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Smart Technologies for Smart Futures: A Study Across Business, Science and Society

Mr. Sandeep Kumar Sahu[1], Dr. Meenakshi Sharma[2], Anirudh Gupta[3], S. Cyndhiya[4]
[1] Assistant Professor (Grade-II), [1]School of Finance & Commerce, Galgotia's University, Uttar Pradesh, India
[2] Assistant Professor, [2] School of Business, Mody University of Science and Technology, Lakshmangarh, Rajasthan[3] Assistant Professor, Applied Sciences, Suresh Gyan Vihar University, Rajasthan, India
[4] B.E. Biomedical, SETHU Institute of Science and Technology, Kariyapatti, Tamil Nadu, India
[1] sandeepks1@gmail.com, [2] meenakshisharma.sob@modyuniversity.ac.in,
[3] anirudh.gupta2020@gmail.com [4]cyndhiya96@gmail.com

Abstract: *Smart technologies are no longer future concepts as they are already shaping the way businesses operate, scientists innovate, and societies function. This study explores the growing role of smart technologies across business, science, and society, with special focus on artificial intelligence, Internet of Things, big data analytics, blockchain, cloud computing, and cyber-physical systems. The study is based on secondary sources and reviews recent literature to understand how these technologies support innovation, productivity, decision-making, public service delivery, and sustainable development. It also highlights that technological progress is not free from challenges. Issues such as digital divide, cybersecurity risks, high implementation costs, lack of digital skills, data privacy, and ethical concerns continue to affect adoption. The study further emphasizes the importance of ethical, human-centric, and sustainable implementation. It concludes that smart technologies can create a smarter and more inclusive future only when innovation is balanced with responsibility, equity, and human well-being.*

Keywords: Artificial Intelligence, Digital Transformation, Human-Centric Technology, IoT, Smart Society.

I. INTRODUCTION

The present global environment is changing at a very fast pace. Much of this change is being shaped by the growing connection between smart technologies, new business models, scientific progress, and changing social expectations. Technologies such as artificial intelligence, the Internet of Things, big data analytics, cloud computing, and blockchain are no longer limited to technical use only. They are now influencing the way organizations work, make decisions, innovate, and create value across different sectors (Hu et al., 2026). This change is not simply about shifting from manual systems to digital platforms. It is much deeper than that. Digital transformation has become a strategic shift that affects business processes, organizational structures, and even the basic ways through which value is created and delivered (Fawwaz & Resen, 2026).

In the 21st century, digital transformation has become a necessity for organizations rather than just a competitive advantage. The speed of technological innovation has increased rapidly, and interest in digital transformation has grown strongly in recent years. This shows that businesses, governments, and society are becoming more aware of the need to adjust to digital change (Ponomarenko et al., 2024). However, this transformation is not taking place equally everywhere. Some industries have already adopted advanced Industry 4.0 technologies, including intelligent automation, cyber-physical systems, and real-time data processing. On the other hand, many sectors are still at the early stage of digital adoption and continue to face practical barriers in implementation (Editors, 2023). Smart technologies are also changing the relationship between business, science, and society. Their impact is visible not only in corporate decision-making but also in areas such as healthcare, sustainability, education, governance, and urban development.

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The combination of digital tools with emerging innovations has created new possibilities for solving complex social and environmental problems (Nichifor et al., 2025). For example, smart cities are using IoT and AI-based systems to improve public services, strengthen governance, and support sustainable development. In a similar way, scientific and industrial fields are using smart technologies for real-time monitoring, predictive analysis, and automated decision-making. These capabilities were difficult to imagine a few decades ago (Alam et al., 2025; Kumar et al., 2026).

At the same time, the rise of smart technologies also creates several challenges. Although these technologies offer efficiency, innovation, and competitive benefits, their adoption is not always simple. Organizations often face problems related to technical integration, employee skills, ethical use, data security, and equal access (Van Veldhoven & Vanthienen, 2021). One major concern is the digital divide. The lack of digital skills, weak infrastructure, cybersecurity risks, and the concentration of technological power in advanced economies may increase existing inequalities. In addition, the environmental and social effects of expanding digital infrastructure are still not fully understood or properly regulated (Mostova et al., 2023; Althaf et al., 2025).

This research paper examines smart technologies through three connected areas: business, science, and society. Instead of studying these areas separately, the paper views them as interdependent. It reviews the role of smart technologies in business, science and society and also understand the importance of ethical, human-centric and sustainable technology implementation.

