







# Presenting a Productivity Improvement Model Based on Artificial Intelligence Practices in Small and Medium Enterprises to Achieve Sustainable Development

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**Received:** 2024-01-15    **Reviewed:** 2024-01-20    **Revised:** 2024-03-14    **Accepted:** 2024-03-20    **Published:** 2024-03-31

## Abstract

In the current era, artificial intelligence (AI) is recognized as one of the vital tools on the path toward sustainable development, assisting businesses in optimizing resources, reducing costs, and increasing efficiency. This study, focusing on automating production processes, optimizing energy consumption, and improving human resource management, demonstrates that the use of AI can have positive effects on innovation and production flexibility. The aim of this research is to design and present a productivity improvement model based on AI practices in small and medium enterprises (SMEs) to achieve sustainable development. The study was organized using the Delphi method and thematic analysis, classified as applied in terms of objective and qualitative in terms of data collection methods. The statistical population includes experts and senior managers of SMEs, who were localized and selected based on the Delphi process. The data collection tool for this research was a Delphi questionnaire, and after collecting the information, the codes from the written interviews were analyzed using thematic analysis. The validity of the research was ensured by expert agreement, and its reliability was obtained through consensus of opinions and face validity. The qualitative research method, utilizing a thematic network with 118 basic themes, 24 organizing themes, and 7 overarching themes, revealed that all identified themes are relevant according to experts, and there is a high level of agreement on their importance.

**Keywords:** *Productivity, Artificial Intelligence Practices, Small and Medium Enterprises, Sustainable Development.*

## How to cite this article:

Fotohi Ardakani H, Keramati M, Mehrinejad S, Mehrani A. (2024). Presenting a Productivity Improvement Model Based on Artificial Intelligence Practices in Small and Medium Enterprises to Achieve Sustainable Development. *Management Strategies and Engineering Sciences*, 6(1), 108-114.



## 1. Introduction

Artificial Intelligence (AI) is a technology that can exhibit machine intelligence as opposed to human intelligence [1-3]. It can perform cognitive functions such as learning and problem-solving, which are typically carried out by humans [4].

AI, a rapidly developing technology in recent years, has shown immense potential and is increasingly being applied in various domains of social activities [2]. As its applications continue to expand, AI holds the potential to significantly impact sustainability, productivity, and economic growth [5-7]. In some specialized fields, AI is already capable of performing on par with humans, such as in computer vision. Given the abundance of available data, it is not far-fetched to view AI as the next generation of General-Purpose Technology (GPT). Historically, successive general-purpose technologies have consistently had profound effects on productivity and overall economic sustainability [5].

People generally hold positive attitudes toward the sustainability opportunities offered by Industry 4.0. Sustainable development encompasses not only environmental concerns but also economic growth and social resources. AI, considered one of the most advanced categories of technology, is expected to play a crucial role in influencing economic sustainability. Researchers express confidence that the adoption of Industry 4.0 and related digital technologies will have a positive impact on sustainable development [8].

Productivity has always been a critical indicator of an economy's potential to achieve sustainability [8]. Economies with higher productivity are more likely to sustain long-term economic growth, while companies that demonstrate greater productivity exhibit higher survival rates compared to their less productive counterparts. From an economic perspective, sustainability can be seen as a sustained increase in productivity. An increase in productivity means that a company's current production methods surpass its previous methods (Bonti et al., 2022). Therefore, continuous growth in productivity indicates the establishment of a sustainable production model that enables companies to achieve sustainability from an economic standpoint. While the productivity gains from AI can be felt in many ways [1], during this period of rapid AI development, Total Factor Productivity (TFP) in countries worldwide has been significantly declining, which is the primary reason many researchers remain pessimistic about AI. However, the reasons for this phenomenon are often

attributed to a transitional period in which economies need to rebuild and reorganize their production patterns or to observation bias due to statistical errors [9].

AI's adaptability has garnered the attention of the industrial sector, which seeks to harness these capabilities in organizational operations [10, 11]. This is because AI uses multidisciplinary approaches to collect and precisely analyze data and then share that data without human intervention [12]. There is considerable optimism that AI technology applications can transform various functions of organizations, including innovation, production, and operations. It is expected that such AI technology applications will face several intertwined challenges, which will impact organizational and situational characteristics, technology-related issues, and skilled personnel within organizations [13].

