IEEE Access
Multidisciplinary ⋮ Rapid Review ⋮ Open Access Journal

Received 17 June 2024, accepted 22 July 2024, date of publication 25 July 2024, date of current version 5 August 2024.

Digital Object Identifier 10.1109/ACCESS.2024.3433474

RESEARCH ARTICLE

Driving Sustainable Performance in SMEs Through Frugal Innovation: The Nexus of Sustainable Leadership, Knowledge Management, and Dynamic Capabilities

FANDI ACHMAD[1], (Member, IEEE), AND IWAN INRAWAN WIRATMADJA[2], (Member, IEEE)
[1]Department of Industrial Engineering, Telkom University, Bandung 40257, Indonesia
[2]Department of Industrial Engineering, Bandung Institute of Technology, Bandung 40132, Indonesia
Corresponding author: Fandi Achmad (fandiac.achmad@gmail.com)

ABSTRACT Small and Medium Enterprises (SMEs) often need help to achieve sustainable performance due to constraints such as limited human and financial resources and restricted access to information. Frugal innovation, an approach that emphasizes cost-effective and resource-efficient solutions, offers the potential to address these challenges. This study explores how sustainable leadership, dynamic capabilities, and knowledge management interplay with frugal innovation to enhance the sustainable performance of SMEs. A quantitative survey was conducted using purposive sampling, collecting data from 236 craft SMEs in East Java, Indonesia. The research model was analyzed using Partial Least Square Structural Equation Modeling (PLS-SEM). The findings reveal significant positive relationships between sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation. Additionally, frugal innovation directly impacts sustainable performance and partially mediates the relationships between sustainable leadership, knowledge management, dynamic capabilities, and sustainable performance ($p \leq 0.001$). These insights contribute to the knowledge of SME sustainability by demonstrating that frugal innovation, supported by sustainable leadership, dynamic capabilities, and knowledge management, can significantly enhance sustainable performance. Practically, this research offers valuable implications for stakeholders and policymakers in crafting strategies that foster sustainable development in SMEs.

INDEX TERMS Sustainable performance, frugal innovation, sustainable leadership, knowledge management, dynamic capabilities.

I. INTRODUCTION

Organizational sustainability is a strategic focus in the context of sustainable development [1], [2], [3]. Sustainable performance in an organizational context has become an essential focus in modern business literatures [3] and [4]. This concept refers to the ability of an organizational entity to achieve its goals effectively while paying attention to and minimizing negative impacts on the environment, society, and the economy as a whole [4], [5], [6]. Thus, an organization must prioritize achieving its financial and economic goals, consider the resulting social impacts, and maintain environmental sustainability [6]. In addition, sustainable performance mandates that every organization

The associate editor coordinating the review of this manuscript and approving it for publication was Francisco J. Garcia-Penalvo.

can meet current needs without ignoring the needs of future generations [7], [8], [9].

In the context of Small and Medium Enterprises (SMEs), sustainable performance is crucial considering the vital role of SMEs in the national economy [10], [11], [12], [13], [14]. SMEs are expected to pay attention to the three aspects of sustainable performance, namely economic, social, and environmental, to ensure optimal contribution to sustainable development [10], [11]. SMEs play a significant role in the global economy, making a major contribution to economic growth, job creation, and innovation [10]. The optimal role of SMEs in achieving sustainable performance can have a significant positive impact on the economy of society and the country as a whole [15], [16]. SMEs are the backbone of the economy by creating jobs, increasing per capita income, and contributing to overall economic growth [12], [14], [17]. SMEs have great potential to innovate. Compared to large companies, SMEs are often more agile and flexible, allowing them to adapt quickly to market changes and innovate efficiently. This is important to increasing SMEs' competitiveness in dynamic markets and limited access to resources [10], [11], [12], [13], [14]. Apart from that, SMEs face unique sustainability challenges but offer significant opportunities to drive sustainable development. Policymakers can design more targeted support mechanisms to improve SMEs' sustainability, while practitioners can adopt best practices that improve SMEs' resilience and performance. This research focuses on SMEs due to their economic and social significance and the unique opportunities and challenges they present in the field of sustainability. It provides valuable insights for academics and practitioners and enriches understanding of how SMEs in Indonesia can drive sustainable performance through innovation.

However, amidst increasingly fierce competition and growing environmental challenges, SMEs are faced with certain obstacles, such as financial and resource limitations, which make it difficult for them to achieve optimal and sustainable performance [18], [19], [20]. First of all, in terms of human resources, SMEs often face limitations in terms of the number and skills of the workforce [19], [21]. The limited size of these organizations may hinder their ability to attract and retain high-potential employees, as they are unable to compete with the wages offered by larger companies [22], [23]. In addition, a lack of opportunities for skills development and training can limit employees' ability to contribute optimally to increasing productivity and innovation within the company [23], [24], [25], [26]. Second, financial constraints are often a significant obstacle to the growth and sustainability of SMEs [26], [27]. Capital limitations make it difficult for SMEs to access the financial resources needed to start, develop, or manage their businesses effectively [26]. Lack of access to loans, investments, or venture capital financing can also hinder their ability to expand operations or undertake the innovation necessary to meet increasingly fierce market competition. Third, limitations in knowledge and access to information are other obstacles to SMEs achieving sustainable performance [28]. SMEs' lack of understanding of market trends, the latest technologies, or best business practices can hinder their ability to make strategic and effective decisions [29], [30]. In addition, lack of access to knowledge resources or professional networks can also limit their ability to learn and collaborate with external stakeholders who can support their growth and development, thereby hindering SMEs' efforts to achieve sustainable performance in the long term [30], [31]. To overcome the challenges experienced by SMEs, an innovative approach needs to be taken that considers limited resources.

One innovative approach that can help SMEs achieve sustainable performance is frugal innovation [32], [33], [34], [35], [36]. In an era that increasingly demands sustainability, frugal innovation provides a framework that enables SMEs to create products and services that are not only cost-effective but also environmentally friendly. Frugal innovation is very relevant in the context of SMEs because of the limited resources they have. Frugal innovation is an approach that emphasizes developing cost-effective solutions that utilize minimal resources to create maximum value [32], [33], [34]. This is especially important for SMEs, which often need more finances, infrastructure, and access to advanced technology. By focusing on frugal innovation, SMEs can improve operational efficiency and remain competitive in a dynamic market. Apart from that, frugal innovation is highly relevant in the context of developing countries like Indonesia. Many SMEs in Indonesia operate in resource-constrained environments and face significant challenges in accessing technology and capital. Frugal innovation provides a practical and realistic approach for SMEs in Indonesia to improve performance and contribute to sustainable development. This concept carries the idea of creating effective and resource-saving solutions without sacrificing quality or added value. Frugal innovation becomes relevant for SMEs because it can overcome the obstacles faced, allowing organizations to achieve optimal performance by utilizing limited resources efficiently and effectively [32], [35], [36]. Frugal innovation refers to an approach to developing products, services, or business processes that efficiently use resources, including time, money, and labor, without sacrificing quality or performance [32], [36]. In the context of SMEs, frugal innovation becomes an important tool to overcome obstacles related to limited resources and increase their competitiveness in increasingly complex markets [37]. Several critical aspects of frugal innovation in SMEs, namely sustainable leadership [38], dynamic capabilities [39], [40], [41], and knowledge management are very crucial [42].

Sustainable leadership is key to driving sustainable innovation in SMEs [38]. Sustainable leaders not only focus on achieving short-term financial goals but also pay attention to the social and environmental impacts of organizational decisions [43], [44], [45]. They encourage an organizational

culture that supports creativity, collaboration, and social responsibility, which are essential foundations for implementing frugal innovation. Leaders can inspire employees to innovate resource-efficiently through a commitment to sustainability principles in their leadership [38]. Apart from that, dynamic capabilities also influence an organization's ability to adapt and change proactively in the face of a changing business environment [39]. In the context of frugal innovation, dynamic capabilities enable SMEs to identify new opportunities, develop innovative solutions, and implement changes quickly and efficiently [39], [40], [41]. The ability to learn continuously, adapt to market changes, and adjust their business strategies are critical aspects of dynamic capabilities that support implementing frugal innovation [46], [47]. Furthermore, knowledge management processes are essential in supporting frugal innovation and achieving sustainability because they enable SMEs to collect, store, manage, and share relevant knowledge efficiently across the organization [42], [47]. Having access to the proper knowledge at the right time, employees can generate innovative ideas, solve problems better, and increase operational efficiency. In addition, knowledge management also facilitates organizational learning, enabling SMEs to draw lessons from past experiences and continuously improve their performance in the long term [48], [49].

From previous research [32], [35], [36], [38], [39], [40], [41], [43], discussion of factors that encourage sustainability performance through sustainable leadership, dynamic capabilities and knowledge management mediated by frugal innovation is still limited. However, a comprehensive study integrating these factors with frugal innovation to enhance SME sustainable performance remains limited [6], [32], [35], [36], [38], [39], [40], [41], [42], [43]. The novelty of this research lies in a holistic approach that combines the concepts of sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation to encourage sustainable performance in SMEs. This research addresses this gap by investigating the complex relationships between sustainable leadership, knowledge management, dynamic capabilities, frugal innovation, and sustainable performance in SMEs. The study's unique contribution lies in developing a holistic framework that integrates these factors to optimize sustainable performance in SMEs. By providing a comprehensive analysis of how these elements interact, the research offers valuable insights into the mechanisms that drive sustainability in SMEs.

By highlighting the importance of holistic integration of these four roles to optimize sustainable performance, the implications of this research can have broad impacts, both in academic contexts, SMEs, and policymakers. Academically, this research can help complete our understanding of the factors that influence the sustainability performance of SMEs. Analyzing the relationship between sustainable leadership, knowledge management, dynamic capabilities, frugal innovation, and sustainable performance can provide new insights into the mechanisms involved in achieving sustainability in the context of small and medium sized businesses. In addition, the practical implications of this research are to guide owners and managers of SMEs in developing effective strategies to improve their sustainability performance. By understanding the critical role of sustainable leadership, knowledge management, and dynamic capabilities in supporting frugal innovation, SMEs can take concrete steps to increase operational efficiency, reduce costs, and create added value for their stakeholders. Furthermore, this research can provide practical guidance for policymakers to develop effective strategies for achieving sustainability goals.

The structure of this paper consists of several main parts. First, an introduction illustrates the importance of strategic factors in improving sustainability performance. Second, the literature and theory review will discuss in detail the arguments that support the formulation of the hypothesis. Third, an in-depth explanation of the empirical research methodology used in this study. Next, the results of hypothesis testing will be presented. Finally, the study's findings and their implications will be discussed, while suggestions for future research will also be provided.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

A. SUSTAINABLE PERFORMANCE

Sustainable performance is rooted in the Triple Bottom Line (TBL) theory by Kouaib et al. [50], which emphasizes the integration of economic, environmental, and social dimensions in organizational strategies to ensure long-term sustainability [4], [5], [6]. This involves adopting practices that balance financial profitability with environmental management and social responsibility. Sustainable performance in SMEs refers to the ability of an organizational business to maintain and improve its performance sustainably by paying attention to economic, environmental, and social aspects [6]. Economically, SMEs with sustainable performance can generate profits consistently while also paying attention to long-term financial sustainability, including efficient cost management and wise fund allocation [6], [51]. From an environmental perspective, SMEs can implement environmentally friendly practices, such as using renewable raw materials, waste reduction, and green energy, to reduce their ecological footprint [6], [52]. Socially, sustainable performing SMEs also pay attention to their impact on the surrounding community, including empowering the local workforce, paying attention to employee welfare conditions, and contributing to the development of the community as a whole [6], [7], [8], [9]. By integrating these principles into their operations, SMEs can achieve sustainable growth, gain competitive advantage, and become agents of positive change in inclusive and sustainable economic development [7]. Organizations aim to achieve resilience, competitive advantage, and sustainable value creation by pursuing sustainable performance while advancing broader environmental and social goals [9], [13].

