Technology Push vs. Society Pull: Navigating Big Data for Service Innovation and Trust in the Age of Digital Transformation

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Abstract—**Technology push and society pull are driving an increasing number of people to come online, creating new opportunities for collaboration across both economic and social sphere. As digital tools and platforms evolve, they enable greater connectivity, allowing individuals and organizations to collaborate more easily, share knowledge, and innovate. This digital shift is not only transforming business models and economies, but also reshaping social dynamics, empowering people to engage in global conversations, build communities, and address complex issues in real time. However, the transition to the digital era brings significant challenges. Digital Transformation (DT) relies primarily on networks and Information Technology (IT) paradigms, which facilitate knowledge sharing. In this dynamic ecosystem, adapting to rapidly evolving high-tech innovations can be challenging. People are under constant pressure to adapt to technology and those affected by this transformation also influence the DT process. Alongside the acceleration of innovation, concerns around security and privacy remain critical. Recent advancements such as big data and Artificial Intelligence (AI) add agility to this paradigm, making it essential to establish a secure and responsible path forward. By balancing the advantages of technology with the need for authentic human interaction, we can foster a more harmonious and inclusive societal landscape. This article aims to explore the interplay between technology push and societal pull in the context of digitalization.**

Keywords—**digital transformation, information technology, big data, social network, society, trust**

I. INTRODUCTION

Bringing technology closer to people has made social life more comfortable and significantly improved time management. While this paradigm shift brings notable advantages, it is also reshaping social behavior in ways that raise emerging moral and legal concerns [1]. Furthermore, the increasing integration of Machine Learning (ML) and Artificial Intelligence (AI) has led to algorithms that deeply affect every aspect of our life [2, 3]. The primary objective of this study is to identify the key challenges associated with digitalization, including:

- Social Behavior: Growing dependence on apps can sometimes have negative consequences, affect valuable time and reduce overall social performance, both physically and mentally. Excessive reliance on technology can lead to reduced face-to-face interactions, feelings of isolation, and a decline in meaningful relationships. Being immersed in apps and devices can distract people from real life, making it difficult to stay present.

- Trust: Dependency on technology can be harnessed as a tool to redirect social interactions in specific directions. The extensive data we continuously generate is frequently analyzed and leveraged to subtly steer individual priorities in ways that serve broader capitalist interests. In this context, in an age of rapid digital innovation, transparency and trust have become indispensable elements to ensure ethical and responsible management of personal data.

- Security Challenges: In the context of reliability and security, digital platforms must ensure that their tools and infrastructure are robust and secure enough to deliver high-quality, seamless services. The ongoing digital transformation requires significant investment and innovation to secure cyberspace against all types of malicious use [4].

This article aims to investigate the dynamic interplay between technology-driven innovation ("technology push") and societal needs and expectations ("societal pull") in the context of digitalization. By analyzing how these forces influence each other, the article sheds light on the mutual shaping of technological development and social adaptation.

In this study, we conduct an in-depth case study on social networks, analyzing the efficiency of social media platforms with a specific focus on their accessibility across various regions and their overall effectiveness. To carry out this investigation, we employ a combination of questionnaires, interviews, and discussions with diverse demographic groups in two distinct countries.

The reminder of the study is organized as follows: theoretical background and related works are discussed in section II. Online platform and data analytics introduced in III. Concept of technology push and society pull introduced in section IV. Digital transformation and its challenges discussed in section V. Case study and discussion is in section VI, and we conclude paper in section VII.

II. THEORETICAL BACKGROUND AND RELATED WORK

Undoubtedly, the emergence of digital transformation affects different domains, mainly the competitive business market. Emerging AI technologies are opening new avenues for innovation and profoundly impacting human lives, reshaping everything from personal experiences to broader societal structures. "Human-centered AI" focuses on developing AI that prioritizes human needs, improves

human-machine interaction, and bridges the gap between people and technology. It aims to enhance overall quality of life by improving efficiency, accessibility, safety, and health [5]. Hence, digital transformation has become a hot topic of research in the last decade.