In today's rapidly evolving business environment, Small and Medium Enterprises (SMEs) play a crucial role in driving economic growth and innovation. However, SMEs often face challenges such as limited resources, inefficient operations, and the need to remain competitive in an increasingly globalized market. These challenges necessitate the adoption of modern technologies and strategies that enhance productivity, improve decision-making, and ensure long-term sustainability. Artificial Intelligence (AI), with its ability to process vast amounts of data, automate processes, and optimize operations, offers transformative potential for SMEs [21].

Practically, the challenges associated with AI adoption in small and medium enterprises (SMEs) are significant [10, 11]. These include the compatibility, complexity of organizations, and their readiness to adopt AI. Situational risks may also create issues such as technological dynamism and pressure from external competition [14]. If AI solutions are too difficult to implement or incompatible with existing systems, technical challenges may arise. Additionally, as is always the case with technology adoption, trust factors and the learning capabilities of employees have significant impacts on organizational strategies, helping organizations decide whether or not to adopt a new system [15].

Improving productivity in SMEs through AI methods can serve as a key strategy for achieving sustainable development [16]. These practices can utilize big data analysis, machine learning, algorithmic optimization, and robotics to improve production processes, inventory management, marketing, and other production elements [17].

The use of big data analysis and machine learning can help SMEs identify and improve complex patterns in their processes. These analyses can assist them in identifying incremental improvements that were not achievable through traditional methods, thereby increasing their productivity through the implementation of appropriate changes [18].

For example, automation of production through robotics can enhance production processes, leading to increased speed and accuracy in product manufacturing [10, 11]. Additionally, the use of AI in supply chain management can improve material inventory operations and product distribution, reducing resource waste. These methods not only contribute to cost reduction and increased profitability but also help minimize negative environmental impacts, which is a key factor in sustainable development [19]. In fact, studies show that AI has the potential to increase productivity and achieve economic sustainability, although macro-level productivity effects are not immediately apparent due to delays in organizational restructuring, again indicating that evidence of productivity gains from AI is not yet recorded at the macro level [20]. This research aims to develop a productivity improvement model tailored to SMEs by leveraging AI practices. The focus is on demonstrating how AI can enhance operational efficiency, reduce waste, and drive sustainable development in these enterprises. While large corporations have already begun to harness the benefits of AI, SMEs often lag due to financial constraints, limited technological expertise, and perceived risks associated with adopting new technologies. Nonetheless, AI offers a wide range of scalable solutions that can be customized to fit the specific needs and capacities of SMEs.

Sustainable development, characterized by its focus on balancing economic growth with environmental protection and social well-being, has become a critical goal for businesses worldwide. The United Nations' Sustainable Development Goals (SDGs) further underscore the importance of sustainability in achieving global prosperity. By integrating AI into their operations, SMEs can not only enhance productivity but also contribute to the realization of these goals. This research will examine how AI-based solutions can help SMEs achieve economic sustainability by optimizing resource use, reducing environmental impacts, and fostering innovation [11].

The remainder of this paper will explore the current challenges SMEs face, the potential of AI in addressing these issues, and present a productivity improvement model that aligns AI adoption with sustainable development objectives.

This research raises the question of whether AI leads to sustainability, in order to effectively record evidence of AI's impact on productivity in SMEs. However, few studies have examined AI-induced sustainability at the micro-level. Therefore, this study seeks to answer the question: How can a productivity improvement model based on AI practices in SMEs lead to sustainable development?

## 2. Theoretical Framework and Literature Review

Artificial Intelligence (AI) has revolutionized many businesses by performing tasks that traditionally required human intelligence [18]. By simulating, enhancing, or complementing human intelligence with precision and efficiency, AI has significantly contributed to the execution of complex scientific and engineering tasks. Fraud detection in banking, chatbots used in customer service, and accurate diagnostics in the health and medical sectors are some examples of tasks that have been facilitated by AI [12].