B. FRUGAL INNOVATION AND SUSTAINABLE PERFORMANCE

Frugal innovation, aligned with the Resource-Based View (RBV) theory by Al Omoush et al. [34], is an innovation that focuses on key strategies for cost reduction by minimizing significant raw material inventories and using efficient technologies and processes [32], [33]. This theory supports the idea that SMEs can enhance their sustainable performance through frugal innovation by minimizing resource use, reducing costs, and creating value through efficient processes [53]. The RBV framework emphasizes the strategic importance of leveraging limited resources to drive innovation and sustainability [35], [36]. Al Omoush et al. [34] identify frugal innovation's focus on core functions, improving performance and quality, which relate to sustainable performance in economic, environmental, and social dimensions. Yousaf et al. [35] find a positive relationship between frugal innovation and firm performance in China, demonstrating that it enhances cost efficiency and market responsiveness. Frugal innovation enables resource-wise allocation, encouraging more efficient use of natural resources, reducing waste, and minimizing environmental impact. Tjahjana et al. [53] show that frugal innovation improves sustainable performance in SMEs by cutting production costs, increasing competitiveness, and addressing environmental impacts [53]. This aligns with principles of environmental sustainability that preserve resources for future generations. Frugal innovation also enhances product and service accessibility for economically disadvantaged communities, fostering inclusivity and social welfare [32], [33], [36]. Thus, integrating frugal innovation in business strategy can significantly contribute to achieving sustainable performance that covers economic, environmental, and social aspects. Therefore, based on the literature review, it can be concluded that frugal innovation is very important for the sustainability of organizational performance. Therefore, we put forward the following hypothesis:

H1*: frugal innovation has a positive influence on sustainable performance.*

C. KNOWLEDGE MANAGEMENT, FRUGAL INNOVATION AND SUSTAINABLE PERFORMANCE

Knowledge management theory, as articulated by Nazarian et al. [42] highlights the creation, acquisition, sharing and application of knowledge within organizations. This theory is essential for SMEs, which rely on effective knowledge management to support innovation and enhance sustainable performance. The knowledge management process includes identifying, collecting, storing, and effectively utilizing organizational knowledge, acting as a strong foundation to facilitate innovation [42], [54]. The Knowledge-Based View (KBV) suggests that organizational knowledge is a critical resource for innovation and competitive advantage, aligning with the study's focus on integrating knowledge management with frugal innovation and sustainability [46], [55], [56], [57]. Knowledge management, frugal innovation, and sustainable performance are important aspects of sustainability-oriented business strategies [42], [47]. On the other hand, frugal innovation, an innovative approach that aims to create more affordable, simpler, and efficient solutions by utilizing limited resources, can be strengthened by adopting effective knowledge management practices [35], [36]. Recent studies have highlighted the importance of knowledge management in the context of innovation and sustainable performance. According to Nazarian et al. [42], knowledge management forms a strong foundation for facilitating frugal innovation, which aims to create more affordable and efficient solutions by utilizing limited resources. Effective implementation of a knowledge management process allows organizations to identify and utilize internal knowledge optimally, accelerate the innovation process, and facilitate collaboration between departments or teams [46], [55]. Additionally, Gómez-Marín et al. [56] emphasized that knowledge management is important in promoting sustainable innovation development by providing a supporting infrastructure for organizations to produce environmentally friendly solutions and consider their long-term impacts. Kun [36] investigated the relationship between knowledge management, frugal innovation, and sustainable performance in SMEs. The research found that adopting effective knowledge management practices can help SMEs produce sustainable, frugal innovation and improve organizational performance [36]. In addition, research by Iqbal and Piwowar-Sulej [57] explored the role of knowledge management in promoting frugal innovation for sustainable performance in an organization. The research results show that applying good knowledge management practices can support developing and implementing frugal innovation, ultimately improving sustainable performance [57]. Integrating knowledge management processes with frugal innovation creates an environment that supports the development of sustainable innovation [58]. Collaboration between teams or departments supported by a good knowledge management system allows organizations to produce environmentally friendly solutions and consider their long-term impacts [58]. Implementing frugal innovation supported by an effective knowledge management process can significantly contribute to an organization's sustainable performance [35], [36]. By reducing operational costs, increasing efficiency, and developing environmentally friendly solutions, organizations can achieve a better balance between economic growth, environmental sustainability, and social welfare in the long term [36], [42], [54]. However, although the literature highlights the importance of knowledge management in frugal innovation and sustainable performance, there is still a need to empirically test the relationship between KM, frugal innovation, and sustainable performance. Hence, we proposed the following hypothesis:

H2a*: Knowledge management has a positive influence on frugal innovation.*

H2b*: Knowledge management has a positive influence on sustainable performance.*

D. DYNAMIC CAPABILITIES, FRUGAL INNOVATION AND SUSTAINABLE PERFORMANCE

Dynamic Capabilities Theory, introduced by Jiraphanumes et al. [39], emphasizes an organization's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments [39], [40], [41]. This theory is crucial in understanding how SMEs can adapt to market dynamics and innovate efficiently through frugal innovation. It underscores the importance of dynamic capabilities in achieving sustainable performance by enhancing organizational flexibility and responsiveness [59], [60], [61], [62]. Dynamic capabilities refer to the ability of an organization to flexibly adapt and develop its resources and competencies to face rapid environmental changes [39], [40]. The relationship between dynamic capabilities, frugal innovation, and sustainable performance is an exciting subject in organizational management. The relationship between capability dynamics, frugal innovation, and sustainable performance plays a vital role in driving an organization's ability to innovate effectively, respond to market changes, and adapt to the changing business environment [39], [40], [41]. Organizations with strong capability dynamics tend to better identify innovation opportunities, including opportunities to adopt frugal innovation as part of their strategy [37], [46]. Recent studies highlight the importance of dynamic capabilities in the context of innovation and sustainable performance. Jiraphanumes et al. [39] highlight dynamic capabilities' role in shaping frugal innovation and organizational adaptation. Additionally, research by Ferreira et al. [59] emphasizes that organizations with strong capability dynamics tend to be better able to seize innovation opportunities and respond to market changes more quickly and effectively. In the context of sustainable performance, dynamic capabilities are also considered a key factor. According to Scarpellini et al. [60], organizations that have good dynamic capabilities tend to have the ability to create long-term value, including economic, social, and environmental value. Research by Bocken and Geradts [61] emphasizes that organizations with strong dynamic capabilities tend to be better able to seize new opportunities, avoid threats, and create sustainable value. By being able to adapt quickly to environmental changes and utilizing limited resources efficiently, organizations can create innovative solutions that not only reduce operational costs but also consider broader social and environmental impacts [62]. Frugal innovation, resulting from effective capability dynamics, can contribute positively to an organization's sustainable performance [39], [41]. In addition, frugal innovation often creates new opportunities to create value for stakeholders, which in turn can improve reputation and support sustainable performance in the long term [46]. The relationship between capability dynamics, frugal innovation, and sustainable performance reflects the importance of integration between organizational flexibility in responding to change, cost-effective innovation, and awareness of social and environmental impacts in achieving sustainable business goals [39], [40], [41]. Although the literature highlights the importance of capability dynamics in the context of frugal innovation and sustainable performance, there is still a need to empirically test the relationship between capability dynamics, frugal innovation, and sustainable performance. Hence, we proposed the following hypotheses:

***H3a**: Dynamic capabilities has a positive influence on frugal innovation.*

***H3b**: Dynamic capabilities has a positive influence on sustainable performance.*

E. SUSTAINABLE LEADERSHIP, KNOWLEDGE MANAGEMENT, DYNAMIC CAPABILITIES AND FRUGAL INNOVATION

Sustainable leadership theory, as described by Avery and Bergsteiner [63], integrates considerations of social, environmental, and economic impacts in organizational decision-making [43], [44], [45]. This theory provides a framework for understanding how leaders can foster a culture of sustainability and innovation within SMEs. Sustainable leadership refers to a leadership style that integrates considerations of social, environmental, and economic impacts in organizational decision-making [43], [44], [45]. Sustainable leadership is linked to improved knowledge management, dynamic capabilities, and frugal innovation, all of which contribute to sustainable performance [64], [65], [66], [67]. Research by Ur Rehman et al. [38] shows that sustainable leadership positively impacts the sustainable performance of organizations by promoting responsible and sustainable business practices. Sustainable leadership has become an increasingly interesting research subject in management literature due to its important role in shaping sustainable and innovative organizational cultures [64]. According to Iqbal and Ahmad [64], sustainable leaders tend to have a long-term vision of environmental, social, and economic sustainability. They lead by example, encourage responsible practices, and promote collaboration and organizational learning. Mariani et al. [65] highlighted that sustainability-oriented leaders tend to create work environments that support cost-effective innovation by promoting the efficient use of resources and strengthening commitment to innovative practices. Research by Iqbal et al. [66] found that sustainable leadership is positively related to organizational performance and innovation. On the other hand, the literature also highlights the importance of sustainable leadership in encouraging knowledge management practices, dynamic capabilities, and frugal innovation. Research by Suriyankietkaew et al. [67] found that sustainable leadership is positively related to an organization's ability to adapt to market changes and create long-term value. In knowledge management, sustainable leadership can create an organizational culture that supports knowledge sharing, collaborative learning, and effective use of knowledge to achieve sustainability goals [67]. Additionally, sustainable leadership can also stimulate cost-effective innovation by promoting efficient use of resources and strengthening commitment to innovative

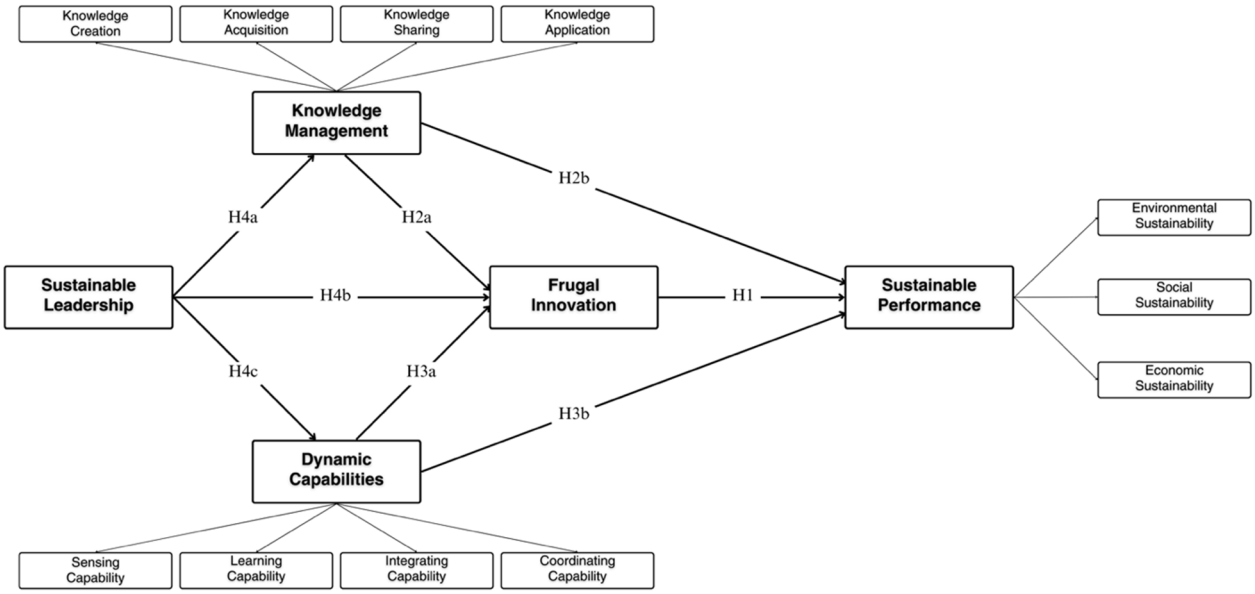

FIGURE 1. Proposed research model (source: self-produced).

practices [38]. Finally, sustainable leadership is also considered capable of strengthening the dynamics of organizational capabilities by encouraging flexibility, adaptation, and continuous organizational learning [66]. The relationship between sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation reflects the importance of integrating a responsible leadership style, effective knowledge management, organizational flexibility in facing change, and environmentally friendly and efficient innovation in achieving sustainable business goals. Hence, we proposed the following hypotheses:

H4a*: Sustainable leadership has a positive influence on knowledge management.*

H4b*: Sustainable leadership has a positive influence on frugal innovation.*

H4c*: Sustainable leadership has a positive influence on dynamic capabilities.*

This research uses concepts of sustainable leadership, knowledge management, dynamic capabilities, frugal innovation, and sustainable performance as basic theoretical principles. The research conceptual model is presented in Figure 1. The research hypotheses are proposed and given below.