In literature, digital transformation is seen both as a social phenomenon and a cultural evolution. For companies, it is an evolution or creation of business models [6]. It refers to fundamental changes in a company's organizational structure, production, and industry through the optimal integration of traditional processes and digital technologies. For more information, we refer the reader to [7–10], which provides comprehensive details on digital transformation for the reader. In terms of culture, the most recent study [11–14] have primarily focused on business or organizational culture, whereas our study shifts the focus toward social culture and its interaction with digitalization. Table 1 summarizes the most cited studies on digital transformation published in the last 5 years which cover four main topics include healthcare, social culture, lockdown, and education.

In digital transformation, AI technologies possess human-like cognitive abilities, such as the capacity to learn, perceive, sense, act, and reason [15]. The integration of AI can greatly impact organizations and various stakeholders, including consumers, vendors, and service providers [16]. AI can improve government understanding of the needs and issues of citizens, enabling more effective solutions and faster implementation. However, a significant gap remains between the hype surrounding AI and its actual implementation within organizations [17].

AI-powered algorithms, especially those enhanced by deep learning, must ensure transparent decision-making throughout their life cycle. This transparency must be compatible with human dignity and align with ethical principles at every stage of the process. Concerns about AI, such as its societal boundaries, ethical issues, potential for "creative destruction", impact on work structures, and its role in competitiveness, will influence public perception and determine how willing individuals are to support and adopt these technologies [18, 19].

All these works addressed the use of technology across various domains; however, none of them provided an in-depth discussion of the technical concepts behind data analysis or critically examined the darker aspects of technology dependence. These gaps are a key focus of this research.

Table 1. Digital challenges across different countries considering developing metrics (years 2020–2024)

Ref.	Description	Health	Culture	Lockdown	Education
[9]	Analyzing the effect of DT in healthcare	✓	✗	✗	✗
[20]	Using DT for innovative solutions to improve healthcare	✓	✗	✗	✗
[21]	Overview of challenges in integrating DT with healthcare	✓	✗	✗	✗
[22]	Benefits and challenges of smart culture for citizens' well-being	✗	✓	✗	✗
[23]	A general model of DT for society, businesses, and education	✗	✓	✗	✗
[24]	A model of culture, covering social and technological aspects	✗	✓	✗	✗
[25]	DT maturity boosts adaptability, while lower maturity raises risk	✗	✗	✓	✗
[26]	Investigates how knowledge can improve the role of DT	✗	✗	✓	✗
[27]	Explores the impact of the global pandemic on success of DT	✗	✗	✓	✗
[28]	Research on turning challenges into advantages leveraging DT	✗	✗	✗	✓
[29]	Explore DT in higher education and the challenges institutions face	✗	✗	✗	✓
[30]	Analyze the impact of DT in education from a teacher's perspective	✗	✗	✗	✓
[31]	Explore DT in education and key factors for leaders driving change	✗	✗	✗	✓

III. ONLINE PLATFORMS AND DATA ANALYTIC

In the digital ecosystem, people affected by technology play an important role in shaping the digital landscape. Individuals' behaviors, feedback, and interactions with digital tools influence how technology evolves and is implemented. Fig. 1 shows the general concept of big data analytics, showing the different steps involved from data collection to final visualization, and highlighting the key characteristics of big data and the technologies used. Data is delivered globally through Content Delivery Networks (CDNs), where individuals connect to edge servers to access services such as web browsing, online shopping, and social media interactions. Each online action generates data that can be traced by the service provider. On the other hand, service providers that offer online services (e.g., e-commerce, social networks) collect user-generated data for analysis. In this context, real-time data streams need immediate processing to be valuable for decision-making.