II. REVIEW OF LITERATURE

Ali et al. (2025) examined the use of digital technologies in logistics entrepreneurship. They found that digital tools can improve supply chain transparency and customer satisfaction. However, the adoption of these technologies is not always easy for small and medium enterprises. High implementation costs, privacy concerns, and data-related risks continue to limit wider adoption.

Khalid et al. (2025) discussed the growing role of artificial intelligence in human resource management. Their study highlighted an important paradox. On one side, AI improves productivity and supports faster decision-making. On the other side, it also creates challenges such as technostress and digital literacy gaps. The study suggested that organizations should not adopt AI only for efficiency. A more human-centred approach is needed.

Zhang et al. (2025) highlighted that digital transformation readiness depends on more than technology. It is shaped by organizational support, learning opportunities, and the development of employee capabilities. Their study shows that digital change becomes smoother when employees are properly prepared for it. Training, guidance, and workplace support play an important role in this process. This study is more suitable than weaker sources because it directly explains readiness as an organizational issue, not only as a technical matter.

Jewapatarakul & Ueasangkomsate (2024) examined digital organizational culture and readiness in small and medium enterprises. Their study showed that digital transformation is not driven by technology alone. It is also shaped by organizational culture, knowledge acquisition, and internal preparedness. The findings suggest that firms need supportive people practices along with digital tools. Employees must be ready to learn, adapt, and work in a changing environment. This study strengthens the argument that culture and learning are central to successful digital transformation. Without internal readiness, even advanced technology may not deliver strong outcomes.

Conradty and Bogner (2023) focused on STEAM-based teaching and professional development. Their study revealed that the integration of arts with science and technology can improve students' creativity and motivation. It also showed that education systems need flexible and innovative teaching methods to prepare learners for a technology-driven future.

Zhao et al. (2023) studied whether digital transformation can improve the quality of enterprise innovation in China. Their study found a positive link between digital transformation and innovation quality. The results showed that digital transformation helps firms strengthen internal control and gain more analyst attention. This, in turn, improves overall firm performance. The study also suggests an important point. Digital transformation becomes more effective when it is

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supported by strong organizational systems, proper management practices, and internal readiness. Technology alone is not enough.

Teng et al. (2020) investigated data-driven models for industrial energy savings. Their study found that the major challenge was not only related to modelling techniques. Instead, data communication infrastructure was a key concern. The authors also emphasized the need for digital twin-based approaches in industrial systems to support better monitoring, analysis, and energy efficiency.

III. RESEARCH GAP

Although previous studies have examined smart technologies in areas such as HRM, logistics, education, industrial energy systems, and innovation performance, most of them are limited to specific sectors. There is a lack of integrated research that connects the role of smart technologies across business, science, and society. Moreover, existing literature discusses both benefits and barriers, but limited attention has been given to a balanced, human-centric, and sustainable approach to technology adoption. This study addresses this gap by examining smart technologies from a multidisciplinary perspective

Research Objectives

1. To review the role of smart technologies in business, science, and society.
2. To understand the importance of ethical, human-centric and sustainable technology implementation.

IV. RESEARCH METHODOLOGY

This study is based on a **secondary research approach**. The required information has been collected from published research papers, journal articles, reports, and other reliable academic sources related to smart technologies, digital transformation, artificial intelligence, IoT, blockchain, and Industry 4.0/5.0. The study follows a **descriptive and analytical method.** It reviews existing literature from 2021 to 2026 to understand the role of smart technologies in business, science, and society. Special attention has been given to ethical, human-centric, and sustainable technology implementation. This helps the study develop a balanced and multidisciplinary understanding of smart technologies.

V. RESULTS AND DISCUSSION

The Role of Smart Technologies in Business, Science and Society

The review of recent literature from 2021 to 2025 shows that smart technologies are now becoming an important part of business, science, and society. These technologies include artificial intelligence, Internet of Things, big data analytics, blockchain, and cyber-physical systems. Their role is not limited to simple automation or digital adoption. They are changing the way organizations work, how scientific research is conducted, and how societies are governed. In this sense, smart technologies represent a wider transformation. They influence business strategies, research methods, public services, and even the relationship between people and institutions.