III. RESEARCH METHODOLOGY

This section explains the research design, including research procedures, instrument development, and sample and data collection. Thus, the development of this new research model is based on a deeper understanding of the relationship between sustainable leadership, knowledge management, dynamic capabilities, frugal innovation, and sustainable performance, which is the main focus of this research, as well as the methodological steps taken to test the relationship.

A. RESEARCH PROCEDURE

This research is empirical and is mostly based on primary data. The research framework was tested using the Structural Equation Modeling (SEM) approach utilizing Partial Least Squares (PLS) methodology. PLS-SEM is appealing to numerous researchers because it can assess intricate models featuring numerous constructs, indicator variables, and structural paths without necessitating reliance on assumptions regarding data distribution. Therefore, the research procedures in this study follow the SEM-PLS approach proposed by Hair et al. [68]. SEM-PLS involves two main stages: measurement model measurement and structural model assessment [68]. The measurement model assessment aims to verify the validity and reliability of the measurement model. In contrast, the structural model assessment aims to test the structural relationships proposed in the research framework [68]. In this study, SEM-PLS was used using SmartPLS software.

Assessment of measurement models involves evaluating indicator loadings and internal consistency reliability [68]. According to Hair et al. [68], indicator loadings must show that the construct can explain more than 50 percent of the variation in the indicator, or in other words, the Average Variance Extracted (AVE) exceeds 0.5. Internal consistency reliability can be evaluated through the composite reliability value or Cronbach's alpha value, which is recommended to have a value greater than 0.7. The heterotrait-Monotrait Ratio (HTMT) method is used instead of Fornell and Larcker for discriminant validity. HTMT is a more rigorous technique and provides a more accurate assessment of discriminant validity [69]. A construct is considered to have good discriminant validity if its HTMT value is less than 0.90 [69]. Structural model evaluation is carried out

after satisfactory results are obtained from the measurement model assessment. A hierarchical approach is also used to assess the validity and reliability of second-order constructs. This approach involves assessing the validity and reliability of the dimensions that form second-order constructs and the first-order constructs that form those dimensions. This structural assessment involves using various metrics, such as the coefficient of determination (R^2), a blindfolding-based cross-validated measure of redundancy (Q^2), and the statistical significance and relevance of path coefficients. It is also essential to check the Variance Inflation Factor (VIF) value to identify the presence of collinearity before evaluating structural relationships so that the regression results are not influenced by collinearity.

B. MEASURES AND INSTRUMENT DEVELOPMENT

All variables used in this study were measured using a series of items, and each item was rated via a 6-point Likert scale, ranging from "1" (strongly disagree) to "6" (strongly agree). The choice of a 6-point questionnaire scale was made because the aim was to provide an adequate level of subtlety in expressing respondents' responses [68]. The 6-point scale allows respondents to express their level of agreement or disagreement, more specifically with the statements presented in the questionnaire [68].

The questionnaire consists of 68 statement items regarding variables, with details of sustainable leadership having 6 items [38], [63]. Knowledge management [42], with first-order knowledge creation having 4 items, knowledge acquisition having 5 items, knowledge sharing having 5 items, and knowledge application having 5 items. Dynamic capabilities [39], [40], [41] with first order sensing capability having 4 items, learning capability having 5 items, integrating capability having 5 items, and coordinating capability having 5 items. Frugal innovation has 9 items [32], [35], [36]. Meanwhile, sustainable performance [6], [36], [42] with first-order environmental sustainability has 5 items, social sustainability has 5 items, and economic sustainability has 5 items. In addition, the questionnaire also contains 6 items, which also include information about the respondent's gender, age, and education level, as well as the size and length of operation of the respondent's SMEs. The size of SMEs is estimated based on the number of employees working in them. The questionnaire was prepared by utilizing measurements that have been proven and verified through previous research, as well as reliable studies (see Table 1). The measurement items used in this research (see in Appendix) are adaptations from previous studies that have validated the construct.

TABLE 1. Source of measurement items.

Construct	Indicator	Source
Sustainable Leadership (SL)		[38], [63]
Knowledge Management (KM)	Knowledge Creation (KC) Knowledge Acquisition (KAC) Knowledge Sharing (KS) Knowledge Application (KAP)	[42]
Dynamic Capabilities (DC)	Sensing Capability (SC) Learning Capability (LC) Integrating Capability (IC) Coordinating Capability (CC)	[39], [40], [41]
Frugal Innovation (FI)		[32], [35], [36]
Sustainable Performance (SP)	Environmental Sustainability (ENS) Social Sustainability (SCS) Economic Sustainability (ECS)	[6], [36], [42]

C. SAMPLE AND DATA COLLECTION

This research is cross-sectional, with data collection through purposive sampling techniques to ensure appropriate representation of the target population. The population that is the focus of this research is craft SMEs because craft SMEs are considered one of the backbones of the Indonesian economy [10], [11], [70], especially Sidoarjo Regency, East Java. Sidoarjo Regency was chosen because it is the center of East Java, Indonesia's rapidly growing bag and suitcase craft industry, offering a wide variety of products and supported by adequate infrastructure and government support [71], [72]. Bag and suitcase craft SMEs in Sidoarjo Regency, East Java, have a significant role in the local economic structure [72]. Its contribution to the regional economy can be seen from the latest statistical data, where this sector significantly contributes to regional gross domestic product (GDP) [73]. The handicraft bag and suitcase industry in Sidoarjo is one of the leading sectors in the creative economy sector, which shows the need for in-depth research in this sector.

The data collection process was carried out from September 2023 to February 2024. Questionnaires were distributed directly to bag and suitcase craft SME industry players. The characteristics of filling out the questionnaire are managerial level SMEs with work experience of more than 1 year, allowing them to understand the conditions of their organization well. This questionnaire is designed to clearly explain the variables to be measured, the purpose of the survey, and the scales used to avoid delays in responses. In addition, this survey was conducted confidentially to ensure the confidentiality and anonymity of respondents. The number of questionnaires collected was 236 from 247 respondents, or 95.55% of the total respondents who were valid for data processing (see Table 2).

Our research sample was obtained from employees at craft SMEs in Sidoarjo Regency, East Java. Table 2 describes the demographic characteristics of the respondents. The analysis results show that 61.02% of survey respondents were men, while the remaining 38.98% were women. The age range of respondents ranged from 20 to 61 years, with the largest age group being those aged between 31 and 40 years, reaching 45.76%. In terms of the size of SMEs, most SMEs have between 5 and 10 employees (47.88%), followed by SMEs with 11 to 15 people (17.80%) and those with <5 people (17.80%). Regarding the length of operation of SMEs, the majority of SMEs have been in business for 1 to 3 years

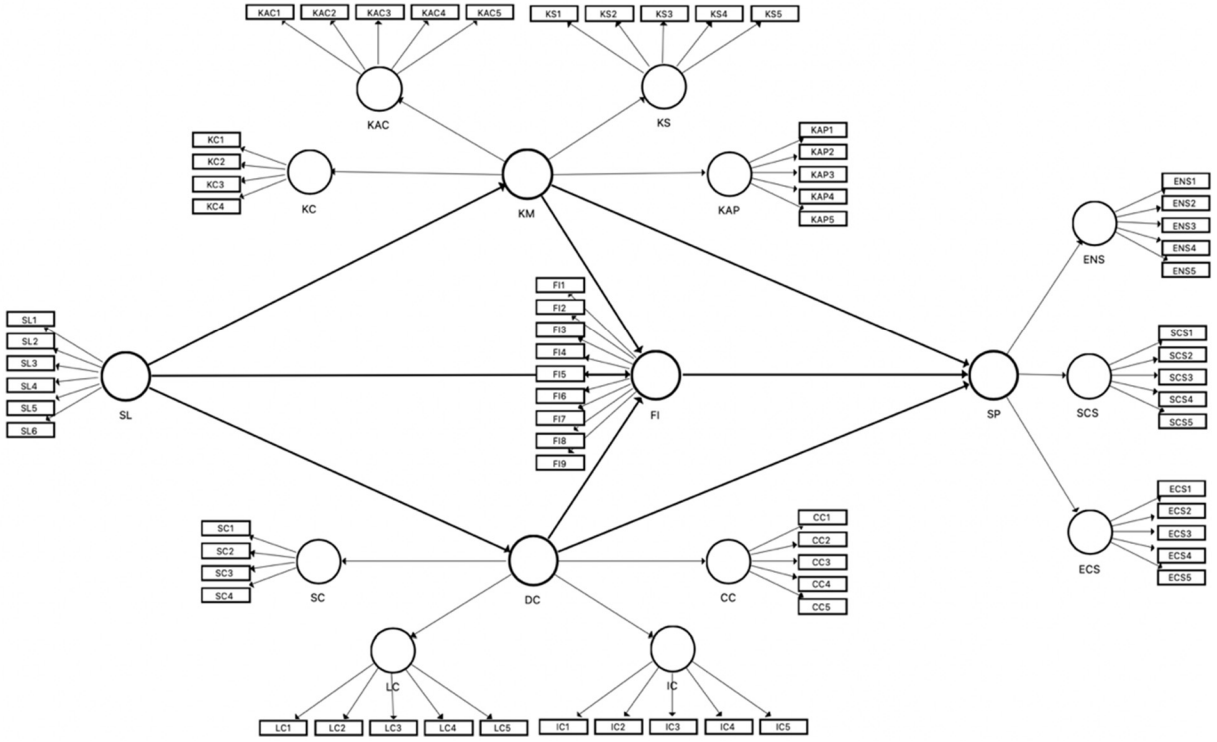

FIGURE 2. Relationships based on measurement and structural models in PLS-SEM.

TABLE 2. Profiles of respondents.

Demograpics	Details	Frequency	Percent
Gender	Male	144	61.02%
	Female	92	38.98%
Age (year)	20 – 30	11	4.66%
	31 – 40	108	45.76%
	41 – 50	87	36.86%
	51 – 60	24	10.17%
	Above 61	6	2.54%
SMEs size (workers)	< 5	42	17.80%
	5 – 10	113	47.88%
	11 – 15	43	18.22%
	16 – 20	18	7.63%
	21 – 25	13	5.51%
	>25	7	2.97%
Operating(years)	Less than 1	22	9.32%
	1 – 3	96	40.68%
	4 – 6	65	27.54%
	7 – 9	33	13.98%
	Above 10	20	8.47%
Total aset (million rupiah)	<1000	184	77.97%
	≥ 1000	52	22.03%

(40.68%), followed by those that have been in operation for 4 to 6 years (27.54%) and 7 to 9 years (13.98%).

IV. RESULT

In this research, we examine more deeply and comprehensively the role of sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation in influencing an organization's ability to achieve sustainable performance, especially for SMEs. Figure 2 shows the relationship of the dependent and independent variables in SmartPLS software.

A. MEASUREMENT MODEL

The evaluation of the measurement model's quality was conducted utilizing assessments of convergent and discriminant validity [68]. The findings of the convergent validity assessment are detailed in Table 3, encompassing cronbach's alpha, composite reliability, and average variance extracted (AVE). These results have gone through three iterations, which are used to ensure that the constructs are measured appropriately and that the indicators used meet the specified criteria by the recommendations provided by Hair et al. [68]. The Cronbach's alpha coefficient test showed a range between 0.701 and 0.923, exceeding the accepted value (0.70) by the recommendations of Hair et al. [68]. All composite reliability values ranged from 0.820 to 0.906, all exceeding the acceptable value (0.70), indicating acceptable measurement reliability. Likewise, the average AVE of each construct ranged from 0.542 to 0.751, exceeding the accepted value (0.50) by the recommendations of Hair et al. [68]. The findings suggest that the present research model fulfills the prerequisites for convergent validity.

