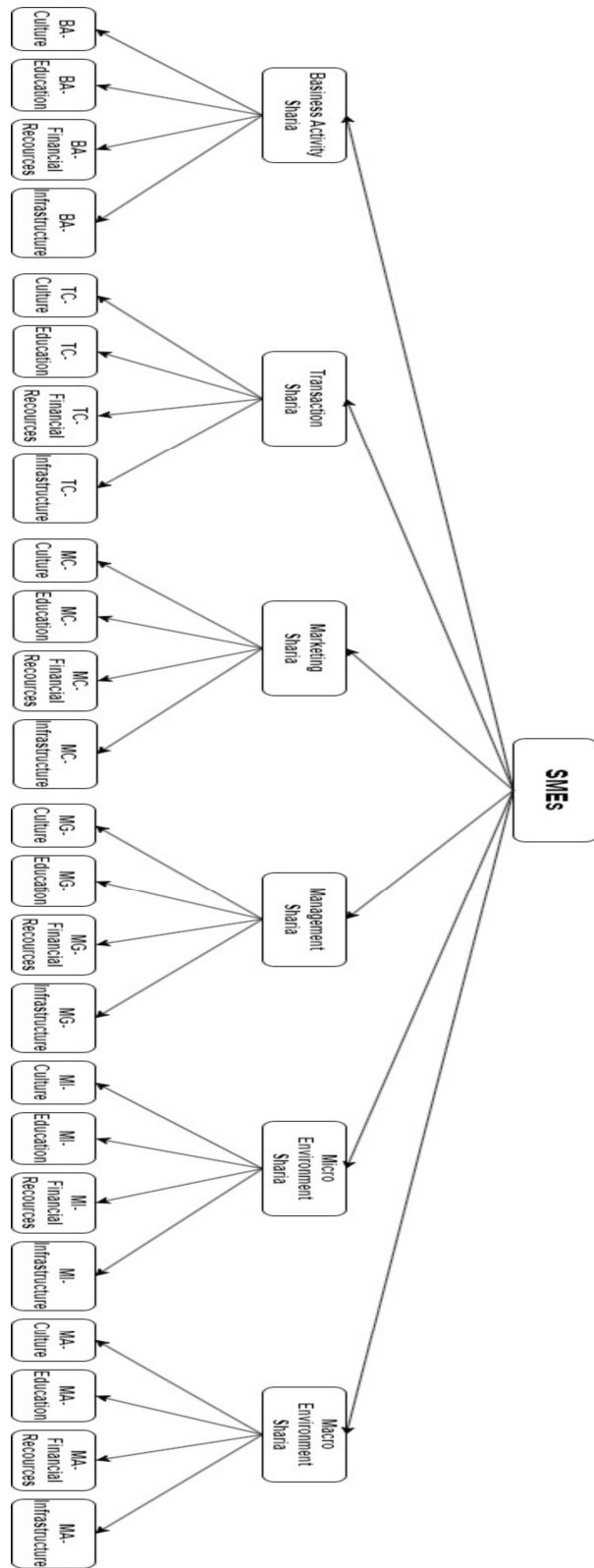


Figure 2. Hierarchical structure of SMEs' digitalization readiness model towards sharia fintech

Table 2. Scale of fuzzy AHP usage fuzzy conversion Scale

Scale	TFN Scale	TFN Invers Scale
1	(1,1,1)	(1,1,1)
2	(1/2, 1, 3/2)	(2/3, 1, 2)
3	(1,3/2, 2)	(1/2, 2/3, 1)
4	(3/2, 2, 5/2)	(2/5, 1/2, 2/3)
5	(2, 5/2,3)	(1/3, 2/5, 1/2)
6	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)
7	(3,7/2, 4)	(1/4, 2/7, 1/3)
8	(7/2, 4, 9/2)	(2/9, 1/4, 2/7)
9	(4, 9/2, 9/2)	(2/9, 2/9, 1/4)

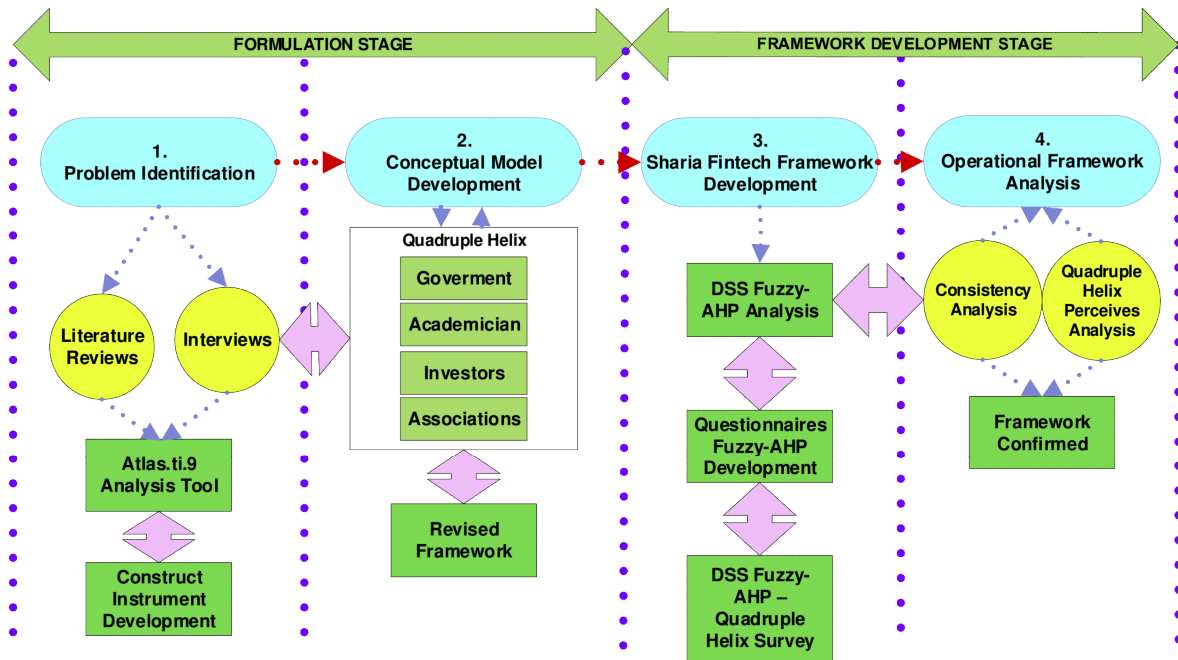


Figure 3. Research flow activities

level management from each Quadruple Helix component with knowledge and experience in Sharia Fintech services and SMEs at a minimum maturity of 3 years. This instrument aimed to ask respondents' opinions regarding their assessment of six