The goal of AI is to simulate human intelligence processes through machines, particularly computer systems. The fundamental principle of AI is machine learning, or the ability of a computer to improve its capabilities by continuously analyzing its interactions with real-world environments. In other words, machine learning is a subset of AI that enables systems to learn and improve autonomously [4].

Over time, with the advent of information technology, numerous changes have occurred in various fields. One technology that has been rapidly growing and evolving, influencing businesses across multiple sectors, is AI. AI is considered the most transformative technology of the present century, with vast and unlimited potential to impact diverse fields [11]. Currently, there are many discussions and challenges regarding how AI has impacted and changed various businesses [10]. According to research, over the past few decades, AI has played an increasingly important role globally. The latest reports suggest that investments and spending in this field are expected to rise from \$1.2 billion to \$36.1 billion by 2025, with an annual growth rate of 50.2% [5].

Machine learning focuses on programs that learn from experience and improve their decision-making and predictive accuracy. It involves algorithms capable of learning complex tasks and creating predictive models using sample data. Often, a set of useful and meaningful features is selected or generated through a method called feature engineering for building the predictive model. The availability of large amounts of data and computational

power has led to the successful application of machine learning in fields like natural language processing (NLP), computer vision, robotics, and diagnostics. NLP, a branch of AI, analyzes human language and aims to interpret and understand it through computers or machines. In recent years, innovations such as broadband networks and cloud computing have significantly enhanced the capabilities of machine learning and NLP [11].

Although AI has been around for some time, it continues to grow rapidly. Today, AI has infiltrated many businesses, bringing significant changes. AI is now considered a part of the business landscape and is advancing quickly. However, one concern about the future of AI in businesses is the potential for widespread job losses. Research predicts that by 2030, approximately 73 million jobs may be lost due to automation. For instance, with the emergence of driverless cars, many people working in the taxi or transportation industries could lose their jobs. However, it is also predicted that new jobs will emerge as AI infiltrates businesses, requiring individuals to be trained for these roles [6].

There are numerous discussions about the extent to which AI may affect the future of businesses. Some researchers believe that jobs requiring creativity and innovation will remain safe from AI replacement. They argue that AI will always struggle to recognize and utilize human creativity. However, others believe that AI has already penetrated creative fields by producing art and music, and in the future, it could impact businesses that rely on creativity and innovation. AI could develop new creative concepts that may be employed in the workplace, potentially contributing to the creation of smart workplaces [9]. AI systems can provide safe and comfortable working environments by better understanding task patterns and creative processes. It is also anticipated that hybrid work environments (a combination of humans and AI) will become more widespread in the future. Although hybrid work environments exist today, they are not yet common worldwide. For example, many companies use AI systems in recruitment processes to help managers make easier hiring decisions. L'Oréal is one such company, using AI-based software to recruit international applicants, reducing the time required to screen candidates by 90%. Such AI-driven systems are still in their infancy, but they are expected to advance in the future [21].

The productivity of Small and Medium Enterprises (SMEs) is crucial for sustainable development in the economic system of a country. SMEs are often considered key drivers of job creation and economic growth, playing a

significant role in sustainable development. Improving productivity in these enterprises can directly contribute to the sustainable economic development of countries [14].

One of the key aspects of improving productivity in SMEs is the creation of sustainable jobs and high-quality employment. By enhancing the performance and efficiency of these enterprises, the possibility of creating and sustaining better quality jobs increases, which contributes to sustainable economic development and improves social welfare. Additionally, improving productivity in SMEs can lead to increased income and profitability. By optimizing processes and efficiently utilizing resources, it is possible to produce high-quality goods and services at lower costs, further contributing to sustainable development and economic growth [8].

As a result, management policies and planning aimed at increasing productivity in SMEs are crucial for sustainable development in society. This productivity improvement can help improve the economic and social conditions of society, reduce poverty and unemployment, and achieve sustainable development goals [10].