For discriminant validity, we used the Heterotrait-Monotrait Ratio (HTMT) method. HTMT is a more rigorous technique and provides a more accurate assessment of discriminant validity [69]. A construct is considered to have good discriminant validity if its HTMT value is less

TABLE 3. Validity and reliability for constructs.

Measuring Instrument	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Sustainable Performance (SP)	0.777	0.849	0.565
Environmental Sustainability (ENS)	0.833	0.889	0.668
Social Sustainability (SCS)	0.716	0.895	0.574
Economic sustainability (ECS)	0.701	0.833	0.542
Frugal Innovation (FI)	0.923	0.940	0.726
Dynamic Capabilities (DC)	0.870	0.905	0.621
Sensing Capability (SC)	0.732	0.833	0.557
Learning Capability (LC)	0.817	0.872	0.585
Integrating Capability (IC)	0.834	0.900	0.751
Coordinating Capability (CC)	0.818	0.873	0.578
Knowledge Management (KM)	0.816	0.891	0.733
Knowledge Creation (KC)	0.701	0.890	0.567
Knowledge Acquisition (KAC)	0.816	0.891	0.733
Knowledge Sharing (KS)	0.708	0.820	0.534
Knowledge Application (KAP)	0.737	0.833	0.558
Sustainable Leadership (SL)	0.861	0.906	0.637

TABLE 4. Heterotrait-monotrait ratio (HTMT).

	CC	DC	ECS	ENS	FI	IC	KAC	KAP	KC	KM	KS	LC	SC	SCS	SL	SP
CC																
DC	0.685															
ECS	0.201	0.430														
ENS	0.679	0.590	0.134													
FI	0.667	0.539	0.142	0.550												
IC	0.584	0.263	0.118	0.550	0.556											
KAC	0.537	0.421	0.149	0.417	0.485	0.432										
KAP	0.462	0.440	0.240	0.411	0.418	0.404	0.461									
KC	0.550	0.477	0.171	0.381	0.323	0.445	0.523	0.464								
KM	0.537	0.421	0.149	0.417	0.485	0.432	0.225	0.461	0.523							
KS	0.521	0.535	0.196	0.495	0.354	0.472	0.758	0.595	0.610	0.758						
LC	0.510	0.347	0.162	0.522	0.468	0.327	0.368	0.434	0.447	0.368	0.550					
SC	0.571	0.635	0.132	0.565	0.475	0.413	0.381	0.428	0.394	0.381	0.417	0.734				
SCS	0.277	0.377	0.249	0.436	0.181	0.385	0.149	0.210	0.187	0.149	0.161	0.366	0.356			
SL	0.326	0.273	0.159	0.213	0.417	0.267	0.373	0.431	0.321	0.373	0.344	0.280	0.335	0.262		
SP	0.689	0.610	0.168	0.164	0.524	0.583	0.397	0.414	0.378	0.397	0.458	0.546	0.594	0.238	0.231	

than 0.90 [69]. Table 4 presents the results of HTMT values for all pairs of constructs and confirms that all values are below the recommended thresholds.

B. STRUCTURAL MODEL

The analysis of the structural model is conducted by scrutinizing the measurement model. A comprehensive assessment is undertaken to ensure the reliability and validity of the data employed in this evaluation. To test the hypothesis that has been formulated and carry out analysis of the structural model paths in this research, SmartPLS software was used, in line with the methodology described by Hair et al. [68]. The approach was to explore the structural path coefficients (β) and T-statistics determined through the bootstrap method by carrying out 5,000 sample repetitions. Accelerated bootstrapping facilitates the rapid generation of many bootstrap samples, thus helping estimate model parameter sampling distribution [68]. The estimation results of this structural equation model are presented in Table 5, while the structural model of the proposed research can be seen in Figure 3. This analysis shows that there is a positive and significant influence on all hypotheses from this research, starting from H1 namely FI and SP, H2a namely KM and FI, H2b namely KM and SP, H3a namely DC and FI, H3b namely DC and SP, H4a namely SL and KM, H4b namely SL and FI, and H4c SL and DC.

In the evaluation of the structural model, it is imperative to scrutinize the coefficient of determination (R^2) value to determine the significance and strength of each established path [68]. The R^2 and path coefficient values offer insights into the degree to which the data supports the proposed model. As posited by Hair et al. [68], an R^2 value surpassing 0.5 signifies a substantial correlation among these dimensions, effectively elucidating the construct. The R^2 values presented in Table 5 surpass 0.5, with the highest R^2 recorded for ENS at 0.747. Upon scrutinizing the R^2 outcomes from **Table 6**, it becomes evident that the variance in endogenous constructs can be robustly elucidated by exogenous constructs [68].

Additionally, beyond the structural relationships' significance, the model testing underscores the importance of the relationship between knowledge management as a second-order construct and its first-order constructs, KC, KAC, KS, and KAP. Similarly, the relationship between

TABLE 5. Significance of structure relationship.

Hypothesis				Path Coefficient	T-Statisctic	P Value	Conclusion
H1	FI	→	SP	0.760	15.02	0.000	Accept *
H2a	KM	→	FI	0.750	18.31	0.000	Accept **
H2b	KM	→	SP	0.592	6.59	0.001	Accept **
H3a	DC	→	FI	0.856	21.67	0.000	Accept **
H3b	DC	→	SP	0.841	21.52	0.000	Accept **
H4a	SL	→	KM	0.769	19.87	0.000	Accept *
H4b	SL	→	FI	0.672	10.22	0.000	Accept *
H4c	SL	→	DC	0.713	14.305	0.000	Accept **

Table information:
* : significant at level 0.01
** : significant at level 0.05

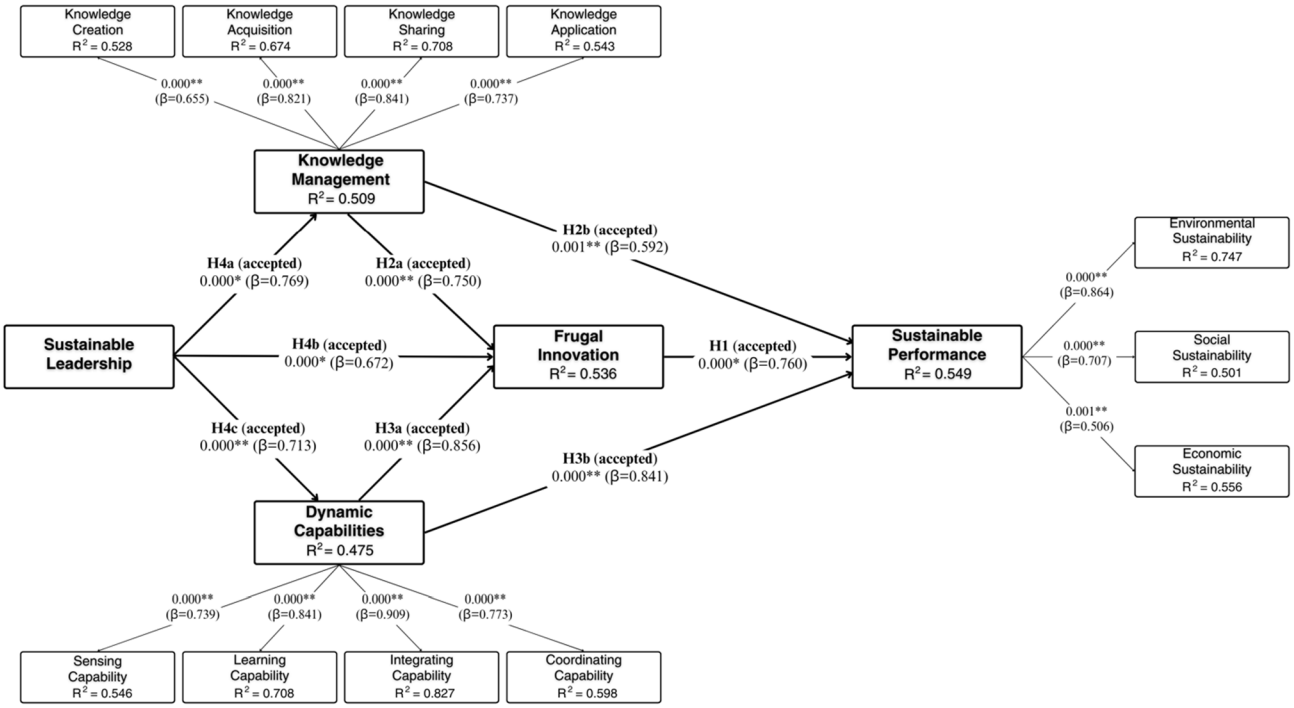

FIGURE 3. Estimated relationships of structural model.

TABLE 6. The R^2 value.

	R Square	R Square Adjusted
CC	0.598	0.596
DC	0.475	0.471
ECS	0.556	0.553
ENS	0.747	0.746
FI	0.536	0.528
IC	0.827	0.826
KAC	0.674	0.673
KAP	0.543	0.541
KC	0.528	0.526
KM	0.509	0.505
KS	0.708	0.706
LC	0.708	0.706
SC	0.546	0.544
SCS	0.501	0.498
SP	0.549	0.541

dynamic capabilities as a second-order construct and its first-order constructs, SC, LC, IC, and CC, is highlighted. Moreover, the significance of the relationship between sustainable performance as a second-order construct and its second-order constructs, ENS, SCS, and ECS, is emphasized.

Tables 7, 8, and 9 illustrate the importance of knowledge management, dynamic capabilities, and sustainable performance. In Table 7, it is clear that each aspect of the knowledge management construct shows an important correlation with the overall construct. Therefore, these aspects are considered capable of measuring the construct effectively [68]. Likewise, Table 8 shows that each dimension in the dynamic capabilities construct shows a significant relationship with the overall construct, thus implying its suitability for measuring the construct. Finally, Table 9 illustrates that each dimension of the sustainable performance construct has a significant relationship with this construct, thus confirming the adequacy of these dimensions to measure this construct. That way, all the constructs of this research can be explained by their dimensions.

TABLE 7. Relationship significance for knowledge management with its dimension.

Relationship	Correlation Value	T- Statistic	P Value	Conclusion
Knowledge Management → Knowledge Creation	0.655	12.545	0.000	Significant
Knowledge Management → Knowledge Acquisition	0.821	23.515	0.000	Significant
Knowledge Management → Knowledge Sharing	0.841	29.119	0.000	Significant
Knowledge Management → Knowledge Application	0.737	16.804	0.000	Significant

TABLE 8. Relationship significance for dynamic capabilities with its dimension.

Relationship	Correlation Value	T- Statistic	P Value	Conclusion
Dynamic Capabilities → Sensing Capability	0.739	14.134	0.000	Significant
Dynamic Capabilities → Learning Capability	0.841	36.003	0.000	Significant
Dynamic Capabilities → Integrating Capability	0.909	65.156	0.000	Significant
Dynamic Capabilities → Coordinating Capability	0.773	15.801	0.000	Significant

TABLE 9. Relationship significance for sustainable performance with its dimension.

Relationship	Correlation Value	T- Statistic	P Value	Conclusion
Sustainable Performance → Environmental Sustainability	0.864	5.078	0.000	Significant
Sustainable Performance → Social Sustainability	0.707	11.568	0.000	Significant
Sustainable Performance → Economic Sustainability	0.506	3.974	0.001	Significant

TABLE 10. VIF value.

