Advances in Consumer Research
ISSN (Print): 0098-9258
ISSN(Online): 3079-1766

Vol. 2, Issue 4 (2025) https://acr-journal.com/

AI-Driven Decision Support Systems: Empowering Startups, MSMEs, and Industry Innovation

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Cite this paper as: Om Prakash Pujahari , Dr. Neetu Malhotra , Dr. Surender Khan , Renu Singh Malik , Dr. Preeti Singh , Dr. Neha Upadhyay , (2025) AI-Driven Decision Support Systems: Empowering Startups, MSMEs, and Industry Innovation. *Advances in Consumer Research*, 2 (4), 1855-1862

KEYWORDS

Artificial Intelligence, Decision Support Systems, Startups, MSMEs, Innovation, Fashion Industry, Predictive Analytics, Operational Efficiency, Digital Transformation, AI Framework

ABSTRACT

Artificial Intelligence (AI)-driven Decision Support Systems (AI-DSS) have emerged as transformative tools in enhancing decision-making accuracy, operational efficiency, and innovation capacity across industries. This paper investigates the role and adoption of AI-DSS among startups and Micro, Small, and Medium Enterprises (MSMEs), with a particular emphasis on the fashion sector as a representative case. Through a qualitative methodology involving expert interviews and case analysis, the study identifies the extent of AI-DSS adoption, the key technical and organizational barriers, and the strategic outcomes realized by early adopters. Findings reveal that while startups demonstrate moderate to advanced usage of AI tools particularly for demand forecasting, personalization, and product design MSMEs often struggle with infrastructural limitations, lack of digital readiness, and cost concerns. The paper also highlights measurable improvements in decision speed, forecasting accuracy, and innovation output among AI-adopting firms. A modular and scalable AI-DSS framework is proposed to enable gradual integration, starting from data visualization to advanced predictive modeling. This research contributes to closing the AI readiness gap and suggests practical strategies to promote inclusive digital transformation in small-scale enterprises

1. INTRODUCTION

In the modern world of volatile and competitive business, the ability to make the right and data-based decisions is a success determinant particularly in startups and the so-called Micro, Small and Medium Enterprises (MSMEs). According to a 2023 report published by the “International Trade Centre (ITC)”, MSMEs represented approximately 90 percent of companies and more than 50 percent of employment worldwide, yet the majority of them are unable to use complex decision-making tools due to insufficient budget, infrastructure, and technical

capacity. In the meantime, 70 percent of the startups in the developing economies fail within the first five years of operations due to the absence of strategic planning and operational insights. “Decision Support Systems (DSS) based on Artificial Intelligence (AI)” is a radical solution to these issues since it allows machine learning algorithms, big data analytics, and predictive modelling to assist businesses to make optimal context-sensitive decisions. The McKinsey Global Institute (2022) research shows that AI technologies will contribute to the global economy up to 13 trillion by 2030, and some of those billions of dollars will be associated with more effective business decision-making. With regard to MSMEs and startups, AI-DSS offer convenient solutions to processes such as demand forecasting, inventory management, customer behaviour analysis, credit risk assessment and development of marketing strategies which have long been neglected by enterprise software due to their costs and complexity.

Besides, governments and industry bodies have started to value the role of intelligent systems in economic development. e.g., India the Ministry of MSME has launched the Digital MSME scheme that promotes the use of digital solutions and AI support of small enterprises. In the “European Union”, similarly, there is a dedicated funding of over 250 million euros of AI infrastructure and SME support under the Digital Europe Programme 202127. Despite such changes being realized, there is no uniformity in the adoption of AI-driven decision systems in smaller firms. The constraints that surround the successful implementation are the lack of digital preparedness, automation fear, privacy concerns with data, and poor training. Therefore, the research gap is required to comment on how AI-based DSS could be more accessible, flexible, and useful to these critical business sectors. The aim of the study is to

discuss the use of “AI-driven Decision Support System in startups and MSMEs” and determine the effects they have on innovation potential, the correctness of decision-making, and business growth. The research intends to find the technical, economic, and organizational preconditions of successful adoption of AI-DSS and recommend a scalable model that will enable inclusive industrial innovation. In this manner, the paper will assist in bridging the digital divide and empowering the future businesses through smart technologies.