Smart Technologies in Business Transformation

In the business sector, smart technologies have become strong drivers of innovation and competitive advantage. Ivanova et al. (2025) highlighted that artificial intelligence helps organizations improve productivity and efficiency. Automation can reduce operational costs by 20–40 percent, while also creating demand for new digital and professional skills. AI-based analytics also helps firms make better decisions. It allows businesses to understand customer behaviour, personalize services, and respond quickly to market changes. However, the success of these technologies depends on many internal factors. Organizational readiness, strong digital infrastructure, and employee digital literacy are very important (Mostova et al., 2023). The challenge is greater for small and medium-sized enterprises. Even though smart technologies can provide long-term benefits, their implementation requires heavy investment. Qader et al.

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(2025) noted that the cost may range from $100,000 to $1,000,000. For many smaller firms, this becomes a serious barrier.

Scientific Applications and Research Innovation

Smart technologies have also created new possibilities in scientific research. They support large-scale data collection, real-time monitoring, and predictive analysis (Kumar et al., 2026). These tools help researchers observe patterns, test ideas, and make more accurate predictions. In industrial and scientific settings, Industry 4.0 technologies have improved decision-making, supply chain resilience, and sustainable performance (Qader et al., 2025). Technologies such as digital twins, IoT sensor networks, and AI-based predictive maintenance are changing traditional research and manufacturing practices.

Societal Transformation and Smart Cities

At the societal level, smart technologies are reshaping urban life and public governance. Smart city projects use IoT, AI, and data analytics to improve infrastructure, public services, and sustainability outcomes (Adel & Alani, 2024). Digital public administration is also changing the way governments interact with citizens. Kaponda (2025) described this shift as a move from traditional public management toward more citizen-centred governance. This means public services are becoming faster, more transparent, and more responsive. Still, smart cities cannot succeed only through technology. There are many social and technical challenges. Digital divides, privacy concerns, weak policy coordination, and unequal access to digital services remain major issues (Bing et al., 2024).

Cross-Sectoral Integration and Sustainability

One important finding from the literature is that smart technologies can support sustainability when they are used responsibly. Ismael & Sulaiman (2025) argued that digital transformation becomes more meaningful when it is combined with human-centred planning and ethical governance. Smart technologies can improve supply chain transparency, environmental monitoring, and resource management (Verma, 2024). They can also help cities and organizations use resources more efficiently. Quality 4.0 technologies have shown positive effects on smart city development and quality of life, especially in developing regions (Ismael & Sulaiman, 2025). This shows that technology can support social progress, but only when it is planned with people's needs in mind.

Critical Barriers and Ethical Considerations

Despite their benefits, the adoption of smart technologies faces several barriers. Many organizations still lack digital skills. Cybersecurity risks are also increasing, and gaps in interoperability standards make integration more difficult (Dwivedi et al., 2019). Ethical issues are another major concern. Pototskyi (2026) emphasized the need for transparency, accountability, and human oversight in the use of smart technologies. Without proper governance, these technologies may create new risks instead of solving existing problems. Overall, smart technologies are transforming business, science, and society in powerful ways. But their success depends on more than technical adoption. They need proper strategy, responsible governance, skilled people, and a human-centred approach. Only then can smart technologies support innovation, sustainability, and inclusive development.

VI. THE IMPORTANCE OF ETHICAL, HUMAN-CENTRIC AND SUSTAINABLE TECHNOLOGY IMPLEMENTATION

Recent literature from 2021 to 2025 highlights an important paradox. Smart technologies offer strong technical capabilities, higher efficiency, and better operational performance. Yet their real success depends on something beyond technology. It depends on ethics, human-centred design, and sustainability. This marks a shift from the automation-focused approach of Industry 4.0 toward the more balanced and inclusive vision of Industry 5.0.

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The Human-Centric Imperative

Human-centric technology is not only about making systems easier to use. It is about placing human well-being, creativity, safety, and dignity at the centre of technological development. In this approach, people are not treated as passive users of machines. They become active participants in the design and use of technology. Industry 5.0 supports this idea at different levels. At the process level, it focuses on worker safety, human-robot collaboration, and customer participation. At the system level, it supports ergonomic design and inclusive production planning. At the management level, it encourages ethical business practices and social responsibility. Studies show that organizations adopting human-centric digital practices often experience better employee resilience, adaptability, and job satisfaction. Digital leadership also plays an important role here. Leaders who understand ethics, empathy, and digital change can create a healthier environment for transformation. This approach is important because smart technologies affect many people. Workers, customers, citizens, and communities are all connected to these systems. Therefore, their voices should be included during planning, development, and implementation.