Collinearity Between	VIF	Decision
Knowledge Management → Knowledge Creation	1.000	No collinearity
Knowledge Management → Knowledge Acquisition	1.000	No collinearity
Knowledge Management → Knowledge Sharing	1.000	No collinearity
Knowledge Management → Knowledge Application	1.000	No collinearity
Dynamic Capabilities → Sensing Capability	1.000	No collinearity
Dynamic Capabilities → Learning Capability	1.000	No collinearity
Dynamic Capabilities → Integrating Capability	1.000	No collinearity
Dynamic Capabilities → Coordinating Capability	1.000	No collinearity
Sustainable Performance → Environmental Sustainability	1.000	No collinearity
Sustainable Performance → Social Sustainability	1.000	No collinearity
Sustainable Performance → Economic Sustainability	1.000	No collinearity

Furthermore, multicollinearity in the context of a regression model is identified by calculating the Variance Inflation Factor (VIF), which measures how much the variance of the estimated regression coefficients increases when the independent variable is linearly related to other independent variables [68]. If the VIF value exceeds the threshold of 5.00, this indicates significant collinearity. Test results are presented in the form of VIF values, which are analyzed in accordance with established standards. Furthermore, a detailed analysis can be found in Table 10, which confirms the absence of a significant correlation between variables. Thus, there are no multicollinearity problems that need to be considered.

It's vital to assess variable influence using the effect size measure (f^2), which quantifies the proportion of variance explained by the latent variable relative to the total variance of the dependent variable. A higher f^2 value indicates a more substantial contribution to elucidating variance within the dependent variable. Hair et al. [68] delineate that an f^2 value below 0.02 suggests an exceedingly weak contribution, while 0.02 to < 0.15 indicates a weak to moderate contribution. A range of 0.15 to < 0.35 signifies a moderate to strong contribution, and an f^2 value ≥ 0.35 denotes a very strong contribution. In this study, all constructs show an f^2 value exceeding 0.2, indicating their appropriateness and substantial contribution; there is no weak contribution for any construct.

V. DISCUSSION

In this research, we examine more deeply and comprehensively the role of sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation in influencing an organization's ability to achieve sustainable performance, especially for SMEs. Frugal innovation has become a significant focus in recent research on innovation due to the growth potential and business opportunities it offers, especially in developing countries such as Indonesia. The object of this research is to craft SMEs located in Sidoarjo Regency. Sidoarjo Regency is one of Indonesia's significant craft production centers, with various SMEs

operating in this sector. The existence of craft SMEs in Sidoarjo Regency reflects significant local economic potential, which influences overall regional economic development [70], [71], [72], [73], [74]. Data for this research was collected through a questionnaire using a purposive sampling technique, and the respondent group was employees of craft SMEs. This research uses SmartPLS software to analyze data empirically. The model measurement stage shows that the model built meets the reliability and validity standards required for further analysis. The results of this assessment show that the measuring instrument used is reliable and consistent in measuring the variables studied [68]. The findings show a positive and significant relationship between sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation. Furthermore, the results show that the direct positive impact of frugal innovation on sustainable performance has been comprehensively tested. Our findings reveal a positive relationship between sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation, with frugal innovation playing a mediating role between these variables and sustainable performance. These results align with previous studies and extend our understanding of these relationships in the context of SMEs.

Findings related to hypothesis 4a show that the relationship between sustainable leadership and knowledge management has been validated. The relationship between sustainable leadership and knowledge management is consistent with the findings of Akram et al. [75], who highlighted that sustainable leadership positively influences knowledge management by fostering a work environment that encourages knowledge exchange and collaboration. Tian and Wang [32] also observed that sustainable leadership practices, which include environmental, social, and economic aspects, enhance the effectiveness of knowledge management. Our study confirms these observations, demonstrating that sustainable leadership significantly contributes to the effective management of knowledge within organizations. Thus, this research provides a new contribution to understanding the relationship between sustainable leadership and knowledge management and confirms previously existing findings in the academic literatures [32] and [57]. Hypothesis 4b also shows that the relationship between sustainable leadership and frugal innovation has been validated. Our results support the findings of Iqbal and Piwowar-Sulej [57], who reported that sustainable leadership positively impacts frugal innovation. Suriyankietkaew et al. [67] noted that organizations with strong sustainable leadership practices tend to promote a culture of experimentation and development of efficient solutions. Therefore, robust and sustainable leadership practices are predicted to positively affect an organization's ability to implement frugal innovation [38], [67]. Also, hypothesis 4c was validated. The research results on SMEs in the craft sector are consistent with the findings reported by Iqbal and Ahmad [64], which show that sustainable leadership positively impacts dynamic capabilities in the organizational context. Mahdi and Nassar [76] highlighted that sustainable leadership practices, which include commitment to environmental, social, and economic aspects, play an important role in developing an organization's ability to adapt to environmental changes and exploit new opportunities [44], [45]. In the context of SMEs in the craft sector in Sidoarjo Regency, well-integrated sustainable leadership practices can strengthen the dynamic capabilities of SMEs to respond to market changes, identify new trends, and develop innovative solutions. Thus, the findings of this study reinforce previous findings in the academic literature, which show that sustainable leadership positively and significantly influences KM, FI, and DC. It provides a deeper understanding of how sustainable leadership practices can be a critical factor in strengthening the competitiveness and sustainability of craft sector SMEs, especially in facing complex challenges and opportunities in an ever-changing business environment.

In addition, the results of the analysis of hypothesis 3a and hypothesis 3b show that the hypothesis between dynamic capabilities with frugal innovation and sustainable performance is accepted and is significantly positive. The results of research on SMEs in the Sidoarjo Regency, East Java craft sector, consistently support the findings reported by Borchardt et al. [37], which show that dynamic capabilities positively impact frugal innovation. This research strengthens our understanding of the link between an organization's dynamic capabilities and the ability to produce cost-efficient innovations, particularly in SMEs. Not only that, Jiraphanumes et al. [39] highlighted that SC enables organizations to recognize and respond quickly to environmental changes, whereas LC facilitates continuous learning and innovation. IC and CC help integrate and coordinate organizational resources and activities to achieve sustainable goals. López-Sánchez and Santos-Vijande [46] highlighted that dynamic capabilities, which include adapting quickly to market changes, utilizing resources flexibly, and responding to innovation opportunities, play a key role in driving frugal innovation [46]. This research confirms that SMEs with strong dynamic capabilities tend to be better able to identify opportunities to develop cost-effective innovations and implement cost-efficient solutions. Strong dynamic capabilities in SC, LC, IC, and CC tend to better adapt to market changes, increase operational efficiency, and produce quality products or services, all of which contribute to sustainable performance [39], [40]. Aminu and Mahmood [41] emphasized that an organization's dynamic capabilities, which include identifying and exploiting new market opportunities and addressing complex environmental challenges, can enhance sustainable performance. This research provides a deeper understanding of the relationship between an organization's ability to adapt quickly and sustainable performance, particularly in the context of SMEs.

Hypotheses 2a and 2b in this study were accepted. This supports the findings reported by Fischer et al. [77] and Shehzad et al. [78], which show that knowledge management positively impacts frugal innovation and sustainable

performance. This research provides an important contribution, especially in the context of SMEs, in strengthening understanding of the relationship between the dimensions of knowledge management, namely knowledge creation, knowledge acquisition, knowledge sharing, and knowledge application, with frugal innovation and sustainable performance. According to Nazarian et al. [42], effective knowledge management, characterized by KC, KAC, KS, and KAP processes, positively influences an organization's ability to produce cost-effective innovations. These results show that SMEs in the craft sector that can create, acquire, share, and apply knowledge effectively have a higher ability to produce cost-efficient innovations and achieve sustainable performance [42]. Thus, the findings of this study provide additional empirical evidence that confirms the findings of Iqbal and Ahmad [64], Fischer et al. [77], and AlMuhim [79] about the importance of knowledge management in supporting frugal innovation and sustainable performance. This confirms that investment in effective knowledge management can be an invaluable strategy for craft sector SMEs to achieve a competitive advantage and sustainability in the long term.

On the other hand, hypothesis 1 in this study shows that frugal innovation has a positive and significant impact on sustainable performance. Kun [36] highlights that frugal innovation, characterized by the ability to produce cost-effective solutions using limited resources, can improve an organization's sustainable performance. This research confirms that adopting frugal innovation can help SMEs reduce production costs, expand market reach, and increase competitiveness, contributing to sustainable performance [36]. In the face of economic challenges facing SMEs in Sidoarjo Regency, frugal innovation has become a vital strategy in increasing competitiveness and business continuity. By prioritizing cost efficiency, frugal innovation allows SMEs to develop products or services that remain high quality and financially affordable. This allows SMEs to maintain and increase their profitability and opens up opportunities to expand market penetration. By offering affordable solutions, SMEs can reach a wider market segment, including consumers with financial limitations. In addition, frugal innovation encourages SMEs to become more responsive to rapidly changing market needs, enabling rapid adaptation to changing trends and consumer preferences [42]. Thus, the findings of this study provide additional confirmation of the findings of Yousaf et al. [35], Nazarian et al. [42], Dima et al. [80], and Cuevas-Vargas et al. [81] about the important role of frugal innovation in supporting sustainable performance. This confirms that innovation strategies that focus on cost efficiency and efficient use of resources can be the key for craft sector SMEs in achieving economic, social, and environmental sustainability.

VI. CONCLUSION

This research strengthens our understanding of the influence of sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation on an organization's ability to achieve sustainable performance, especially in SMEs. These findings illustrate that frugal innovation has become the main focus of current innovation, especially in developing countries such as Indonesia, where growth potential and business opportunities are increasingly recognized. In the context of this research, the research object, which is to craft SMEs in Sidoarjo Regency, Indonesia, highlights the importance of this sector in the local economy, influencing overall regional economic development. Through data collection using purposive sampling techniques, 236 SMEs were obtained and analyzed using SmartPLS; this research found a positive and significant relationship between sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation. Furthermore, frugal innovation has been comprehensively proven to positively impact sustainable performance. These results align with previous findings that emphasize the importance of sustainable leadership practices in strengthening knowledge management, increasing innovation, and influencing overall organizational dynamics. Then, testing hypotheses related to the relationship between dynamic capabilities with frugal innovation and sustainable performance shows results consistent with previous findings, strengthening understanding of the critical role of dynamic capabilities in creating cost-effective innovation and improving sustainable performance. In addition, the hypothesis testing the influence of knowledge management on frugal innovation and sustainable performance was also proven to be significant, adding empirical evidence about the relationship between effective knowledge management and an organization's ability to produce cost-effective innovation and achieve sustainable performance. Thus, these findings provide an important contribution to understanding the factors that influence sustainable performance in the context of SMEs, particularly in the crafts sector, and illustrate the importance of innovative practices such as frugal innovation in supporting business growth and continuity amidst changing economic challenges.

A. THEORETICAL IMPLICATION

This research is rooted in several relevant theories that form the conceptual framework. First, the sustainable leadership theory by Ur Rehman et al. [38], provides a basis for understanding how sustainability-oriented leaders can encourage frugal innovation practices. This theory posits that sustainable leadership focuses on short-term profitability and long-term environmental and social impacts. Second, the knowledge management theory by Nazarian et al. [42] explains the importance of creating, disseminating, and applying knowledge within organizations. This theory is crucial in SMEs, which require effective knowledge management to support innovation. Third, the dynamic capabilities theory by Jiraphanumes et al. [39] emphasizes an organization's ability to integrate, build, and reconfigure internal and external resources to respond to environmental changes. This theory is essential for understanding how

SMEs can adapt to dynamic market conditions through frugal innovation.

Based on these theories, this research has important theoretical implications in expanding the understanding of the relationship between sustainable leadership, knowledge management, dynamic capabilities, and frugal innovation in SMEs. The finding that frugal innovation positively and significantly impacts sustainable performance implies that this innovative approach is relevant for both large companies and SMEs. This reinforces the concept of frugal innovation, demonstrating its value across different organizational scales. Additionally, dynamic capabilities, sustainable leadership, and knowledge management are pivotal in facilitating frugal innovation and achieving sustainable performance. This emphasizes the importance of an organization's ability to adapt and evolve in response to environmental changes. This research enriches the concept of dynamic capabilities, which consist of sensing capability, learning capability, integrating capability, and coordinating capability, by highlighting their specific role in cost-effective innovation and sustainability. It underlines the importance of incorporating these dynamic capabilities into business strategies. Furthermore, knowledge management is crucial not only for large companies but also for SMEs, which must optimize their innovation potential to achieve long-term sustainability. Finally, this research strengthens our understanding of the critical role of sustainable leadership in creating an environment that supports cost-effective innovation and sustainable performance. Leaders who implement sustainable leadership practices drive innovation and ensure organizational continuity.