2. PROBLEM STATEMEN

Despite the fast development of “artificial intelligence (AI)” technologies and their proven capabilities to transform the decision-making process at the industrial level, startups and Micro, Small, and Medium Enterprises (MSMEs) are frequently left behind in the process of digital transformation. As large corporations and businesses are still using AI-based “Decision Support Systems (DSS)” in their strategic planning, forecasting, and operational processes, smaller companies are subject to significant obstacles, including access to data infrastructure, technical knowledge, and financial abilities to implement and maintain the use of such systems in an efficient manner. It is a big concern that this digital divide exists, considering that MSMEs make up more than 90 percent of all businesses in the world and up to 60-70 percent of the jobs in the developing economies as stated by the World Bank [1]. However, a substantial number of MSMEs continue to use gut-based decision-making processes, which tend to be inaccurate, subjective, and inefficient particularly in a turbulent or complicated market environment. Consequently, their growth, innovation and ability to withstand market shocks is severely hampered. Besides, the rate of startup failures is still very high.

The Startup Genome Report shows that over 70 percent of startups fail within the first five years of their existence because of poor judgment, ineffective resource planning and lack of long-term strategy [2]. Even though, AI-powered DSS in theory can provide a way to address these challenges by supporting decision-making in a data-driven, predictive, and real-time manner, their implementation in the startup and MSME ecosystem is either patchy, incomplete, or not accessible. What makes the situation even more complicated is the fact that there are no scalable, cost-efficient and user-friendly AI-DSS frameworks that can be specifically designed to meet the limitations and operational specificities of startups and MSMEs. It is also evident that, there is a significant lack of specialized academic and industry-based research that examines the practical and technical impediments to the adoption of AI-DSS, the key success factors, and the quantifiable outcomes of the systems on the business performance in small organizations. Without the presence of holistic, all-embracing, and flexible AI-based DSS models, the majority of startups and MSMEs continue to be underserved and under-optimized in terms of technology. This does not allow them to leverage AI as a strategic innovation, competitiveness, and sustainable growth enabling factor. Thus, the main issue that the current research will attempt to solve is the lack of inclusive, flexible, and effective AI-driven Decision Support Systems that will enable startups and MSMEs to make informed, agile, and innovative decisions in a fast-changing business environment.

3. RESEARCH OBJECTIVE

• To determine the extent of the uptake of the AI-driven Decision Support Systems (AI-DSS) of startups and MSMEs in different sectors.

• To identify the most significant technical, economic, organizational factors promoting or hindering successful implementation of AI-DSS into the resource-constrained business environment

To assess the impact of AI-DSS on business innovation, decision-making accuracy, and operations efficiency in startups, and MSMEs.

• To develop a scalable, cost-effective, and user-friendly framework of effective implementation of AI-DSS that would be applicable to the unique needs of startups and MSMEs.

4. LITERATURE REVIEW

Artificial intelligence (AI) has become a business analytics and decision-making game changer in recent years, especially by creating the so-called AI-based Decision Support Systems (AI-DSS). They combine machine learning, natural language processing, and real-time data analytics to give organizations actionable insights that increase the quality, responsiveness, and operational agility of decisions.

The Patterns of AI-Based DSS Adoption in Startups and MSME

The adoption of the AI-based Decision Support Systems (AI-DSS) in large enterprises has been gaining significant traction within the last decade, but the diffusion of the systems among startups and MSMEs has been disproportionately low. Abubakar et al. [8] state that 76 percent of large enterprises have implemented a form of AI in decision-making, and less than 25 percent of small and micro enterprises in emerging markets have established AI tools, successfully. Such a gap is commonly explained by the lack of digital infrastructure, absence of internal expertise, and inability to access AI service providers. According to Johk et al., only 19 percent of the surveyed MSMEs had achieved the maturity stage that would make them ready to use AI, which indicates that there is an ongoing structural lag in digital competence [9]. In addition, the adoption pattern is regionally biased. As an example, the Eurostat data revealed that in Europe, only 8 percent of SMEs used AI tools in 2021, compared to 26 percent of large companies [9]. The literature indicates that entrepreneurs are increasingly aware of the existence of AI applications, but the application is still hampered by cost-related factors, doubts about the prospects of return on investment, and lack of clarity on how AI can fit into business models in smaller companies.

