

**A PROPOSED EVALUATION FRAMEWORK OF AI'S BUSINESS EFFECTS
ON SUSTAINABILITY FROM A MICRO-ENTERPRISE ORGANIZATIONAL
STRUCTURE TYPE PERSPECTIVE USING FIE**

(MİKROİŞLETME ORGANİZASYON YAPISI TÜRÜ PERSPEKTİFİNDEN, BSU
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İbrahim Can ERTAN, B.S.

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INTELLIGENCE'S BUSINESS EFFECTS ON SUSTAINABILITY FROM A
MICRO-ENTERPRISE ORGANIZATIONAL STRUCTURE TYPE
PERSPECTIVE USING FUZZY INTUITIONISTIC EXTENSIONS**

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LIST OF SYMBOLS

AI	: Artificial Intelligence
ANN	: Artificial Neural Network
App	: Appendix
BSU	: Bulanık Sezgisel Uzantılar (Fuzzy Intuitionistic Extensions)
CINFUS	: Continuous Intuitionistic Fuzzy Set
CRM	: Customer Relationship Management
CSR	: Corporate Social Responsibility
FIE	: Fuzzy Intuitionistic Extensions
GAN	: Generative Adversarial Networks
HRI	: Human Robot Interaction
HRM	: Human Resources Management
ICT	: Information and Communication Technology
IFN	: Intuitionistic Fuzzy Number
IT	: Information Technology
IVIFN	: Interval-Valued Intuitionistic Fuzzy Number
ME	: Microenterprise
NLP	: Natural Language Processing
SME	: Small Microenterprise

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ABSTRACT

The increasing incorporation of Artificial Intelligence (AI) into corporate structures demands a thorough investigation of the implications for sustainability, especially in the complex environment of micro-enterprises. This study aims to provide a comprehensive assessment framework designed for examining the complex interactions between AI implementation and sustainability results, with a particular emphasis on the organizational structures characteristic of micro-enterprises.

In order to acknowledge and account for the inherent uncertainties and imprecisions that characterize sustainability indicators in this dynamic setting, the proposed approach leans on fuzzy intuitionistic extensions. With a primary focus on sustainability issues, this study attempts to close current gaps in the academic discussion by offering a methodologically valid approach to evaluate the complex business implications of AI integration in the particular microenterprise environment. By utilizing fuzzy intuitionistic logic, the framework takes into account the natural desires and errors that come with sustainability metrics. This allows for a more realistic and nuanced representation of the complex relationships that exist between AI technologies and the organizational structures that are essential to micro-enterprises.

Important components of the suggested assessment system include defining relevant sustainability aspects, creating fuzzy intuitionistic indicators relevant to micro-enterprises, and including a strict assessment process. By systematically utilizing this paradigm, our research aims to provide insightful information about the possible benefits and difficulties associated with implementing AI in micro-enterprises, so contributing to a more nuanced understanding of the technology's implications for sustainable business practices.

The expected results of this study will provide fundamental information for later academic investigations and guide policy decisions intended to promote ethical and sustainable AI adoption in the microenterprise space.

The adoption of a fuzzy intuitionistic framework, which is especially well-suited for resolving the inherent uncertainties and complexities associated with sustainability indicators, is at the heart of this research. The necessity to reflect the frequently imprecise and confusing nature of sustainability indicators in the quickly changing microenterprise business environment justifies this methodological decision. Because it takes into account the subjectivity and variability that come with assessing the sustainability consequences of artificial intelligence, the fuzzy intuitionistic method makes the assessment more adaptable and realistic.

The study's methodology is painstakingly created to analyze and assess many sustainability factors that are pertinent to microbusinesses. It includes a wide range of fuzzy intuitionistic indicators that are tailored to the particular operational, financial, and environmental circumstances of these small businesses. The approach attempts to give a thorough study of how AI integration can affect sustainability results through a thorough assessment procedure. This entails looking at both the possible advantages—like increased productivity and resource optimization—and the drawbacks—like moral dilemmas and technological obstacles.

For the purpose of determining and classifying the criteria and sub-criteria pertaining to artificial intelligence, sustainability, and micro-enterprises, the methodology section's fishbone diagram is an essential tool. This methodical approach makes it easier to investigate in detail the underlying causes and causal links that influence the overall sustainability performance of micro-enterprises using AI technologies. The fishbone

diagram helps to create a greater understanding of the complex dynamics at play by methodically arranging various components.

The study's conclusions from using the suggested framework on actual case studies of microenterprises are presented in the results section. It is anticipated that these results will clarify the real-world effects of AI adoption by providing information on both effective tactics and possible drawbacks. The research seeks to identify important places where more support or intervention may be required, as well as particular areas where AI can achieve sustainable benefits.

The research's conclusions are ultimately meant to influence policy-making as well as scholarly discussion. Through offering a comprehensive and methodologically sound assessment of AI's influence on sustainability in micro-enterprises, the study aims to provide important information that can direct future investigations and processes for making decisions. Future research recommendations will center on resolving limits that have been found and investigating fresh approaches to improving the sustainable integration of AI in micro-enterprises, making sure that these tiny but essential businesses can prosper in a society that is becoming more and more reliant on technology.

ÖZET

Yapay Zekanın (AI) kurumsal yapılara giderek daha fazla dahil edilmesi, özellikle mikro işletmelerin karmaşık ortamında sürdürülebilirlik üzerindeki etkilerinin kapsamlı bir şekilde araştırılmasını gerektirmektedir. Bu çalışma, mikro işletmelerin karakteristik organizasyon yapılarına özellikle vurgu yaparak, yapay zeka uygulaması ve sürdürülebilirlik sonuçları arasındaki karmaşık etkileşimleri incelemek için tasarlanmış kapsamlı bir değerlendirme çerçevesi sağlamayı amaçlamaktadır. Bu dinamik ortamda sürdürülebilirlik göstergelerini karakterize eden doğal belirsizlikleri ve belirsizlikleri kabul etmek ve açıklamak için önerilen yaklaşım, bulanık sezgisel uzantılara dayanmaktadır.

Sürdürülebilirlik konularına öncelikli olarak odaklanan bu çalışma, belirli bir mikro işletme ortamında yapay zeka entegrasyonunun karmaşık iş sonuçlarını değerlendirmek için metodolojik olarak geçerli bir yaklaşım sunarak akademik tartışmalardaki mevcut boşlukları kapatmaya çalışmaktadır. Bulanık sezgisel mantığı kullanarak çerçeve, sürdürülebilirlik ölçümleriyle birlikte gelen doğal arzuları ve hataları hesaba katar. Bu, yapay zeka teknolojileri ile mikro işletmeler için gerekli olan organizasyonel yapılar arasında var olan karmaşık ilişkilerin daha gerçekçi ve incelikli bir şekilde temsil edilmesine olanak tanır.

Önerilen değerlendirme sisteminin önemli bileşenleri arasında ilgili sürdürülebilirlik hususlarının tanımlanması, mikro işletmelerle ilgili bulanık sezgisel göstergelerin oluşturulması ve sıkı bir değerlendirme sürecinin yer alması yer almaktadır.

Yapay zekanın mikro işletmelerde uygulanmasıyla ilgili olası faydalar ve zorluklar hakkında aydınlatıcı bilgiler sağlamayı, böylece teknolojinin sürdürülebilir iş uygulamalarına yönelik etkilerinin daha incelikli bir şekilde anlaşılmasına katkıda bulunmayı amaçlıyor.

Bu çalışmanın sonuçları, daha sonraki akademik araştırmalar için temel sağlayacak ve mikro işletme alanında sürdürülebilir yapay zekanın benimsenmesini teşvik etmeyi amaçlayan kararlara rehberlik edecektir.

Sürdürülebilirlik göstergeleri ile ilgili doğal belirsizlikleri ve karmaşıklıkları çözmek için özellikle uygun olan bulanık sezgisel bir çerçevenin benimsenmesi bu araştırmanın merkezinde yer almaktadır. Hızla değişen mikro işletme iş ortamında sürdürülebilirlik göstergelerinin sıklıkla belirsiz ve kafa karıştırıcı doğasını yansıtmaya zorunluluğu, bu metodolojik kararı haklı çıkarmaktadır. Yapay zekanın sürdürülebilirlik sonuçlarının değerlendirilmesiyle gelen öznellik ve değişkenliği hesaba kattığı için bulanık sezgisel yöntem, değerlendirmeyi daha uyarlanabilir ve gerçekçi hale getirir.

Çalışmanın metodolojisi, mikro işletmelerle ilgili birçok sürdürülebilirlik faktörünü analiz etmek ve değerlendirmek için titizlikle oluşturulmuştur. Bu küçük işletmelerin belirli operasyonel, finansal ve çevresel koşullarına göre uyarlanmış çok çeşitli bulanık sezgisel göstergeleri içerir. Yaklaşım, kapsamlı bir değerlendirme prosedürü yoluyla yapay zeka entegrasyonunun sürdürülebilirlik sonuçlarını nasıl etkileyebileceğine dair kapsamlı bir çalışma sunmaya çalışmaktadır. Bu, hem artan üretkenlik ve kaynak optimizasyonu gibi olası avantajlara hem de ahlaki ikilemler ve teknolojik engeller gibi dezavantajlara bakmayı gerektirir.

Yapay zeka, sürdürülebilirlik ve mikro işletmelere ilişkin kriterlerin ve alt kriterlerin belirlenmesi ve sınıflandırılması amacıyla metodoloji bölümünün balık kılıcı diyagramı önemli bir araçtır. Bu metodolojik yaklaşım, yapay zeka teknolojilerini kullanan mikro işletmelerin genel sürdürülebilirlik performansını etkileyen altta yatan

nedenlerin ve nedensel bağlantıların ayrıntılı olarak araştırılmasını kolaylaştırır. Balık kılçığı diyagramı, çeşitli bileşenleri yöntemli bir şekilde düzenleyerek, mevcut karmaşık dinamiklerin daha iyi anlaşılmasına yardımcı olur.

Çalışmanın, önerilen çerçevenin mikro işletmelere ilişkin gerçek vaka çalışmaları üzerinde kullanılmasından elde edilen sonuçları, sonuçlar bölümünde sunulmaktadır. Bu sonuçların, hem etkili taktikler hem de olası dezavantajlar hakkında bilgi sağlayarak yapay zekanın benimsenmesinin gerçek dünyadaki etkilerini açıklığa kavuşturması bekleniyor. Araştırma, daha fazla destek veya müdahalenin gerekli olabileceği önemli yerlerin yanı sıra yapay zekanın sürdürülebilir faydalar elde edebileceği belirli alanları belirlemeyi amaçlıyor.

Araştırmanın sonuçlarının nihai olarak politika oluşturmayı ve bilimsel tartışmayı etkilemesi amaçlanıyor. Yapay zekanın mikro işletmelerde sürdürülebilirlik üzerindeki etkisine ilişkin kapsamlı ve metodolojik olarak sağlam bir değerlendirme sunan çalışma, gelecekteki araştırmaları ve karar alma süreçlerini yönlendirebilecek önemli bilgiler sağlamayı amaçlıyor. Gelecekteki araştırma önerileri, bulunan sınırların çözülmesine ve yapay zekanın mikro işletmelerde sürdürülebilir entegrasyonunu geliştirmeye yönelik yeni yaklaşımların araştırılmasına odaklanacak ve bu küçük ama önemli işletmelerin teknolojiye giderek daha fazla bağımlı hale gelen bir toplumda başarılı olabilmelerini sağlayacak.

1. INTRODUCTION

This thesis looks into how artificial intelligence (AI) affects sustainability, especially in the context of microenterprises, which have particular difficulties because of their small budgets and unusual organizational setups. Notwithstanding these obstacles, AI offers these tiny enterprises the chance to improve their production, efficiency, and inventiveness. The use of AI in microbusinesses, however, brings up important ethical, societal, and financial issues that need to be properly considered. Thus, the purpose of this study is to investigate, from a sustainability standpoint, the possible advantages and disadvantages of implementing AI in microenterprises. This research aims to provide a methodologically sound framework for evaluating the intricate relationships between AI integration and sustainability outcomes by incorporating fuzzy intuitionistic extensions to address uncertainties and by proposing an evaluation framework specific to micro-enterprise characteristics.

The speed at which artificial intelligence (AI) technologies have advanced in recent years has revolutionized a number of industries and changed how businesses function. AI's capacity to promote productivity, efficiency, and innovation has drawn a lot of interest from a variety of commercial sectors. Investigating how AI may help achieve sustainability goals becomes essential as worries about climate change and the need for sustainable development grow.

The purpose of this thesis is to examine how artificial intelligence affects sustainability, particularly as it relates to micro-enterprises, a type of organizational structure distinguished by its tiny size, constrained resources, and unique operational difficulties. Although a lot of research has been done on how AI is affecting big businesses and the economy as a whole, little has been known about how AI specifically affects microbusinesses and how they might contribute to sustainability.

This study acknowledges the variety of organizational structures and the particular difficulties faced by small-scale organizations in integrating AI technologies by concentrating on micro-enterprises. Comprehending the appropriate application of AI in various contexts is essential to realizing the revolutionary possibilities of technology in promoting sustainability at the community level.

Sustainability is a multifaceted notion that involves environmental, social, and economic elements. It comprises implementing strategies that maximize resource efficiency, lessen adverse effects on the environment, improve social justice, and support long-term economic viability. Artificial intelligence (AI) has the potential to be a tool that helps micro-enterprises tackle sustainability issues and take advantage of new possibilities because of its capacity to handle enormous volumes of data, make intelligent judgments, and automate tasks.

Though AI has a lot of promise, there are a number of ethical, social, and financial issues to be aware of. It is crucial to assess the risks and unforeseen repercussions that could occur when microenterprises attempt to implement AI technologies. In order to provide insights and suggestions for sustainable AI adoption, this thesis aims to investigate the advantages and difficulties of implementing AI from the viewpoint of microenterprises.

In order to accomplish this, a mixed-methods approach will be used in the research, involving quantitative analysis to evaluate the effect of AI on sustainability metrics, qualitative interviews to gather the viewpoints and experiences of micro-enterprises, and an extensive literature review to place the results in the context of the body of current knowledge.

In the early 1980s, Haier - a well-known Chinese multinational - was just a little, struggling refrigerator plant in Qingdao (Liu, 2002). Even though Haier is a big participant in the consumer electronics and home appliances industries today, the

company's humble beginnings are consistent with the microenterprise idea. As is the case with any microenterprise aiming for expansion, the company's early focus was on laying a solid foundation through innovations that prioritized the needs of the client and quality improvement. The story of Haier, which began as a modest business and has now grown to become a global leader, shows how smart management, constant innovation, and flexibility can propel a microenterprise's success in a cutthroat market.

It is paradoxical that bureaucracy still exists in modern business despite its well-known disadvantages. CEOs who publicly criticize bureaucracy for impeding initiative, creativity, and risk-taking include Jamie Dimon of JPMorgan Chase and Doug McMillon of Walmart (Hamil & Zanini, 2018). They refer to bureaucracy as a "disease" and a "villain," respectively. Berkshire Hathaway's Charlie Munger compares the company's growth to cancer. Still, bureaucracy is pervasive in spite of this broad condemnation. For many, it is an inevitable consequence of doing business in intricate international and regulatory contexts. In the United States, the number of managers and administrators has more than doubled since 1983, exceeding the rise of other jobs. In contrast to Peter Drucker's assumption that modern corporations will have fewer layers and managers compared to their 1980s counterparts, this trend has resulted in a major growth in bureaucracy within organizations.

Productivity has stalled while bureaucracy has increased. The average annual growth rate of U.S. labor productivity in nonfinancial enterprises was 2.5% between 1948 and 2004. The growth rate has since dropped to just 1.1% annually. The U.S. economy is dominated by large enterprises, where the fall in productivity is most noticeable. Nowadays, more than one-third of American workers are employed by companies employing more than 5,000 people, where frontline staff are usually buried under multiple tiers of management.

Although some view start-ups as a possible remedy for bureaucracy, when these businesses grow, they frequently give in to bureaucratic tendencies. Even profitable start-ups with lean beginning structures, like Uber and Airbnb, eventually expand into complicated hierarchies. One quickly rising IT provider, for example, grew to \$4 billion

in yearly sales while hiring 600 vice presidents, illustrating how bureaucratic expansion may affect even entrepreneurial endeavors.

The fact that bureaucracy may be efficient is one of the reasons it is so often used, especially in large enterprises. Bureaucracy can help achieve efficiency at scale because of its specialized divisions, defined tasks, and distinct lines of authority. Many leaders find comfort in this well-known organizational model since it is adaptable to several industries, cultures, and political systems.

But the way the economy and labor are evolving implies that bureaucracy need not be the end result. Today's workforce differs from that of the past in that it is typically skilled and literate, innovation rather than size determines competitive advantage, communication is instantaneous, and change happens quickly. Due to these circumstances, alternative organizational models that are in opposition to conventional bureaucratic structures have emerged.

One prominent example is the largest appliance manufacturer in the world, Haier, a Qingdao-based business. Haier is a competitor of Whirlpool and Electrolux, two of the biggest names in the business with \$35 billion in revenue and 75,000 workers worldwide. Haier has grown at an impressive rate over the last ten years, with annual gross profit rises of 23% and revenue growth of 18% in its main appliance industry. Haier's creative management approach, which forgoes conventional bureaucracy in favor of a decentralized organization, is credited with this accomplishment.