- *Data Collection:* Involves three key steps: i) Collection; this is the initial stage where data is collected from various sources. ii) Transformation; in this stage, data is cleaned and converted to a usable format. iii) Summarization; involves aggregating data to generate meaningful insights, which may include statistical summaries or extraction of key features.
- *AI and Data Processing*: AI-assisted big data analytics and algorithms help identify trends and predict future events [32]. Distributing workloads across multiple servers facilitates efficient management of large data sets and significantly increases speed and reliability.
- *Data Visualization:* After the data is processed, the results are visualized using charts, graphs, and dashboards. This step allows stakeholders to easily interpret complex data and identify trends or insights that can help with decision-making.
- *Insight and Decision-Making:* The ultimate goal of the entire process is to gain actionable insights that support
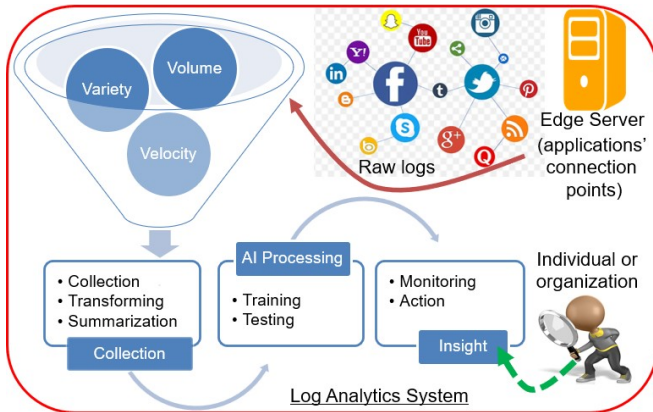
informed decision-making.

Fig. 1. Encapsulates perspective of the entire life cycle of big data from generation through processing to decision-making. By focusing on the properties of big data (volume, variety, velocity) and using efficient processing techniques, organizations can leverage data to drive strategic decisions. Adapted from [33], with modification.

Continuous feedback from users helps organizations and individuals improve their digital strategies [34]. This interaction fosters a cycle in which digitalization evolves in response to real-world experiences. As people adapt to new technologies, their needs and preferences can lead to further innovation through collaboration. Successful collaboration can lead to new ideas and approaches that improve the overall digital ecosystem, including organizations and communities.

IV. TECHNOLOGY PUSH AND SOCIETY PULL

Fig. 2 illustrates how the interaction between technology pushes, society pulls, and business forces is critical in driving innovation and shaping the future.
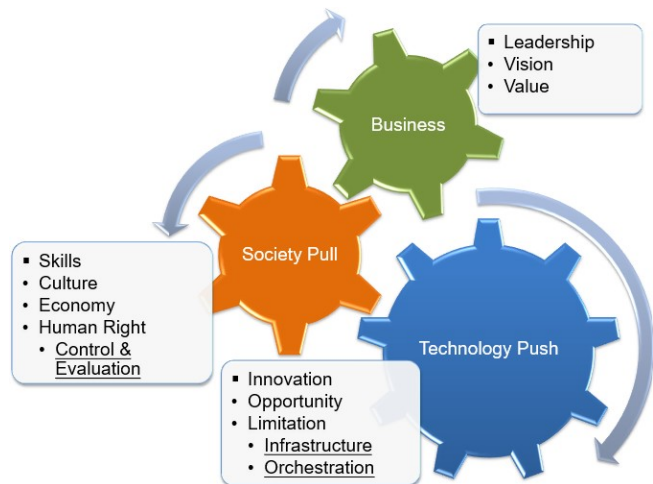

Fig. 2. The interaction between technology push, society pull, and business leadership drives innovation by aligning technological advancements with societal needs and economic factors, while guiding them through strong leadership, vision, and values for sustainable growth and value creation.

- *Technology Push*: Refers to advances in innovation, the opportunities they present, and the constraints that come with them. Technological advances often open new frontiers and offer the potential for improved products, services, and efficiency. However, these innovations can also create challenges, such as limitations in accessibility, or integration into existing systems, economies, and cultures.

- *Society Pull*: On the other hand, the growing demand for new skills, driven by changing educational landscapes and the emergence of specialized professions, plays an important role in determining how technologies are deployed. Cultural norms and values shape which technologies are adopted and how they are integrated into daily life. Economic factors (e.g., market demand, purchasing power, and global trade) also determine which innovations are adopted and which are lost.