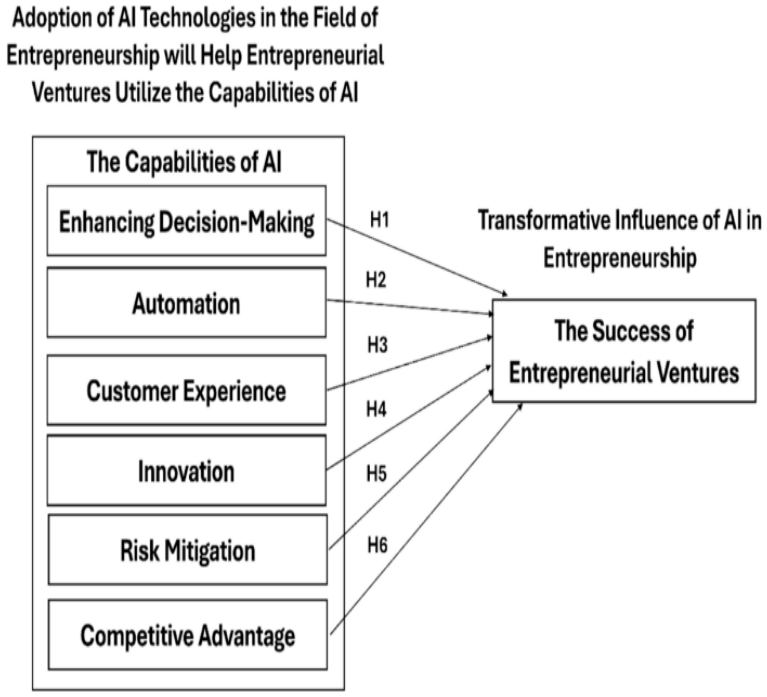

Figure 1: AI-based Decision Support Systems (AI-DSS) [2]

Barriers to AI-DSS Adoption in Startups and MSMEs

Despite the revolutionary potential of "AI-driven Decision Support Systems (AI-DSS)", its implementation in startups and MSMEs is not extensive, as there are several obstacles to it. One of the problems is the low level of digital maturity as most small companies still do not have integrated data systems and use legacy tools [9]. Also, data governance issues, including data quality, non-standardization, and inadequate privacy practices render AI model training unreliable in such environments [9]. The adoption is also hindered by financial limitations. Initial investment and maintenance costs of AI tools are usually large, and they also need trained staff which is usually unaffordable to MSMEs. A 2022 survey conducted by OECD has shown that more than 60 percent of SMEs cited cost as the main obstacle to implementing AI technologies [10]. There are also limitations of human capital. Small firms are characterized by a low level of organizational readiness because most employees do not have AI or data literacy. This is worsened by the apprehension of losing their jobs, as more than 40 percent

of the MSME employees consider AI as a menace, and not an instrument [9]. Lastly, the lack of access to outside AI consultants and government support that is specific to MSMEs further increases the digital divide and the large-scale implementation of AI-DSS is hard in this industry.