Zhang Ruimin, the CEO of Haier, has long considered bureaucracy to be a liability to competition. Haier has changed under his direction into a company where conventional hierarchies have been replaced by an open ecosystem, staff operate like entrepreneurs, and everyone is answerable to customers. Rendanheyi, the management philosophy of Haier, places a strong emphasis on the close alignment of value provided for consumers and value received by employees.

According to Haier's strategy, the corporation is divided into over 4,000 microenterprises, or MEs, each of which has a sizable degree of autonomy. These MEs can be divided into three groups: node MEs, which supply market-facing MEs with component goods and services, changing MEs, who are reimagining heritage enterprises, and incubating MEs, which are wholly new endeavors. Similar to the internet's architecture, Haier's modular construction enables it to be adaptable and sensitive to changes in the market.

For its MEs, Haier additionally establishes challenging growth and transformation objectives called as "leading targets." These goals are intended to promote bold thinking and creativity and are based on market data. It is anticipated that MEs would have revenue and profit growth that is noticeably higher than the industry average, fostering competition and ongoing progress.

An other essential component of Haier's concept is internal contracting. Haier gives MEs the freedom to select the service providers they want, in contrast to typical corporations where functional departments work as internal monopolies. This structure guarantees that internal departments stay effective and customer-focused while also promoting competition. MEs work with nodes to establish service agreements; failing nodes can be replaced, and nodes must compete with outside suppliers.

Platforms that bring related MEs together facilitate coordination inside Haier. Owners of platforms encourage cooperation between MEs by assisting in opportunity identification and resource sharing. This decentralized method makes sure that responsiveness and speed are not sacrificed for coordination.

Haier sets itself apart from conventional bureaucratic organizations with its dedication to open innovation. Haier shortens time-to-market and speeds up innovation by integrating users and outside partners in the development process. Haier stays abreast of industry demands and developments by soliciting feedback from the public and recruiting talent and ideas via internet platforms.

Haier promotes an entrepreneurial culture by pushing staff members to act and think like business owners. A lot of MEs are run by people who have a personal interest in their development, and Haier frequently invests after new businesses have secured outside capital. This strategy optimizes innovation potential while reducing risk.

Bureaucracy is still a popular organizational style, but in the quick-paced, innovation-driven economy of today, its drawbacks become more obvious. Haier and other companies exemplify how alternative structures, marked by open innovation, decentralization, internal rivalry, and an entrepreneurial culture, can result in increased productivity, agility, and competitiveness. More companies may turn to these models as the business environment changes in an effort to break free from bureaucratic limitations and seize fresh chances for expansion.

Microbusinesses in Turkey

Microbusinesses, which will account for an astounding 98% of Turkey's 3.2 million companies in 2023, are the backbone of the country's economy. They account for a substantial 25% of the GDP and are the driving force behind 60% of all jobs (<https://www.kosgeb.gov.tr/>). Nevertheless, these companies confront numerous challenges in spite of their obvious significance. It is difficult for them to obtain loans and other essential financial resources, which limits their capacity to grow and invest. During establishment and operation, they are beset by bureaucratic red tape that consumes their time and resources. They are burdened by a high tax burden, which lowers profitability and deters investment. Moreover, owners' and workers' inability to acquire the necessary knowledge and skills reduces their productivity and ability to compete in the market.

Lastly, a lack of technology adoption keeps them from taking advantage of contemporary sales and marketing strategies and from branching out into new markets like e-commerce. The government, commercial sector, and civil society organizations must work together to address these issues. It is imperative that important policies be

implemented to increase financing options, streamline bureaucratic processes, provide tax relief, create education and skills programs, and encourage the use of technology. Given their indisputable importance within the Turkish economy, resolving the issues microbusinesses encounter is ultimately essential not just for economic development but also for social well-being and preserving a healthy job landscape.

In conclusion, the purpose of this thesis is to provide insight into how artificial intelligence affects sustainability from the standpoint of micro-enterprise organizational structures. The goal of this research is to advance knowledge about how small businesses might use technology to create a more sustainable future by examining the particular difficulties faced by microenterprises and examining the potential of AI to drive sustainability in this context.

2. LITERATURE REVIEW

Different studies have examined the critical significance that various traits play in the dynamic sector of entrepreneurship. The study explores the concept of risk-taking propensity and its implications for entrepreneurial pursuits (Cater et al., 2021). Offered valuable perspectives on adaptability and flexibility, highlighting the crucial role that cognitive flexibility plays in the entrepreneurial mindset (Brenes et al., 2021).

An investigation of the strategic planning of hotel and restaurant enterprises, highlighted the necessity of a model that energises possible management themes for steady growth (Bryindzia et al., 2020). An assessment of the variables influencing the use of strategic planning in SMEs, emphasized the importance of technical innovation, resource capacity development, and strategic leadership (Kidombo, 2014). Efficient inventory and procurement management strategies are critical to improving a company's overall performance (Rono and Miroga, 2019). In exploration of supply chain management for retailers, highlighted the function that supply chain management plays in regulating costs, inventory levels, and product quality from the standpoint of the consumer (Krishnamoorthy and Korah, 2020).

In exploration of e-CRM and its customer relationship building tactics, highlighted the need of placing a greater emphasis on the unique demands of each individual client (Kampani and Jhamb, 2020). Examined how customer service representatives utilize CRM systems and the effects this has on customer satisfaction through various channels of service (Chen et al., 2021).

In evaluation of the efficiency of digital marketing tactics in raising consumer satisfaction, placed a strong emphasis on exposure to digital marketing principles (Zanubiya et al., 2023). In investigation of marketing trends and promotional media components in the context of Industry 4.0, emphasized the value of utilizing digital platforms (Wanof and Gani, 2023). Educational institutions can better tailor their marketing strategies to meet the needs of today's learners by taking into account variables including student needs, educator quality, data security, and social media usage (Harini et al., 2023).

A unique paradigm for learning and modifying theories that forecast future features as well as the domain in which predictions are true is put forth (Wu and Tegmark, 2019). Computer vision is a basic component of artificial intelligence and serves as the foundation for many image processing techniques (Wang and Li, 2019). Integrated multicriteria decision analysis and classical scenario planning to solve democratic urban land use planning through a goal-reasoning artificial intelligence agent (Chen et al., 2020). Algorithms combining declarative knowledge techniques with reasoning are surveyed for sequential decision-making under uncertainty (Zhang and Sridharan, 2022). Insights from a study on AI's capacity to foster creative potential in innovators, managers of innovation, and workshop facilitators are shared, also provided suggestions for preserving innovation and commercial viability (Siemon et al., 2022).

Municipalities' participation in social equity policy is greatly influenced by procedural justice, particularly formal citizen engagement and cross-agency collaboration (Liao et al., 2019). This is evident when examining distributional and procedural justice lenses. Examined the complex aspects of sustainability and highlights the significance of social justice in relation to access to sufficient and healthful food Barbarini and De Mario, 2020. In their investigation of livelihood interventions, development, and empowerment, as well as their effects on community well-being, gone deeply into community development initiatives (Kumar et al., 2022). The significance of using

natural capital sustainably is emphasized and suggested using local ecological footprint accounts to gauge the strain on local natural capital (Wu et al., 2021).

The notion of knowledge platforms for sustainability is introduced also drawn attention to the conflict that exists between stakeholder engagement and the established bases of epistemic authority (Esguerra and van der Hel, 2021). Stakeholder participation is encouraged in assessments of the water-energy-food nexus in order to attain social, economic, and environmental sustainability (Melloni et al., 2020). An analytical approach on institutional change is presented, highlighting regional differences in actor skills and institutional frameworks (Thompson and Harris, 2021).

2.1. Microenterprises

There were gaps in the literature since the majority of research on SMEs and economic performance was done. Microenterprises are characterized by easy entry, single or family ownership, reliance on indigenous resources, small-scale operations, and labor-intensive nature (with limited skills and formal schooling) that compete in unregulated competitive markets (Alam et al., 2011). Additionally, microenterprises are typically unique informal enterprises that differ from their small- to medium-sized counterparts.

Kantor (2005) examines the factors that contribute to a two-dimensional notion of women's microenterprise success in Ahmedabad, India, by examining information from a 1998 study of independent clothing manufacturers. In order for women to participate in and gain from decisions made about how to use their resources, microenterprise scholars and practitioners must concentrate on raising the status of women in their families. Because microenterprise offers impoverished people a feasible path out of poverty through greater and more diversified revenue streams, the function of ICT in microenterprise is the specific development issue examined. Duncombe (2007) studies

analyzes ICT applications for microenterprise-based poverty reduction utilizing the livelihoods framework. An application of the livelihoods framework is illustrated with a case study of Botswana. The impacts of a positive export shock on labor allocation between the formal business sector and the informal, microenterprise sector in a low-income nation are studied (McCaig et al., 2014). According to McCaig et al. (2014), Vietnam's formal manufacturing labor force grew by 5 percentage points as a result of the US tariff reductions. Developing microenterprises is a major policy focus in most nations as they are a significant source of employment. Presenting evidence on company success, management practices, happiness, business knowledge, and noncognitive talents, Berge et al. (2015) used data from three survey rounds, a lab experiment, and administrative records of the microfinance firm. In a randomized experiment carried out in urban Ghana, tailoring microenterprises were given cash, assistance from a global consulting business, both, or neither (Karlán et al., 2015). According to Karlán et al. (2015), all three treatments had the desired instant results, which included altered business procedures and higher investment. According to studies of Blattman et al. (2015), war-affected, severely impoverished women in northern Uganda demonstrate high returns on a \$150 cash package that includes five days of business skills training and ongoing supervision. Participants increased their ownership and profits from microenterprises 16 months after funding, mostly from small-scale trading. Brooks et al. (2018) shows through a randomized controlled experiment that mentoring by an experienced entrepreneur in the same neighborhood benefits novice female microenterprise owners in a Kenyan slum. Mentoring has a 20 percent average rise in revenues, with significant effects at first that diminish as pairings end.

Sales and Marketing

Koldyshev (2020) aims to provide a qualitative analysis of mobile applications as a tool for sales promotion in industrial (B2B) glass company marketing. The ideas of digital

B2B marketing, B2B organizations' capacity for digitization, customer relationship building, and customer focus are all expanded upon in this study. The value chain management plan for digital marketing firms can be developed with the help of several instruments suggested by the theory of managing a pricing strategy, which optimizes the integrative framework for profit-driven B2B pricing models. In the course of their investigation, the writers examine several approaches to pricing digital marketing firms and the many web services they offer. The goal of Makarova et al. (2020) is to replace traditional pricing methods for digital marketing services with strategic ones. This involves understanding the agency's role in the process, the value they provide, flexibility, critical thinking, and the entire scope of work, which includes the time and resources needed to complete a project. Bramasta (2020) collects primary data for their study through in-depth interviews using a qualitative, descriptive research approach. Bramasta (2020) is significant because it highlights how marketing is evolving from transactional to relationship-based, along with the ongoing digital revolution. Marketing analytics use (MAU) enables firms to gain valuable knowledge and insights for improving firm performance. Research has shown that customer-linking marketing capabilities, such as customer relationship management (CRM) and brand management, are important drivers of marketing performance. How businesses use MAU to enhance their CRM and brand management has not received much attention. In order to examine the capability-developing mechanisms that allow a company to use marketing analytics to enhance its CRM and brand management capabilities, thereby improving its marketing performance, Cao et al. (2020) draws on the absorptive capacity theory, research on marketing capabilities, and marketing analytics. Based on an examination of 289 replies obtained through an online survey from middle and senior managers of Chinese companies with adequate training and expertise in applying marketing analytics for survey participation, a research model is created and put to the test. The results show that the relationship between MAU and marketing performance is mediated by both CRM and brand management capabilities, and that MAU is positively correlated with both of these factors, which are correlated with marketing performance.

Ponisciakova et al. (2021) subjects that priority goals can include the establishment of a working CRM system in a particular business and the addition of particular CRM tools to the online store. The investigation of the impact of Customer Relationship Management (CRM) on the market performance of the Cooperative Bank of Oromia (CBO) in West Shoa Zone branches is the contribution of Tulu et al. (2021). The results verify that the market performance of the bank is positively and significantly correlated with customer knowledge management, relationship marketing, CRM-based technology, and a primary customer focus. Customer orientation can be greatly aided and expedited, according to the continuing study "Application of systems for customer relationship management in the environment of small and medium-sized enterprises."

The crucial points are identified by Botlík et al. (2021): The use of CRM in EU countries is compared in relation to specific elements of the digital economy using techniques of system analysis, including mathematical prediction, statistical approaches, and multicriteria analysis. Conclusions and Added Value: There have been designated years with significant drops and disproportions.

The work done by Burhan et al. (2021) consists of determining the performance level and customer expectations of the goods and services offered by CV Rumah Mesin. Appropriate marketing strategies are then developed based on the findings of this analysis. The corporation might employ the target market segmentation method to offer its products to consumer agencies like industrial and tourism services.

Information Technology

A new survey module is introduced by Zolas et al. (2020) with the goal of enhancing and broadening research on the factors that lead to and affect the adoption of

sophisticated technologies. Conversely, the adoption of advanced technology is uncommon and typically favors larger, more established companies. The identification of socioeconomic and demographic parameters that promote Internet adoption and use among Mexico's rural population is the contribution of Martínez-Domínguez et al. (2020). While adults of working age use the internet for information, communication, and e-commerce, younger people are more likely to engage in online amusement activities. Cristobal-Fransi et al. (2020) aims to ascertain if agri-food cooperative websites are suited for e-commerce and enable efficient communication in an online setting. The extended model of internet commerce adoption, or EMICA approach, is used to analyze this kind of organization's maturity level. The goal of Gedik et al. (2020) is to investigate the information and communications technology (ICT) adoption as well as possible and present ICT use in the forest products business. The study found that in the forest products industry, information and communications applications were more prevalent than e-business and e-commerce.

Nicoletti et al. (2020) investigates the factors influencing the adoption of two major categories of digital technologies by businesses: cloud computing and back- or front-office integration, using a unique data set of digital technology usage across 25 industries in 25 European countries between 2010 and 2016. Last but not least, Nicoletti et al. (2020) demonstrate that the two sets of factors have significant complementarities, with market incentives enhancing the benefits of increased business capabilities on the adoption of digital technology. Wang et al. (2021) conceptualizes the structures of shopper-facing technologies and analyze how task-technology fit and technology-trust interact to shape shoppers' adoption of multidimensional technologies. This study looks at the growing presence of technologies in shopping activities under social distancing. More significantly, it is discovered that task-technology fit and technology trust exhibit distinct explanatory capacities with regard to consumers' adoption of various technology categories. The goal of Setiyani et al. (2021) is to examine how SMEs in Karawang Regency, Indonesia, are implementing e-commerce. It has been demonstrated that every

technological indicator—compatibility, perceived utility, complexity, security risk, and relative advantage—has a major impact on technology when it comes to the decision to adopt e-commerce. In order to ascertain if Colombia's ICT policies are effective in preparing small and medium-sized businesses (SMEs) in the trading industry for the adoption of the Internet of Things (IoT), Parra-Sánchez et al. (2021) plan to evaluate ICT policies for digital transformation. Consequences for practice The findings confirm that the national government must develop IoT policies that encourage SMEs in the trading sector to utilize IoT-based e-commerce. The goal of Hoque et al. (2021) is to pinpoint important theoretical pillars and current research directions in the clothing sector. Studies of the technology-organization-environment and institutional theories of technology adoption in the garment sector are lacking in the literature.

Financial Management

The impact of the Integrated Financial Management Information System on Kwale County Government's financial performance is evaluated (Ndzovu et al., 2019). The findings showed that the county's financial performance was positively and significantly impacted by electronic budgeting, automated cash management, electronic procurement, and automated financial reporting. According to Barclay et al. (2020), executives in charge of corporate finance policy take into account the firm's target and present levels of leverage, investment goals, projected cash flows, and the effects of different financing transaction sequences when they operate in efficient markets. Time-series and cross-sectional forecasts are produced by the analysis for managing leverage and investment spending, using maturity, priority, and convertibility covenants, and managing dividends, share repurchases, cash balances, and credit lines. Magni (2020) offers a novel method for valuing capital asset investments and making investment decisions. Therefore, a wide range of readers, including academics and researchers, business professionals, executives, and managers, as well as students studying corporate finance, managerial finance, engineering economics, financial management,

management accounting, operations research, and financial mathematics, will find great value in this book. MSMEs encounter numerous cash flow issues, many of which are related to MSME actors' ignorance of and lack of comprehension of financial management. For a business to grow successfully and to have access to financing, owners or managers of MSMEs must possess financial literacy. Susan (2020) seek to examine how owners' or managers' financial literacy affects their ability to obtain financing and the expansion of MSMEs in West Java, Indonesia. Jovanović et al. (2020) concentrate on the examination of reporting in the national budgeting process, as well as the function and use of accounting and budgeting information in Slovenia. These results could serve as a basis for reforming Slovenia's public financial management, as well as those of other comparable nations. The impact of cash flow activities on the financial performance of commercial banks in Kenya: a case study of Kakamega County is examined (Eyahuma et al., 2020). 114 participants in the study made up the sample size. Financial performance was statistically significantly impacted by cash flow from financing activities. Charaeva (2021) establishes the methodological foundation for corporate finance management within the framework of their strategic development, when financing and investment choices are especially significant in terms of assessing acceptable risks and the corporation's financial health. The use of managing the corporation's financial plan's implementation and the deployment of budgeting technology are suggested as means of enhancing the caliber of the corporate finance management strategy. Dolo (2021) uses a descriptive study design with 98 people as the target population. Dolo (2021) discovered that financial reporting systems, internal control systems, cash management and budgeting systems, and organizational accountability systems all had a favorable and significant impact on the financial management of the public sector.