In this dynamic ecosystem, strong business and political leadership are crucial. Successful organizations align technology with societal needs through clear vision and values, ensuring innovation creates meaningful value for both consumers and stakeholders. This vision supports decision-making and ensures that business strategies are sustainable, ethical, and responsive to societal expectations and technological trends.

A. Global Diversity and Digital Platforms

The interaction of diverse cultures through digital platforms (e.g., Instagram and LinkedIn) can inspire new ideas and approaches, leading to solutions that may not emerge in a more homogeneous environment [35]. This fosters global discussions and idea-sharing, enabling individuals to easily connect, share insights, and collaborate on projects that address global challenges. Digital transformation provides businesses with tools and platforms that streamline operations and increase revenue [36]. However, analyzing behavior on social networks reveals several challenges, including but not limited in Table 2.

Table 2. Common social behavior and challenge

Challenge	Description	Impacts
Privacy	human right & human dignity loss of trust	loss of trust and loss of data
Addiction	dependency on social media	mental health, loss of contribution
Misleading	emphasis idealized lives	unrealistic standards
Low self-esteem	chasing validation through likes	mental health
Pressure to conform	present themselves to gain attention	focusing on appearance over contributions

B. Culture Impacts on Digital Transformation

Although organizational culture is often seen as a valuable strategic asset that can support business transformation and the effective use of digital technologies, it can also become a source of inertia, hindering the ability to embrace change [37]. Many global companies struggle with digital culture due to misconceptions about digital transformation. Employees often lack the motivation and digital skills needed to drive meaningful cultural change [38].

Culture within the ecosystem can facilitate or hinder digital transformation. Change can be challenging, especially for communities that have grown on stable, established practices. Individuals who embrace change and are open to learning new skills contribute positively to the ecosystem. However, fear of change can be a barrier to digital transformation [39]. Many regional cultures prioritize the preservation of traditional practices, values, and identities. This emphasis on heritage can lead to resistance against innovations that seem to threaten local customs or ways of life. Other regional factors that can impact the velocity of

digital transformation include:

- *Access and Infrastructure*: In some regions, limited access to Internet technology and infrastructure can hinder the adoption of digital innovations.
- *Suspicion Towards Technology*: In some contexts, there may be a general distrust of technology and its effects. This skepticism can stem from fears of job loss, data privacy, and erosion of social relationships.
- *Economic Factors:* In regions where economies rely heavily on traditional industries (like agriculture, crafts, or tourism), people might feel that digitalization doesn't address their immediate needs or concerns.
- *Social Dynamics:* Strong social relationships can lead to resistance to individual innovations that digital technologies often promote. In these contexts, innovation can be seen as disruptive rather than beneficial.
- *Religion, Identity, and Autonomy:* For some regional cultures, embracing digital technologies may feel like a loss of autonomy to global forces. There is often a fear that digital tools will impose outside values and practices that conflict with religion and local traditions.

Leadership and vision play a key role in guiding digital transformation. Therefore, despite these challenges, many regional cultures, such as the UAE and Saudi Arabia, also find ways to adapt to and integrate digital technologies that respect and enhance their unique identities. This duality can lead to innovative approaches that blend traditional practices with modern technology.

C. Balancing Technology, Culture, and Leadership

Successful digital transformation is a collaborative journey that requires active participation of people at all levels. Although technology provides tools and platforms for change, it is the people who drive, shape, and sustain that change. Recognizing this interconnectedness enables organizations to create a more holistic approach to digital transformation, ensuring that both technological and human factors are aligned for success. A skilled and confident workforce in the use of technology is vital to maximizing its potential.

The implementation of a technology-driven strategy should prioritize human needs. Sociotechnical system designs should aim to optimize both social and technical aspects, encouraging collective thinking and cultural alignment to build the necessary capabilities for successful digital transformations [11]. In the context of adapting to digitalization, culture and humane-centric design have higher priority. Successful digital tools are often designed with the user in mind. Engaging users during the design process ensures that the technology is intuitive and meets real-world demands, leading to higher adoption rates. Change management strategies, which involve communication, training, and support, are essential to help employees transition smoothly.