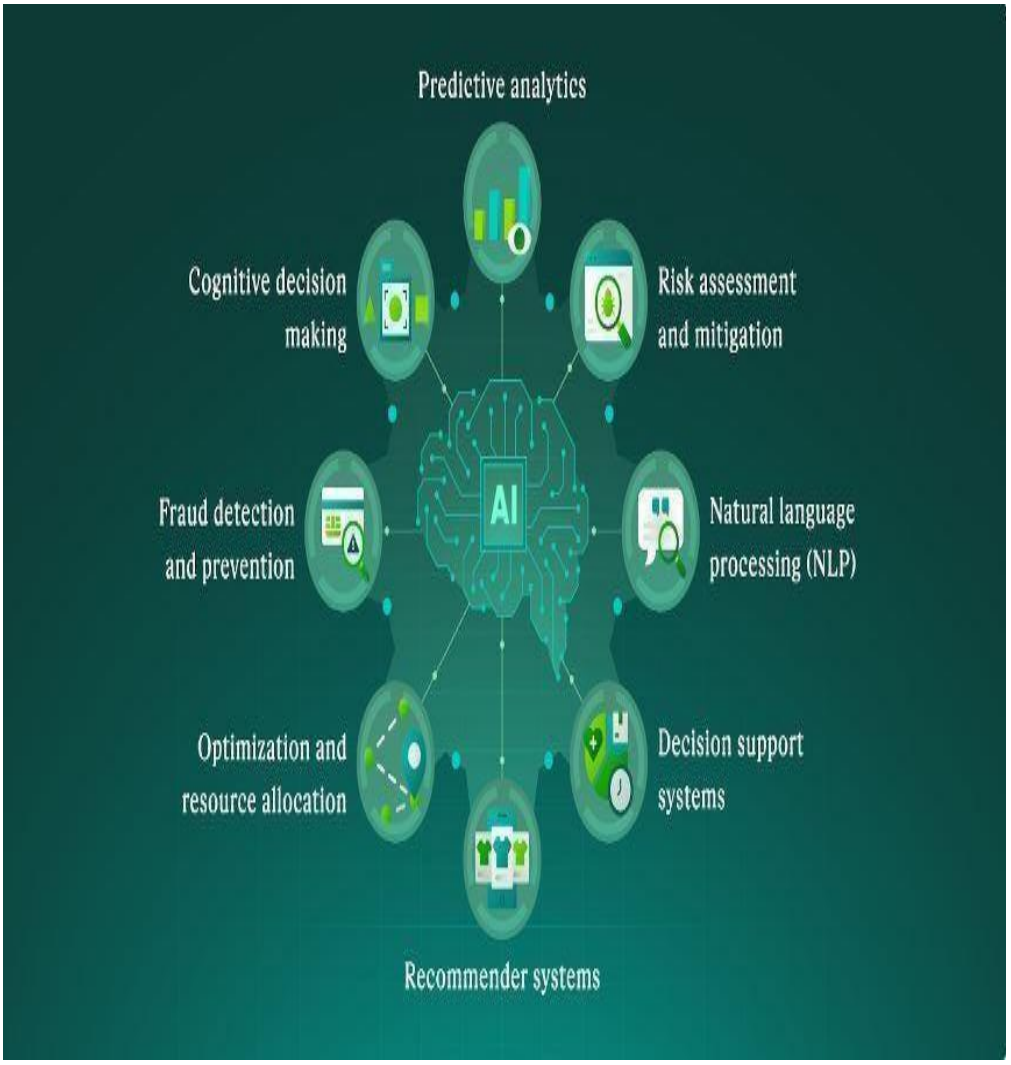

Figure 2: Key Functional Components of AI-Driven Decision Support Systems [5]

AI-Driven Innovation and Competitive Advantage

The introduction of the "AI-driven Decision Support Systems (AI-DSS)" has become one of the core sources of innovation and strategic capabilities among startups and MSMEs willing to compete in turbulent markets. The systems make it possible to gain real-time insights, automate repetitive processes, and become more accurate in predictive analysis, which is critical to the output of innovation and business agility. Dubey et al. [10] found that MSMEs utilising AI-DSS had gained a 34 percent forecasting accuracy and a 21 percent decrease in response time to market change, enabling more rapid innovation cycles and improved customer fit. AI-DSS also promotes data-driven experimentation, so small firms can experiment with new ideas and differentiate customer offerings and resource allocations with little risk. According to Abubakar et al. [8], the AI tool adoption yielded a 28 percent new product development in startups than the non-adopters. These systems enable companies to shift to proactive strategies in which the trends in the market and the nature of consumer behavior are detected even before their competitors. Nevertheless, the competitive AI-DSS is subject to proper implementation, quality of data, and its correspondence to business objectives. Mistaken outputs and inadequately trained models may result in erroneous decisions. Therefore, startups and MSMEs should pursue the adoption of AI in a strategic way to enable its full potential innovation, and reduce operational risk.