2.2. Microenterprises – Effects to Sustainability

Microenterprise sustainability was significantly enhanced by commitment, conceptual, opportunity-recognizing, organizational, and relational abilities (Alam et al., 2011). Studies from the past and present have concentrated on the external and internal elements that have shaped the growth of micro and small businesses. Although a number of factors could influence the growth of microenterprises, it was suggested that the most important ones for determining the scope of operations and economic activities of micro-entrepreneurships were individual-specific entrepreneurial factors combined with economic, political, cultural, social, and technological constructs (Alam et al., 2011).

Due to their inability to meet pertinent goals for meeting current and future economic, environmental, and social demands, the majority of microenterprises were unable to sustain themselves over the long term (Bruwer & Coetzee 2016). According to the literature currently in publication, personnel who lack managerial skills, are illiterate and unskilled, and have inadequate or incompetent human resources are the main obstacles to the development of microentrepreneurship (Alam et al., 2011; Bruwer & Coetzee 2016; Mutyeniyoka & Madzivhandila, 2014).

2.3. Artificial Intelligence

Goldberg (2015) address feed-forward networks, convolutional networks, recurrent networks, recursive networks, input encoding for natural language applications, and the computation graph abstraction for autonomous gradient calculation. Features of an intelligent interface that allows access to a vast amount of data spread across a computer network using natural language are explained. (Hendrix et al., 1978) Research on creating an interface for complex data in natural language. Examples are provided to discuss and demonstrate a practical method to language access that has been successful in creating database interfaces. Though the discipline of deep learning has decades-old

roots, it wasn't until slightly over five years ago that studies like Krizhevsky, Sutskever, and Hinton's now-classic (2012) deep network model of Imagenet rekindled interest in the area and made the phrase "deep learning" famous. Marcus presents ten concerns for deep learning against the backdrop of significant advancements in fields like speech recognition, image recognition, and gaming, as well as significant excitement in the popular press. He suggests that deep learning needs to be supplemented by other techniques if it is to reach artificial general intelligence (Marcus, 2018).

2.4. Artificial Intelligence – The Concept of Management

Expert systems (ES) and artificial intelligence (AI) have seen a meteoric rise in popularity in recent years. The contribution of Fordyce et al. (1986) is to address three AI/ES queries that the MS/OR practitioner is currently confronted with: (1) What are expert systems and artificial intelligence? Artificial Intelligence (AI), which includes neural networks, expert systems, and voice recognition systems, has been implemented by numerous businesses in recent years. Describe some methodological strategies and theoretical models for examining those relationships using particular instances from practice and research (Duchessi et al., 1993). Artificial intelligence methods, like Bayesian belief networks, neuro-fuzzy modeling systems, and artificial neural networks, are intricate mathematical models derived from the structure and function of human neurons (Abbod et al., 2007). Abbod et al. (2007) examined the fundamental ideas behind artificial intelligence methods and examined the ways in which this novel, dynamic technology may be used to different urological cancer treatment scenarios. According to Nikulin et al. (2020), management is changing as artificial intelligence becomes more significant in social life, production, and governance. The methods of logic investigation, analysis, and synthesis used (Nikulin et al., 2020) are systems and creative approach, methodology of technological waves. An review of artificial intelligence applications in pancreatic disease management is the goal of the 2020 article by Morris et al. The findings demonstrated how quickly machine learning-based

technologies are developing and influencing precision medicine in clinical, endoscopic, and radiologic settings for the treatment of pancreatic disorders. Particularly in the area of management accounting, artificial intelligence opens up new avenues for supporting managerial choices. Creating guidelines for the application of artificial intelligence in agricultural organizations' management accounting is the aim of Korobeynikova et al. (2021).

2.5. Sustainability

In the context of business ethical value and culture, Rezaee et al. (2019) investigate the relationship between the quantity and quality of sustainability disclosures and earnings quality. Tests show that the positive relationship between intrinsic earnings quality and sustainability disclosure quantity can be strengthened by sustainability disclosure quality, while the negative relationship between discretionary earnings quality and sustainability disclosure quantity can be lessened. While scholars and professionals concentrate on the environmental and economic aspects of sustainability, the social aspect of sustainability receives less attention, especially in developing nations. However, these scholars and professionals fail to take into account the problem of social sustainability that freight transportation corporations face. In order to address this problem, Kumar et al. (2019) offer a paradigm for calculating the social sustainability index that is predicated on the dimensions, traits, and facilitators of social sustainability in freight transportation. Importantly, location and identity have a mediating role in the relationship between empathy and sustainability, both constraining and shaping empathy's function in pro-environmental sustainability behavior. A novel model examining the relationships between place, identity, and empathy for sustainability is proposed by Brown et al. (2019). The goal of Hu et al. (2019) is to determine OSM stakeholders' perspectives of sustainability based on their business data. The social, environmental, and economic sustainability elements have all been covered by the sustainability perceptions of OSM stakeholders; the social sustainability perceptions

were more concentrated than the others. To that end, Jan et al. (2019) offer a framework for measuring sustainability in Islamic banking. A thorough investigation showed that, with the exception of their economic sustainability policies, the market is not interested in banks investing in their environmental and social sustainability. By using these methodologies to uncover the links between ecological sustainability, human sustainability, and overall sustainability performance—as well as the decision rules—this research aims to expand on earlier sustainability assessment systems. Study uses a machine learning approach to measure sustainability through ecological and human sustainability (Nilashi et al., 2019). The suggested approach is adaptable enough to accommodate a wide range of sustainability indicators for use in evaluating the sustainability of various nations. Ives et al. (2019) contend that people's "inner worlds," or their feelings, thoughts, identities, and beliefs, have been neglected as a result of an obsession with outside events and societal institutions. Sustainability science needs to prioritize investigating the relationship between spirituality, contemplation, and sustainability transformation; it also needs to take into account how language both shapes and is shaped by worldviews. Finally, scholars and practitioners should be encouraged to consciously cultivate their inner worlds in order to fortify the inner resources required for tackling sustainability challenges. The findings show that there are complex precedence relationships between the several Industry 4.0 sustainability functions. Ghobakhloo (2020) assists Industry 4.0 stakeholders, including academics, businesspeople, and leaders in the public and private sectors, in better understanding the potential opportunities for sustainability presented by the digital revolution. They also collaborate more closely to guarantee that Industry 4.0 fulfills its intended sustainability functions as efficiently, fairly, and effectively as possible on a global scale. The question of whether sustainability reports reflect corporate sustainability performance—that is, the degree to which such disclosure is instructive—is examined (Papoutsis et al., 2020). 51 sustainability indicators of practices were gathered from the literature and sustainability reporting rules in order to extract pertinent data from sustainability reports. The idea of social sustainability has received less attention despite recent trends toward the inclusion of environmental and economic factors in sustainability evaluation

frameworks for buildings. Using a multi-criteria approach and social sustainability indicators, local experts assisted in determining the criteria priority (Fatourehchi et al., 2020).

2.6. Sustainability and Management

In their efforts to strike a balance between social and environmental responsibility and economic growth, organizations all over the world are finding that sustainability is a crucial concern. The goal of this review of the literature is to consolidate and summarize research findings on sustainability and management. This review looks at the connection between business performance and corporate social responsibility (CSR) activities in an effort to highlight the advantages and disadvantages of sustainable practices.

A major finding from the research is that companies who perform better in terms of corporate social responsibility have far less capital limitations (Desa, 2016). This implies that businesses are more likely to draw funding and investment if they place a high priority on sustainability and adopt socially conscious practices. Businesses can improve their long-term viability and financial stability by coordinating their operations with sustainable development goals (Robinson et al., 2016).

Another crucial realization is that businesses can improve support behaviors and positive stakeholder sentiments by participating in CSR initiatives (Dhaliwal et al., 2011). This suggests that companies are more likely to win over stakeholders' confidence and support when they proactively show their dedication to sustainability. Positive relationships with consumers, staff members, and communities help businesses establish a solid reputation and a devoted clientele.

The research also shows that, in some circumstances, CSR initiatives can increase a company's worth (Ghoul et al., 2010). Evidence demonstrates that CSR activities can contribute to value creation when they are managed well and linked with the main company plan, notwithstanding the complexity of the relationship between CSR and corporate performance. This suggests that businesses should strategically integrate sustainability measures into their entire management strategy with great care.

Additionally, according to Garrido et al. (2015), the release of independent CSR reports is linked to a decrease in analyst forecast inaccuracy. This research implies that thorough and open reporting of CSR initiatives can improve the precision of financial experts' projections. Organizations may boost their reputation and lower ambiguity in the eyes of investors by giving stakeholders comprehensive information about their sustainability initiatives.

2.6.1. Business Sustainability

Yarovoy et al. (2020) want to protect the information security of the world's most developed nations by identifying dangers to their e-governance system development. An examination of the effects of digital technology on the financial facets of the oil and gas industry is provided by Malykh et al. (2020). Underfunding of businesses' computing and information infrastructure can provide a significant challenge to building the oil and gas industry's financial foundation. Mema et al. (2020) seek to incorporate both public and commercial entities in identifying areas that need technology advancements. The primary hypothesis emphasizes how the modernization of public services and the adaptability of business produce a sustainable economy. The goal of Li et al. (2020) is to investigate how businesses use digital twin platform networks to produce benefits that are social, economic, and environmental in a variety of ways, as

well as how these benefits are coupled. Li et al. (2020) provides recommendations for digital transformation and general tactics that help businesses design sustainable business models. The Internet and digital platforms allow businesses to function and offer services. This new business environment is known as the "digital economy." The impact of digital financial services on the expansion of SMEs in Kenya is examined (Awinja et al., 2021). A random sample of 300 SMEs was chosen from among the 1000 SMEs who had officially registered in the study area.

Scale-up modes: analyzing activity configurations in scaling techniques are studied by Piaskowska et al. (2021). Scaling enterprises, often known as scale-ups, provide a significant economic impact. To solve this, Piaskowska et al. (2021) identify the crucial growth-enabling activities of scaling organizations with digital business models: financing, innovation, digitization, and acquisitions. They do this by drawing on the Penrosean view of company growth and the literature on high-growth firms. Digital financial services are replacing conventional, face-to-face modes of service for banks in particular. Drawing upon the notion of entrepreneurial orientation (EO), Niemand et al. (2021) seek to elucidate how banks might employ the manoeuvres and approaches linked with EO to attain enhanced performance in the era of digitalization. The goal of Yuan et al. (2021) is to investigate how the digital economy affects technological innovation in the context of business-financed R&D expenses, income, and financial risk for the G7 economies between 1990 and 2017. Technological innovation in G7 countries is mostly driven by the digital economy, bank financing of R&D expenses, and financial risk. Interdependent elements representing environmental, social, and economic sustainability are included in a firm's sustainability architecture at various organizational levels. These elements allow enterprises to increase value and/or decrease harm. awareness the sustainability–performance link requires an awareness of the dynamics of sustainability changes, which are highlighted by the intertemporal renewal of this architecture and its interdependencies with non-sustainability components. Uniqueness and worthBy creating a conceptual framework that might

serve as a foundation for unifying the various management-related sustainability studies, this paper advances the field of sustainability research (Lichtenthaler, 2021). Finally, because the intertemporal perspective of altering a firm's sustainability architecture emphasizes the necessity of ongoing sustainability transformations, this research provides fresh perspectives on strategy dynamics.

2.7. AI Effects to Microenterprises

Applications of artificial intelligence (AI) models are spreading into high-risk fields including conservation and health. Because the quality of data used in these AI models has a large downstream impact on predictions, such as loan allocations, cancer detection, and wildlife poaching, it is crucial. It is odd, though, because data is frequently underestimated and disregarded in the AI process, despite its crucial importance.

Lundberg et al. (2020) have demonstrated the increased importance of data quality in high-stakes artificial intelligence applications. They stress that, in fields like health and conservation, data quality is a key factor in determining the precision and dependability of AI forecasts. The quality of the data used has a significant impact on how AI models perform downstream tasks, such cancer detection and stopping wildlife poaching. This result emphasizes how crucial it is to guarantee high-quality data for AI applications (Lundberg et al., 2020).

According to Sambasivan et al. (2021), data quality is frequently underestimated and de-glamorized in the AI process, which lends more credence to this idea. They contend that although AI models garner a lot of attention, data significance and the labor-intensive nature of data work are frequently disregarded. This result emphasizes how

important it is for high-stakes AI applications to identify and give priority to data quality (Sambasivan et al., 2021).

The idea of "data cascades" in high-stakes AI is covered by Sambasivan et al. (2021). In this context, the caliber of data used in AI models can have cascading impacts on predictions made later on. They clarify that data cascades happen when biases or inaccuracies in the data spread across the AI system, producing predictions that are skewed or erroneous. In order to reduce the dangers connected with data cascades in high-stakes AI applications, this research highlights the necessity of strict data validation and quality control procedures (Sambasivan et al., 2021).

One area of research might be explainable AI systems, which would provide transparent and comprehensible explanations for the decisions made by AI models in addition to precise forecasts. This can support the development of microenterprises' and their stakeholders' trust and acceptance of AI technology (Shin, 2021).

2.8. Microenterprises Effects to Sustainability

In the global economy, microenterprises are important, especially in developing nations. These tiny enterprises support the creation of jobs, economic expansion, and the fight against poverty. Their impact on sustainability—which includes social, environmental, and economic aspects—has, however, generated discussion.

Numerous scholarly investigations have emphasized the beneficial effects of microenterprises on sustainability. According to Bonilla et al. (2018), using Industry 4.0 technology can help microenterprises contribute to sustainability. These technologies facilitate increased productivity, decreased waste, and optimized resource efficiency.

Microenterprises can reduce their environmental impact and support the economy's overall sustainability by using sustainable practices.

However, there are worries that microenterprises may have a detrimental effect on sustainability. Online food delivery platforms have a negative impact on sustainability even though they present convenience and financial potential, according to a review by Li et al. (2020). Because these platforms generate more packaging waste and transportation waste, they raise carbon emissions. Furthermore, the gig economy model that is popular among microenterprises frequently results in subpar working conditions and labor exploitation, which threatens the sustainability of society.

2.9. AI Features and Subfeatures

Artificial intelligence (AI) systems are being used extensively across a range of industries, making decisions that have a big impact on people's lives and society as a whole. Nonetheless, questions have been raised about possible violations of human rights connected to these AI systems. It is imperative to go beyond conventional AI algorithms that are tuned for predicted performance in order to allay these worries. Instead, these algorithms must be designed, trained, and implemented using ethical and legal guidelines.

The significance of incorporating moral and legal precepts into AI system design, training, and implementation is emphasized by Ntoutsis et al. (2020). They contend that conventional AI systems might ignore possible human rights issues since they are only concerned with prediction performance. Integrating ethical and legal considerations into AI systems is essential to ensuring social good while utilizing AI's enormous potential. This result emphasizes the necessity of giving the ethical implications of AI decision-making processes precedence over technical optimization.

Predictive modeling in practice frequently makes use of tree-based machine learning models, such as gradient boosted trees, random forests, and decision trees. But there hasn't been much focus on providing an explanation for the predictions these models make. Researchers have made great strides toward enhancing the interpretability of tree-based models in order to close this gap. First, in order to calculate optimal explanations, they have created a polynomial time algorithm based on game theory. Tree-based models can produce explanations that improve their transparency thanks to this method. Second, a novel kind of explanation has been presented that quantifies the consequences of local feature interaction directly. This development sheds light on the interactions between various features inside the model. In conclusion, scientists have created instruments to comprehend the whole framework of models based on trees by including multiple local explanations for each prediction. These tools make it easier to comprehend the general structure of the model in its entirety. These results underscore the significance of interpretability in AI systems and open up new directions for investigating how to make prediction models more transparent.

Although artificial intelligence (AI) has advanced significantly in fields like text comprehension, computer vision, and speech recognition, its use in clinical care is still lagging. Clinical care has not yet reached the fundamental stage of automating health care information interactions through electronic health records, according to Beam and Kohane (2016). This result emphasizes the necessity of additional study and advancement in the use of AI to clinical treatment. Future research could examine how AI might be used to automate transactions involving health care information, enhancing the precision and efficiency of clinical procedures.