variables, namely BA, TC, MG, MC, MA, and MI, with 24 sub-criteria (See Table 1). Furthermore, the pursuit of DSS-Fuzzy AHP in this questionnaire effectively accommodates the Quadruple Helix perspective of diversity in transcribing the

linguistic data (Liu et al., 2021). A stage process of DSS Fuzzy-AHP is undertaken by following the section 2.2 from Equation [1] to [4]. An expert judgment was conducted through a Focus Group Discussion (FGD) by applying a pairwise comparison approach of DSS Fuzzy-AHP to validate the analysis. This translated qualitative evaluations into numerical assessments and examined the consistencies. Therefore, the eigenvector values for each variable were normalized and the significant level was accomplished to confirm the framework. To answer the research problems on operational framework, two kinds of analysis was conducted using the Fuzzy-AHP. One analysis emphasizes on the framework development, and the second one concerns on the Quadruple Helix contribution analysis on the significant indicators and constructs. In a nutshell, the Sharia Fintech framework will describe the essential of the Quadruple Helix perception as a policymaker in translating and ensuring the model's success.

4. RESULTS

Following the DSS Fuzzy-AHP stages at Section 2.2, the constructs and indicators of Sharia SMEs Fintech readiness Model are analyzed as below.

a. The Hierarchy diagram of the SMEs' Digitalization Readiness Model toward Sharia Fintech can be depicted in Figure 2. Level 1 indicates the constructs development, including BA Sharia, TC Sharia, MC Sharia, MG Sharia, MA Sharia, MI Sharia. Level 2 depicts the twenty-four indicators or sub criteria to elucidate the mapping analysis of Sharia economic and IT perceives, viz., BA-Culture, BA- Education, BA-Financial, and BA-Infrastructure, and follows by the similar pattern for TC Sharia, MC Sharia, MG Sharia, MA Sharia, and MI Sharia.

b. DSS Fuzzy-AHP Analysis on Sharia Economic Perspective

Referring to Equations [1 to 4], The result of the analysis is explained in Table 2 and 3. Table 2 explains the Fuzzy-AHP conversion scale in transforming the respondents' answers from the questionnaires (TFN). Meanwhile, the Table 3 shows the CR value

Table 3. Matrix of pairwise comparison and fuzzy AHP synthesis weight value of sharia economic perspectives

Factor	Low	Middle	Upper	AHP Eigen Vector Values	FuzzyAHP Eigen Vector Values	CI	CR	RI	λ
BA	0.14	0.14	0.14	0,23	0.17				
TC	0.12	0.12	0.12	0,18	0.17				
MC	0.10	0.10	0.10	0,14	0.17	0.0	0.0	1.2	6.03
MG	0.13	0.13	0.13	0,21	0.17	1	1	4	
MI	0.09	0.09	0.09	0,12	0.15				
MA	0.09	0.09	0.09	0,12	0.16				

of 0.01 (standard CR value <10%), indicating that the entire variables are consistence in developing the SMEs' Digitalization Readiness for Sharia Fintech Model. The DSS Fuzzy-AHP eigenvector values determine the priority weights of each construct from an economic perspective. This is conducted by the highest significance values being BA (Business Activities) Sharia, TC (Transactions) Sharia, MC (Marketing) Sharia, and MG (Management) Sharia, with a weighted score of 0.17. It is then followed by the MA Sharia construct (Macro Environment) and MI (Micro Environment) Sharia with the values of 0.16 and 0.15, respectively.

c. DSS Fuzzy-AHP Analysis of mapping sub-indicators of Economic Perspective against IT Perceives is illustrated in Table 4.

Table 4 shows that the highest significance value of sub-indicators in BA Sharia is BA-Technical infrastructure with a weight of 0.27, followed by BA-Culture, BA-Education, and BA-Financial Resources with a weight of 0.24. The TC Sharia construct indicating the highest significance value of the sub-indicator is TC-Technical infrastructure with a weight of 0.28, followed by the TC-Culture, TC-Education, and TC-Financial Resources with a weight of 0.24. For the MC Sharia contracts, the highest significance value is MC-Culture, MC-Education, and MC-Financial Resources with a weight of 0.27. This is followed by the MC-Technical infrastructure with a significance weight of 0.20 as the lowest weight. For the MG Sharia, the construct with the highest significance value is MG-Culture with a weight of 0.34. This is followed by the sub-variables MG-Education, MG-Financial Resources, and MG-Technical Infrastructure with a weight

of 0.22. For the MI Sharia, the construct with the highest significance value of sub-indicator is MI-Technical infrastructure with a weight of 0.29, followed by the MC-Education, MI-Culture, and MI-Financial Resources with a significance weight of 0.24. Meanwhile, MA Sharia accomplishes MA-Technical infrastructure as the highest significance value of sub-indicators with a weight of 0.32, followed by MA-Culture, MA-Education, and MA-Financial Resources with a significance weight of 0.23.

d. DSS Fuzzy-AHP Analysis based on the Quadruple Helix Previews

The recapitulation of the DSS Fuzzy-AHP analysis based on the general Quadruple Helix previews can be seen in Table 5. Table 5 reviews the priority scale in preparing SMEs' Digitalization Readiness Model-based Sharia Fintech by growing the vitality of Sharia Business Activity-BA (0.16), Transaction-TC (0.16), Marketing-MC (0.16), Management-MG (0.16), and Macro Environment-MA (0.16) through the development of Technical Infrastructure for facilitating the economy activities. This is achieved using the proper technical infrastructure, sharpening the marketing strategy with culture, education, and financial resources, enhancing the competitive management business and culture, powering the macro economy through technical infrastructure advancement, and increasing the technical infrastructure of the micro economy.