Transformation toward a digital culture must begin with the behavior of senior management [40]. On a broader scale, the promotion of a culture of innovation fosters an environment in which people feel comfortable experimenting with new ideas and technologies. Furthermore, user experience is a key determinant of whether technology is adopted successfully. Having an audit system [41] and establishing feedback channels allows organizations to adapt their digital strategies based on employee and customer insight. This responsiveness helps ensure that technology remains relevant and effective. Prioritizing user experience design ensures that technology enhances productivity rather than hinders it. Finally, leaders play an essential role in facilitating digital transformation [42–44]. Their commitment to the process can inspire others to engage and invest in the changes that are being made. Leaders who provide a clear vision and demonstrate the value of digital initiatives can motivate teams to embrace the transformation.

In conclusion, the synergy between technology push, society pull, and business leadership creates an interconnected framework that drives progress. Companies that understand and effectively manage these forces are better positioned to lead innovation, create value, and shape a future where technology benefits society. The balance between pushing the boundaries of what is possible, responding to societal needs, and maintaining a strong business vision is the key to success in the modern, ever-evolving landscape.

V. CHALLENGES IN DIGITAL TRANSFORMATION

As society continues to adopt digital technologies, it is crucial to prioritize ethical considerations and implement strong security measures to create a safe, inclusive digital environment. Here is a comprehensive overview of how these elements interconnect:

A. Security and Trust

As our lives become increasingly integrated with technology, the risk of cyber threats - such as data breaches, identity theft, and cyberbullying- also grows significantly [45]. This raises significant privacy concerns, as individuals may not fully understand how their information is used or how to protect it. Organizations and individuals must be aware of securing their digital presence [46]. Security breaches can undermine trust in digital platforms, leading to hesitance in online interactions. Users may become more cautious about sharing personal information or engaging with services that don't prioritize security.

A key aspect of a social system is the establishing of trust between devices, networks, and humans, with stakeholders needing control over the data they share. Raising awareness and providing education on identifying cybersecurity threats is essential for ensuring the security of both individuals and organizations. Individuals should be educated about safe online behaviors, such as using strong passwords, being careful with personal information, and understanding privacy settings, especially on social media. Secure verification techniques, such as multi-factor authentication, are essential to protect accounts and sensitive information from unauthorized access.

B. Security Threats

Information security management plays a vital role in ensuring the smooth operation of an organization by overseeing its information, personnel, and policies [47]. Digital transformation exposes individuals to various cybersecurity threats, such as phishing, malware, and identity theft. The *Equifax breach* and *Facebook-Cambridge Analytica scandal* both highlight major concerns over data

security and privacy, exposing vulnerabilities in how personal information is handled. Despite evolving security threats, emerging solutions like blockchain are proposed to address these challenges [48].

C. Data Protection and Ethics

Every online action contributes to an individual's digital footprint. Awareness of how personal information is shared and used can help individuals manage their online presence and protect their privacy. Furthermore, laws, strong privacy policies and regulations such as the General Data Protection Regulation (GDPR) is vital for safeguarding individuals' rights. Although GDPR aims to enhance personal data control and unify data protection across, challenges remain to ensure data privacy in other countries. These challenges highlight the need for a global approach to data protection. Furthermore, proposed protection rules must be regularly updated to integrate emerging technologies, such as artificial intelligence, to ensure that they remain effective in addressing new privacy concerns.

Ethical discussion is enhanced by incorporating established frameworks, including the European Commission's AI Ethics guidelines and the Association for Computing Machinery (ACM) code of ethics. The AI ethics guidelines emphasize principles like transparency, accountability, and respect for fundamental rights, offering a foundation for evaluating technologies against human-centric values. Meanwhile, the ACM code provides guidance on responsible conduct in computing, including commitments to avoid harm, protect privacy, and promote fairness [49]. With these frameworks, ethical analysis moves beyond general considerations to address concrete issues such as data governance, algorithmic bias, and compliance with regulations like the GDPR.