The question of how to use norms—including those pertaining to international law—to resolve issues relating to the fundamentals and technical protocol of deploying artificial

intelligence is brought up by changes. The issues of legal regulation surrounding the development and application of artificial intelligence, as well as the definition of the technology in accordance with accepted scientific theories, are the focus of Shestak et al. (2019). Other topics covered include the examination of doctrinal approaches to the understanding of the role of artificial intelligence in legal relations, the evidence that suggests giving artificial intelligence the status of a person is not supported by the law, and a critical analysis of the arguments made by certain American researchers that artificial intelligence should abide by all laws currently in use for human producer and operator. The legal concerns surrounding the use of artificial intelligence in jurisprudence are covered (Mekhmonov, 2020). The author concludes by drawing logical conclusions about how to strengthen legislation pertaining to artificial intelligence in jurisprudence. The creation of the Internet of Things has the potential to accelerate advancements in artificial intelligence, given the swift growth of this field inside the framework of the Internet. Mo et al. (2020) introduce artificial intelligence learning algorithms to the wheel detection under the Internet of Things system, which can address the shortcomings of the traditional method's robustness and poor feature anti-interference in addition to being highly significant for the wheel detection system's future development. However, artificial intelligence is the study of intelligence agents that take into account the circumstances of their surroundings and successfully accomplish their objectives. Soni (2020) examines the problems and potential solutions for artificial intelligence in US cybersecurity. The purpose of this study paper is to assess the present artificial intelligence cybersecurity challenges in the United States. Egorova et al. (2021) pose the topic of what areas of regulation should be prioritized when it comes to the use of artificial intelligence, mainly in order to promote innovative technological entrepreneurship and sustainably build the economy during a pandemic. The COVID-19 epidemic raises several ethical issues related to digital and artificial intelligence. These issues are recognized, and the future of Russian legislation in this area is discussed. Artificial intelligence, which is currently widely utilized and developed in the field of information technology and is a part of life, is described by Raximov et al. (2021). The fundamental ideas and categories of artificial intelligence,

together with its characteristics, study fields, and analytical data on its developmental stages, are explained.

2.10. Fuzzy Intuitionistic Extensions

In recent times, there has been a growing interest in the application of artificial intelligence (AI) in several sectors. In their 2020 study, Ranjbar et al. explored the modeling of asphalt pavement surface distress using computational intelligence (CI) frameworks such as swarm intelligence, fuzzy logic, artificial neural networks, and evolutionary computation. The intricacy of issues in pavement management systems cannot be fully addressed by conventional systems or classical methodologies, underscoring the necessity for more efficient systems. Tseng et al. (2021) carried out a bibliometric analysis and applied the fuzzy Delphi technique to the field of operation engineering and sustainable industrial to offer insights into trends and issues as the sector evolves towards Industry 4.0. This work adds to the body of literature by providing a cutting-edge analysis and recommendations for further research in operation and sustainable industrial engineering. Using artificial intelligence algorithms, Kapa et al. (2022) investigated the fuzziness of the confrontation between non-ESG and ESG investing models in the context of investments. This study clarifies how AI and fuzzy logic are used in investment decision-making processes. The present status of research on AI-based decision support systems for enhancing the sustainability of building projects was assessed by Smith et al. in 2022. The survey showed that, in addition to economic sustainability, there is a tendency toward a greater focus on social and environmental sustainability objectives in building projects. Tang et al. (2022) presented a two-echelon responsive health analytic model that leverages artificial intelligence and the Internet of Medical Things to improve healthcare services in nursing homes. The goal of the project was to make nursing homes' healthcare systems more sustainable and efficient.

In order to assess the sustainability of smart technology applications in healthcare, Chen et al. (2022) suggested a hybrid subjective and objective fuzzy group decision-making

technique with explainable artificial intelligence. The study sought to offer a thorough assessment of how long-term smart technology applications will be viable after the COVID-19 pandemic. Finally, a novel method for sustainable logistic operations utilizing Q-rung orthopair fuzzy soft information aggregation was presented by Riaz et al. (2023). The study sought to increase the field's understanding by critically evaluating earlier studies and identifying potential directions for sustainable logistics in the future. Fuzzy logic and AI algorithms combined with decision-making processes have demonstrated encouraging outcomes in solving intricate issues and enhancing sustainability in general.

3.MATERIALS AND METHODS

3.1. Problem Definition

Artificial intelligence (AI) has been developing at a rapid pace in recent years, which has had significant effects on many different industries, including sustainability. The purpose of this master's thesis is to examine how artificial intelligence (AI) affects sustainability from the standpoint of a "micro-enterprise" organizational structure type. Modern considerations like the COVID-19 pandemic, the increasing use of remote work arrangements, the ever-changing startup scene, and the ubiquitous impact of technology on small businesses are what led to the decision to concentrate on microenterprises.

3.1.1. Background and Justification

The advent of artificial intelligence (AI) technology has brought about revolutionary shifts in decision-making procedures, organizational dynamics, and corporate operations. Nevertheless, most of the current research on artificial intelligence and sustainability tends to concentrate on larger businesses, frequently ignoring the unique potential and challenges encountered by micro-enterprises. The importance of micro-enterprises in today's economic environment makes it imperative to comprehend the complex effects of artificial intelligence on sustainability at this level of organization.

3.1.2. Microenterprises' Significance

Micro-enterprises function in a distinct environment that is defined by variables including flexibility, adaptability, and resource limits. They are distinguished by their tiny size and limited resources. Examining how AI affects sustainability in this setting becomes crucial because of the potential impact these businesses might have on regional economies, job markets, and community growth.

3.1.3. Modern Motivators for Microbusinesses

The COVID-19 epidemic continues to be strong, which has accelerated trends like digital transformation and remote work. This presents opportunities as well as obstacles for microenterprises. The significance of researching the relationship between artificial intelligence (AI) and sustainability in microenterprises is further enhanced by the interrelated elements of technical breakthroughs, the changing startup ecosystem, and the requirement for robust business models.

3.1.4. Research Gap

Although the literature on AI and sustainability is expanding, there is still a significant knowledge void about the particular implications for small businesses. In order to close this gap, this study investigates the ways in which artificial intelligence (AI) can support or undermine sustainability initiatives in microenterprises.

3.1.5. Proposed Methodology

The present study suggests the application of the Fuzzy Intuitionistic Extensions as a decision-making framework for a thorough analysis of the effects of artificial intelligence (AI) on sustainability in microenterprises. The methodology of Fuzzy Intuitionistic Extensions is selected since it can manage ambiguity and uncertainty in decision-making, offering a strong basis for assessing all aspects of sustainability affected by AI.

In conclusion, the goal of this master's thesis is to add to the reservoir of knowledge by examining how artificial intelligence (AI) affects sustainability in the particular setting of microenterprises. The research aims to provide insights that can assist policymakers and decision-makers in promoting sustainable practices within the micro-enterprise sector in light of the rapidly changing AI and technology landscape through the proposed Fuzzy Intuitionistic Extensions framework.

3.2. Fishbone

The Ishikawa or cause-and-effect diagram, sometimes referred to as the fishbone diagram, is a visual aid for methodically locating and displaying the causes of a given issue. It is widely used to deconstruct complicated problems into simpler parts in a variety of fields. The fishbone diagram can assist in defining and classifying criteria and subcriteria when assessing AI's business effects on sustainability inside microenterprises. We may methodically investigate a variety of topics, including technological issues, economic implications, social influences, and environmental considerations, by using this technique. This methodical methodology guarantees that

all pertinent factors are taken into account, enabling a thorough examination of how AI installation affects sustainability outcomes in small organizational structures.

The criteria and subcriteria found using the Fishbone method are given in the relevant tables. Sub-criteria of microenterprise, artificial intelligence and sustainability is included in Figure 3.4. Criteria and subcriteria of artificial intelligence are included in Appendix C.1. Criteria and subcriteria of microenterprise are included in Appendix C.2. Criteria and subcriteria of sustainability are included in Appendix C.3.

Features and subfeatures are given below in details as fishbones for AI, micro-enterprises and sustainability.

3.2.1. Fishbone for AI

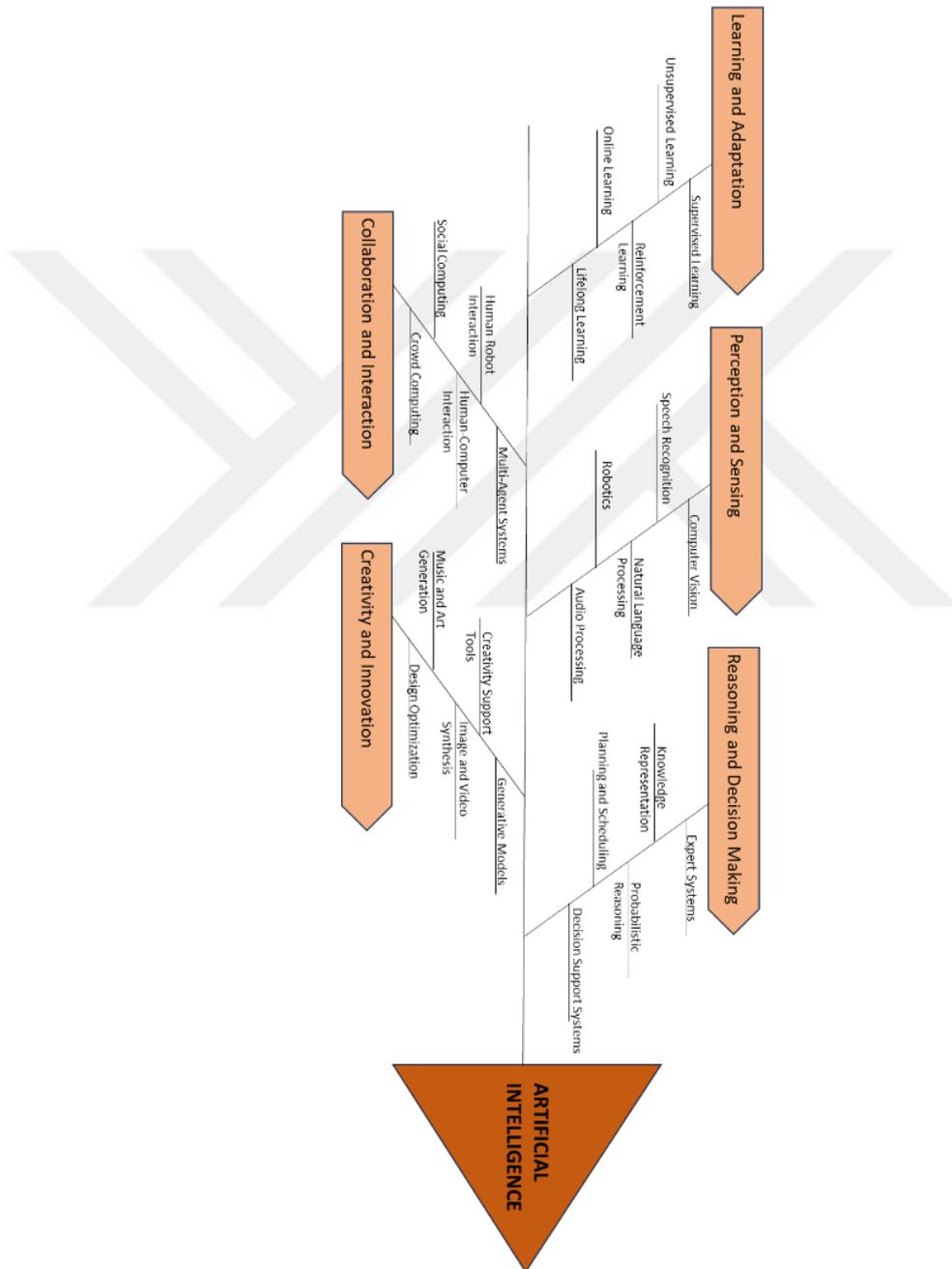


Figure 3.1: Fishbone for Artificial Intelligence Features

3.2.2. Fishbone for Micro-enterprises

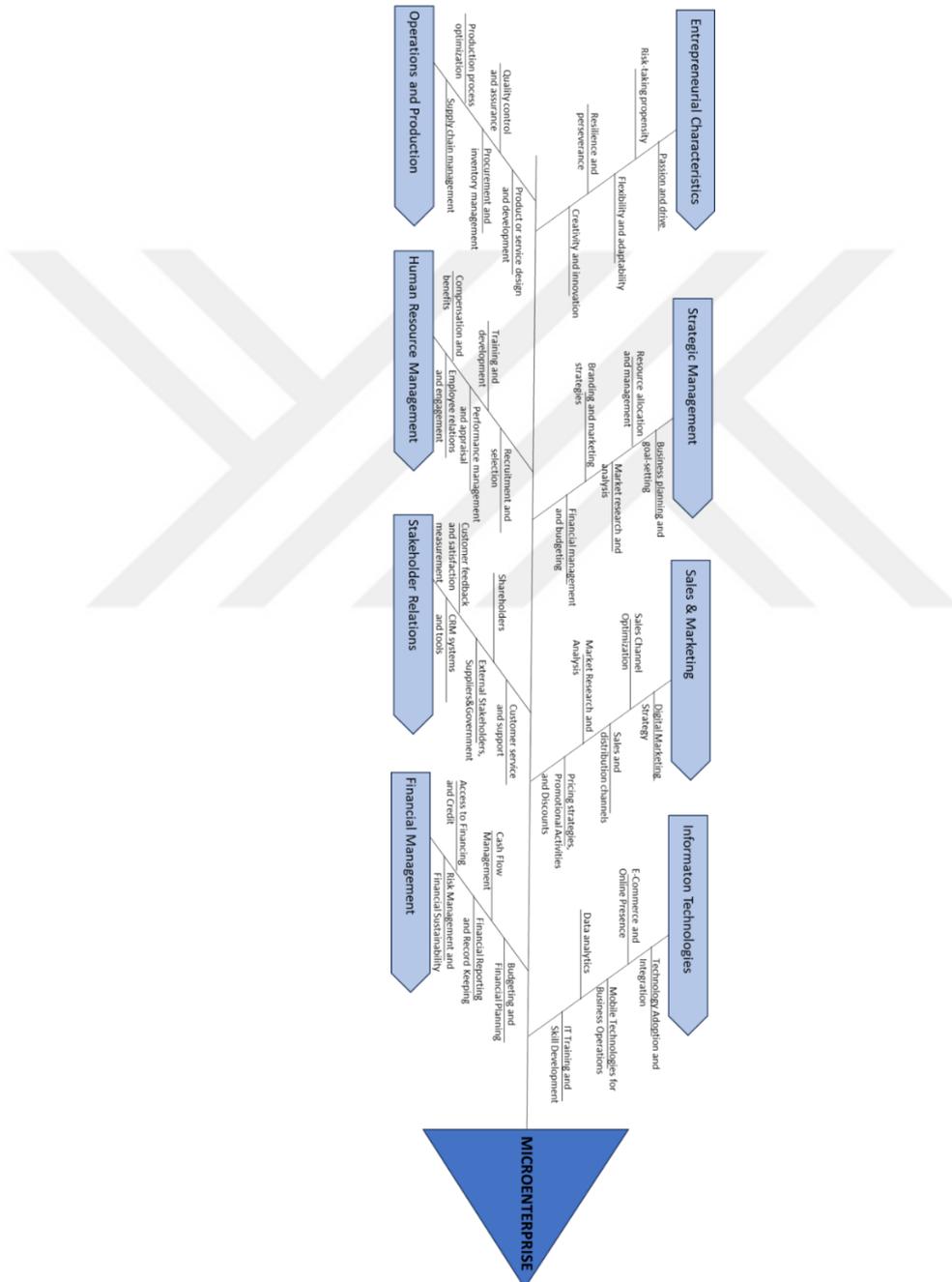


Figure 3.2: Fishbone for Microenterprise Features

3.2.3. Fishbone for Sustainability

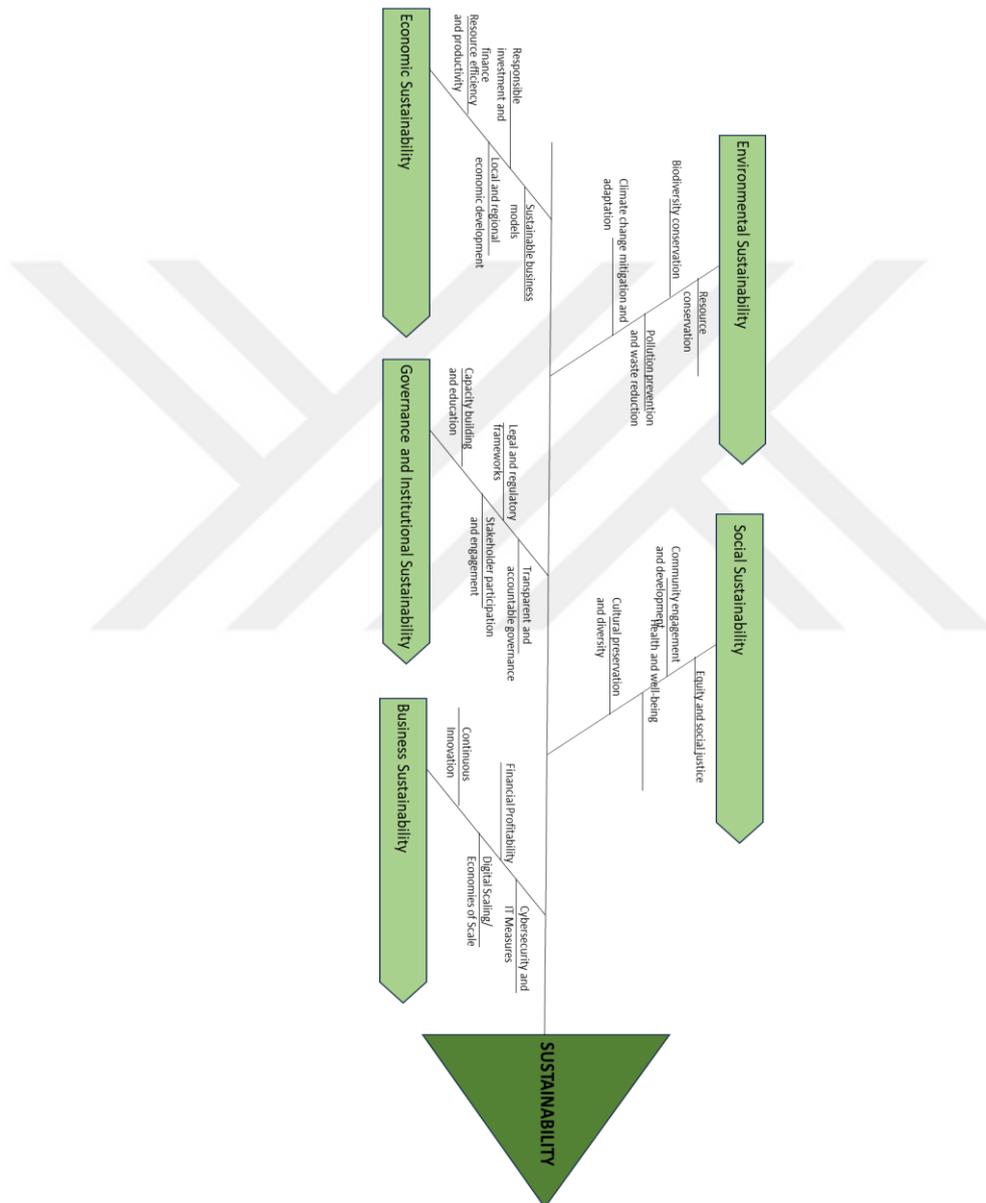


Figure 3.3: Fishbone for Sustainability Features

3.3. Facts (Criteria)

MICROENTERPRISE	ARTIFICIAL INTELLIGENCE	SUSTAINABILITY
Entrepreneurial characteristics	Learning and Adaptation	Environmental
Strategic management	Perception and Sensing	Social and Cultural
Operations and Production	Reasoning and Decision-Making	Economic
Human Resource Management	Creativity and Innovation	Governance and Institutional
Stakeholder Relations	Collaboration and Interaction	Business
Sales & Marketing		
Information Technologies		
Financial Management		