5. DISCUSSION

a. Sharia Fintech Framework

As a result, a Sharia Fintech operational

Table 4. Economic perspective pairwise comparison matrix and fuzzy-AHP synthesis weight value based on IT perspectives (1/2)

Factor	Low	Middle	Upper	AHP Eigen Vector Values	Fuzzy-AHP Eigen Vector Values	CI	CR	RI	λ
Business Activity (BA)									
BA-Culture	0.20	0.28	0.39	0.30	0.24				
BA-Education	0.17	0.25	0.38	0.27	0.24				
BA-Financial Resources	0.16	0.25	0.38	0.25	0.24	0.01	0.01	0.9	4.03
BA-Technical Infrastructure	0.15	0.22	0.32	0.18	0.27				
Transaction (TC)									
TC-Culture	0.18	0.24	0.32	0.24	0.24				
TC-Education	0.18	0.26	0.37	0.26	0.24				
TC-Financial Resources	0.20	0.28	0.41	0.31	0.24	0.01	0.02	0.9	4.04
TC-Technical Infrastructure	0.16	0.22	0.31	0.19	0.28				
Marketing (MC)									
MC-Culture	0.22	0.29	0.39	0.35	0.27				
MC-Education	0.18	0.27	0.39	0.28	0.27				
MC-Financial Resources	0.17	0.24	0.35	0.21	0.27	0.01	0.01	0.9	4.03
MC-Technical Infrastructure	0.14	0.20	0.29	0.16	0.20				
Management (MG)									
MG-Culture	0.17	0.23	0.31	0.23	0.34	0.00	0.00	0.9	4.01
MG-Education	0.18	0.27	0.39	0.28	0.22	3	4	9	
MG-Financial Resources	0.18	0.27	0.39	0.27	0.22				
MG-Technical Infrastructure	0.16	0.23	0.34	0.21	0.22				
Micro-environment (MI)									
MI-Culture	0.19	0.26	0.36	0.28	0.24				
MI-Education	0.18	0.26	0.38	0.30	0.24				
MI-Financial Resources	0.16	0.25	0.36	0.24	0.24	0.01	0.02	0.9	4.04
MI-Technical Infrastructure	0.16	0.23	0.33	0.19	0.29				

Table 4. Economic perspective pairwise comparison matrix and fuzzy-AHP synthesis weight value based on IT perspectives (2/2)

Factor	Low	Middle	Upper	AHP Eigen Vector Values	Fuzzy-AHP Eigen Vector Values	CI	CR	RI	λ
Macro-environment (MA)									
MA-Culture	0.18	0.25	0.32	0.25	0.23				
MA-Education	0.18	0.26	0.37	0.25	0.23				
MA-Financial Resources	0.18	0.27	0.39	0.29	0.23	0.01	0.01	0.9	4.03
MA-Technical Infrastructure	0.16	0.23	0.32	0.21	0.32				

framework has been detailed explained and developed. The significant analysis of each construct and sub-indicators has been ranked and recapped as Table 5. The finding at Table 5 are also supported by Peillon and Dubruc (2019) that found the technical barriers commonly construct during the operational process as well as business activities, effectiveness, and efficiency of digital transformation readiness, including the financial support and technical resources. Mittal et al. (2018) argued that the lack of financial and technical infrastructure adoption affects the un-optimal achievement of digitalization success. The technological developments and the industrial revolution demand the adoption of technology leading to the use of the internet of things, big data analysis, cloud computing, cybersecurity, augmented reality, smart manufacturing solutions, additive manufacturing, connected manufacturing simulation, manufacturing digitalization strategic road mapping, and artificial intelligence in every SMEs business, operational activity, and services. Saghafian et al., (2021) also studied that technology adoption motivates the employees to be more engaged and

communicative. They are more likely to be innovative and to feel more secure and willing to share and acquire knowledge from others. Moreover, the technology changes that aligned with the organizational culture, tailored to the audience, consistent, continuous, and honest will enhance the employees' sense of trust and perceived fairness, and reduce feelings of anxiety thus creates the coherence and harmonization of collaboration. Therefore, the proper adoption and transformation of technical infrastructure implicates as media in controlling of Shariah trust principles, fairness, communicativeness, and honesty within Business Activities-BA, Transaction-TC, Marketing-MC, Management-MG, and Macro Environment-MA. The Shariah fintech provides efficiency in mobile banking, cheap transaction costs, and transparency and flexibility are essential aspects of Shariah rules and objectives, thus it facilitates the collaborative effort of resource and information sharing that influence on the economy, environment, and society.

Meanwhile, Micro Environment MI (0.15) was indicated as the lowest priority

Table 5. Recapitulation of priority values on variables and sub-variables based on general quadruple helix previews (1/2)

No	Variable and Sub Variable	Priority Value (Eigen Vector)	Priority Value (Eigen Vector)	Priority Value (Eigen Vector)			
				Government	Academics	Investors	Association
1.	Bisnis Activity (BA)	0.16		0.19	0.32	0.17	0.17
	BA-Culture		0.24	0.23	0.23	0.44	0.24
	BA-Education		0.24	0.23	0.30	0.19	0.24
	BA-Financial Resources		0.24	0.23	0.23	0.17	0.24
	BA-Technical Infrastructure		0.27	0.29	0.23	0.20	0.27
2.	Transaction (TC)	0.16		0.19	0.24	0.17	0.17
	TC-Culture		0.24	0.31	0.32	-0.01	0.24
	TC-Education		0.24	0.31	0.03	0.33	0.24
	TC-Financial Resources		0.24	0.28	0.36	0.33	0.24
	TC-Technical Infrastructure		0.28	0.10	0.29	0.33	0.28
3.	Marketing (MC)	0.16		0.15	0.26	0.17	0.17
	MC-Culture		0.27	0.23	0.16	1	0.27
	MC-Education		0.27	0.30	0.50	0	0.27
	MC-Financial Resources		0.27	0.23	0.34	0	0.27
	MC-Technical Infrastructure		0.20	0.23	0	0	0.20
4.	Management (MG)	0.16		0.19	0.20	0.17	0.17
	MG-Culture		0.34	0.26	0.34	0	0.34
	MG-Education		0.22	0.26	0.19	0.33	0.22
	MG-Financial Resources		0.22	0.26	0.25	0.33	0.22
	MG-Technical Infrastructure		0.22	0.22	0.21	0.33	0.22
5.	Micro Environment (MI)	0.15		0.14	0	0.16	0.16
	MI-Culture		0.24	0.30	0.80	0.24	0.24
	MI-Education		0.24	0.23	0.20	0.24	0.24
	MI-Financial Resources		0.24	0.23	0	0.24	0.24
	MI-Technical Infrastructure		0.29	0.23	0	0.29	0.29