Ethical Governance and Accountability

Although smart technologies are becoming more advanced, ethical governance is still weak in many organizations and societies. Responsible AI requires clear rules. These rules should focus on transparency, accountability, fairness, and human supervision. A major concern is that AI development is still concentrated in advanced economies. This creates risks for developing regions and smaller organizations. Issues such as algorithmic bias, data privacy violations, and unequal access to technology can become serious problems if proper governance is missing. Ethical AI should not be treated only as a legal or compliance requirement. It should be seen as a strategic capability. Organizations that follow ethical practices are more likely to build trust, improve stakeholder relationships, and support sustainable innovation. Effective governance needs more than written policies. It requires algorithmic audits, transparency tools, monitoring systems, and community accountability. In simple words, technology must be powerful but it must also be answerable.

Sustainability and Resource Optimization

Sustainability is another key part of responsible technology adoption. Smart technologies can support environmental goals when they are linked with circular economy practices and green resource management. Technologies such as AI, IoT, digital twins, blockchain, and smart networks can improve resource efficiency, reduce waste, and strengthen environmental resilience. They can also make supply chains more transparent and help organizations monitor their environmental impact more accurately. However, sustainability benefits do not happen automatically. They require careful design. For example, AI systems should be developed in ways that reduce energy consumption. Waste management systems should protect both the environment and human dignity. Supply chain technologies should improve transparency without increasing unnecessary digital burden.

Key Barriers and the Way Forward

Even though ethical, human-centric, and sustainable technology adoption is necessary, many barriers still exist. Organizations often face low digital literacy, rising cybersecurity threats, weak regulatory standards, and high implementation costs. These challenges are even more serious for small and medium-sized enterprises. There is also a gap between technological innovation and actual human benefit. Many systems are technically advanced, but they may not fully consider cultural differences, social needs, psychological effects, or fairness concerns. Overall, ethical and human-centred implementation is not an extra feature of smart technology. It is the foundation. Smart technologies can support innovation, equity, and sustainability only when they are guided by responsible governance, inclusive design, and long-term environmental thinking.

Organizations and policymakers therefore need to treat ethics, human well-being, and sustainability as core priorities. They should not be added later. They must be built into the technology from the beginning.

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VII. CONCLUSION

The present study concludes that smart technologies are no longer limited to technical systems or organizational tools. They have become a major force shaping business, science, and society. Technologies such as artificial intelligence, Internet of Things, big data analytics, blockchain, cloud computing, and cyber-physical systems are changing the way decisions are made, services are delivered, and innovation is created. In business, these technologies support productivity, customer understanding, automation, and competitive advantage. They help organizations respond quickly to market changes. Still, their success depends on digital skills, infrastructure, leadership, and readiness for change. Small and medium enterprises face greater challenges because of high costs and limited technical capacity. In science and industrial research, smart technologies have opened new possibilities. Real-time monitoring, predictive analytics, digital twins, and AI-based systems make research and production more accurate and efficient. These tools help in identifying problems early and improving performance. At the societal level, smart technologies are improving public services, smart city development, governance, and sustainability efforts. However, technology alone cannot solve every problem. Issues such as privacy, cybersecurity, unequal access, digital divide, and ethical risks need serious attention. The study also highlights the importance of ethical, human-centric, and sustainable implementation. Smart technologies should not replace human values. They should support human well-being, fairness, transparency, and environmental responsibility. Overall, smart technologies can create a smarter and more inclusive future. But this future will depend on responsible planning, ethical governance, skilled human participation, and sustainable use of technology.

VIII. LIMITATIONS AND FUTURE DIRECTION OF STUDY

This study is based on secondary sources only. Therefore, it does not include primary data from employees, managers, policymakers, researchers, or technology users. The findings are developed through the review of existing literature, so they may not fully represent practical experiences from different industries or regions. Another limitation is that smart technologies are changing very quickly. New developments in artificial intelligence, IoT, blockchain, and digital twins may create fresh opportunities and challenges that are not covered in the present study. Future research can use primary data to understand how smart technologies are actually adopted in organizations and society. Comparative studies may also be conducted across sectors such as business, education, healthcare, logistics, and public administration. Further studies can focus on ethical governance, digital literacy, cybersecurity, and sustainability. These areas need deeper investigation, especially in developing economies where digital access and infrastructure remain uneven.

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