B. PRACTICAL IMPLICATION

This research provides several practical implications that SMEs can directly implement to achieve sustainable performance through frugal innovation. First, SMEs must hold training programs that focus on the principles of sustainable leadership. These training programs include efficient resource management, ethical decision-making, and sustainable innovation. For example, monthly workshops by sustainability experts can help promote sustainable practices among SME managers. Additionally, SME leaders must adopt internal policies that support environmentally friendly and energy-saving practices, such as using recyclable raw materials and energy-saving technologies in production processes. Second, SMEs must implement an integrated knowledge management system to facilitate information sharing and innovation. Digital platforms like a company intranet can help store and share knowledge between departments. In addition, collaboration between SMEs and academics, research institutions, and other organizations should be encouraged. Forming partnerships with local universities for joint research and internship programs and holding seminars with experts from various fields can enrich knowledge and innovation in SMEs. Third, SMEs must emphasize the importance of building an organizational culture supporting innovation and sustainable growth. Leaders and managers in SMEs need to play a vital role in creating a work environment that facilitates experimentation, measured risk-taking, and collaboration between teams. This can be achieved through providing incentives for employees who contribute to innovation, creating open and inclusive communication mechanisms, and introducing new and effective ideas and solutions. Fourth, SMEs should invest in training programs that enhance employees' dynamic capabilities. Regular training in technology adaptation and change management is essential to improve SMEs' adaptability to market changes. For example, employees can be trained in using new technologies and efficient production methods. In addition, developing a system to monitor and evaluate dynamic capabilities periodically is also needed. Performance evaluation tools that measure adaptability and response to market changes, such as key performance indicators (KPIs), can help SMEs optimize their dynamic capabilities. Lastly, SMEs should focus on product designs that use minimal resources but are still high-quality. Adopting a simple yet functional design approach can reduce production costs without sacrificing quality. For example, cheap and environmentally friendly local materials can be used for bags and suitcases. In prioritizing cost efficiency, SMEs can use local materials that are cheap and easy to obtain, as well as simple but effective production techniques. For example, they use raw materials from local industries and energy-saving processing techniques to reduce production costs. Optimizing production processes to reduce waste and increase efficiency is also very important. Implementing lean production techniques can help SMEs identify and eliminate waste and use simple automation technology that can increase production speed without increasing costs.

C. LIMITATIONS AND FUTURE RESEARCH

Although this research provides valuable insight into the relationship between sustainable leadership, knowledge management, dynamic capabilities, frugal innovation, and sustainable performance in SMEs, several limitations must be noted. Limitations related to time and financial resources are the main obstacles in this research, which may hinder the abilities of future researchers. This study used a cross-sectional approach, which limits the ability to make conclusions about the causality of the relationships between the variables studied. Longitudinal or experimental studies may be needed to more accurately test causal relationships between these variables. In addition, this research was conducted in one specific geographic area, namely Sidoarjo Regency, East Java, so the generalization of the findings to a wider context may be limited. Therefore, we suggest that future research could involve broader samples from various regions or countries to validate these findings more widely. Finally, in the context of future research, there are several interesting research directions to expand, one of which is exploring the influence of contextual factors, such as organizational culture or industry regulations, on the relationship between the variables studied. In addition, research can deepen

understanding of the mediating and moderating mechanisms that may influence the relationships between these variables. By taking these limitations into account and taking these suggestions as a starting point, future research can broaden the scope of our knowledge of how sustainable business practices can improve the performance and sustainability of SMEs in various industrial sectors.

APPENDIX

Sustainable Performance (SP)

measurement items were adapted from [6], [36], and [42].

Environmental Sustainability (ENS)

ENS1	Our organization handled or stored toxic waste responsibly
ENS2	Our organization manufactured products with less environmentally damaging inputs than in previous years or than its competitors
ENS3	Our organization reduced waste by streamlining processes
ENS4	Our organization reduced the likelihood of environmental accidents through process improvements
ENS5	Our organization reduced environmental impacts of production processes or eliminated environmentally damaging processes

Social Sustainability (SCS)

SCS1	Our organization regularly participates in social development programs, e.g., support to underprivileged and needy individuals to improve society
SCS2	Our organization regularly provides opportunities to youngsters, e.g., training and development to promote their talent
SCS3	Our organization regularly provides financial and non-financial support to NGOs, medical institutions, and related organizations for a healthy lifestyle
SCS4	Our organization provides financial and non-financial support to educational institutions for students' learning and development
SCS5	Our organization encourages its employees to participate in voluntary activities

Economic Sustainability (ECS)

ECS1	We offer innovative products and services at low cost
ECS2	Our operating cost is less than our competitors
ECS3	Our effective operational performance has resulted in improved market share and profitability
ECS4	Our organization has experienced a significant increase in overall profit
ECS5	We generate revenue from solid waste products

Frugal Innovation (FI)

measurement items were adapted from [32], [35], and [36].

FI1	Our organization provides products and services that focus on core functionality rather than additional functionality
FI2	Our organization regularly searches for new solutions that offer ease of use of products/services
FI3	Our organization regularly improves the durability of the products/services
FI4	Our organization introduces new solutions that offer good and cheap products/services
FI5	Our organization significantly reduces cost in the operational process
FI6	Our organization significantly reduces the final price of the products/services
FI7	Our organization always cares for environmental sustainability in the operational process
FI8	Our organization frequently improves partnerships with local firms in the operational process
FI9	Our organization always searches for efficient and effective solutions to customers' social/environmental needs

Sustainable Leadership (SL)

measurement items were adapted from [38] and [63].

SL1	Leaders in our organization act in a socially responsible manner
SL2	Leaders in our organization act in an environmentally responsible manner
SL3	Leaders in our organization act in an ethically responsible manner
SL4	Leaders in our organization make decisions considering the entire organization
SL5	Leaders in our organization officially recognize when a mistake is made that affects sustainability
SL6	Leaders in our organization are willing to correct mistakes that affect sustainability

Knowledge Management

measurement items were adapted from [42].

Knowledge Creation (KC)

KC1	Our employees work in teams to create new knowledge
KC2	Our employees participate in brainstorming sessions to create new knowledge
KC3	Our organization create new knowledge, ideas, and solutions
KC4	Our organization give to employees who create new knowledge, ideas, and solutions

Knowledge Acquisition (KAC)

KAC1	Our employees attend training, seminars, or courses to acquire knowledge

KAC2	Our employees acquire knowledge from the owner-manager
KAC3	Our employees contact customers or suppliers to acquire knowledge
KAC4	Our employees spend browsing the Internet to acquire knowledge
KAC5	Our employees access the company's knowledge repositories to acquire knowledge

Knowledge Sharing (KS)

KS1	Our employees participate in informal discussions to share knowledge
KS2	Our organization holds regular weekly/monthly meetings
KS3	Our employees using technological tools (e.g., email, social media) to transfer knowledge
KS4	Our organization has mentors and mentees to share knowledge
KS5	Our organization has good interaction between our employees

Knowledge Application (KAP)

KAP1	We regularly apply newly obtained knowledge into practice to solve different operational issues
KAP2	Our organization quickly responds to customers' and suppliers' needs
KAP3	Our organization uses acquired knowledge to produce new products and services
KAP4	We use the knowledge obtained from our experiences and mistakes to improve our operational and financial performance
KAP5	We use the acquired knowledge to develop our strategies

Dynamic Capabilities (DC)

measurement items were adapted from [39], [40], and [41].

Sensing Capability (SC)

SC1	We frequently scan the environment to identify new business opportunities
SC2	We periodically review the likely effect of changes in our business environment on customers
SC3	We often review our products and services development efforts to ensure they align with what customers want
SC4	We spend a great deal of time implementing ideas for new products and services and improving our existing products or services

Learning Capability (LC)

LC1	We have effective routines to identify the value and import new information and knowledge
LC2	We have appropriate routines to assimilate new information and knowledge
LC3	We are effective in transforming existing information into new knowledge
LC4	We are effective in utilizing knowledge in new products or services
LC5	We are effective in developing new knowledge that has the potential to influence product or service development

Integrating Capability (IC)

IC1	Our employees' individual contributions are channeled through their work group
IC2	Members of our organization have a global understanding of each other's tasks and responsibilities
IC3	We are fully aware of who in the organization has specialized skills and knowledge relevant to our work
IC4	We carefully inter-relate actions between members of our organization to face changing conditions
IC5	Members of our organization successfully interconnect their activities

Coordinating Capability (CC)

CC1	We ensure that the output of each employee's work is synchronized with that of the rest of the group
CC2	We ensure appropriate allocation of resources (e.g., information, time, reports)
CC3	Our employees are assigned to tasks commensurate with their relevant knowledge and skills
CC4	We ensure that employees' expertise is compatible with the work processes they are assigned to
CC5	Overall, our employees are well coordinated

ACKNOWLEDGMENT

The authors extend their sincere gratitude to INTAKO Tanggulangin Sidoarjo for their invaluable contribution and support throughout this research. Their collaboration and assistance in data collection were essential to the successful execution of this study. They deeply appreciate their dedication and cooperation, and look forward to continued collaboration in the future.

REFERENCES

[1] P. B. D. O. Claro and N. R. Esteves, "Sustainability-oriented strategy and sustainable development goals," *Marketing Intell. Planning*, vol. 39, no. 4, pp. 613–630, May 2021, doi: 10.1108/mip-08-2020-0365.

[2] M. Shahzad, Y. Qu, A. U. Zafar, and A. Appolloni, "Does the interaction between the knowledge management process and sustainable development practices boost corporate green innovation?" *Bus. Strategy Environ.*, vol. 30, no. 8, pp. 4206–4222, Dec. 2021, doi: 10.1002/bse.2865.

[3] A. Adamik and D. Sikora-Fernandez, "Smart organizations as a source of competitiveness and sustainable development in the age of Industry 4.0: Integration of micro and macro perspective," *Energies*, vol. 14, no. 6, p. 1572, Mar. 2021, doi: 10.3390/en14061572.

[4] H. Y. Li, Q. Liu, and H. Z. Ye, "Digital development influencing mechanism on green innovation performance: A perspective of green innovation network," *IEEE Access*, vol. 11, pp. 22490–22504, 2023, doi: 10.1109/ACCESS.2023.3252912.

[5] J. Dias Lopes, J. Estevão, and A. Toth-Peter, "Industry 4.0, multinationals, and sustainable development: A bibliometric analysis," *J. Cleaner Prod.*, vol. 413, Aug. 2023, Art. no. 137381, doi: 10.1016/j.jclepro.2023.137381.

[6] F. Achmad, Y. Prambudia, and A. A. Rumanti, "Sustainable tourism industry development: A collaborative model of open innovation, stakeholders, and support system facilities," *IEEE Access*, vol. 11, pp. 83343–83363, 2023, doi: 10.1109/ACCESS.2023.3301574.

[7] M. Junaid, Q. Zhang, M. Cao, and A. Luqman, "Nexus between technology enabled supply chain dynamic capabilities, integration, resilience, and sustainable performance: An empirical examination of healthcare organizations," *Technolog. Forecasting Social Change*, vol. 196, Nov. 2023, Art. no. 122828, doi: 10.1016/j.techfore.2023.122828.

[8] C. de Villiers, R. Dimes, and M. Molinari, "How will AI text generation and processing impact sustainability reporting? Critical analysis, a conceptual framework and avenues for future research," *Sustainability Accounting, Manage. Policy J.*, vol. 15, no. 1, pp. 96–118, Jan. 2024, doi: 10.1108/sampj-02-2023-0097.

[9] Y. Yu, J. Xu, B. Huo, J. Z. Zhang, and Y. Cao, "The impact of supply chain social responsibility on sustainable performance," *J. Cleaner Prod.*, vol. 385, Jan. 2023, Art. no. 135666, doi: 10.1016/j.jclepro.2022.135666.