Figure 3.4: Sub-criteria of microenterprise, artificial intelligence and sustainability.

Micro-enterprise success hinges on mastering seven key areas. Entrepreneurial characteristics encompass the owner's risk-taking, innovation, and decision-making skills. Strategic management involves coordinating goals, resources, and actions for long-term growth amidst competition. Sales and marketing encompass finding, keeping customers, and effectively selling products or services. Finally, financial management tackles overseeing the business's money, including cash flow, investments, and budg-ets. Mastering these areas strengthens a microenterprise's foundation for success.

AI systems are defined by seven key capabilities. Learning and adaptation allow them to acquire knowledge and improve over time. Perception and sensing equip them to gather information from their surroundings. Reasoning and decision-making enable them to analyze data and make logical choices. Creativity and innovation empower them to generate new ideas and solutions. Collaboration and interaction allow them to work effectively with people and other technologies. Performance and efficiency determine how well they utilize resources to complete tasks.

Business sustainability encompasses four key areas. Environmental sustainability analyzes a company's impact on the environment and its commitment to eco-friendly practices. Social and cultural sustainability examines how a business promotes diversity, equity, and inclusion, while considering community involvement and cultural preservation. Economic sustainability focuses on financial practices, resource allocation, and profitability methods to ensure long-term viability. Finally, governance and institutional sustainability assess the rules, procedures, and structures that promote transparency, accountability, and ethical behavior. By mastering these areas, businesses can operate responsibly while achieving long-term success.

3.4. Main fact: Type of Micro-enterprise Organization Structure

Micro-enterprises, sometimes referred to as micro-businesses, are little companies with less than ten workers and minimal annual sales. These companies are usually focused on serving the local market with goods and services, and they are frequently managed by a single person or small group of people. Micro-enterprises, despite their diminutive size, are crucial to the world economy. Especially in developing nations, they provide jobs and income for a large number of people and can aid in reducing poverty and fostering economic progress.

Micro-enterprises do, however, also have a number of difficulties, such as restricted market opportunities, restricted access to capital, and a deficiency of business expertise. Microenterprises may find it challenging to expand and attain long-term sustainability as a result of these obstacles. Scholarly investigations of micro-enterprises can aid in tackling these obstacles and advancing the expansion and durability of these companies. Studies on the elements that influence microenterprise development and success, the effects of government policies and initiatives, and the role of innovation and technology in fostering microenterprise expansion are some examples of the types of study that can be conducted in this area.

The social and environmental effects of microenterprises can also be studied in microenterprise research. Studies on the contribution of microenterprises to social and economic development as well as the effects of microenterprise operations on the environment may fall under this category. For academics interested in entrepreneurship, small business development, and economic development, micro-enterprises constitute a significant and vibrant field of study. Through the examination of micro-enterprises, scholars can acquire a deeper understanding of the obstacles and prospects associated with launching and managing small enterprises. Additionally, they can devise tactics and methods to facilitate the expansion and long-term viability of these ventures. The contribution of technology and innovation to the expansion and sustainability of microenterprises is a significant field of study. Numerous micro-enterprises function in surroundings with limited resources, and it's possible that they don't have access to contemporary business methods or technologies that could make them more competitive and efficient.

Examining how new technologies—like social media and mobile phones—are adopted and used to assist business operations is one way to do research on micro-enterprise

innovation. Examining the creation and application of fresh business plans or approaches that are customized to the requirements and limitations of microbusinesses may also be part of it. Furthermore, studies on microenterprises might investigate how entrepreneurship education and training contribute to the prosperity of these companies. Many microbusiness owners might not have received conventional business training or education, therefore they could gain from interventions or programs that provide them the know-how and abilities they need to be successful.

Lastly, studies on microenterprises can also investigate how social and environmental elements support the viability and longevity of small companies. Examining the effects of social networks, neighborhood support, and environmental laws on the growth and sustainability of microenterprises is one way to do this. All things considered, scholars with an interest in entrepreneurship, small business development, and economic development will find a rich and varied field of study in microenterprise research. Through the examination of micro-enterprises, scholars can acquire a deeper understanding of the obstacles and prospects associated with launching and managing small enterprises. Additionally, they can devise tactics and methods to facilitate the expansion and long-term viability of these ventures.

3.4.1. Attributes and Subfeatures for Micro-enterprises

3.4.1.1. Attribute Definitions of Microenterprises

Entrepreneurial Characteristics: Understanding the viability and longevity of microenterprises requires an examination of their entrepreneurial features, such as a penchant for taking risks, inventiveness, and decision-making abilities.

Strategic Management: Examining microenterprises' strategic management procedures reveals how much they coordinate their objectives, assets, and course of action to manage competitive environments and promote long-term growth.

Operations and Production: Examining how microenterprises operate and produce information reveals how well they use resources, how efficient they are, and where they may be improved to improve overall performance.

Human Resource Management: Assessing microenterprises' HRM procedures clarifies how they draw in, nurture, and keep talent, which influences the culture of the company and worker output.

Stakeholder Relations: To evaluate how contacts with suppliers, consumers, and the community affect the success of the business, it is crucial to comprehend the dynamics of stakeholder relations in microenterprises.

Sales & Marketing: Analyzing microenterprises' attempts to acquire and retain customers, establish their brands, and penetrate new markets are all crucial to the overall expansion of their businesses.

Information Technologies: Examining how information technologies are integrated and used in microenterprises can provide details about their digital capabilities, data handling, and technological infrastructure, all of which have an impact on their competitiveness and operational efficiency.

Financial Management: Examining microenterprises' financial management procedures aids in determining their level of financial stability, cash flow management, investment choices, and budgeting. This information helps to provide a thorough picture of the businesses' potential for growth and economic sustainability.

List of attributes and subfeatures of micro enterprises is given below in the table with respect to their references.

Table 3.1: Criteria and sub-criteria, and their correspondent references

#	Criteria	#	Sub-criteria	Covered by
C_1	Entrepreneurial Characteristics	C_{11}	Risk-taking propensity	Sambasivan et al. (2021)
		C_{12}	Flexibility and adaptability	Ives et. al. (2019)
		C_{13}	Passion and drive	This study
		C_{14}	Creativity and innovation	Alam et al. (2011)
		C_{15}	Resilience and perseverance	This study
C_2	Strategic Management	C_{21}	Business planning and goal-setting	Robinson et al. (2016)
		C_{22}	Resource allocation and management	Bonilla et al. (2018)
		C_{23}	Market research and analysis	Alam et al. (2011)
		C_{24}	Branding and marketing strategies	Ghoul et al. (2010)
		C_{25}	Financial management and budgeting	Garrido et al. (2015)
C_3	Operations and Production	C_{31}	Product or service design and development	Nikulin et. al. (2020)
		C_{32}	Quality control and assurance	Rezaee et. al. (2019), Lundberg et al. (2020)
		C_{33}	Procurement and inventory management	This study
		C_{34}	Production process optimization	Nikulin et. al. (2020)
		C_{35}	Supply chain management	This study
C_4	Human Resource Management	C_{41}	Recruitment and selection	This study
		C_{42}	Training and development	Brooks et. al. (2018)
		C_{43}	Performance management and appraisal	Berge et. al. (2015)
		C_{44}	Compensation and benefits	This study
		C_{45}	Employee relations and engagement	This study
C_5	Customer Relations	C_{51}	Customer service and support	Adam et. al. (2020)
		C_{52}	Sales and distribution channels	This study
		C_{53}	Pricing strategies and discounts	This study
		C_{54}	Customer feedback and satisfaction measurement	This study
		C_{55}	CRM systems and tools	Sambasivan et al. (2021)

3.4.1.2. Subcriteria Definitions of Attributes of Microenterprises

Subfeatures of Entrepreneurial Characteristics:

1. Risk-taking propensity: Prosperous microenterprise owners demonstrate a readiness to take calculated risks, capitalizing on growth prospects while minimizing possible setbacks.
2. Adaptability and flexibility: Leaders of microenterprises skillfully handle changing market situations, showcasing the ability to quickly adjust operations and plans in response to evolving conditions.
3. Passion and drive: Entrepreneurs' unshakable passion and enthusiasm are the driving forces behind microenterprise success, enabling them to overcome obstacles and pursue their mission with unwavering tenacity.
4. Creativity and innovation: Successful microbusinesses depend on creative thinking and inventive solutions to meet market demands and set themselves apart from rivals. They are always looking for new and inventive methods to do these things.
5. Resilience and perseverance : Microenterprise operators demonstrate perseverance in the face of difficulty, enduring setbacks and disappointments with steadfast will to accomplish their long-term objectives.

Subfeatures of Strategic Management:

1. Business planning and goal-setting: To drive their strategic direction and guarantee long-term sustainability, successful microenterprises painstakingly create thorough business plans and establish attainable goals.
2. Resource allocation and management: Microenterprise executives skillfully distribute limited resources, including cash and labor, increasing production and maximizing efficiency to meet their corporate goals.
3. Market research and analysis: To comprehend customer wants, spot new trends, and seize unexplored prospects within their target market, prosperous microenterprises carry out in-depth market research and analysis.
4. Branding and marketing strategies: To position their goods and services in the market, create brand awareness, draw in and keep consumers, microbusiness owners create strong branding and marketing strategies.
5. Budgeting and financial management: To guarantee financial stability and expansion, microenterprise managers exhibit competence in budgeting and financial management, keeping correct financial records, keeping an eye on cash flow, and making well-informed judgments.

Subfeatures of Operations and Production:

1. Product or service design and development: To satisfy changing client needs and maintain market competitiveness, microenterprises adopt agile design and development procedures, with a focus on ongoing product or service innovation.

2. Quality assurance and control: Owners of microenterprises put strict quality control procedures in place to make sure that their goods and services constantly live up to or beyond client expectations. This builds their brand and encourages repeat business.
3. Procurement and inventory management: To maximize resource utilization, reduce expenses, and maintain sufficient stock levels to satisfy customer demand while avoiding excess inventory, microenterprises need to have effective procurement and inventory management systems in place.
4. Production process optimization: Leaders of microenterprises optimize production processes by applying lean concepts and continuous improvement techniques, which maximize effectiveness, cut waste, and raise total productivity.
5. Supply chain management: To build strong bonds with suppliers, oversee logistical operations, and guarantee prompt delivery of goods or services, microenterprises need to practice effective supply chain management. This will reduce disruptions and preserve customer happiness.

Subfeatures of Human Resource Management:

1. Recruitment and selection: To ensure a harmonious and effective team dynamic, microenterprises carefully seek out and choose applicants whose values and skill set complement the company's goals.
2. Training and development: To improve skills, encourage creativity, and adjust to changing market trends, microenterprise owners make ongoing investments in the training and development of their staff.
3. Performance management and appraisal: To establish a culture of accountability and excellence, microenterprises use performance management systems to set clear expectations, offer helpful feedback, and acknowledge accomplishments.

4. Compensation and benefits: To encourage performance and build loyalty, microbusiness owners create benefits and compensation plans that are competitive and customized to their workers' requirements.

5. Employee relations and engagement: Open communication, chances for feedback, and programs that encourage a sense of fulfillment and belonging inside the company are microenterprise executives' top priorities when it comes to building excellent employee relations and engagement.

Subfeatures of Stakeholder Relations:

1. Customer service and support: Microenterprises place a high value on providing outstanding customer service and support. They do this by establishing trusting bonds with clients by responding quickly to their needs and interacting with them in a way that encourages satisfaction and loyalty.

2. Customer feedback and satisfaction measurement: In order to determine areas for improvement, measure customer contentment, and successfully customize their goods and services to match the needs of their clientele, microenterprises actively seek out and evaluate consumer input.

3. CRM systems and tools: To improve customer engagement and retention, microenterprises use Customer Relationship Management (CRM) systems and tools to track sales, manage customer interactions, and streamline marketing initiatives.

4. External stakeholder, Suppliers (Outsourcing) & Government: In order to support business operations, microenterprises cultivate favorable relationships with external stakeholders like suppliers and government agencies. These ties encourage cooperation, transparency, and regulatory compliance.

5. Shareholders: In order to secure long-term support and investment in the firm, microenterprise owners interact with shareholders by sharing corporate objectives, performance, and strategic plans. This builds trust and aligns interests.

Subfeatures of Sales and Marketing:

1. Digital Marketing Strategy: By leveraging channels like social media, email, and content marketing to raise brand awareness and encourage consumer interaction, microenterprises use digital marketing techniques to effectively reach target audiences.

2. Sales Channel Optimization: In order to maximize reach and accessibility and make sure that goods and services are available when and where customers choose to buy them, microenterprise owners deliberately optimize both online and offline sales channels.

3. Market Research and Analysis: To determine customer demands, assess rivals, and detect new trends, microenterprises carry out in-depth market research and analysis. This information helps them make strategic decisions that will help them effectively seize market opportunities.

4. Sales and distribution channels: To increase market reach and provide easy access for customers, microenterprises create a variety of sales and distribution channels, such as e-commerce platforms, retail partnerships, and direct sales.

5. Pricing tactics, Promotional Activities and Discounts: In order to balance profitability with competitive positioning in the market, microenterprise owners use pricing strategies, promotional activities, and discounts to boost demand, increase sales, and improve customer loyalty.

Subfeatures of Information Technologies:

1. **Technology Adoption and Integration:** By utilizing tools and systems to automate procedures and boost efficiency, microenterprises embrace technology adoption and integration to improve productivity, streamline operations, and maintain their competitiveness in the digital age.
2. **E-Commerce and Online Presence:** In an increasingly digital world, microenterprise owners build a strong online presence to broaden their customer base, boost sales, and offer easy ways for customers to make purchases.
3. **Data analytics:** By utilizing data analytics, microenterprises may obtain important insights into market trends, customer behavior, and operational performance. This information helps them make well-informed decisions and develop strategic plans for business expansion.
4. **Mobile Technologies for Business Operations:** Microenterprises use mobile technologies to make business operations easier. They allow for real-time communication, remote work, and on-the-go access to vital information, which improves responsiveness and flexibility.
5. **IT Training and Skill Development:** To guarantee that staff members are proficient in using technology tools and systems efficiently and to promote an innovative and flexible culture inside the company, microenterprise executives place a high priority on IT training and skill development.

Subfeatures of Financial Management

1. **Budgeting and Financial Planning:** To allocate resources effectively, set realistic goals, and direct decision-making for long-term growth and profitability, microenterprises carefully prepare budgets and financial plans.
2. **Cash Flow Management:** To guarantee sufficient liquidity for daily operations, control costs, and take advantage of expansion prospects while reducing financial risks, microenterprise owners employ efficient cash flow management techniques.
3. **Financial Reporting and Record Keeping:** Microenterprises uphold strict reporting guidelines and keep accurate financial records, giving stakeholders responsibility and transparency while promoting well-informed decision-making.
4. **Access to Financing and Credit:** To finance operations, build their company, and seize growth opportunities, microenterprise leaders look for a variety of financing and credit sources, promoting flexibility and resilience in their finances.
5. **Risk Management and Financial Sustainability:** To detect, evaluate, and reduce financial risks and maintain long-term financial sustainability and resilience in the face of market volatility, microenterprises give priority to risk management techniques.