Table 5. Recapitulation of priority values on variables and sub-variables based on general quadruple helix previews (2/2)

No	Variable and Sub Variable	Priority Value (Eigen Vector)	Priority Value (Eigen Vector)	Priority Value (Eigen Vector)			
				Government	Academics	Investors	Association
6.	Macro Environment (MA)	0.16		0.14	-0.01	0.17	0.17
	MA-Culture		0.23	0.28	0.90	0.12	0.23
	MA-Education		0.23	0.24	0.10	0.29	0.23
	MA-Financial Resources		0.23	0.24	0	0.29	0.23
	MA-Technical Infrastructure		0.32	0.24	0.	0.29	0.32

among variables from the preparedness of sub indicators MI-Culture, MI-Education, and MI-Financial Resources (0.24). This can be understood that most of these variables are under Indonesia's government regulation and policy authority instead of SMEs itself, such as the regulation/strategy/vision, pricing and licensing, the opportunities on demand and supply of halal products, and controlling the monopolistic market competition. Nevertheless, the Technical Infrastructure on supporting MI grows into the crucial factors in providing the advance digital marketing analytical system, stakeholders' views, market and halal product analysis demand and supply with the value of 0.29. Herein, the Sharia fintech values in terms of halal product qualification and licensing, Muslim consumer's behavior, no usury, and mashlahah becomes the consideration variables.

Darnihamedani and Terjesen, (2022) found that entrepreneurs' growth ambitions are higher in countries with more efficient regulations, particularly those countries characterized by fewer labor law restrictions and greater monetary freedoms. A business without excessive government interventions

as well as regulation efficiency around registering, hiring, and firing employees, and price controls on currency develops into more freedom to start and run the business activities. Because, the efficiency of regulations varies substantially among countries and imposes additional costs and risks on entrepreneurs' activities, organizational structure, management and leaderships, and decision making. Moreover, reduce the bureaucratic processes, transparency and oversight on cash transfers, involve SMEs in procurement process, review internal procedures and regulations to facilitate digital adoption, and provide the proactive role to persuade SMEs in registering their businesses become the main government targeted on the sustainability of SMEs business activities particularly in facing post Covid-19 (Kergroach, 2020).

Concerning the values of sub variable culture and education (skills and competencies), especially for construct Management (MG) and Marketing (MC) aspects plays the significant roles in ensuring the achievement of SMEs' Digitalization Readiness Model towards Sharia Fintech. These issues are also supported by Peillon et

al. (2018), who stated that achieving SMEs digital business is strongly influenced by changes in organizational management, especially related to skills and supporting competencies, digital transformation, organizational culture readiness, awareness, unwillingness to change, and pessimism about the success of the change. The creativity, innovation, and collaboration of resources are needed in management, especially from the leadership aspect to trigger the production activities, operations, and the concept of SMEs' business management. Klein et al. (2018) and Ghobakhloo and M. Iranmanesh (2021) found that abilities, competencies, and skills in using digital technology are related to marketing competencies in sales, customer analysis, and service improved through training and education. The Quadruple Helix components stated that Management (MG), Marketing (MC), Transaction (TC), and Business Activity (BA) are fairly influential variables towards the success of SMEs' Digitalization Readiness Model. However, there is no significant difference between Macro (MA) and Micro Environment (MI) variables, especially for the academic perceptions. A similar outcome is also denoted by Wahjusaputri et al. (2020), who studied the impact of Fuzzy-AHP on the success of SMEs in Indonesia. Furthermore, Yıldızbaşı and Unlü (2020) also stated that information technology is an indispensable factor in achieving prosperity in SMEs businesses.

b. The Quadruple Helix Contribution

The mind-map decision-making priorities of Quadruple Helix in supporting the SMEs success digitalization are explained of Tables 6. Tables 6 explained the roles and

recommendation for Quadruple Helix' components in policy making, regulation controls, and partnerships in order to align with SMEs achievements and activities. Table 6 indicates that the government should be concerned with the development of technical infrastructure within Business Activities as well as Transaction. For instance, the government provide a deposit insurance agency as a guarantee institution to cover the squander of lender's funds by preparing the regulation, policy-making, and sense of protection regards to the existence of Sharia fintech within the business platform, starting from business model, managerial, and operationalize across the stakeholder's involvement. In addition, the government through Financial Services Authority (OJK), Bank Indonesia, and the others government agencies administer the growth of Sharia fintech within SMEs' business activities by facilitating the licensing, registering, hiring, firing employees, price controls, and creation and innovation of halal products or any outcome sharia based. The facts that Sharia fintech relies heavily on the technological and infrastructure solution in providing the financial services as well as financial and products transaction. Unfortunately, the lack of Sharia banking system as Sharia fintech partners thus following OJK's regulation in terms of numbers and quality impacts to the availability of digital financial features and access and supporting technological devices. Besides, the assistance of Sharia supervisory board in monitoring and evaluating the context alignment of Sharia fintech requires a full consideration by government.