Ethical concerns in digital transformation involve data collection and informed consent [50], respect for user autonomy [51], and the risks of algorithmic bias in areas like social media and recruitment, which challenge fairness and equity. Unequal access to digital benefits raises issues of social justice and the need for inclusive policies. Responsible innovation requires transparency, user privacy, and inclusive design [52], while promoting digital literacy helps individuals make ethical and informed decisions. Regulatory bodies are essential in creating frameworks that uphold users' rights and ethical standards in digital environments.

D. Infrastructure

Critical infrastructures are vital assets for public safety, economic stability, and national security. However, their vulnerabilities have grown with the widespread adoption of information technologies. The human factor is often seen as the weakest link in a computer system, which makes professional training essential [53]. It is important not only to raise user awareness but also to equip technical personnel with the skills required to manage and implement the necessary protection measures.

Leaders in low-income regions often face challenges due to limited planning and understanding [54], while developed countries typically possess the infrastructure and resources to respond more effectively. In contrast, developing and underdeveloped nations require targeted investment, support, and capacity-building to strengthen their digital resilience. This disparity is summarized in Table 3.

For example, during COVID-19, the rapid move to online education exposed major digital gaps, especially in developing countries. Many low-income households lacked devices, and even with internet access, technical issues and unfamiliarity with tools created barriers. Unprepared governments and families deepened the educational divide, leading to lower motivation, engagement, and academic performance [55].

Table 3. Digital challenges across different countries considering developing metrics

Development Status		Challenges
Developed Countries	Infrastructure	Advanced digital infrastructure with widespread internet and high-speed connectivity.
	Digital Literacy	High digital literacy facilitates engagement with technology and innovation.
	Regulatory Frameworks	Strong data protection and cybersecurity regulations, though compliance can be challenging.
	Investment in Technology	More resources for cybersecurity measures and technological advancements.
	Security Challenges	Faces sophisticated cyber threats but has robust defenses and response capabilities.
Developing Countries	Infrastructure	Uneven digital infrastructure: urban areas typically have better access than rural regions.
	Digital Literacy	Varying levels of digital literacy, with some lacking training and resources.
	Regulatory Frameworks	Existing regulations often lack enforcement and may not keep pace with technology.
	Investment in Technology	Limited resources for cybersecurity and digital tools increase vulnerability.
	Security Challenges	Prevalent cybersecurity threats with less awareness and resources to combat them.
Undeveloped Countries	Infrastructure	Lack of basic digital infrastructure leads to minimal internet access and poor connectivity.
	Digital Literacy	Low digital literacy limits engagement with technology and economic opportunities.
	Regulatory Frameworks	Little to no regulatory framework for data protection and cybersecurity.
	Investment in Technology	Limited financial resources impede progress in digital transformation efforts.
	Security Challenges	Minimal cybersecurity measures make these countries highly vulnerable to threats.

Additionally, the digital divide [56] highlights systemic inequalities, demonstrating how socioeconomic status profoundly influences access to education. The digital divide highlights the gap between people with sufficient access to Information and Communication Technology (ICT) and those with limited or no access [57]. In many cases, students from disadvantaged backgrounds fell further behind their peers, raising concerns about the long-term implications for

their future opportunities. To address these challenges, policymakers must invest in infrastructure that ensures equitable access to education. This involves not only providing devices and Internet connectivity but also training teachers to effectively deliver online instruction.

VI. DISCUSSION

In this section, we provide a brief review of existing research focusing on the effective use of social networks, such as WhatsApp and Instagram, by various demographic groups. The key research questions driving this study are: i) What is the average amount of time individuals spend on social media per day? ii) How do social media usage patterns vary based on factors such as age, gender, or occupation?

A. Research Design

This study employed a quantitative, cross-sectional survey designed to assess attitudes, behaviors, or perceptions across different demographic and professional groups. The design was chosen to allow for statistical comparison between participant categories and to capture a broad overview of patterns within the population.