3.5. Affecting fact: Artificial Intelligence (fact to effect)

The discipline of computer science known as artificial intelligence, or AI, is expanding quickly and focuses on creating intelligent machines that are capable of tasks like speech recognition, visual perception, language translation, and decision-making that normally need human intelligence. Because AI systems are built to learn from

experience and adapt to new circumstances, they are effective tools for resolving challenging issues.

The first artificial intelligence (AI) algorithms were created in the 1950s by researchers who wanted to replicate human thought processes. Growing amounts of processing power, data storage, and machine learning techniques have made it possible for researchers to develop increasingly complex artificial intelligence (AI) systems throughout time that are highly accurate at a variety of tasks. Artificial intelligence (AI) systems come in a variety of forms, such as rule-based, expert, neural network, and evolutionary algorithm systems. Every one of these methods has advantages and disadvantages, and scientists are always looking for new ways to boost AI's capabilities and increase its usefulness across a range of industries.

Numerous industries, including healthcare, banking, manufacturing, and transportation have already seen the significant effects of AI. Important moral and societal issues have also been brought up by it, such as how AI will affect employment in the future and its place in society. AI technology is expected to have a bigger impact on how mankind develops in the future as it continues to advance. All things considered, artificial intelligence is a fascinating and quickly developing topic with much of potential for scholarly study. Researchers can learn more about the nature of human intellect, create new applications and technologies, and influence the ethical and societal ramifications of this potent technology by delving into the field of artificial intelligence.

Machine learning, which entails creating algorithms that let machines learn from data and get better over time, is one of the main focuses of AI research. Machine learning comes in a variety of forms, such as reinforcement learning, unsupervised learning, and supervised learning. In supervised learning, data that has already been tagged with the

right response or output is used to train the system. With this labeled data, the algorithm learns to predict. In unsupervised learning, the machine learns to recognize patterns and relationships in unlabeled data. With reinforcement learning, a computer is trained to respond in a way that accomplishes a specific objective in response to rewards or feedback from its surroundings.

Natural language processing (NLP), which entails creating algorithms that can comprehend and produce human language, is another significant field of AI study. Language translation, chatbots, and virtual assistants are just a few of the many uses for natural language processing. Another crucial field of AI study is computer vision, which focuses on creating algorithms that can decipher and evaluate visual data from our environment. Numerous applications, such as object detection, facial recognition, and self-driving automobiles, rely on computer vision. AI research includes broader questions of ethics, policy, and the societal ramifications of AI in addition to these technical domains. It is crucial for academics to think about how AI might affect society as it develops and to create moral standards for its application.

All things considered, AI is a complicated and quickly developing topic with much of potential for scholarly study. Researchers can learn more about the nature of intelligence, create new applications and technologies, and influence the direction of this potent technology by studying artificial intelligence (AI).

3.5.1. Attributes and Subfeatures for Artificial Intelligence

3.5.1.1. Attribute Definitions of Artificial Intelligence

Learning and Adaptation: Gaining insight into artificial intelligence systems' capacities for knowledge acquisition, enhanced performance, and long-term evolution is essential.

Perception and Sensing: Investigating artificial intelligence's methods for perception and sensing provides insight into how these systems perceive and react to their surroundings, improving their capacity to engage with humans.

Reasoning and Decision-Making: Assessing artificial intelligence systems' capacity to draw logical conclusions and make defensible decisions in the face of complex data requires examining their reasoning and decision-making processes.

Creativity and Innovation: Investigating artificial intelligence systems' creative and innovative characteristics indicates their ability to produce original solutions, advancing the fields of idea generation and problem-solving.

Collaboration and Interaction: Evaluating the interactive and collaborative aspects of AI systems sheds light on how well they can cooperate with people and other technology to create mutually beneficial relationships.

List of attributes and subfeatures of AI is given below in the table with respect to their references.

Table 3.2: Criteria and sub-criteria, and their correspondent references

#	Criteria	#	Sub-criteria	Covered by
C_1	Learning and Adaptation	C_{11}	Online Learning	Huang et. al. (2011)
		C_{12}	Unsupervised Learning	This study
		C_{13}	Reinforcement Learning	This study
		C_{14}	Supervised Learning	This study
		C_{15}	Lifelong Learning	This study
C_2	Perception and Sensing	C_{21}	Computer Vision	Beam and Kohane (2016)
		C_{22}	Speech Recognition	Goldberg (2015), Marcus (2018)
		C_{23}	Natural Language Processing	Manning and Schütze (1999), Goldberg (2015)
		C_{24}	Robotics	This study
		C_{25}	Audio Processing	Huang et. al. (2011)
C_3	Reasoning and Decision Making	C_{31}	Expert Systems	Fordyce et. al. (1986), Duchessi et. al. (1993)
		C_{32}	Knowledge Representation	Zhang, Wang and Liu (2018), Ntoutsis et. al. (2020)
		C_{33}	Probabilistic Reasoning	Manning et. al. (1999)
		C_{34}	Planning and Scheduling	Mahendrakar, Wilde and White (2021)
		C_{35}	Decision Support Systems	Gorris et. al. (2020), Nilashi et. al. (2019)
C_4	Creativity and Innovation	C_{41}	Generative Models	This study
		C_{42}	Creativity Support Tools	This study
		C_{43}	Design Optimization	This study
		C_{44}	Image and Video Synthesis	This study
		C_{45}	Music and Art Generation	This study
C_5	Collaboration and Interaction	C_{51}	Multi-Agent Systems	Mo et. al. (2020)
		C_{52}	Human-Robot Interaction	This study
		C_{53}	Human-Computer Interaction	This study
		C_{54}	Social Computing	Kumar and Anbanandam (2019)
		C_{55}	Crowd Computing	This study

3.5.1.2. Subcriteria Definitions of Attributes of Artificial Intelligence

Subfeatures of Learning and Adaptation:

1. Online Learning: AI systems continuously update their knowledge and adjust to new data streams in real-time by using online learning algorithms. This allows them to respond dynamically to changing user wants and situations.

2. **Unsupervised Learning:** Artificial Intelligence algorithms may autonomously discover insights and adapt to complex, unstructured datasets by using unsupervised learning approaches to find patterns and structures within data without explicit supervision.
3. **Reinforcement Learning:** Artificial intelligence uses techniques from reinforcement learning to learn from mistakes, adapt strategies to maximize cumulative rewards, and interact with environments to optimize decision-making. This allows for autonomous learning and adaptation in dynamic scenarios.
4. **Supervised Learning:** With the help of human feedback and supervised learning algorithms, artificial intelligence systems may learn from labeled data, anticipate the future, and modify their models in response to observed results. This allows for precise decision-making and task-specific adaptation.
5. **Lifelong Learning:** Artificial intelligence systems adopt lifelong learning strategies, continuously picking up new information, improving models, and adjusting to shifting circumstances over time, guaranteeing relevance and continuing improvement in a variety of applications and scenarios.

Subfeatures of Perception and Sensing:

1. **Computer Vision:** Applications like object detection, image categorization, and scene understanding are made possible by artificial intelligence's use of computer vision algorithms to interpret and comprehend visual information from photos or videos.
2. **Speech Recognition:** Artificial Intelligence uses speech recognition technologies to comprehend and transcribe spoken language, allowing for highly accurate and efficient voice-activated interfaces, virtual assistants, and real-time transcription services.

3. Natural Language Processing: Artificial Intelligence systems analyze and comprehend human language through natural language processing (NLP), enabling tasks like sentiment analysis, language translation, and text summarization, facilitating human-machine interaction and communication.

4. Audio Processing: Artificial Intelligence makes use of audio processing techniques to analyze and interpret sound signals. This allows for the creation of music, audio recognition, and speech augmentation, among other applications that improve the functionality of audio-based systems and voice-enabled devices.

5. Image Recognition: With its advanced visual perception capabilities, artificial intelligence is revolutionizing a number of industries. It uses image recognition algorithms to identify and classify objects or patterns within images, enabling applications like autonomous driving, medical image analysis, and facial recognition.

Subfeatures of Reasoning and Decision Making:

1. Expert Systems: In order to simulate human competence and decision-making processes in particular domains, artificial intelligence uses expert systems. This allows for effective problem-solving and decision-support based on specified rules and knowledge.

2. Knowledge Representation: Artificial intelligence uses knowledge representation techniques to structure and organize data in a way that makes it comprehensible and useful for intelligent systems. This makes it easier for intelligent systems to reason and make decisions.

3. Probabilistic Reasoning: To model uncertainty and make decisions in the face of insufficient or ambiguous information, artificial intelligence uses probabilistic reasoning

techniques. This allows for more dependable and robust decision-making in intricate, unpredictable situations.

4. **Planning and Scheduling:** Artificial intelligence systems use planning and scheduling algorithms to create the best possible action sequences to accomplish particular tasks or goals. This allows for effective resource allocation and job management across a range of industries.

5. **Decision Support Systems:** Artificial Intelligence incorporates decision support systems to help human decision makers by offering pertinent data, insights, and suggestions based on modeling and data analysis. This improves the efficacy and efficiency of decision-making in a variety of applications and domains.

Subfeatures of Creativity and Innovation:

1. **Generative Models:** By learning patterns and structures from preexisting data, artificial intelligence uses generative models to produce unique and varied outputs, such as literature, music, or graphics. This promotes creativity and innovation in the creation of content.

2. **Creativity Support Tools:** By offering guidance, inspiration, and feedback, Artificial Intelligence enables users to brainstorm, explore, and improve creative ideas. This promotes original thinking and speeds up the creative process.

3. **Design Optimization:** AI improves design workflows by maximizing configurations and parameters to satisfy predetermined goals or limitations. This facilitates effective exploration of design spaces and the identification of creative solutions.

4. **Image and Video Synthesis:** Using methods like generative adversarial networks (GANs) or deep learning, artificial intelligence creates realistic images and movies,

promoting artistic expression in the visual arts and media and allowing the production of lifelike visual content.

5. Music and Art Generation: Artificial intelligence pushes the frontiers of creativity and opens up new avenues for artistic expression through the generation of original music compositions and visual artworks using sophisticated algorithms and models.

Subfeatures of Collaboration and Interaction:

1. Multi-Agent Systems: To represent and simulate interactions between several autonomous agents, artificial intelligence makes use of multi-agent systems. This allows for cooperation, coordination, and negotiation in complicated situations.

2. Human-Robot Interaction: Artificial Intelligence enables smooth communication and cooperation between humans and robots through human-robot interaction (HRI) approaches, improving efficiency and safety in a range of industries, from manufacturing to healthcare.

3. Human-Computer Interaction: Artificial Intelligence improves user experience and facilitates more productive human-machine cooperation by providing natural language processing, gesture recognition, and other intuitive interfaces.

4. Social Computing: AI makes social computing possible by assessing and simulating human behavior in online social networks. This makes it easier for users to collaborate, share information, and make decisions as a group in virtual communities.

5. Crowd Computing: By utilizing crowd computing platforms, artificial intelligence is able to leverage the collective intelligence of crowds to solve complex problems and produce insightful information. Distributed problem-solving, data annotation, and content creation tasks are made possible.

3.6. Inclusive fact: Sustainability

The idea of sustainability is to satisfy current needs without endangering the capacity of future generations to satisfy their own. It is an all-encompassing strategy that aims to create a sustainable future for everyone by striking a balance between social, economic, and environmental factors. The environmental movement of the 1960s and 1970s, which increased awareness of the effects of human activities on the natural world, is credited with giving rise to the idea of sustainability. The idea of sustainability has expanded throughout time to include more topics pertaining to community well-being, economic growth, and social justice.

Sustainability is frequently understood as a three-pronged strategy that aims to strike a balance between social, environmental, and economic factors. Environmental sustainability is limiting the effects of human activity on the environment, conserving natural resources, and cutting back on waste and pollution. Promoting social justice, diversity, and inclusion as well as making sure that everyone in society has access to needs like food, shelter, and medical care are all part of social sustainability. In order to achieve economic sustainability, responsible resource usage, job and opportunity creation, and sustainable economic growth must all be prioritized.

Sustainability is based on a number of fundamental ideas, such as intergenerational equality, the polluter pays concept, and the precautionary principle. According to the precautionary principle, actions should be done to prevent harm when there is uncertainty regarding the effects an activity will have on the environment or human health. According to the polluter pays concept, people who cause environmental pollution should pay for the necessary cleanup. Future generations should have equal access to resources and opportunities as current generations, according to the

intergenerational equity principle. Due to its complexity and diversity, sustainability calls for interdisciplinary study and cooperation in a number of disciplines, including economics, science, the social sciences, and policy. Additionally, the severity of the effects of climate change, biodiversity loss, and other environmental issues makes it an urgent issue.

All things considered, the idea of sustainability is essential to the future of both our world and our society. Researchers may build new technologies and solutions, understand the intricate relationships between social, economic, and environmental concerns, and influence policy and decision-making to build a more sustainable future for all by focusing on sustainability.

3.6.1. Sustainability in the Concept of Organizations

Apart from the aspects of sustainability that pertain to the environment and society, there is an increasing focus on sustainability within the context of companies. A growing number of organizations and companies are realizing the value of sustainability and implementing it into their operations and decision-making procedures. In the context of organizations, sustainability can refer to a variety of actions and projects, such as cutting greenhouse gas emissions and energy consumption, encouraging sustainable supply chain management, and interacting with stakeholders to encourage social and environmental responsibility. In order to monitor their sustainability performance and inform stakeholders, several businesses have also implemented sustainability reporting frameworks, such as the Sustainability Accounting Standards Board (SASB) or the Global Reporting Initiative (GRI).

Organizations can also use sustainability as a source of competitive advantage. Organizations may stand out from the competition, draw in clients who appreciate sustainability, enhance their reputation, and enhance their brand image by implementing sustainable practices and promoting sustainability throughout their operations. Organizations may encounter obstacles in implementing sustainable practices, such as the requirement for supplementary funding, possible inconsistencies with immediate financial objectives, and opposition from stakeholders who may be averse to change. By suggesting tactics and ideas that can assist companies in removing obstacles to sustainability and more successfully promoting sustainable practices, sustainability researchers can contribute to the resolution of these issues.

All things considered, the topic of sustainability in the context of companies is dynamic and complicated, with plenty of room for scholarly inquiry. Through the examination of sustainability in this particular context, scholars can acquire a deeper understanding of the obstacles and possibilities associated with advancing sustainability in businesses, devise novel tactics and methods for advancing sustainability, and contribute to the development of sustainable business practices in the future.

The role of sustainability in corporate governance and management is a significant component of sustainability studies in the context of corporations. Nowadays, a lot of businesses are integrating sustainability concerns into their corporate governance frameworks and realizing the value of sustainability in their decision-making processes. This can entail creating sustainability policies and plans, appointing committees or executives dedicated to sustainability, and incorporating sustainability measures into incentive programs and performance reviews. Mission statements, values statements, and company cultures can all incorporate sustainability.

Moreover, research on sustainability can assist in determining the elements that motivate firms to adopt sustainable practices as well as the obstacles that stand in their way. This may entail researching the incentives and driving forces behind sustainable behavior in addition to the social and psychological aspects of organizational decision-making. All things considered, academic research has a plethora of options in the rich and complicated field of sustainability study in the context of organizations. Through the examination of sustainability in this particular context, scholars can acquire a deeper understanding of the obstacles and possibilities associated with advancing sustainability in businesses, devise novel tactics and methods for advancing sustainability, and contribute to the development of sustainable business practices in the future.

3.6.2. Attributes and Subfeatures for Sustainability

3.6.2.1. Attribute Definitions of Sustainability

Environmental Sustainability: Analyzing the environmental sustainability component offers a thorough grasp of an organization's ecological footprint and dedication to responsible stewardship by assessing how practices affect ecosystems, conserve resources, and lessen environmental degradation.

Social and Cultural Sustainability: Examining an organization's efforts to promote diversity, equity, and inclusivity while taking into account community involvement and cultural preservation helps to provide a comprehensive evaluation of its ethical behavior and social responsibility.

Economic Sustainability: To ensure long-term viability, economic resilience, and beneficial contributions to local and global economies, economic sustainability analysis entails evaluating financial practices, resource allocation, and profitability methods.

Governance and Institutional Sustainability: Assessing governance and institutional sustainability comprises looking at the rules, procedures, and organizational structures to make sure that there is openness, responsibility, and moral behavior. This promotes flexibility and resilience in the face of difficulties.

Business Sustainability: To comprehend business sustainability, one must look at how a company combines social, environmental, and economic factors into its strategic planning and day-to-day operations in order to balance profitability with ethical and sustainable business practices.

List of attributes and subfeatures of sustainability is given below in the table with respect to their references.