With the continuous advancements and innovations in technology, the global industrial landscape has undergone significant changes in recent years. The goal of the Fourth Industrial Revolution, or Industry 4.0, is to transform traditional industries into smart industries by integrating innovative technologies. This revolution enables the integration of physical assets into intertwined digital and physical processes, resulting in the creation of smart factories and intelligent production environments. The Internet of Things (IoT) is a rapidly growing technology that has greatly contributed to the realization of Industry 4.0. It aims to penetrate everyday environments and their objects, linking the physical world to the digital one. IoT allows individuals and "things" to be connected at any time, in any place, using any network or service. IoT is seen as a dynamic and global network of interconnected devices that are uniquely addressable and communicate based on standard communication protocols with interoperability and self-configuration capabilities. Despite being in its early stages of development, adoption, and implementation, Industry 4.0 and IoT offer numerous contemporary solutions, applications, and services. As a result, they improve quality of life and are expected to provide significant personal, professional, and economic benefits in the near future [12]. Today, the internet is one of the most rapidly expanding and evolving technologies, gaining popularity worldwide. IoT is a system that includes a device, a sensor, a network,

cloud storage, and an application. Each interface communicates with another device via the internet to share information and achieve specific goals. IoT is a new technology that is being recognized across various fields globally [20].

In line with this, Saboor (2023) conducted research titled *Adoption of AI Technologies in Small and Medium-Sized Enterprises in Iran: Results of an Empirical Study*. This paper examines the adoption of AI technologies in SMEs in Iran, discussing perspectives on AI implementation in these enterprises based on an empirical study conducted in 2022, involving 300 companies.

Nakabi and colleagues (2024) also conducted a study titled *Enhancing Work Productivity through Generative AI: A Comprehensive Literature Review*. The findings indicate a strong and accelerating trend in generative AI research, expected to continue through 2024 and beyond. Additionally, this study highlights potential future research directions, emphasizing the need for improved GAI design and long-term strategic planning, particularly in evaluating its impact on user experience across various professional contexts.

Gao and colleagues (2023) presented a study titled *AI-Driven Productivity Gains: AI and Company Productivity*. This study demonstrates that the effects of AI on productivity vary across different property rights and industry concentration contexts. Moreover, the factor endowment structure in companies can also influence the productivity benefits derived from AI. Our study provides compelling evidence of AI's role in enhancing economic sustainability within the framework of Industry 4.0.

### 3. Methodology

Since the research title focuses on a productivity model based on artificial intelligence practices in small and medium enterprises (SMEs) to achieve sustainable development, the present study is qualitative in nature, a combination of both library-based and field studies in terms of data collection. It is fundamental in its research objective and cross-sectional regarding the timing of data collection. The method of data analysis employed is thematic analysis. To conduct the research and develop a logical framework based on the stated objectives, a qualitative approach utilizing thematic networks was adopted. Accordingly, with

the aim of discovering the dimensions, components, and indicators of the productivity model based on AI practices in SMEs to achieve sustainable development, relevant literature and research background were reviewed. Simultaneously, documents and studies using content analysis methods were examined. Following this phase and the preparation of necessary documentation, the groundwork for extracting the factors and components of the productivity model based on AI practices in SMEs, with an integrated learning approach stemming from it, was established.

On the other hand, qualitative researchers not only localized the approach using the Delphi method but also employed strategies to validate their research. The validation process was conducted through peer review by two researchers and member-checking. Coding was performed separately by two individuals (the researcher and a colleague), and the extracted codes were compared. Cohen's kappa coefficient was 86.9%, with a significance level of 0.001, indicating almost perfect agreement between the two coders. Additionally, besides the researcher, advisors and supervisors, the categories and model were reviewed by three business and service industry researchers, whose feedback was used to enrich and improve the model. To align with the participants, considering their relevant educational backgrounds, the results of the analysis process and categorization were shared with three interviewees, and the results were revised and refined based on their feedback.

### 4. Findings and Results

In this research, the sampling method is qualitative and has evolved theoretically based on the concepts that emerged during data analysis. Data sufficiency was achieved through the interpretation and analysis process. The main and influential indicators of productivity based on artificial intelligence (AI) practices in small and medium enterprises (SMEs) for achieving sustainable development were identified, which were derived from the theoretical foundations of the research. After analyzing the data obtained from the text and using a thematic network with 118 basic themes, 24 organizing themes, and 7 global themes, the following were extracted (Table 1).