[10] A. A. Rumanti, A. F. Rizana, and F. Achmad, "Exploring the role of organizational creativity and open innovation in enhancing SMEs performance," *J. Open Innov., Technol., Market, Complex.*, vol. 9, no. 2, Jun. 2023, Art. no. 100045, doi: 10.1016/j.joitmc.2023.100045.

[11] A. A. Rumanti, A. F. Rizana, F. Ramadhan, and R. Reynaldo, "The impact of open innovation preparation on organizational performance: A systematic literature review," *IEEE Access*, vol. 9, pp. 126952–126966, 2021, doi: 10.1109/ACCESS.2021.3111091.

[12] T. T. Le, "Corporate social responsibility and SMEs' performance: Mediating role of corporate image, corporate reputation and customer loyalty," *Int. J. Emerg. Markets*, vol. 18, no. 10, pp. 4565–4590, Nov. 2023, doi: 10.1108/ijoem-07-2021-1164.

[13] F. Achmad, Y. Prambudia, and A. A. Rumanti, "Improving tourism industry performance through support system facilities and stakeholders: The role of environmental dynamism," *Sustainability*, vol. 15, no. 5, p. 4103, Feb. 2023, doi: 10.3390/su15054103.

[14] D. I. C. Melo, G. A. Queiroz, P. N. Alves Jr., T. B. D. Sousa, W. F. Yushimito, and J. Pereira, "Sustainable digital transformation in small and medium enterprises (SMEs): A review on performance," *Heliyon*, vol. 9, no. 3, Mar. 2023, Art. no. e13908, doi: 10.1016/j.heliyon.2023.e13908.

[15] S. Y. Dwikat, D. Arshad, and M. N. M. Shariff, "Effect of competent human capital, strategic flexibility and turbulent environment on sustainable performance of SMEs in manufacturing industries in Palestine," *Sustainability*, vol. 15, no. 6, p. 4781, Mar. 2023, doi: 10.3390/su15064781.

[16] N. Abid, F. Ceci, and J. Aftab, "Attaining sustainable business performance under resource constraints: Insights from an emerging economy," *Sustain. Develop.*, vol. 32, no. 3, pp. 2031–2048, Jun. 2024, doi: 10.1002/sd.2763.

[17] F. Achmad, I. T. Abdillah, and H. Amani, "Decision-making process for tourism potential segmentation," *Int. J. Innov. Enterprise Syst.*, vol. 7, no. 1, pp. 19–30, Jan. 2023, doi: 10.25124/ijies.v7i01.204.

[18] H. Etemad, "Managing uncertain consequences of a global crisis: SMEs encountering adversities, losses, and new opportunities," *J. Int. Entrepreneurship*, vol. 18, no. 2, pp. 125–144, Jun. 2020, doi: 10.1007/s10843-020-00279-z.

[19] R. P. Setyaningrum, M. N. Kholid, and P. Susilo, "Sustainable SMEs performance and green competitive advantage: The role of green creativity, business independence and green IT empowerment," *Sustainability*, vol. 15, no. 15, p. 12096, Aug. 2023, doi: 10.3390/su151512096.

[20] M. Alfarizi, T. Widiastuti, and Ngatindriatun, "Exploration of technological challenges and public economic trends phenomenon in the sustainable performance of Indonesian digital MSMEs on industrial era 4.0," *J. Ind. Integr. Manage.*, vol. 9, no. 1, pp. 65–96, Mar. 2024, doi: 10.1142/s2424862223500045.

[21] N. N. Yuliarmi, N. P. Dewi, S. D. Rustariyuni, A. A. I. N. Marhaeni, and G. Andika, "The effects of social capital and human resources on financing and SMEs performance," *Int. J. Hum. Capital Urban Manage.*, vol. 6, no. 1, pp. 1–16, 2021.

[22] C. M. Mabaso, M. T. Maja, M. Kavir, L. Lekwape, S. S. Makhasane, and M. T. Khumalo, "Talent retention strategies: An exploratory study within the consulting industry in Gauteng province, South Africa," *Acta Commercii*, vol. 21, no. 1, pp. 1–14, Jun. 2021, doi: 10.4102/ac.v21i1.885.

[23] A. J. Nyberg, G. Reilly, and O. R. Cragun, "A strategic recruiting system model for integrating human capital resources to solve strategic organizational challenges," in *Essentials Employee Recruitment*. Evanston, IL, USA: Routledge, 2024, pp. 56–76.

[24] F. Achmad, Y. Prambudia, and A. A. Rumanti, "Examining the feedback effects of support system facilities on tourism industry performance: A causal loop diagram modeling approach," in *Proc. IEEE Int. Conf. Ind. Eng. Eng. Manage. (IEEM)*, Dec. 2023, pp. 768–772, doi: 10.1109/IEEM58616.2023.10407015.

[25] A. B. Raya, R. Andiani, A. P. Siregar, I. Y. Prasada, F. Indana, T. G. Y. Simbolon, A. T. Kinasih, and A. D. Nugroho, "Challenges, open innovation, and engagement theory at craft SMEs: Evidence from Indonesian batik," *J. Open Innov., Technol., Market, Complex.*, vol. 7, no. 2, p. 121, Jun. 2021, doi: 10.3390/joitmc7020121.

[26] H. Indrawati, "Barriers to technological innovations of SMEs: How to solve them?" *Int. J. Innov. Sci.*, vol. 12, no. 5, pp. 545–564, Nov. 2020, doi: 10.1108/ijis-04-2020-0049.

[27] G. Cecere, N. Corrocher, and M. L. Mancusi, "Financial constraints and public funding of eco-innovation: Empirical evidence from European SMEs," *Small Bus. Econ.*, vol. 54, no. 1, pp. 285–302, Jan. 2020.

[28] M. N. Alraja, R. Imran, B. M. Khashab, and M. Shah, "Technological innovation, sustainable green practices and SMEs sustainable performance in times of crisis (COVID-19 pandemic)," *Inf. Syst. Frontiers*, vol. 24, no. 4, pp. 1081–1105, Aug. 2022, doi: 10.1007/s10796-022-10250-z.

[29] S. Coleman, R. Göb, G. Manco, A. Pievatolo, X. Tort-Martorell, and M. S. Reis, "How can SMEs benefit from big data? Challenges and a path forward," *Qual. Rel. Eng. Int.*, vol. 32, no. 6, pp. 2151–2164, Oct. 2016, doi: 10.1002/qre.2008.

[30] P. Chatzoglou and D. Chatzoudes, "Factors affecting e-business adoption in SMEs: An empirical research," *J. Enterprise Inf. Manag.*, vol. 29, no. 3, pp. 327–358, 2016, doi: 10.1007/s11187-018-0090-9.

[31] I. I. Wiratmadja, W. B. Profityo, and A. A. Rumanti, "Drivers of innovation ambidexterity on small medium enterprises (SMEs) performance," *IEEE Access*, vol. 9, pp. 4423–4434, 2021, doi: 10.1109/ACCESS.2020.3048139.

[32] H. Tian and A. Wang, "Sustainable leadership, knowledge sharing, and frugal innovation: The moderating role of organizational innovation climate," *SAGE Open*, vol. 13, no. 4, Oct. 2023, Art. no. 21582440231200946, doi: 10.1177/21582440231200946.

[33] M. S. Shahid, M. Hossain, S. Shahid, and T. Anwar, "Frugal innovation as a source of sustainable entrepreneurship to tackle social and environmental challenges," *J. Cleaner Prod.*, vol. 406, Jun. 2023, Art. no. 137050, doi: 10.1016/j.jclepro.2023.137050.

[34] K. Al Omoush, C. Lassala, and S. Ribeiro-Navarrete, "The role of digital business transformation in frugal innovation and SMEs' resilience in emerging markets," *Int. J. Emerg. Markets*, 2023, doi: 10.1108/ijoem-12-2022-1937. [Online]. Available: https://www.emerald.com/insight/content/doi/10.1108/IJOEM-12-2022-1937/full/html

[35] Z. Yousaf, M. Panait, U. Tanveer, A. Cretu, A. Hrebenciuc, and S. M. Zahid, "Value creation through frugal innovation, innovation capability and knowledge sharing in a circular economy," *Sustainability*, vol. 14, no. 14, p. 8504, Jul. 2022, doi: 10.3390/su14148504.

[36] M. Kun, "Linkages between knowledge management process and corporate sustainable performance of Chinese small and medium enterprises: Mediating role of frugal innovation," *Frontiers Psychol.*, vol. 13, Mar. 2022, Art. no. 850820, doi: 10.3389/fpsyg.2022.850820.

[37] M. Borchardt, G. Pereira, A. R. Ferreira, M. Soares, J. Sousa, and D. Battaglia, "Leveraging frugal innovation in micro- and small enterprises at the base of the pyramid in Brazil: An analysis through the lens of dynamic capabilities," *J. Entrepreneurship Emerg. Economies*, vol. 13, no. 5, pp. 864–886, Nov. 2021, doi: 10.1108/jeee-02-2020-0031.

[38] K. Ur Rehman, R. S. Anwar, V. M. Antohi, U. Ali, C. Fortea, and M. Laura Zlati, "Driving frugal innovation in SMEs: How sustainable leadership, knowledge sources and information credibility make a difference," *Frontiers Sociol.*, vol. 9, Mar. 2024, Art. no. 1344704, doi: 10.3389/fsoc.2024.1344704.

[39] K. Jiraphanumes, S. Aujirapongpan, and Y. Songkajorn, "Influence of diagnostic and dynamic capabilities on frugal innovation development: An empirical study of the Thai auto parts industry," *Asia Pacific Manage. Rev.*, vol. 28, no. 2, pp. 229–239, Jun. 2023, doi: 10.1016/j.apmrv.2022.10.001.

[40] P. Mikalef, M. Boura, G. Lekakos, and J. Krogstie, "Big data analytics capabilities and innovation: The mediating role of dynamic capabilities and moderating effect of the environment," *Brit. J. Manage.*, vol. 30, no. 2, pp. 272–298, Apr. 2019, doi: 10.1111/1467-8551.12343.

[41] M. I. Aminu and R. Mahmood, "Mediating role of dynamic capabilities on the relationship between intellectual capital and performance: A hierarchical component model perspective in PLS-SEM path modeling," *Res. J. Bus. Manage.*, vol. 9, no. 3, pp. 443–456, Aug. 2015, doi: 10.3923/rjbm.2015.443.456.

[42] A. Nazarian, M. Shahzad, X. Ding, and A. Appolloni, "Do TQM instigate sustainable development: Identifying the key role of green innovation and knowledge management," *J. Knowl. Economy*, vol. 15, no. 1, pp. 2499–2524, Mar. 2024, doi: 10.1007/s13132-023-01256-2.

[43] S. Choiriah and Y. A. Sudibyo, "Competitive advantage, organizational culture and sustainable leadership on the success of management accounting information system implementation," *Saudi J. Econ. Finance*, vol. 4, no. 9, pp. 481–494, Sep. 2020, doi: 10.36348/sjef.2020.v04i09.009.

[44] E. Domínguez-Escrig and F. F. Mallén-Broch, "Leadership for sustainability: Fostering organizational learning to achieve radical innovations," *Eur. J. Innov. Manage.*, vol. 26, no. 2, pp. 309–330, Mar. 2023, doi: 10.1108/ejim-03-2021-0151.

[45] R. Kramar, "Sustainable human resource management: Six defining characteristics," *Asia Pacific J. Hum. Resour.*, vol. 60, no. 1, pp. 146–170, Jan. 2022, doi: 10.1111/1744-7941.12321.

[46] J. Á. López-Sánchez and M. L. Santos-Vijande, "Key capabilities for frugal innovation in developed economies: Insights into the current transition towards sustainability," *Sustainability Sci.*, vol. 17, no. 1, pp. 191–207, Jan. 2022, doi: 10.1007/s11625-021-01071-1.

[47] M. Haffar, R. Ozcan, M. Radulescu, N. Isac, and A. Nassani, "Hegemony of network capabilities, frugal innovation and innovation strategies: The innovation performance perspective," *Sustainability*, vol. 14, no. 1, p. 2, Dec. 2021, doi: 10.3390/su14010002.