Table 3.3: Criteria and sub-criteria, and their correspondent references

Criteria	#	Sub-criteria	Covered by
C ₁ Environmental Sustainability	C ₁₁	Resource conservation	Sellers (2007), Bukari et al. (2017)
	C ₁₂	Pollution prevention and waste reduction	Sellers (2007), Bukari et al. (2017), Kurniawan et al. (2022), Ali et al. (2023)
	C ₁₃	Biodiversity conservation	Kok et al. (2018)
C ₂ Social and Cultural Sustainability	C ₁₄	Climate change mitigation and adaptation	This study
	C ₂₁	Equality and social justice	Liao et al. (2019), Barbarini et al. (2020), Asayama et al. (2020)
	C ₂₂	Community engagement and development (Social Responsibility and Benefit)	Liao et al. (2019), Kumar et al. (2020), Donkersloot et al. (2020), Ungar et al. (2020), Perkins et al. (2021)
	C ₂₃	Health and well-being	Barbarini et al. (2020), Donkersloot et al. (2020), Ungar et al. (2020), Perkins et al. (2021)
C ₃ Economic Sustainability	C ₂₄	Cultural preservation and diversity	Donkersloot et al. (2020)
	C ₃₁	Sustainable business models	Zemtsov et al. (2020)
	C ₃₂	Responsible investment and finance	Zhang (2020), Kwitinski et al. (2023)
	C ₃₃	Local and regional economic development	Long et al. (2020), Putra et al. (2021), Wu et al. (2021)
	C ₃₄	Resource efficiency and productivity	Cao et al. (2024)
C ₄ Governance and Institutional Sustainability	C ₄₁	Transparent and accountable governance	Esguerra et al. (2020), Mänttinen (2020), Randa (2021), Haghighi et al. (2024)
	C ₄₂	Legal and regulatory Frameworks	Molla (2020), Strydoms et al. (2020), Thompson et al. (2021),
	C ₄₃	Stakeholder participation and engagement	Esguerra et al. (2020), Molla (2020), Mänttinen (2020), Strydoms et al. (2020), Melloni et al. (2020)
	C ₄₄	Capacity building and education	This study
	C ₄₅	Cybersecurity and IT Measures	Yarovoy et al. (2020)
C ₅ Business Sustainability	C ₅₂	Financial Profitability	Malysk and Khodkovskaya (2020)
	C ₅₃	Digital Scaling/ Economies of Scale	Awajna and Firoki (2021), Pustkowska et al. (2021)
	C ₅₄	Continuous Innovation	Liet al. (2020), Yuan et al. (2021)

3.6.2.2. Subcriteria Definitions of Attributes of Sustainability

Subfeatures of Environmental Sustainability:

1. **Resource conservation:** In order to reduce depletion and maintain ecological balance, environmental sustainability focuses on conserving natural resources including water, energy, and raw materials through responsible management and effective usage.
2. **Pollution prevention and waste reduction:** By implementing clean technologies, recycling programs, and waste management strategies, environmental sustainability initiatives seek to mitigate environmental harm and promote a circular economy while preventing pollution and reducing waste generation.
3. **Biodiversity conservation:** In order to maintain ecological integrity and guarantee the resilience of natural systems, environmental sustainability initiatives include biodiversity conservation measures that guard and preserve species, ecosystems, and genetic diversity.
4. **Climate change mitigation and adaptation:** In order to limit global warming and increase resilience to climate-related hazards for both the present and the future generations, environmental sustainability addresses climate change through mitigation initiatives to lower greenhouse gas emissions and adaptation strategies to deal with its effects.

Subfeatures of Social and Cultural Sustainability:

1. **Equality and social justice:** Social and cultural sustainability places a strong emphasis on advancing social justice and equality by addressing inequalities, standing up for human rights, and making sure that everyone in society has equal access to opportunities, regardless of gender, race, or socioeconomic background.
2. **Community engagement and development (Social Responsibility and Benefit):** Through programs that strengthen social cohesion, empower local communities, and advance collective well-being, social and cultural sustainability promotes community engagement and development. These efforts demonstrate a commitment to social responsibility and generate shared benefits.
3. **Health and well-being:** Social and cultural sustainability programs place a high priority on people's physical, mental, and emotional wellness in order to support sustainable development. They do this by encouraging access to safe housing, wholesome food, clean water, and healthcare.
4. **Cultural diversity and preservation:** Social and cultural sustainability recognizes the intrinsic value of cultural assets and works to promote intercultural understanding, respect, and dialogue in order to strengthen the social fabric and preserve cultural heritage, traditions, and diversity.

Subfeatures of Economic Sustainability:

1. **Sustainable business models:** To ensure long-term viability and good effects on society and the environment, economic sustainability encourages the adoption of sustainable business models that strike a balance between profit generating and social and environmental responsibility.

2. Responsible investment and finance: To generate value for investors and society at large, economic sustainability promotes responsible investment and finance practices that give environmental, social, and governance (ESG) considerations top priority.

3. Local and regional economic development: By promoting entrepreneurship, job creation, and value chain development, as well as by strengthening economic resilience and lowering reliance on outside sources, economic sustainability aims to promote local and regional economic development.

4. Resource efficiency and productivity: To maximize resource use, reduce waste, and boost competitiveness, economic sustainability places a strong emphasis on resource efficiency and productivity improvements. This promotes innovation and economic growth while lowering environmental impact and protecting natural resources.

Subfeatures of Governance and Institutional Sustainability:

1. Transparent and accountable governance: To ensure that decisions are made openly, morally, and accountable to stakeholders, governance and institutional sustainability place a strong emphasis on transparency and accountability in decision-making processes. This promotes legitimacy and trust in institutions.

2. Legal and regulatory frameworks: Sturdy legal and regulatory frameworks that support adherence to the law, uphold its enforcement, and safeguard individuals' rights are essential to governance and institutional sustainability. They also serve as a basis for sustainable development and guarantee justice and stability in society.

3. Participation and engagement of stakeholders: Institutional sustainability and governance place a high priority on the involvement and engagement of stakeholders in decision-making processes. This allows for inclusive governance structures that take

into account a variety of viewpoints, encourage discussion, and strengthen group ownership and support for sustainable initiatives.

4. Capacity building and education: Efforts to strengthen institutional capabilities, empower stakeholders, and improve awareness and understanding of sustainability principles are all part of governance and institutional sustainability. These efforts also help to foster a culture of responsibility and resilience within organizations and society.

Subfeatures of Business Sustainability:

1. Cybersecurity and IT Measures: In an increasingly digital world, business sustainability places a high priority on cybersecurity and IT measures to safeguard digital assets, client information, and operational systems. These measures also help to mitigate cyber risks and guarantee business continuity.

2. Financial Profitability: To build long-term value for stakeholders, shareholders, and society, business sustainability includes financial profitability, which strikes a balance between economic success and environmental and social responsibility.

3. Digital Scaling/Economies of Scale: In order to maximize resource utilization, streamline processes, and generate efficiencies, business sustainability embraces digital scaling and economies of scale. This allows for expansion while lowering environmental effect and boosting competitiveness.

4. Continuous Innovation: In order to ensure resilience and relevance in ever-changing markets, business sustainability promotes a culture of continuous innovation. This culture encourages the creation of new goods, services, and procedures that benefit clients while tackling environmental and social issues.

4. RESULT

Table 4.1: Linguistic scale for ratings of alternatives in terms of criteria

Linguistic Terms	C-INFUN Weights	
	μ	ν
Unquestionably SmallWeight - (USW)	$0.000\tau - 0.000\tau^2$	$4.000\tau - 4.000\tau^2$
PromptlySmall Weight - (PSW)	$0.5\tau - 0.5\tau^2$	$3.5\tau - 3.5\tau^2$
Small Weight - (SW)	$1.0\tau - 1.0\tau^2$	$3.0\tau - 3.0\tau^2$
SomewhatSmall Weight - (SSW)	$1.5\tau - 1.5\tau^2$	$2.5\tau - 2.5\tau^2$
Moderate Weight - (MW)	$2.0\tau - 2.0\tau^2$	$2.0\tau - 2.0\tau^2$
SomewhatLarge Weight - (SLW)	$2.5\tau - 2.5\tau^2$	$1.5\tau - 1.5\tau^2$
Large Weight - (LW)	$3.0\tau - 3.0\tau^2$	$1.0\tau - 1.0\tau^2$
PromptlyLarge Weight - (PLW)	$3.5\tau - 3.5\tau^2$	$0.5\tau - 0.5\tau^2$
Unquestionably Large Weight - (ULW)	$4.000\tau - 4.000\tau^2$	$0.000\tau - 0.000\tau^2$

Step 1&2. We have constructed the criteria (C_j) of artificial intelligence to be valued on effects to sustainability in the concept of microenterprise. In this scenario, the decision maker (DM) group represents the shared decision-making perspective among respondents of the questionnaire given in Table 4.2, Appendix D.1 and Appendix D.2. We've created a linguistic pairwise comparison matrix where each respondent assigns τ values. These τ values are then used to form interval-valued intuitionistic fuzzy numbers (IVIFNs) given in Appendix D.4 and Appendix D.5.

Step 3&4. We'll adhere to the continuous intuitionistic fuzzy AHP (C-INFUS AHP) methodology. Once we've adjusted the consistency of each DM's pairwise comparison matrices, we'll use Eq. (1) to convert respondents' answers from fuzzy to crisp values.

$$Def(\tilde{A}_i) = 9 \times \left(\frac{\mu_{A_i}^L + \mu_{A_i}^U + (1 - \vartheta_{A_i}^L) + (1 - \vartheta_{A_i}^U) + \mu_{A_i}^L \times \mu_{A_i}^U - \sqrt{(1 - \vartheta_{A_i}^L) \times (1 - \vartheta_{A_i}^U)}}{4} \right)^3 \quad (1)$$

Step 5&6. The score judgement matrix and the interval multiplicative matrix are created using Equation (2) and Equation (3), respectively (Alkan and Kahraman, 2024) given in Appendix D.6 and Appendix D.7.

$$\tilde{P} = \begin{bmatrix} (\mu_{11}^L - \vartheta_{11}^U, \mu_{11}^U - \vartheta_{11}^L) & \cdots & (\mu_{1n}^L - \vartheta_{1n}^U, \mu_{1n}^U - \vartheta_{1n}^L) \\ \vdots & \ddots & \vdots \\ (\mu_{n1}^L - \vartheta_{n1}^U, \mu_{n1}^U - \vartheta_{n1}^L) & \cdots & (\mu_{nn}^L - \vartheta_{nn}^U, \mu_{nn}^U - \vartheta_{nn}^L) \end{bmatrix} \quad (2)$$

$$\Xi = \begin{bmatrix} (10(\mu_{11}^L - \vartheta_{11}^U), 10(\mu_{11}^U - \vartheta_{11}^L)) & \cdots & (10(\mu_{1n}^L - \vartheta_{1n}^U), 10(\mu_{1n}^U - \vartheta_{1n}^L)) \\ \vdots & \ddots & \vdots \\ (10(\mu_{n1}^L - \vartheta_{n1}^U), 10(\mu_{n1}^U - \vartheta_{n1}^L)) & \cdots & (10(\mu_{nn}^L - \vartheta_{nn}^U), 10(\mu_{nn}^U - \vartheta_{nn}^L)) \end{bmatrix} \quad (3)$$

Table 4.2: Pairwise comparison made by DM1 of AI criteria

	C1	C2	C3	C4	C5
C1	MW : (0,5), (0,5)	PSW : (0,42), (0,68)	SW : (0,3), (0,47)	PSW : (0,85), (0,94)	PSW : (0,17), (1)
C2	USW : (0,42), (0,67)	MW : (0,5), (0,5)	USW : (0,23), (0,58)	SW : (0,63), (0,85)	SSW : (0,42), (0,55)
C3	SSW : (0,3), (0,47)	LW : (0,25), (0,45)	MW : (0,5), (0,5)	USW : (0,26), (0,73)	SSW : (0,53), (0,58)
C4	MW : (0,85), (0,85)	MW : (0,62), (0,75)	USW : (0,64), (0,67)	MW : (0,5), (0,5)	PLW : (0,24), (0,47)
C5	SSW : (0,17), (1)	PSW : (0,57), (0,93)	ULW : (0,04), (0,45)	SW : (0,07), (0,14)	MW : (0,5), (0,5)

Step 7&8. We determined the interval $\tilde{\omega}_j$ for each criterion using Equation (4) and built the possibility degree matrix $Y = (v_{i'j})_{n \times n}$ using Equation (5) given in Appendix D.8 and Appendix D.9.

$$\tilde{\omega}_j = \left[\frac{\sum_{j=1}^n \xi_{i'j}^L}{\sum_{j=1}^n \sum_{j=1}^n \xi_{i'j}^U}, \frac{\sum_{j=1}^n \xi_{i'j}^U}{\sum_{j=1}^n \sum_{j=1}^n \xi_{i'j}^L} \right] \quad (4)$$

$$Y(\tilde{\omega}_{i'} > \tilde{\omega}_j) = v_{i'j} = \frac{\max(0, \omega_{i'}^U - \omega_j^L) - \max(0, \omega_{i'}^L - \omega_j^U)}{(\omega_{i'}^U - \omega_j^L) + (\omega_{i'}^L - \omega_j^U)} \quad (5)$$

Step 9&10. We computed prioritized vectors and subsequently normalized them. The resulting scores are presented in Table 4.3 and Table 4.4.

4.1. Findings

Based on the application of CINFUS, normalized weights of artificial intelligence criteria have been calculated and shown in Table 4.3. The ranking of criteria is shown in Table 4.4.

Table 4.3: Normalized Weights of Criteria

#	Criteria	Normalized Weights
C_1	Learning and Adaptation	0,223
C_2	Perception and Sensing	0,219
C_3	Reasoning and Decision Making	0,186
C_4	Creativity and Innovation	0,151
C_5	Collaboration and Interaction	0,223
Average		0,2004

Table 4.4: Ranking of AI Criterion

#	Criteria	Normalized Weights
C_1	Learning and Adaptation	0,223
C_5	Collaboration and Interaction	0,223
C_2	Perception and Sensing	0,219
C_3	Reasoning and Decision Making	0,186
C_4	Creativity and Innovation	0,151

Based on the application of CINFUS, normalized weights of microenterprise criteria have been calculated and shown in Table 4.5. Microenterprise criteria normalized weights have been found as entrepreneurial characteristics 0,088; strategic management 0,239; operations and production 0,196; human resource management 0,213; stakeholder management 0,267. Stakeholder management has been found and ranked in the most importance place. Following this criteria, strategic management criterion has 0,239 as normalized weight and importance is ranked as second following “stakeholder management” criterion. Human resource management followed the strategic management with the weight of 0,213. Entrepreneurial characteristics criterion has the minimum weight as 0,088 and ranked in the last position of importance.

Table 4.5: Ranking of Microenterprise Criteria

Microenterprise Criteria	
Criteria	Normalized Weights
Entrepreneurial characteristics	0,088
Strategic Management	0,239
Operations and Production	0,196
Human Resource Management	0,213
Stakeholder Management	0,267

Based on the application of CINFUS, normalized weights of sustainability criteria have been calculated and shown in Table 4.6. Sustainability criteria normalized weights have been found as environmental 0,278; social and cultural 0,148; economic 0,179;

governance and institutional 0,112; business 0,285. Business sustainability has been found and ranked in the most importance place. Following this criteria, environmental sustainability criterion has 0,278 as normalized weight and importance is ranked as second following “business sustainability” criterion. Economic sustainability followed the business sustainability with the weight of 0,179. Governance and institutional sustainability criterion have the minimum weight as 0,112 and ranked in the last position of importance.

Table 4.6: Ranking of Sustainability Criteria

Sustainability Criteria	
Criteria	Normalized Weights
Environmental	0,278
Social and Cultural	0,148
Economic	0,179
Governance and Institutional	0,112
Business	0,285

Based on the application of CINFUS, normalized weights of subcriteria have been calculated and shown in Table 4.7. Subcriteria normalized weights have been found as online learning 0,254; unsupervised learning 0,108; reinforcement learning 0,161; supervised learning 0,194; lifelong learning 0,286. Lifelong learning has been found and ranked in the most importance place. Following this criteria, online learning criterion has 0,254 as normalized weight and importance is ranked as second following “lifelong learning” criterion. Supervised learning followed the online learning with the weight of 0,194. Unsupervised learning criterion has the minimum weight as 0,108 and ranked in the last position of importance.

Table 4.7: Ranking of Subcriteria1

SubCriteria1		
#	Criteria	Normalized Weights
C11	Online Learning	0,254
C12	Unsupervised Learning	0,108
C13	Reinforcement Learning	0,161
C14	Supervised Learning	0,194
C15	Lifelong Learning	0,286

Based on the application of CINFUS, normalized weights of subcriteria2 have been calculated and shown in Table 4.8. Subcriteria2 normalized weights have been found as computer vision 0,093; speech recognition 0,191; natural language processing 0,203; robotics 0,201; audio processing 0,315. Audio processing has been found and ranked in the most importance place. Following this criteria, natural language processing criterion has 0,203 as normalized weight and importance is ranked as second following “audio processing” criterion. Robotics followed the natural language processing with the weight of 0,201. Computer vision criterion has the minimum weight as 0,093 and ranked in the last position of importance.