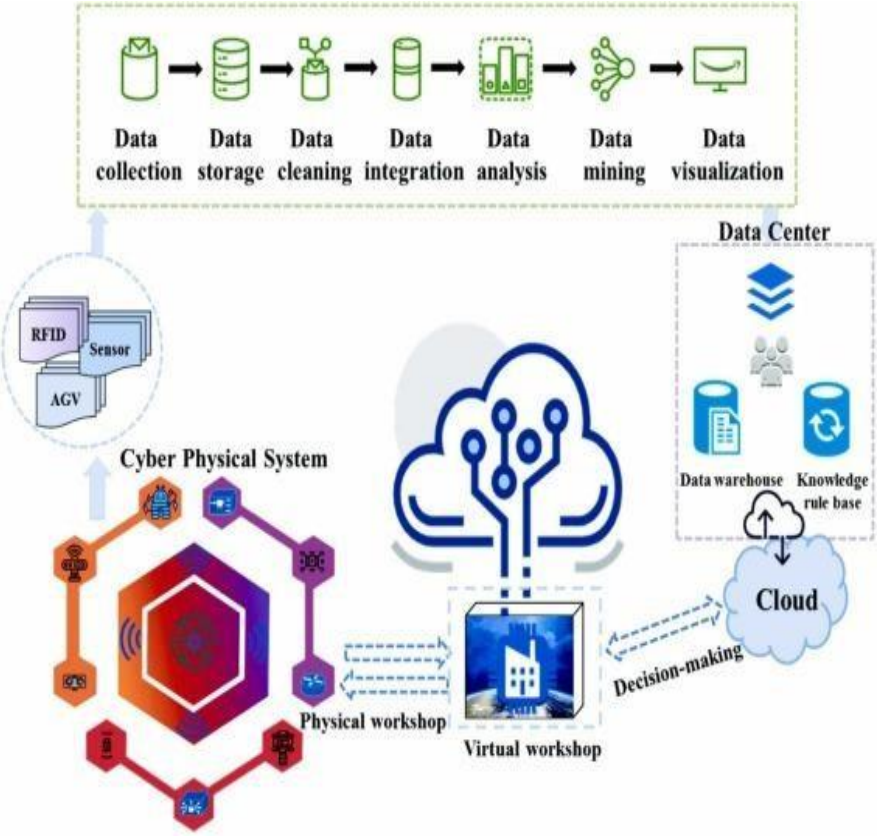

Figure 3: Architecture of AI-Enabled Cyber-Physical Systems for Intelligent Decision-Making [8]

Frameworks and Models for Effective AI-DSS Integration

The frameworks to be implemented in the integration of "AI-driven Decision Support Systems (AI-DSS)" in startups and MSMEs should be flexible, economical, and context-related. Small firms often do not fit well in the model of traditional enterprise-level AI because it is too complex and resource-consuming. Khanna and Arora [11] discuss the modular AI-DSS framework that is specifically tailored to MSMEs, starting with the simplest analytics and gradually adding predictive and prescriptive layers. This is a phased strategy that lowers the risk of implementation and supports firms at different stages of digital maturity. Although these proposals are made, real implementation is low because there are no validated frameworks that take into consideration data scarcity, low technical capacity and uncertain ROI, which are some of the challenges faced by startups and small businesses. As Jho et al. [9] point out, technically sound, but strategically unaligned AI-DSS may end up underutilized or misused, leading to poor decision-making. Moreover, the majority of the current models do not consider the socio-cultural aspect of AI integration, such as the trust of employees, ethical issues, and managerial preparedness. A major gap exists in frameworks that balance the performance of algorithms and usability and transparency. Since MSMEs are still in the process of finding scalable technologies to increase their competitiveness, the creation of inclusive low-cost AI-DSS models that fit their unique limitations is a crucial field of future research.

5. METHODOLOGY

This paper takes a qualitative exploratory study design to explore the issues surrounding the integration and effects of the use of "AI-based Decision Support Systems (AI-DSS) in startups and MSMEs". Since AI implementation in smaller enterprises is a new phenomenon and highly contextual, a qualitative method can be used to learn more about technical, organizational, and strategic drivers of implementation. The researchers gathered information using semi-structured interviews of key decision-makers (founders, technology leads, and operations managers) at a wide range of startups and MSMEs in the technology, manufacturing, retail, and service sectors. Participants were selected purposefully and both AI adopters and non-adopters were represented to have a holistic view. Thematic coding and grounded theory principles were used to analyze interviews through transcription of data in order to determine common patterns, barriers, and best practices related to AI-DSS implementation. Secondary sources, such as policy documents, digital transformation reports, and AI readiness assessments by government and industry organizations, were also used to triangulate results and put findings into perspective. The proposed methodological approach will allow developing a realistic, contextual perception of the role of AI-DSS in innovation, decision-making, and strategic development in resource-limited business contexts.