**Table 1.** Codes Derived from Thematic Analysis

Basic Theme	Organizing Theme	Global Theme
Employee experience	Skill development	Sustainable leadership based on understanding and recognition
Employee interest in diverse educational fields		
Educational information skills		
Training facilities	In-house training	
Consultation with experts		
On-the-job training courses		
The ability to record activities and track progress	Motivation of employees	Institutionalizing productivity based on AI practices
Creating sufficient motivation in employees		
Changing managers' perspective on education		
Evaluation of different viewpoints		
Assessment of core beliefs and values		
Developing self-confidence in the learning process		
User-friendly electronic content	Multimedia capabilities	Educational planning and goal-setting
Increasing the speed of education and learning		
Reducing learning costs		
Increasing motivation		
Reducing training expenses	Comprehensive productivity system based on AI	
Interactive training		
Time-saving		
Use of images, text, sounds, videos, or their combination	Educational content	
Conversational style in content		
Voice and text alongside the relevant image		
Analysis and determination of content, methods, and educational tools	Implementation of AI practices	Optimization of educational processes
Support services		
Information usefulness		
Setting educational goals	New productivity system based on AI	
Analysis and determination of evaluation systems		
Linking learning to employee efficiency and capability		
Optimizing intellectual capital and learning management		
Web-based sustainable development environment	University connections	Interactions based on AI practices
Linking to university sustainable development programs		
Improving the quality and quantity of education		
Monitoring sustainable development programs in service industries	Industry interactions	
Interacting with industrial and service companies		
Activating research and development units		
Establishing joint research centers with industries		
Developing distinctive and interdisciplinary models of industry-university interaction		
Creating appropriate platforms for referring learning projects to universities		
Employing creative methods	Sustainable productivity	AI-based productivity indicators
Reducing disorder and confusion in the learning process		
Specifying the boundaries and scope of sustainable development programs		
Synchronizing employees with virtual classrooms		
Building trust	AI-based education	
Educational participation		
Learning skills		
Collaboration with employees		
Effective communication networks with employees		
Implementation method	Structural factors	Characteristics of productive organizations
High-speed internet		
Support from senior managers and financial backing		

Educational software		
Suitable learning environment		
Appropriate hardware		
Internal goal-setting	Environmental barriers	
Information self-efficacy		
Resistance to new conditions		
Inspiring AI in employees	Motivation and talent	Goal setting
Talent identification and understanding managers' behavioral characteristics		
Evaluation of experts based on criteria		
Having a correct understanding of employee talents		
Attracting talented individuals	Identifying educational resources	
Introducing expert managers		
The necessity of agility in learning		
Employee participation in content quality		
Educational branding		
Alignment of educational adaptability with organizational needs		
Assessing sustainable development needs aligned with organizational demands		
Improving content quality		
Aligning education with job requirements	Feasibility of implementation	
Consultation with sustainable development management in establishing a learning environment		
Providing advice to units regarding blended learning		
Support from senior managers		
Training personnel and specialists	Superior capabilities of AI-based productivity in SMEs	Organizational agility based on AI
Developing information and communication skills		
Providing new opportunities for employee sustainable development		
Synergizing information and creating idea-generating thought cycles		
Developing participation-based and team-thinking learning	AI effectiveness in SMEs	
Creating a broad sense of learning		
Use of equipment and facilities for all employees		
Employee motivation		
Continuous learning		
Flexibility in learning		
Increasing creativity and innovation	Knowledge and talent integration	
Employee talent evaluation		
Developing knowledge aligned with AI		
Increasing individual capabilities and employee productivity		
Reducing organizational risk		
Acquiring new ideas and knowledge for AI		
Agile human resources	Talent management	
Strengthening employee knowledge		
In-house workshops	Concentration integration	Developing productivity models
Inspiring human expertise		
Focusing on all aspects of human resource development		
Organizational environment		
Specialization		
Efficiency in performance and output-to-input ratio	Organizational productivity	
Increasing employee productivity		
Retaining key specialists	Competitive advantage	
Educational value-added		
Generating new ideas		
Equalizing learning processes		
Identifying, developing, and retaining high-potential individuals		
Increasing commitment to organizational learning		
Reviewing competitor models		
AI development		
New educational thinking		