Table 4.8: Ranking of Subcriteria2

SubCriteria2		
#	Criteria	Normalized Weights
C21	Computer Vision	0,093
C22	Speech Recognition	0,191
C23	Natural Language Processing	0,203
C24	Robotics	0,201
C25	Audio Processing	0,315

Based on the application of CINFUS, normalized weights of subcriteria3 have been calculated and shown in Table 4.9. Subcriteria3 normalized weights have been found as expert systems 0,156; knowledge representation 0,198; probabilistic reasoning 0,203; planning and scheduling 0,13; decision and support systems 0,315. Decision support systems has been found and ranked in the most importance place. Following this criteria, probabilistic reasoning criterion has 0,203 as normalized weight and importance is ranked as second following “decision support systems” criterion. Knowledge representation followed the probabilistic reasoning with the weight of 0,198. Planning and scheduling criterion has the minimum weight as 0,13 and ranked in the last position of importance.

Table 4.9: Ranking of Subcriteria3

SubCriteria3		
#	Criteria	Normalized Weights
C31	Expert Systems	0,156
C32	Knowledge Representation	0,198
C33	Probabilistic Reasoning	0,203
C34	Planning and Scheduling	0,13
C35	Decision Support Systems	0,315

Based on the application of CINFUS, normalized weights of subcriteria4 have been calculated and shown in Table 4.10. Subcriteria4 normalized weights have been found as generative models 0,154; creativity support tools 0,195; design optimization 0,209; image and video synthesis 0,129; music and art generation 0,315. Music and art generation has been found and ranked in the most importance place. Following this criteria, design optimization criterion has 0,209 as normalized weight and importance is ranked as second following “music and art generation” criterion. Creativity support tools followed the design optimization with the weight of 0,195. Image and video synthesis criterion has the minimum weight as 0,129 and ranked in the last position of importance.

Table 4.10: Ranking of Subcriteria4

SubCriteria4		
#	Criteria	Normalized Weights
C41	Generative Models	0,154
C42	Creativity Support Tools	0,195
C43	Design Optimization	0,209
C44	Image and Video Synthesis	0,129
C45	Music and Art Generation	0,315

Based on the application of CINFUS, normalized weights of subcriteria5 have been calculated and shown in Table 4.11. Subcriteria5 normalized weights have been found as multi-agent systems 0,086; human robot interaction 0,208; human computer interaction 0,236; social computing 0,157; crowd computing 0,315. Crowd computing has been found and ranked in the most importance place. Following this criteria, human computer interaction criterion has 0,236 as normalized weight and importance is ranked as second following “crowd computing” criterion. Human robot interaction followed the human computer interaction with the weight of 0,208. Multi agent systems criterion has the minimum weight as 0,086 and ranked in the last position of importance.

Table 4.11: Ranking of Subcriteria5

SubCriteria5		
#	Criteria	Normalized Weights
C51	Multi-Agent Systems	0,086
C52	Human-Robot Interaction	0,208
C53	Human-Computer Interaction	0,236
C54	Social Computing	0,157
C55	Crowd Computing	0,315

5. CONCLUSION

As a conclusion, this study offers a novel evaluation approach that looks at the complex relationship between the adoption of Artificial Intelligence (AI) and sustainability in micro-enterprises, taking into account different organizational structures like autonomous, decentralized, and centralized. It provides a comprehensive knowledge of the potential benefits and drawbacks of AI's influence on micro-enterprise systems by using fuzzy intuitionistic extensions.

Artificial intelligence criteria normalized weights have been found as learning and adaptation 0,223; collobration and interaction 0,223; perception and sensing 0,219; reasoning and decision making 0,186; creativity and innovation 0,151. Between “learning and adaption” criterion and “collobration and interaction” criterion, no difference has been found and ranked in the most and equal importance. Following this criteria, perception and sensing criterion has 0,219 as normalized weight and importance is ranked as second following “learning and adaption” criterion and “collobration and interaction” criterion. Reasoning and decision making followed the perception and sensing with the weight of 0,186. Creativity and innovation criterion has the minimum weight as 0,151 and ranked in the last position of importance.

The suggested framework offers a strong foundation for assessment, emphasizing the definition of sustainable characteristics, the creation of pertinent indicators, and the application of exacting evaluation processes. With the goal of encouraging constructive organizational changes inside microbusinesses, these findings have important ramifications for the development of policies and the ethical application of AI. In the end, this research should facilitate the ethical adoption of AI and support sustainable business practices in the microenterprise sector by providing insights that will influence future legislative decisions and academic investigations.

5.1 Limitations and Future Work

Furthermore, in this thesis, we provide definitions of criterias, subcriterias of artificial intelligence, microenterprises and sustainability. Comprehensive literature reviews have been done. These criterias and subcriterias can be expended. In the concept of the prioritizing of criterias, fuzzy logic has been applied. These calculations can be expended for further analysis. There are several methods, calculations in the literature to be applied to these criterias. In this thesis, the concept has been chosen as artificial intelligence effects to sustainability by microenterprise opinion. This view can be editable and applicable for different aspects of necessities.

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APPENDICES

Appendix C.1: Criteria and subcriteria of AI

Artificial Intelligence			
#	Criteria	#	Sub-criteria
C_1	Learning and Adaptation	C_{11}	Online Learning
		C_{12}	Unsupervised Learning
		C_{13}	Reinforcement Learning
		C_{14}	Supervised Learning
		C_{15}	Lifelong Learning
C_2	Perception and Sensing	C_{21}	Computer Vision
		C_{22}	Speech Recognition
		C_{23}	Natural Language Processing
		C_{24}	Audio Processing
		C_{25}	Image recognition
C_3	Reasoning and Decision Making	C_{31}	Expert Systems
		C_{32}	Knowledge Representation
		C_{33}	Probabilistic Reasoning
		C_{34}	Planning and Scheduling
		C_{35}	Decision Support Systems
C_4	Creativity and Innovation	C_{41}	Generative Models
		C_{42}	Creativity Support Tools
		C_{43}	Design Optimization
		C_{44}	Image and Video Synthesis
		C_{45}	Music and Art Generation
C_5	Collaboration and Interaction	C_{51}	Multi-Agent Systems
		C_{52}	Human-Robot Interaction
		C_{53}	Human-Computer Interaction
		C_{54}	Social Computing
		C_{55}	Crowd Computing

Appendix C.2: Criteria and subcriteria of Microenterprise

Microenterprise			
#	Criteria	#	Sub-criteria
C ₁	Entrepreneurial Characteristics	C ₁₁	Risk-taking propensity
		C ₁₂	Flexibility and adaptability
		C ₁₃	Passion and drive
		C ₁₄	Creativity and innovation
		C ₁₅	Resilience and perseverance
C ₂	Strategic Management	C ₂₁	Business planning and goal-setting
		C ₂₂	Resource allocation and management
		C ₂₃	Market research and analysis
		C ₂₄	Branding and marketing strategies
		C ₂₅	Financial management and budgeting
C ₃	Operations and Production	C ₃₁	Product or service design and development
		C ₃₂	Quality control and assurance
		C ₃₃	Procurement and inventory management
		C ₃₄	Production process optimization
		C ₃₅	Supply chain management
C ₄	Human Resource Management	C ₄₁	Recruitment and selection
		C ₄₂	Training and development
		C ₄₃	Performance management and appraisal
		C ₄₄	Compensation and benefits
		C ₄₅	Employee relations and engagement
C ₅	Stakeholder Relations	C ₅₁	Customer service and support
		C ₅₂	Customer feedback and satisfaction measurement
		C ₅₃	CRM systems and tools
		C ₅₄	External stakeholder, Suppliers (Outsourcing) & Government
		C ₅₅	Shareholders
c6	Sales and Marketing	C ₆₁	Digital Marketing Strategy
		C ₆₂	Sales Channel Optimization
		C ₆₃	Market Research and Analysis
		C ₆₅	Sales and distribution channels
		C ₆₆	Pricing strategies, Promotional Activities and Discounts
c7	Information Technologies	C ₇₁	Technology Adoption and Integration
		C ₇₂	E-Commerce and Online Presence
		C ₇₃	Data analytics
		C ₇₄	Mobile Technologies for Business Operations
		C ₇₅	IT Training and Skill Development
c8	Financial Management	C ₈₁	Budgeting and Financial Planning
		C ₈₂	Cash Flow Management
		C ₈₃	Financial Reporting and Record Keeping
		C ₈₄	Access to Financing and Credit
		C ₈₅	Risk Management and Financial Sustainability

Appendix C.3: Criteria and subcriteria of Sustainability

Sustainability			
#	Criteria	#	Sub-criteria
C ₁	Environmental Sustainability	C ₁₁	Resource conservation
		C ₁₂	Pollution prevention and waste reduction
		C ₁₃	Biodiversity conservation
		C ₁₄	Climate change mitigation and adaptation
C ₂	Social and Cultural Sustainability	C ₂₁	Equality and social justice
		C ₂₂	Community engagement and development (Social Responsibility and Benefit)
		C ₂₃	Health and well-being
		C ₂₄	Cultural preservation and diversity
C ₃	Economic Sustainability	C ₃₁	Sustainable business models
		C ₃₂	Responsible investment and finance
		C ₃₃	Local and regional economic development
		C ₃₄	Resource efficiency and productivity
C ₄	Governance and Institutional Sustainability	C ₄₁	Transparent and accountable governance
		C ₄₂	Legal and regulatory frameworks
		C ₄₃	Stakeholder participation and engagement
		C ₄₄	Capacity building and education
C ₅	Business Sustainability	C ₅₁	Cybersecurity and IT Measures
		C ₅₂	Financial Profitability
		C ₅₃	Digital Scaling/ Economies of Scale
		C ₅₄	Continuous Innovation

Appendix D.1: Linguistic Pairwise comparison matrix for AI criteria with respect to DM2

	C1	C2	C3	C4	C5
C1	MW : (0,5), (0,5)	PSW : (0,54), (0,73)	SW : (0,31), (0,47)	PSW : (0,52), (0,58)	PSW : (0,33), (0,47)
C2	SSW : (0,42), (0,47)	MW : (0,5), (0,5)	USW : (0,28), (0,47)	SW : (0,45), (0,52)	SSW : (0,21), (0,56)
C3	MW : (0,3), (0,54)	PLW : (0,28), (0,47)	MW : (0,5), (0,5)	SW : (0,31), (0,39)	SW : (0,54), (0,56)
C4	PSW : (0,6), (0,65)	PSW : (0,45), (0,52)	LW : (0,31), (0,39)	MW : (0,5), (0,5)	SLW : (0,11), (0,34)
C5	LW : (0,35), (0,47)	SW : (0,21), (0,56)	PLW : (0,54), (0,56)	ULW : (0,11), (0,34)	MW : (0,5), (0,5)

Appendix D.2: Linguistic Pairwise comparison matrix for AI criteria with respect to DM3

	C1	C2	C3	C4	C5
C1	MW : (0,5), (0,5)	PSW : (0,42), (0,57)	LW : (0,72), (0,78)	PLW : (0,44), (0,51)	SW : (0,44), (0,83)
C2	PLW : (0,35), (0,43)	MW : (0,5), (0,5)	ULW : (0,39), (0,47)	SLW : (0,43), (0,58)	SSW : (0,56), (0,95)
C3	SW : (0,72), (0,78)	ULW : (0,39), (0,47)	MW : (0,5), (0,5)	LW : (0,31), (0,73)	LW : (0,4), (0,48)
C4	SW : (0,44), (0,51)	SW : (0,43), (0,58)	PLW : (0,31), (0,43)	MW : (0,5), (0,5)	SW : (0,17), (0,4)
C5	ULW : (0,53), (0,65)	SSW : (0,56), (0,65)	ULW : (0,4), (0,58)	ULW : (0,15), (0,4)	MW : (0,5), (0,5)

Appendix D.3: IVIF pairwise comparison matrix for criteria with respect to DM1

	C1	C2	C3
C1	([0,5 , 0,5], [0,5 , 0,5])	([0,1088 , 0,1218], [0,7616 , 0,8526])	([0,21 , 0,2491], [0,63 , 0,7473])
C2	([0 , 0], [0,8844 , 0,9744])	([0,5 , 0,5], [0,5 , 0,5])	([0 , 0], [0,7084 , 0,9744])
C3	([0,315 , 0,37365], [0,525 , 0,62275])	([0,5625 , 0,7425], [0,1875 , 0,2475])	([0,5 , 0,5], [0,5 , 0,5])
C4	([0,255 , 0,255], [0,255 , 0,255])	([0,375 , 0,4712], [0,375 , 0,4712])	([0 , 0], [0,8844 , 0,9216])
C5	([0 , 0,21165], [0 , 0,35275])	([0,03255 , 0,12255], [0,22785 , 0,85785])	([0,1536 , 0,99], [0 , 0])

Appendix D.4: IVIF pairwise comparison matrix continuation for AI criteria with respect to DM1

C4	C5
([0,0282 , 0,06375], [0,1974 , 0,44625])	([0 , 0,07055], [0 , 0,49385])
([0,1275 , 0,2331], [0,3825 , 0,6993])	([0,3654 , 0,37125], [0,609 , 0,61875])
([0 , 0], [0,7696 , 0,7884])	([0,3654 , 0,37365], [0,609 , 0,62275])
([0,5 , 0,5], [0,5 , 0,5])	([0,6384 , 0,87185], [0,0912 , 0,12455])
([0,0651 , 0,1204], [0,1953 , 0,3612])	([0,5 , 0,5], [0,5 , 0,5])

Appendix D.5: Aggregated IVIF pairwise comparison matrix continuation for AI criteria

	C1	C2	C3	C4	C5
C1	(0.5, 0.5] , [0.5, 0.5)	(0.109, 0.123] , [0.758, 0.861)	(0.319, 0.381] , [0.43, 0.505)	(0.481, 0.502] , [0.308, 0.399)	(0.089, 0.148] , [0, 0.7)
C2	(0.483, 0.539] , [0.412, 0.438)	(0.5, 0.5] , [0.5, 0.5)	(0.597, 0.816] , [0, 0)	(0.354, 0.381] , [0.492, 0.593)	(0.239, 0.371] , [0.32, 0.617)
C3	(0.322, 0.383] , [0.478, 0.564)	(0.808, 0.946] , [0, 0)	(0.5, 0.5] , [0.5, 0.5)	(0.306, 0.341] , [0.476, 0.513)	(0.469, 0.488] , [0.498, 0.509)
C4	(0.199, 0.203] , [0.554, 0.568)	(0.243, 0.281] , [0.641, 0.69)	(0.562, 0.663] , [0.266, 0.293)	(0.5, 0.5] , [0.5, 0.5)	(0.371, 0.643] , [0.175, 0.314)
C5	(0.694, 0.901] , [0, 0)	(0.188, 0.253] , [0.41, 0.732)	(0.837, 0.963] , [0, 0)	(0.352, 0.853] , [0, 0)	(0.5, 0.5] , [0.5, 0.5)

Appendix D.6: Score judgement matrix

	C1	C2	C3	C4	C5
C1	(0, 0)	(-0,753 , -0,635)	(-0,186 , -0,049)	(0,083 , 0,194)	(-0,612 , 0,148)
C2	(0,046 , 0,127)	(0 , 0)	(0,597 , 0,816)	(-0,239 , -0,112)	(-0,378 , 0,051)
C3	(-0,243 , -0,095)	(0,808 , 0,946)	(0 , 0)	(-0,207 , -0,135)	(-0,041 , -0,01)
C4	(-0,37 , -0,352)	(-0,447 , -0,361)	(0,269 , 0,397)	(0 , 0)	(0,057 , 0,468)
C5	(0,694 , 0,901)	(-0,545 , -0,158)	(0,837 , 0,963)	(0,352 , 0,853)	(0 , 0)

Appendix D.7: Interval multiplicative matrix

	C1	C2	C3	C4	C5
C1	(1 , 1)	(0,177 , 0,233)	(0,653 , 0,894)	(1,209 , 1,563)	(0,245 , 1,406)
C2	(1,111 , 1,338)	(1 , 1)	(3,953 , 6,534)	(0,577 , 0,774)	(0,419 , 1,123)
C3	(0,573 , 0,805)	(6,414 , 8,829)	(1 , 1)	(0,622 , 0,734)	(0,912 , 0,978)
C4	(0,428 , 0,446)	(0,358 , 0,437)	(1,858 , 2,491)	(1 , 1)	(1,14 , 2,934)
C5	(4,934 , 7,957)	(0,286 , 0,696)	(6,858 , 9,183)	(2,247 , 7,125)	(1 , 1)

Appendix D.8: Priority vector

C1	[0,054 , 0,128]
C2	[0,115 , 0,27]
C3	[0,155 , 0,309]
C4	[0,078 , 0,183]
C5	[0,25 , 0,65]

Appendix D.9: Possibility degree matrix

	C1	C2	C3	C4	C5
C1	-	0,056	0	0,278	0
C2	0,945	-	0,372	0,739	0,037
C3	1	0,629	-	0,893	0,108
C4	0,723	0,262	0,108	-	0
C5	1	0,964	0,893	1	-

PUBLICATIONS

- Demircan, M. L., Ertan, İ.C. (2024) A Proposed Evaluation Framework of Artificial Intelligence's Business Effects On Sustainability From A Micro-Enterprise Organizational Structure Type Perspective Using Fuzzy Intuitionistic Extensions, *INFUS 2024 Conference*.