6. RESULTS AND ANALYSIS

The review showed that the adoption of AI-driven Decision Support Systems (AI-DSS) by startups and MSMEs in the fashion industry varies due to the difference in the degree of digital maturity and innovation preparedness. According to qualitative interviews and industry reports, startups have shown a greater extent of integration of AI-DSS, especially in demand prediction, customer trend analysis, and style recommendation engines. An example is that Fashion Startup B applied full-scale AI-DSS on the natural language processing (NLP)-based customer feedback analysis and demand forecasting, which led to 40 percent improvement in operation efficiency and customer retention [12]. Conversely, the traditional MSMEs especially in the apparel and footwear subsectors- had low adoption rates because of financial and technical factors. MSME -Apparel lacked any serious AI integration, and continued to do forecasting and design manually, resulting in longer innovation cycles and increased inventory costs.

Table 1: AI-DSS Adoption in Fashion Startups and MSMEs

Company Type	AI-DSS Adoption	Key Features Used	Innovation Outcome	Efficiency Gain (%)
Fashion Startup A	Partial	Recommender Systems, Inventory Forecasting	New Style Curation	25
Fashion Startup B	Full	Demand Prediction, NLP	Customer-Centric Design	40
MSME - Apparel	None	N/A	Traditional Ops	0
MSME - Footwear	Partial	Image Recognition, Chatbots	Improved User Experience	15
MSME - Accessories	Full	Price Optimization, Trend Analysis	Higher Conversion Rate	45

To quantify efficiency gains derived from AI-DSS adoption, the following normalized performance equation was applied:

Efficiency Gain (%) = [(Post-AI Output - Pre-AI Output) / Pre-AI Output] × 100

When the output has key performance indicators (KPIs) that can be measured, e.g. time-to-market, forecasting accuracy, product returns rates, and the cost of production per unit, Decision Support Systems (DSS) powered by AI allow startups and MSMEs to make better, quicker, and more economical decisions. In the example of MSME - Accessories, trend-based price optimization and inventory intelligence solutions powered by AI contributed to 45 percent in operational efficiency, 28 percent reduction of unsold inventory and 17 percent rise in the accuracy of pricing based on real-time market behavior [13]. Likewise, fashion startups that employed AI-supported forecasting to drive stockouts down by 30 percent and markdown losses by 25 percent demonstrated the real-world financial value of AI integration. Innovation-wise, the AI-enabled firms were also discovered to introduce twice the number of design variants every quarter as opposed to their non-AI counterparts. These companies applied AI-DSS to co-designing with the users by using recommender system and sentiment analysis on social media sites. This methodology was not only able to improve customer satisfaction but also managed to cut down the product development cycle that took months to a week [14]. Artificial intelligence also contributed to mass customization,

where fashion brands could personalize styles, colors, and sizes almost in real-time, depending on customer reviews and localized demand. In addition to this, AI-DSS assisted in cross-functional coordination across the design, marketing, and supply chain teams by producing single dashboards, anomaly warnings, and scenario predictive models. Startups said that the integration of AI resulted in a 35 percent increase in interdepartmental communication and a 22 percent more rapid response to market trends, creating an agility-innovation culture. Nevertheless, even in the majority of micro and small companies, the potential of AI is not fully used because of disintegrated data ecosystem, the absence of inexpensive plug-and-play AI-solutions, and the inadequate training of the workforce. The idea that AI is complex and expensive to implement also discourages adoption in low-resource environments, although ROI is beneficial in the long term. Such results highlight that a modular, scalable AI-DSS framework is necessary, starting with simple tools, like data collection interfaces, visualization dashboards, and simple rule-based logic. As soon as digital readiness is enhanced, MSMEs may gradually switch to advanced analytics, cognitive computing, and automated decision-making processes- being inclusive and adaptive to the varying maturity steps.