[48] M. Obeso, R. Hernández-Linares, M. C. López-Fernández, and A. M. Serrano-Bedia, "Knowledge management processes and organizational performance: The mediating role of organizational learning," *J. Knowl. Manage.*, vol. 24, no. 8, pp. 1859–1880, Jul. 2020, doi: 10.1108/jkm-10-2019-0553.

[49] M. Kordab, J. Raudeliūnienė, and I. Meidutė-Kavaliauskienė, "Mediating role of knowledge management in the relationship between organizational learning and sustainable organizational performance," *Sustainability*, vol. 12, no. 23, p. 10061, Dec. 2020, doi: 10.3390/su122310061.

[50] A. Kouaib, S. Mhiri, and A. Jarboui, "Board of directors' effectiveness and sustainable performance: The triple bottom line," *J. High Technol. Manage. Res.*, vol. 31, no. 2, Nov. 2020, Art. no. 100390, doi: 10.1016/j.hitech.2020.100390.

[51] F.-Y. Lo and P.-C. Liao, "Rethinking financial performance and corporate sustainability: Perspectives on resources and strategies," *Technolog. Forecasting Social Change*, vol. 162, Jan. 2021, Art. no. 120346, doi: 10.1016/j.techfore.2020.120346.

[52] S. Majid, X. Zhang, M. B. Khaskheli, F. Hong, P. J. H. King, and I. H. Shamsi, "Eco-efficiency, environmental and sustainable innovation in recycling energy and their effect on business performance: Evidence from European SMEs," *Sustainability*, vol. 15, no. 12, p. 9465, Jun. 2023, doi: 10.3390/su15129465.

[53] D. Tjahjana, A. H. Manurung, N. J. Setiadi, and W. Kosasih, "Innovation, digital business and frugal innovation type," *Eur. J. Mol. Clinical Med.*, vol. 7, no. 3, pp. 1–12, 2020.

[54] M. M. Migdadi, "Knowledge management processes, innovation capability and organizational performance," *Int. J. Productiv. Perform. Manage.*, vol. 71, no. 1, pp. 182–210, Jan. 2022, doi: 10.1108/ijppm-04-2020-0154.

[55] L. Lam, P. Nguyen, N. Le, and K. Tran, "The relation among organizational culture, knowledge management, and innovation capability: Its implication for open innovation," *J. Open Innov., Technol., Market, Complex.*, vol. 7, no. 1, p. 66, Mar. 2021, doi: 10.3390/joitmc7010066.

[56] N. Gómez-Marín, J. Cara-Jiménez, A. Bernardo-Sánchez, L. Álvarez-de-Prado, and F. Ortega-Fernández, "Sustainable knowledge management in academia and research organizations in the innovation context," *Int. J. Manage. Educ.*, vol. 20, no. 1, Mar. 2022, Art. no. 100601, doi: 10.1016/j.ijme.2022.100601.

[57] Q. Iqbal and K. Piwowar-Sulej, "Sustainable leadership and heterogeneous knowledge sharing: The model for frugal innovation," *Eur. J. Innov. Manage.*, vol. 26, no. 7, pp. 655–673, Dec. 2023, doi: 10.1108/ejim-03-2022-0144.

[58] S. Wang, J. Abbas, M. S. Sial, S. Álvarez-Otero, and L.-I. Cioca, "Achieving green innovation and sustainable development goals through green knowledge management: Moderating role of organizational green culture," *J. Innov. Knowl.*, vol. 7, no. 4, Oct. 2022, Art. no. 100272, doi: 10.1016/j.jik.2022.100272.

[59] J. Ferreira, S. Cardim, and A. Coelho, "Dynamic capabilities and mediating effects of innovation on the competitive advantage and Firm's performance: The moderating role of organizational learning capability," *J. Knowl. Economy*, vol. 12, no. 2, pp. 620–644, Jun. 2021, doi: 10.1007/s13132-020-00655-z.

[60] S. Scarpellini, L. M. Marín-Vinuesa, A. Aranda-Usón, and P. Portillo-Tarragona, "Dynamic capabilities and environmental accounting for the circular economy in businesses," *Sustainability Accounting, Manage. Policy J.*, vol. 11, no. 7, pp. 1129–1158, Jan. 2020, doi: 10.1108/sampj-04-2019-0150.

[61] N. M. P. Bocken and T. H. J. Geradts, "Barriers and drivers to sustainable business model innovation: Organization design and dynamic capabilities," *Long Range Planning*, vol. 53, no. 4, Aug. 2020, Art. no. 101950, doi: 10.1016/j.lrp.2019.101950.

[62] G. Santoro, A. Thrassou, S. Bresciani, and M. D. Giudice, "Do knowledge management and dynamic capabilities affect ambidextrous entrepreneurial intensity and Firms' performance?" *IEEE Trans. Eng. Manag.*, vol. 68, no. 2, pp. 378–386, Apr. 2021, doi: 10.1109/TEM.2019.2907874.

[63] G. C. Avery and H. Bergsteiner, "Sustainable leadership practices for enhancing business resilience and performance," *Strategy Leadership*, vol. 39, no. 3, pp. 5–15, May 2011, doi: 10.1108/10878571111128766.

[64] Q. Iqbal and N. H. Ahmad, "Sustainable development: The colors of sustainable leadership in learning organization," *Sustain. Develop.*, vol. 29, no. 1, pp. 108–119, Jan. 2021, doi: 10.1002/sd.2135.

[65] L. Mariani, B. Trivellato, M. Martini, and E. Marafioti, "Achieving sustainable development goals through collaborative innovation: Evidence from four European initiatives," *J. Bus. Ethics*, vol. 180, no. 4, pp. 1075–1095, Nov. 2022, doi: 10.1007/s10551-022-05193-z.

[66] Q. Iqbal, N. H. Ahmad, and H. A. Halim, "How does sustainable leadership influence sustainable performance? Empirical evidence from selected ASEAN countries," *SAGE Open*, vol. 10, no. 4, Oct. 2020, Art. no. 215824402096939, doi: 10.1177/2158244020969394.

[67] S. Suriyankietkaew, K. Krittayaruangroj, and N. Iamsawan, "Sustainable leadership practices and competencies of SMEs for sustainability and resilience: A community-based social enterprise study," *Sustainability*, vol. 14, no. 10, p. 5762, May 2022, doi: 10.3390/su14105762.

[68] J. F. Hair, J. J. Risher, M. Sarstedt, and C. M. Ringle, "When to use and how to report the results of PLS-SEM," *Eur. Bus. Rev.*, vol. 31, no. 1, pp. 2–24, Jan. 2019, doi: 10.1108/ebr-11-2018-0203.

[69] J. Henseler, C. M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *J. Acad. Marketing Sci.*, vol. 43, no. 1, pp. 115–135, Jan. 2015, doi: 10.1007/s11747-014-0403-8.

[70] F. Achmad, "Tourism industry development model through support system facilities, stakeholder participation, and environmental dynamism: Dealing with post-pandemic COVID-19 approach," *Int. J. Innov., Manage. Technol.*, vol. 15, no. 1, pp. 1–5, 2024, doi: 10.18178/ijimt.2024.15.1.954.

[71] E. Triswanto, T. Ratnawati, and N. Susanti, "Strategy analysis of small-scale business development of leather products in sidoarjo regency of East Java, Indonesia," *Russian J. Agricult. Socio-Econ. Sci.*, vol. 78, no. 6, pp. 250–256, Jun. 2018.

[72] R. Siti, S. Surachman, R. Rofiaty, and S. Ananda, "Environmental influence on business and strategic planning over the small-medium enterprises' performance: A study on featured product produced by SMEs in Sidoarjo, Indonesia," *Russian J. Agricult. Socio-Econ. Sci.*, vol. 61, no. 1, pp. 188–193, Jan. 2017.

[73] H. T. Widodo, "Peran dan manfaat modal sosial dalam peningkatan efektivitas kerja karyawan sektor usaha mikro kecil dan menengah di sentra kerajinan tas dan koper tanggulangin sidoarjo," *JBMP (Jurnal Bisnis, Manajemen dan Perbankan)*, vol. 2, no. 1, pp. 1–14, Mar. 2016, doi: 10.21070/jbmp.v2i1.911.

[74] F. Achmad and I. I. Wiratmadja, "Strategic advancements in tourism development in Indonesia: Assessing the impact of facilities and services using the PLS-SEM approach," *J. Ind. Servicess*, vol. 10, no. 1, pp. 49–62, 2024. [Online]. Available: https://jurnal.untirta.ac.id/index.php/jiss/article/view/24494

[75] M. U. Akram, C. Chauhan, K. Ghosh, and A. Singh, "Knowledge management, sustainable business performance and empowering leadership: A firm-level approach," *Int. J. Knowl. Manage.*, vol. 15, no. 2, pp. 20–35, Apr. 2019, doi: 10.4018/ijkm.2019040102.

[76] O. R. Mahdi and I. A. Nassar, "The business nodel of sustainable competitive advantage through strategic leadership capabilities and knowledge management processes to overcome COVID-19 pandemic," *Sustainability*, vol. 13, no. 17, p. 9891, Sep. 2021, doi: 10.3390/su13179891.

[77] B. Fischer, M. Guerrero, J. Guimón, and P. R. Schaeffer, "Knowledge transfer for frugal innovation: Where do entrepreneurial universities stand?" *J. Knowl. Manage.*, vol. 25, no. 2, pp. 360–379, Mar. 2021, doi: 10.1108/jkm-01-2020-0040.

[78] M. U. Shehzad, J. Zhang, M. Dost, M. S. Ahmad, and S. Alam, "Knowledge management enablers and knowledge management processes: A direct and configurational approach to stimulate green innovation," *Eur. J. Innov. Manage.*, vol. 27, no. 1, pp. 123–152, Jan. 2024, doi: 10.1108/ejim-02-2022-0076.

[79] A. F. AlMulhim, "The role of internal and external sources of knowledge on frugal innovation: Moderating role of innovation capabilities," *Int. J. Innov. Sci.*, vol. 13, no. 3, pp. 341–363, Jun. 2021, doi: 10.1108/ijis-09-2020-0130.

[80] A. Dima, A.-M. Bugheanu, R. Dinulescu, A.-M. Potcovaru, C. A. Stefanescu, and I. Marin, "Exploring the research regarding frugal innovation and business sustainability through bibliometric analysis," *Sustainability*, vol. 14, no. 3, p. 1326, Jan. 2022, doi: 10.3390/su14031326.

[81] H. Cuevas-Vargas, N. Parga-Montoya, and R. Fernández-Escobedo, "The adoption of ICT as an enabler of frugal innovation to achieve customer satisfaction. The mediating effect of frugal innovation," *Proc. Comput. Sci.*, vol. 199, pp. 198–206, Jan. 2022, doi: 10.1016/j.procs.2022.01.025.

FANDI ACHMAD (Member, IEEE) received the Bachelor of Engineering degree in industrial engineering and the Master of Engineering degree in FastTrack program from Telkom University, Bandung, Indonesia, in 2022 and 2023, respectively. He has been with the Department of Industrial Engineering, Telkom University, as a Lecturer, since 2023. He joined the Laboratory at Enterprise System Engineering, Telkom University. In 2022, he participated in a collaborative research program with the Ruhr West University of Applied Sciences, Germany. His research interests include system modeling, innovation management, performance management, and sustainable innovation.

IWAN INRAWAN WIRATMADJA (Member, IEEE) received the Bachelor of Engineering degree in industrial engineering from Bandung Institute of Technology, Bandung, Indonesia, in 1984, and the master's and Ph.D. degrees in engineering from Ecole Supérieure des Affaires, Université Pierre Mendes France, Grenoble II, France, in 1991 and 1995, respectively. He has been with the Faculty of Industrial Engineering, Bandung Institute of Technology, as a Lecturer, since 1984. He is currently a Professor with the Department of Industrial Engineering, Bandung Institute of Technology. Several books and publications have been published, both nationally and internationally. His current research interests include technology transfer, management of technology, and knowledge management field.