Meanwhile, the reinforcement regulation and procedures regard on education, culture, and financial resources within the construct marketing (MC), management (MG), micro-

Table 6. Priority determination of quadruple helix

No	Construct	Priority of Government	Priority of Academics	Priority of Investors'	Priority of Association
1	BA	Technical Infrastructure	Education	Culture	Technical Infrastructure
2	TC	Technical Infrastructure	Culture and Education	Culture, Education, and Financial Resources	Technical Infrastructure
3	MC	Education	Education	Culture	Culture, Education, and Financial Resources
4	MG	Culture, Education, and Financial Resources	Culture	Education, Technical Infrastructure, and Financial Resources	Culture
5	MI	Culture	Culture	Technical Infrastructure, and	Technical Infrastructure
6	MA	Culture	Culture	Education Technical Infrastructure and Financial Resources	Technical Infrastructure

environment (MI), and macro-environment (MA) are required in ensuring the digital transformation within SMEs' environment is success. For instance, the government need to prepare the supporting educational policies as well as knowledge acquisition and skills activities to enhance the utilization of technological promotion tools, Sharia fintech educational sharing, socialization, and awareness with the various application platforms of Sharia context, such as akad (agreement), al- mas'uliyah (responsibility), al-Amanah (trustworthiness), and the boundaries of allowed (halal) or banned (haram) from the standpoint of Maqasid Al-Shariah. The components of al-mas'uliyah and al-Amanah assist the development of individual and social human character towards Islamic culture and ethical standpoints. Herein, the government boost the value co-creation, industry initiation, innovative activities, business environment, islamic capital

market, and customers and partnerships protection schema through the betterment of education, culture, and financial support. Thus, Sharia fintech with its application and platform hand over the guarantee of SMEs sustainability and competitive advantages. Moreover, the government should pay attention on the restriction of demography, the economy country, information technology equity, physical environment, law and political changes in ensuring the flexibility and alignment of policies and procedures of Sharia fintech employment.

Table 6 also points out the perceives of academician whereby they should be concerns on education and culture within the development of six constructs. Academician are triggered to produce the creative and innovative technologies and mechanisms based Sharia context in supporting the SMEs digitalization from up to downstream of supply chain activities by evolving the Internet of things (IoT), big data and

analytics (dashboard, performance measurement tools, market analytics, IoT analytics, customer analytics), cloud computing, cybersecurity (cyberattack, industrial hygiene information, workplace safety artificial), augmented reality, smart manufacturing solutions (3D printing, IoT smart factory, smart packaging and testing), additive manufacturing, connected manufacturing simulation, manufacturing digitalization strategic road mapping, e-commerce advancement/market places (shopee, bukalapak, lazada, tokopedia, Blibli), social media, smart transaction (e-wallet, e-payment, OVO, Quick Response code Indonesia Standard-QRIS, Copay, LinkAja, Dana), Blockchain (smart contracts, cryptocurrency, bitcoin), and artificial intelligence in business activities and services (chat-box, Siri, natural language processing -NLP). Moreover, the collaboration between academician with the third parties of Quadruple Helix components could enhance the production effectiveness, financial and industrial assurance through the socialization, knowledge sharing, and supported workshops.

The investors distinguish to solicitude on the culture for Business Activity (BA), Transaction (TC), and Marketing (MC). The classical obstacles relate to culture is commenced on the restriction efforts of SMEs to increase the company capital instead of hard conditional on government and investors' aid. Moreover, the industry 5.0 challenges SMEs to be fast respond and proactive against the fluctuate of world business and economy. The investors need to create innovative ways for SMEs to increase their income and capital through the deep understanding of Sharia fintech and business applications as well as during the business activity, transaction, and marketing. For

instance, the investors provide the social media platforms-based Sharia (through Instagram, Facebook, and Market places) to adjust the SMEs' mindset and culture for their marketing strategy. Besides, the investors also should be concern on Education, Infrastructure, and Financial Resources within Management (MG), Micro environment (MI), and Macro environment (MA) constructs by facilitating the development of human resources, knowledge and skills through various training/short courses in utilizing and activating the applications and Sharia fintech infrastructure and resources. This can be conducted by collaborating with the other Quadruple Helix such as government, academician, and association.

The recommendation for association is emphasizing on the SMEs culture readiness towards the marketing and management sustainability. Association should support and linkage the collaboration of government, investors, and academician as well as extension agents to directly reach and supervisory communities against the SMEs. What's the new technology idea and innovation from academician, the products and technical infrastructure employment of investors as transformation idea, and supporting government policy regarding on such products and implementation grow into the association guidance in creating the new values and benefits for SMEs. Then, association takes the responsibility in ensuring the optimal utilizing of technical infrastructure, build awareness and educate people about the Sharia fintech, and in driving force for the growth of SMEs in Indonesia (Purnamasari et al., 2020). Sharia fintech improves financial inclusion and literacy of SMEs through the technological development as well as technical

infrastructure which embarks of transaction grows into faster, short, easier, time efficiency, road traffic, transaction queues, and no need for face-to-face meetings thus requires the emergence of start-ups to build the business (Winarto, 2020).

6. CONCLUSION

Various efforts have been undertaken to support the sustainability of the Sharia-based SMEs digitalization business towards Sharia Fintech. This effort is conducted by building a model to measure the digitalization readiness of Sharia-based SMEs by considering the involvement of the Quadruple Helix (government, academics, investors, and associations) from a business economic and IT perspective through the development of DSS Fuzzy-AHP approach. This approach has been functionally successful in facilitating the recommendations for decision-makers with the concern policies in variables BA, MC, MG, TC, MI, and MA as well as IT mapping perceives through IT-Culture, IT-Education, IT- Financial, and IT-Infrastructure based on Sharia. The gauging of these two perceptions employs the SMEs' Digitalization Readiness Model toward Sharia Fintech. Additionally, DSS Fuzzy-AHP has successfully identified the level significance of BA Sharia, TC Sharia, MC Sharia, MG Sharia, MA Sharia, and MI Sharia against the Culture, Education, Financial, and Infrastructure matrix. It determines the successful achievement of digitalization readiness based on SMEs Sharia Fintech. The Quadruple Helix distinguishes the concerns of policymakers in supporting SMEs' success. Sharia Digitalization has been identified through the deep analysis of

variables and sub- variables within Management (MG), Marketing (MC), Transaction (TC), Business Activity (BA), Macro (MA) and Micro Environment (MI). This SMEs' Digitalization Readiness can be utilized as a guideline in adopting the Sharia digital transformation for Quadruple Helix Components as well as government, academician, associations, and investors.