B. Participation and Sampling

Table 4 presents detailed information about the groups interviewed, who reside in two different counties. The sample study include individuals with varying levels of experience in using social networks, focusing on both the time spent and the efficiency of their use. Participants ranged in age from 15 to 50 years, with a total of 185 males (61.7%) and 115 females (38.3%). University students made up the largest share of participants (55%), followed by industry professionals (15%) and school students (13.4%). This distribution ensured a broad and diverse representation of educational and professional backgrounds relevant to the study's goals.

Table 4. The sample study with experience of social network

Participation	Age	Male	Female	Count	%
School students	15–18	19	21	40	13.4
University students	19–23	102	63	165	55.0
School teacher	25–50	26	10	36	12
University Prof.	30–60	11	3	14	4.6
Industry & business	25–50	27	18	45	15.0
Total		**185**	**115**	**300**	**100**

C. Data Collection and Analysis

Data was collected through a structured questionnaire (or interview). The instrument consisted of both closed-ended and demographic questions designed to measure specific variables relevant to the study. Data were analyzed using descriptive statistical methods to summarize participant demographics and group distributions. Statistical analysis was conducted using Microsoft Excel and charts were generated to visualize group sizes and gender ratios.

D. Ethical Consideration

Participation in the study was voluntary. All participants gave informed consent prior to participation. Participants' identities were anonymized, and data were handled with strict confidentiality.

Fig. 3 shows the distribution of time spent on social networks. Effective usage refers to participants who reported using social media purposefully- for tasks such as communication, learning, or professional networking- while passive browsing includes those who primarily scroll or consume content without a clear goal. We found that most people use WhatsApp more productively for calls and data exchange, while Instagram is mainly used for browsing and social interaction. As observed, students at both school and university levels spend significantly more time on social media compared to other groups. However, the data indicates that only 30% of school students and 54.9% of university students consider their online activity to be productive or useful. Across all groups, there is a shared concern about media addiction, particularly linked to Instagram. Promoting self-regulation, mindful habits, and supportive community features may help reduce excessive use.
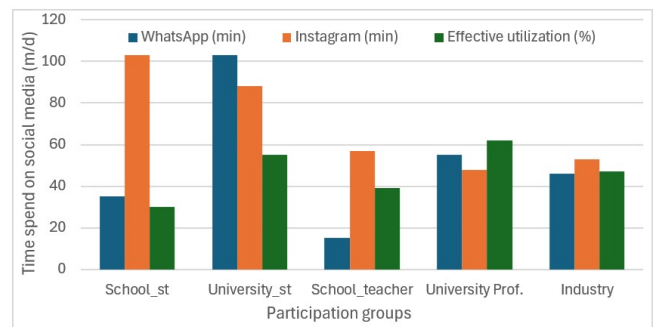

Fig. 3. Distribution of social media usage among participants.

Effective usage refers to participants who reported using social media purposefully. This does not rely on specific metrics to measure effectiveness; it only reflects user perceptions and beliefs.

VII. CONCLUSION

In the evolving landscape of digital transformation, agility is essential for adapting to continuous innovation across sectors such as business, education, and healthcare. This study explores key themes to offer an abstract overview of the factors shaping digital transformation, with emphasis on both technological and societal influences. Although this study is not comprehensive, it aims to encourage future research that continues to explore and refine these concepts, examining how they interact across contexts and contribute to the broader transformation of industries and societies.

We also introduced a simple case study comparing user activity across two Apps, considering different age, gender, and education groups selected randomly. Our findings show that, in general, Instagram users are more passive, using the app less effectively, primarily consuming content rather than engaging in active communication. This passive behavior may be influenced by the platform's visual design, which prioritizes scrolling and viewing over direct interaction.

While the case study has limitations in terms of generalizability, future work could expand to include a wider range of participants from diverse countries.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization, R.K; methodology, R.K; investigation, R.K, M.I; writing-original draft preparation, R.K; writing-review and editing, R.K, M.I.; Visualization, R.K; All authors have read and agreed to the published version of the manuscript. All authors had approved the final version.

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