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Fairness in AI processes	Productivity evaluation based on AI practices in SMEs
Employee adaptability to AI	
Aligning education with learning	
Strengthening employee learning	
Reducing AI costs	
Optimizing learning time	
Saving time for learning	
Perceived AI cost	
Maintaining the learning environment	

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## 5. Discussion and Conclusion

The rapid advancements in Artificial Intelligence (AI) have transformed various industries, including small and medium-sized enterprises (SMEs), by significantly improving productivity and operational efficiency. This study explored the integration of AI into SMEs and its potential impact on achieving sustainable development goals. AI has proven to be a powerful tool in optimizing business processes, automating repetitive tasks, enhancing decision-making, and fostering innovation. However, its adoption in SMEs faces challenges such as limited resources, lack of expertise, and the fear of job displacement due to automation.

One of the key findings of this study is that AI can play a crucial role in increasing the productivity of SMEs, which in turn contributes to sustainable economic growth. By integrating AI technologies such as machine learning, natural language processing, and IoT, SMEs can improve their efficiency, reduce operational costs, and enhance the quality of their products and services. This not only helps businesses remain competitive but also aligns with global sustainability efforts by minimizing resource waste and promoting eco-friendly practices.

Moreover, the study highlighted the importance of addressing the potential negative impact of AI on the workforce. While AI-driven automation could lead to the loss of certain jobs, it also presents opportunities for the creation of new roles that require higher-level skills. Therefore, it is essential for policymakers and business leaders to invest in reskilling and upskilling programs to prepare the workforce for the evolving job market. This proactive approach will ensure that the benefits of AI are maximized without exacerbating social inequalities.

In conclusion, AI presents a significant opportunity for SMEs to enhance their productivity and contribute to sustainable development. However, successful AI integration requires a strategic approach that includes

overcoming technological, financial, and human resource barriers. By fostering a culture of innovation, providing adequate support for AI adoption, and ensuring a smooth transition for the workforce, SMEs can harness the full potential of AI to drive long-term growth and sustainability. Future research should focus on developing frameworks that help SMEs navigate the challenges of AI implementation and maximize the benefits of this transformative technology.

The final model indicates that, in service industries, a holistic perspective and attention to various aspects of productivity in small and medium enterprises (SMEs), utilizing artificial intelligence (AI) practices, are essential. This study aimed to improve productivity in SMEs through AI practices, and the analysis of data derived from a systematic review of relevant studies has led to these findings. The research results are presented in the form of global, organizing, and basic themes. Most of the studies conducted in the area of productivity improvement in SMEs using AI practices have been theoretical rather than experimental and field-based. However, this research not only includes an extensive review of domestic and international studies on the subject but also incorporates a practical study based on expert opinions and perspectives from different angles.

The findings of this study align with and extend the conclusions of previous research on the impact of AI on SMEs and productivity. Similar to the studies by Alizadeh & Khalili Asr (2023) and Motokrisnan et al. (2020), this research highlights the significant role AI plays in transforming business processes through automation, data analysis, and decision-making improvements. Both earlier studies also emphasized how AI technologies like machine learning and natural language processing can enhance operational efficiency across various sectors, including banking, healthcare, and customer service, a point corroborated by our findings.

However, this study goes a step further by focusing specifically on the intersection of AI adoption in SMEs and sustainable development, a dimension less explored in prior



studies. While Catania (2021) and Gissel (2018) discussed the rapid growth of AI and its impact on global industries, their research did not fully address the specific challenges faced by SMEs in implementing AI or the sustainability benefits that can be achieved through AI-driven productivity gains. This study bridges that gap by offering insights into how AI can contribute to sustainable development goals (SDGs) within the SME sector, particularly through resource optimization and eco-friendly practices.