Acknowledgements

The authors would like to thank Research Grand Bank Indonesia (RGUI), No. 23/ 27 /PKS/BINS/2021, Bank Indonesia Institute, and Universitas Islam Negeri Sultan Syarif Kasim Riau Indonesia for funding and support for this research.

References

- Abdullah A., Saraswat S., & Talib F. (2023), Barriers and strategies for sustainable manufacturing implementation in SMEs: A hybrid fuzzy AHP-TOPSIS framework. *Sustainable Manufacturing and Service Economics*, 2, 100012.
- Ariffin, K. A. Z., & Ahmad, F. H. (2021). Indicators for maturity and readiness for digital forensic investigation in era of industrial revolution 4.0. *Computers & Security*, 105, 102237.
- Astanti, R. D., Mbolla, S. E., & Ai, T. J. (2020). Raw material supplier selection in a glove manufacturing: Application of AHP and fuzzy AHP. *Decision Science Letters*, 9, 291-312.
- Axmann, B., & Harmoko, H. (2020). Robotic Process Automation: An Overview and Comparison to Other Technology in Industry 4.0. 2020 10th International

ПРИПРАВНОСТ МАЛИХ И СРЕДЊИХ ПРЕДУЗЕЋА ЗА ДИГИТАЛИЗАЦИЈУ: ШАРИЈАТСКИ ФИНАНСИЈСКО-ТЕХНОЛОШКИ ОКВИР КОРИСТЕЊИ ПЕРЦЕПЦИЈЕ ЧЕТВОРОСТРУКОГ ХЕЛИКСА

Mahyarni Mahyarni, Okfalisa Okfalisa

Извод

Улога Четвороструког Хеликса у промовисању развоја дигитализације МСП-ова истиче значајан допринос шаријатског финтеха (финансијских технологија) као новог изазова за одрживо и креативно суочавање са прекидом изазваним Covid-19. Овај рад развио је оквир готовности МСП-ова за дигитализацију у подршци шаријатском финтеху како би испитао перцепције Четвороструког Хеликса и успех дигитализације. Додатно, примењен је Фази-АХП приступ за анализу значајног утицаја интеракције Четвороструког Хеликса и разлике између универзитета, индустрије, заједница и владе. Ово ствара основу одрживог корпоративног сектора кроз разматрање информационих технологија (ИТ), економије и шаријата у оквиру пословне активности, трансакција, маркетинга, управљања, микро-окружења и макро-окружења, ограничено на 24 под-индикатора. Ово истраживање је открило да универзитетски академици сматрају пословну активност најзначајнијим показатељем за прецену способности дигитализације малих и средњих предузећа (МСП-ова) на основу шаријатског финтеха. Следе маркетинг, трансакције, управљање, микро и макро окружење. У међувремену, остали сектори укључујући индустрију, заједнице и владу различито тумаче маркетинг као разматрање успеха шаријатске дигитализације МСП-ова. Овај оквир стимулише и синергизира интегрисани рад, иновације, економски раст, производњу, технологију, знање и вештине улога Четвороструког Хеликса у суочавању са конкурентним предностима дигиталне ере с обзиром на шаријатске вредности. Приоритетна анализа и препоруке из овог оквира признају се као алат за управљање одлукама и стратешке политике за остваривање успеха дигиталне трансформације.

Кључне речи: шаријатски финтех, четвороструки хеликс, фази-ахп, мала и средња предузећа, дигитална трансформација

Conference on Advanced Computer Information Technologies (ACIT), 559-562. At: Deggendorf, Germany

Bag, S., Wood, L. C., Mangla, S. K., & Luthra, S. (2020). Procurement 4.0 and its implications on business process performance in a circular economy. *Resources, Conservation and Recycling*, 152, 104502.

Ban, A. I., Ban, O. I., Bogdan, V., Sabau

Popa, D. C., & Tuse, D. (2020). Performance evaluation model of romanian manufacturing listed companies by fuzzy ANP and Topsis. *Technological and Economic Development of Economy*, 26 (4), 808-836.

Budhiraja, S. (2019). Organizational readiness for change: An inherent concern for Indian small and medium enterprises (SMEs). *Development and Learning in Organizations: An International Journal*, 33

(2), 4-7.

Camilleri, M. A. (2018). Market segmentation, targeting and positioning. In M. A. Camilleri, *Travel Marketing, Tourism Economics and the Airline Product*, 4, 69– 83.

Castagna, F., Centobelli, P., Cerchione, R., Oropallo, E., Shashi, & Strazzullo, S. (2020). Assessing S M E s ' internationalisation strategies in action. *Applied Sciences*, 10 (14), 4743.

Chen, C.-H. (2020). A novel multi-criteria decision-making model for building material supplier selection based on entropy-AHP weighted TOPSIS. *Entropy*, 22 (2) 259.

Cluley, R., Green, W., & Owen, R. (2020). The changing role of the marketing researcher in the age of digital technology: Practitioner perspectives on the digitization of marketing research. *International Journal of Market Research*, 62 (1), 27-42.

Darnihamedani, P. & Terjesen, S. (2022). Male and female entrepreneurs' employment growth ambitions: the contingent role of regulatory efficiency. *Small Business Economics*, 58, 185–204.

De Marco, C. E., Martelli, I., & Di Minin, A. (2020). European SMEs' engagement in open innovation When the important thing is to win and not just to participate, what should innovation policy do? *Technological Forecasting and Social Change*, 152, 119843.

Garzoni, A., De Turi, I., Secundo, G., & Del Vecchio, P. (2020). Fostering digital transformation of SMEs: A four levels approach. *Management Decision*, 58 (8), 1543–1562.

Ghobakhloo, M., & Iranmanesh, M. (2021). Digital transformation success under Industry 4.0: A strategic guideline for manufacturing SMEs. *Journal of Manufacturing Technology Management*, 32

(8), 1533–1556.