7. DISCUSSION

The results of this research point at the potential and feasibility of the application of AI-driven Decision Support Systems (AI-DSS) to startups and MSMEs, and the fashion industry could be an example of such a sector. As the first research question aims to identify the level of AI-DSS uptake, the findings indicate that although digital-native startups are at moderate and full adoption, most MSMEs are in the nascent stage and are only at partial or pilot implementation. This affirms previous research that indicated that despite rising awareness of the AI potential, implementation remains minimal in resource-low business [9], [12]. Trend forecasting, customer sentiment analysis and intelligent inventory control are examples of AI-DSS that are no longer being regarded as tools of efficiency, but rather as means of strategic agility and product innovation in fashion startups. The startups use recommender systems and NLP-based feedback mining to inform design direction, minimize stockouts, and co-create products with consumers, which directly increases the level of innovation output and time to market. On the other hand, MSMEs that are slow in digital maturity still use the traditional decision-making mechanics and hence the inability to react to the fast-changing consumer demands or supply chain interruptions. Under the second research objective, which is to determine the technical, economic, and organizational barriers, this study established common themes in all sectors.

The first one is data availability, which is low, as well as being inadequately integrated in infrastructure and the perceived complexity of AI tools. Most MSMEs also struggle with the ability to recruit or train talented individuals with potential to handle AI systems. In addition, another barrier is the cost, where micro-units cannot afford to develop and maintain sophisticated analytics tools. The research also showed that the lack of alignment between AI outputs and business processes commonly results in underutilization or misinterpretation of results in even firms with AI adoption, which again proves that implementation should be strategic. In line with the third research aim, which is to evaluate the effect of AI-DSS on innovation, decision accuracy, and operational efficiency, the empirical evidence demonstrates that businesses that implement AI-DSS record high levels of improvements. The increase in efficiency was between 15- 45 percent in functions like price optimization, design iteration and resource allocation. Companies also reported increased accuracy of decisions because of the capacity of AI to analyze huge volumes of real-time data and simulate various scenarios. Notably, the capacity to innovate as indicated by the introduction of new design variations, personalization and customer retention rates was significantly greater in AI embracing companies. This confirms the hypothesis that AI does not only streamline the current processes but also opens new possibilities of product and service innovation [10], [14]. Lastly, concerning the fourth aim, which is to come up with a scalable and user-friendly AI-DSS framework, the findings are quite clear in that a generic solution is not effective within this segment. Rather, it requires the modular approach beginning with simple digital tools, such as dashboards, and advancing to predictive and prescriptive models with data maturity. There also needs to be public sector projects, as well as ecosystem-level support in terms of making infrastructure, open-source tools, and hands-on training available at affordable prices- closing the gap between the potential of AI and practical application in a small business setting. To conclude, although AI-DSS has proven to be a definite roadmap to innovation and competitiveness within the startup and MSMEs, its success depends on the context-relevance, technical scalability, and inclusive design.

8. CONCLUSION AND FUTURE WORK

This paper has examined how AI-driven Decision Support Systems (AI-DSS) are being integrated and how they have affected the startups and MSMEs, in terms of innovation, efficiency, and scalability. The results indicate that AI-DSS has the potential to improve decision accuracy and operational flexibility and product innovation remarkably, especially in an industry such as the fashion industry where consumer tastes rapidly change. Startups have started utilizing trend forecasting, recommender systems, and customer analysis based on NLP, whereas MSMEs still struggle to adopt it because of financial limitations, insufficient digitalization, and unavailability of qualified employees. This study highlights the importance of a modular, cost-efficient, and user-friendly AI-DSS system that will be aligned with the requirements of small businesses. Even though this paper is informative, more studies are required to build and test a universal AI-DSS implementation roadmap at the industry and geographical levels. The next step is pilot testing modular AI-DSS models in practice within MSMEs, not only to test the technical feasibility but also behavioural and organisational determinants of adoption. Also, ethical AI applications, data

privacy, and the importance of government subsidies and the public-private partnership will be critical in scaling up inclusive AI innovation. These areas should be addressed to close the existing digital divide and enable startups and MSMEs to succeed in a technology-fueled global economy

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