Furthermore, while previous research, such as that by Nakabi et al. (2024), focused on the role of generative AI in enhancing work productivity, this study expands on the potential for AI technologies to create sustainable economic growth. It emphasizes not only productivity improvements but also the importance of workforce adaptation through reskilling, a point that was not as thoroughly explored in prior works. In this regard, our research aligns with and adds depth to the discussion started by Gao et al. (2023), who highlighted AI's varying impacts on productivity depending on industry and company structure. Our study reinforces the idea that AI's potential in SMEs is contingent on targeted strategies that address both technological and human resource challenges.

In conclusion, this research supports the conclusions of earlier studies while contributing new insights into the specific role AI can play in SME productivity and sustainable development. It underscores the need for future research to explore frameworks that enable SMEs to overcome the unique barriers they face in adopting AI, particularly in the context of long-term sustainability objectives

Furthermore, no previous research was found that specifically focused on identifying a wide range of industries, the outcomes, and presenting them as a theory or model extracted from such findings. In other words, previous studies have only addressed a limited number of factors, either theoretically or experimentally, without fully explaining them. However, this study has extensively and deeply identified, described, and explained the phenomenon of productivity improvement in SMEs using AI practices, identifying aspects that were not considered in previous studies. Therefore, this research introduces more details that could help SMEs in their efforts to enhance productivity through AI practices.

Moreover, the study does not limit the inclusion of different types of service industries, which could be identified in future research. The Delphi method used in this study, utilizing the opinions of experts and senior managers

from SMEs, led to the identification of 118 basic themes, 24 organizing themes, and 7 global themes. These results highlight the broad impact of AI in improving organizational performance and its importance in sustainable development. The thematic analysis reveals a general consensus on the positive effects of AI on production and management processes. All identified themes were recognized by experts as relevant, with a strong consensus on their importance. In sum, AI, as a strategic tool, offers new opportunities for SMEs to move closer to sustainable development through greater productivity, increased flexibility, and enhanced innovation.

Thus, practical suggestions are as follows:

- Investing in AI infrastructure: Managers should strengthen digital infrastructure and provide AI tools to increase productivity and reduce costs in production and management processes. Investments in machine learning software, AI, and analytical tools can lead to overall organizational performance improvement.
- Training the workforce to use AI: To enhance effectiveness, managers should invest in training their workforce to develop AI-related capabilities. This will allow employees to apply this technology in their daily tasks, thereby increasing organizational productivity.
- Implementing AI for energy resource management: Managers can utilize AI algorithms to optimize energy consumption and reduce related costs. This not only leads to resource savings but also contributes to environmental sustainability.
- Using AI for strategic decision-making: Managers should leverage AI technologies to forecast market trends and analyze big data to make better strategic decisions in areas such as production, marketing, and sales.
- Enhancing innovation and flexibility: By using AI, managers can make their production processes more flexible and innovative. This will help them better adapt to market changes and customer needs while offering new products or services.
- Creating AI-based learning networks: Managers can establish AI-based learning networks and knowledge-sharing platforms where information and experiences are exchanged between employees and managers. This leads to skill enhancement and increased internal and inter-organizational collaboration.

One of the limitations of most qualitative studies, including this one, is the generalizability of the findings. As with many similar studies, the results of this research are based on the analysis of selected expert opinions, experiences, and previous theories, which may limit the generalizability of the findings. To mitigate the limitations related to analysis and the analyst, a research colleague was involved in some phases of the study. Additionally, to ensure the validity of the findings, a survey was conducted among experts in two stages using questionnaires to evaluate the model based on its "understandability," "comprehensiveness," "applicability," and "innovation." The results of these surveys also confirmed the validity of the final model.

Due to the research being conducted during the COVID-19 pandemic, the researcher faced several constraints in conducting interviews with experts. Therefore, most interviews were conducted via phone.

#### **Authors' Contributions**

Authors equally contributed to this article.

#### **Acknowledgments**

Authors thank all participants who participate in this study.

#### **Declaration of Interest**

The authors report no conflict of interest.

#### **Funding**

According to the authors, this article has no financial support.

#### **Ethical Considerations**

All procedures performed in this study were under the ethical standards.

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