Gürdür, D., El-khoury, J., & Törngren, M. (2019). Digitalizing Swedish industry: what is next? *Computers in Industry*, 105, 153-163.

Hassan, M. K., Rabbani, M. R., & Ali, M. A. M. (2020). Challenges for the Islamic Finance and banking in post COVID era and the role of Fintech. *Journal of Economic Cooperation and Development*, 41 (3), 93-116.

Hossain, M. K., & Thakur, V. (2021). Benchmarking health-care supply chain by implementing Industry 4.0: a fuzzy-AHP-DEMATEL approach. *Benchmarking: An International Journal*, 28 (2), 556-581.

Ilbiz, E., & Durst, S. (2019). The Appropriation of Blockchain for Small and Medium-sized Enterprises. *Journal of Innovation Management*, 7 (1), 26–45.

Islam, A., & Wahab, S. A. (2021). The intervention of strategic innovation practices in between regulations and sustainable business growth: A holistic perspective for Malaysian SMEs. *World Journal of Entrepreneurship, Management and Sustainable Development*, 17 (3), 396-421.

Karman, A. (2020). Towards crystallizing circular business models: A critical analysis of literature. *Journal of Sustainability Science and Management*, 15 (6), 175–194.

Kergroach, S. (2020). Giving momentum to SME digitalization. *Journal of the International Council for Small Business*, 1 (1), 28–31.

Moore, J. F., Rong, K., & Zhang, R. (2022). The human ecosystem. *Journal of Digital Economy*, 1 (1), 53-72.

Klein, M. M., Biehl, S. S., & Friedli, T. (2018). Barriers to smart services for manufacturing companies – an exploratory study in the capital goods industry. *Journal of Business & Industrial Marketing*, 33 (6),

846–856.

Li, J., Chen, C.-W., Wu, C.-H., Hung, H.-C., & Lin, C.-T. (2020a). How do partners benefit from IT use in supply-chain management: An empirical study of Taiwan's bicycle industry. *Sustainability*, 12 (7), 2883.

Li, J., Yang, Y., Saaty, T. L., & Guo, H. (2020b). Cultural ranking of countries using the analytic hierarchy process Methodology. In Y. Liu, L. Wang, L. Zhao, & Z. Yu (Eds.), *Advances in Natural Computation, Fuzzy Systems and Knowledge Discovery*, 1074, 949–963.

Liu, H., Sun, C., & Tu, J. (2021). Application of intuitionistic fuzzy evaluation method in aircraft cockpit display ergonomics. *The International Arab Journal of Information Technology*. 18 (6), 856-863.

Lou, E. C. W., Lee, A., & Goulding, J. (2020). E-readiness in construction (ERiC): Self-assessment framework for UK small and medium enterprise building services providers. *Architectural Engineering and Design Management*, 16 (1), 3–22.

Lyu, H.-M., Sun, W.-J., Shen, S.-L., & Zhou, A.-N. (2020). Risk assessment using a new consulting process in fuzzy AHP. *Journal of Construction Engineering and Management*, 146 (3), 04019112.

Li, M., & Tuunanen, T. (2022). Information technology-supported value co-creation and co-destruction via social interaction and resource integration in service systems. *Journal of Strategic Information Systems*, 31(2), 101719.

Mittal, S., Khan, M. A., Romero, D., & Wuest, T. (2018). A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *Journal of Manufacturing Systems*, 49, 194–214.

Okfalisa, O., Anggraini, W., Nawani, G.,

Saktioto, S., & Wong, K. Y. (2021). Measuring the effects of different factors influencing on the readiness of SMEs towards digitalization: A multiple perspectives design of decision support system. *Decision Science Letters*, 10 (3), 425–442.

Okfalisa, O., Anugrah, S., Anggraini, W., Absor, M., Fauzi, S. S. M., & Saktioto, S. (2018). Integrated analytical hierarchy process and objective matrix in balanced scorecard dashboard model for performance measurement. *Telecommunication Computing Electronics and Control*, 16 (6), 2703.

Okfalisa, O., Mahyarni, M., Anggraini, W., Saeed, F., Moshood, T. D., & Saktioto, S. (2022). Quadruple helix engagement: reviews on shariah fintech based SMEs digitalization readiness. *Indonesian Journal of Electrical Engineering and Informatics*, 10 (1), 112–122.

Orciuoli, F., Orciuoli, F. J., & Peduto, A. (2020). A mobile clinical DSS based on augmented reality and deep learning for the home cares of patients afflicted by bedsores. *Procedia Computer Science*, 175, 181–188.

Ozili, Peterson K. (2020). Financial inclusion and fintech during COVID-19 crisis: policy solutions. *The Company Lawyer Journal*, 8.

Pal, A., Singh, D., & Dhaliwal, R. K. (2020). Identification and relevance of e readiness assessment tools for ICT use in agriculture. *Current Journal of Applied Science and Technology*, 39 (16), 93–102.

Paschou, T., Adrodegari, F., Rapaccini, M., Saccani, N., & Perona, M. (2018). Towards Service 4.0: A new framework and research priorities. *Procedia CIRP*, 73, 148–154.

Paschou, T., Rapaccini, M., Adrodegari, F., & Saccani, N. (2020). Digital

- servitization in manufacturing: A systematic literature review and research agenda. *Industrial Marketing Management*, 89, 278–292.
- Peillon, S., & Dubruc, N. (2019). Barriers to digital servitization in French manufacturing SMEs. *Procedia CIRP*, 83, 146–150.
- Peillon, S., Dubruc, N., & Mansour, M. (2018). Service and customer orientation of corporate culture in a French manufacturing SME. *Procedia CIRP*, 73, 91–95.
- Purnamasari, R. S. P., Pramono, I. P., Haryatiningsih, R., & Ismail, S. A. (2020). Technology acceptance model of financial technology in micro, small, and medium enterprises (MSME) in Indonesia. *The Journal of Asian Finance, Economics and Business*, 7 (10), 981–988.
- Lin, R.M., & Ng, T.Y. (2019). New theoretical developments on eigenvector derivatives with repeated eigenvalues. *Mechanical Systems and Signal Processing*, 129, 677–693.
- Randel, A. E., Galvin, B. M., Shore, L. M., Ehrhart, K. H., Chung, B. G., Dean, M.A., & Kedharnath, U. (2018). Inclusive leadership: Realizing positive outcomes through belongingness and being valued for uniqueness. *Human Resource Management Review*, 28 (2), 190–203.
- Roman, M., Varga, H., Cvijanovic, V., & Reid, A. (2020). Quadruple helix models for sustainable regional innovation: engaging and facilitating civil society participation. *Economies*, 8(2), 48.
- Rosyadi, S., Kusuma, A. S., Fitrah, E., Haryanto, A., & Adawiyah, W. (2020). The multi-stakeholder's role in an integrated mentoring model for SMEs in the creative economy sector. *SAGE Open*, 10 (4), 215824402096360.
- Rusydiana, A. S. (2018). Developing islamic financial technology in Indonesia. *Hasanuddin Economics and Business Review*, 2 (2), 143 – 152.
- Saghafian, M., Laumann, K., & Skogstad, M. R. (2021). Stagewise overview of issues influencing organizational technology adoption and use. *Frontiers in Psychology*, 12, 630145.
- Schuh, G., Scheuer, T., Nick, G., Szaller, A. & Várgedő, T. (2021). A two-step digitalization level assessment approach for manufacturing companies. *Procedia Manufacturing*, 54, 25-30.
- Shehzad, H. M. F., Ibrahim, R. B., Yusof, A. F., Khaidzir, K. A. M., Iqbal, M., & Razzaq, S. (2021). The role of interoperability dimensions in building information modelling. *Computers in Industry*, 129, 103444.
- Pingali, S. R., Singha, S., Arunachalam, S., & Pedada, K. (2023). Digital readiness of small and medium enterprises in emerging markets: The construct, propositions, measurement, and implications. *Journal of Business Research*, 164, 113973.
- Ghosh, S., Bhowmik, C., Sinha, S., Raut, R. D., Mandal, M. C., & Ray, A. (2023). An integrated multi-criteria decision-making and multivariate analysis towards sustainable procurement with application in automotive industry. *Supply Chain Analytics*, 3, 100033.
- Suhendi, C., Nugroho, M., Yahya, H. B., & Zahari, A. S. M. (2020). Dynamic Capabilities for SME's: Ready to Change and Cloud Service Role Toward Digital Business. *Proceedings of the 17 Th International Symposium on Management (INSYMA 2020)*. *Proceedings of the 17 th International Symposium on Management (INSYMA 2020)*, Vung Tau City, Vietnam.
- Süße, T., Wilkens, U., Hohagen, S., & Artinger, F. (2018). Digital competence of stakeholders in Product-Service Systems

- (PSS): Conceptualization and empirical exploration. *Procedia CIRP*, 73, 197–202.
- Syarifuddin, S., Muin, R., & Akramunnas, A. (2021). The Potential of Sharia Fintech in Increasing Micro Small and Medium Enterprises (MSMEs) in The Digital Era in Indonesia. *Jurnal Hukum Ekonomi Syariah*, 4 (1), 23.
- Syed, H. M., Khan, S., Rabbani, M. R., & Thalassinos, Y. E. (2020). An artificial intelligence and NLP based islamic fintech model combining zakat and qardh-al- hasan for countering the adverse impact of COVID 19 on SMEs and individuals. *International Journal of Economics and Business Administration*, 8 (2), 351-364.
- Tripathi, S., & Gupta, M. (2021). A holistic model for Global Industry 4.0 readiness assessment. *Benchmarking: An International Journal*, 28 (10), 3006–3039.
- Umeh, F., Tan, C., Pan, Y.-C., & Khan, H. (2020). Developing the digital business readiness assessment framework (DBRAF) for fashion retail SMEs in Lagos, Nigeria. *Proceeding in 25th UK Academy for Information Systems International Conference (UKAIS 2020)*, Oxford, UK.
- Voza, D., Szewieczekb, A., & Grabarac, D. (2022). Environmental sustainability in digitalized SMEs: Comparative study from Poland and Serbia. *Serbian Journal of Management*, 17 (1), 15–31.
- Wahjusaputri, S., Bunyamin, S. F., & Tashia Indah Nastiti, A. S. (2020). Teaching factory model for increasing the competency of vocational secondary education students in Indonesian territory. *International Journal of Innovation, Creativity and Change*, 11(1).
- Wahyuni, N. M. D., Wardana, I. M., Yasa, N. N. K., Sukaatmadja, P. G., & Setini, M. (2020). The effect of culture dimension in digitalization era on the complaint behavior in hotel industry. *International Journal of Data and Network Science*, 347–356.
- Winarto, W. W. A. (2020). Effect of sharia financial technology in small and medium enterprises (SME). *Annals of the University of Craiova for Journalism, Communication and Management*, 6 (1), 191-208.
- Wong, L.-W., Leong, L.-Y., Hew, J.-J., Tan, G. W.-H., & Ooi, K.-B. (2020). Time to seize the digital evolution: Adoption of blockchain in operations and supply chain management among Malaysian SMEs. *International Journal of Information Management*, 52, 101997.
- Yıldızbaşı, A., & Ünlü, V. (2020). Performance evaluation of SMEs towards Industry 4.0 using fuzzy group decision making methods. *SN Applied Sciences*, 2 (3), 355.
- Yousaf, S., Anser, M. K., Tariq, M., Sahibzada Jawad, S. U. R., Naushad, S., & Yousaf, Z. (2020). Does technology orientation predict firm performance through firm innovativeness? *World Journal of Entrepreneurship, Management and Sustainable*, 17 (1), 140-151.
- Zavadskas, E. K., Turskis, Z., Stević, Ž., & Mardani, A. (2020). Modelling procedure for the selection of steel pipes supplier by applying fuzzy AHP method. *Operational Research in Engineering Sciences: Theory and Applications*, 3(2), 39-53.