

A literature Review of Research on The Development of Digital Technologies

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Abstract: The rapid development of the digital economy has driven transformative changes in digital technologies. This study aims to systematically examine the evolutionary trajectory of digital technology development by first analyzing its conceptual definitions and characteristic features. Based on an extensive collection and review of relevant literature, we employ a literature analysis approach to synthesize existing research on digital technology advancement. Specifically, this investigation explores the interconnections between digital technologies and six critical domains: 1) industrial restructuring, 2) high-quality economic development, 3) manufacturing transformation, 4) innovation ecosystems, 5) carbon peaking/neutrality goals, and 6) social governance mechanisms. A critical review is subsequently conducted to identify research gaps and propose future directions.

Keywords: Digital technology; Development.

1. Introduction

The new wave of technological revolution is accelerating scientific advancement, generating transformative impacts across multiple domains including industrial restructuring, economic progression, manufacturing evolution, innovation ecosystems, green transition, and social governance. This integration process, where digital technologies facilitate systematic transformations across these sectors, is defined as digital transformation. Fundamentally rooted in technological advancement, this paradigm is operationalized through innovative applications and strategically oriented toward driving systemic change.

Digital technologies have undergone significant evolution from foundational computing architectures to sophisticated network infrastructures and advanced data processing systems. Early-stage research primarily focused on computer hardware and basic software development (1950s-1990s), while contemporary investigations (post-2000s) have shifted toward ubiquitous connectivity solutions, big data analytics, and intelligent applications, fueled by widespread adoption of Internet and mobile communication technologies [21].

The theoretical framework reveals that digital technology development transcends mere technical progress, constituting a socio-economic reconfiguration process. Notably, digital transformation has emerged as a pivotal determinant of corporate competitiveness, fundamentally altering operational paradigms while redefining market dynamics and consumer engagement patterns [22]. Furthermore, these technologies have catalyzed novel business architectures including cloud-based service models and AI-driven personalization systems.

Methodologically, contemporary studies employ interdisciplinary approaches combining computational analytics, predictive modeling, and simulation experiments, enabling comprehensive assessment of technological trajectories and their societal implications [23]. This multidimensional advancement encompasses three synergistic dimensions: technological innovation, theoretical refinement, and practical implementation.

Future research priorities should address two critical challenges: 1) optimizing digital technologies' societal value-

creation mechanisms, and 2) developing ethical governance frameworks to mitigate emerging risks in data security and algorithmic accountability. Organization of the Text

2. Conceptual Definition of Digital Technologies

Digital technologies refer to ICT-embedded or ICT-enabled products/services comprising digital components, platforms, and infrastructure, characterized by programmability, scalability, openness, and interconnectivity (Cai et al., 2019; Chen et al., 2021) [1-2]. These technologies leverage information and communication technologies (ICT) to efficiently process knowledge and information, enabling cross-spatiotemporal information dissemination, data generation, and transaction cost reduction (Liu & Chen, 2022) [3].

2.1. Technological Perspectives

From a technical standpoint, digital technologies encompass cutting-edge innovations including big data, cloud computing, and artificial intelligence (AI), which collectively drive rapid advancements in digital entrepreneurship [24]. Digital electronics, as a critical subset, exemplifies their role in enhancing operational efficiency and scientific progress. The evolution of digital information technologies has fundamentally transformed both the typology of information resources and their dissemination mechanisms, while significantly boosting societal productivity.

2.2. Socioeconomic-Cultural Dimensions

As the foundational enabler of the digital economy, digital technologies create novel value paradigms through digital industry innovation and cross-sectoral integration. Digital transformation constitutes a pivotal marker of modern society's transition toward post-industrialization, emphasizing knowledge and information as fundamental socioeconomic resources [50]. Concurrently, their development necessitates multidimensional analysis of digital society concepts through philosophical, cultural, and political lenses to comprehend societal impacts [25].

2.3. Methodological Frameworks

Theoretical investigation requires interdisciplinary methodologies integrating quantitative and qualitative analytical frameworks to holistically understand digital technologies' conceptual dimensions and societal ramifications [26]. For instance, model-based digital definition technologies demonstrate manufacturing applications through synchronized three-dimensional spatial dimension tolerance marking and manufacturing requirement annotation, enabling standardized product characterization.

2.4. Human-Technology Nexus

Digital technologies have redefined human-machine interaction paradigms, fostering open societies and citizen-centric governance [49]. The concept of digital competencies emphasizes individual/societal adaptability to digital realities, proving crucial for designing innovation roadmaps and transformation initiatives [27].

3. Research on the Development of Digital Technologies

Digital technology is a critical technology related to national welfare, social development, and economic growth. It transcends spatial barriers, mitigates information asymmetry, enhances global connectivity, and improves work efficiency, making it a vital means of enhancing core competitiveness in the digital era [48]. From the perspective of digital technology's impact, a review of existing literature reveals that research on digital technologies primarily focuses on the following aspects:

3.1. Digital Technology and Industrial Structure

Digital technology has significantly accelerated industrial digitization, structurally transforming and upgrading traditional industries through digital empowerment. By deeply integrating with conventional sectors, it facilitates comprehensive industrial modernization, fosters the emergence of new industries, and drives structural optimization [47].

The application of digital technology presents new challenges to traditional industries, prompting theoretical innovation and practical transformation [42]. It reshapes business models and strategies by creating new products, services, and business formats, empowering the real economy through integration, optimizing industrial structures, and promoting high-quality economic development (Yan Zichun et al., 2020) [4]. A multi-sector Schumpeterian endogenous growth dynamic stochastic general equilibrium (DSGE) model incorporating digital technology reveals heterogeneous effects on industrial transformation: long-term structural adjustments in production sectors and short-term alleviation of financing constraints in financial sectors, thereby driving high-tech development and high-quality industrial upgrading (Tian Xiujuan & Li Rui, 2022) [5].

3.2. Digital Technology and High-Quality Economic Development

Digital technology serves as a catalyst for economic growth and an essential tool for enhancing productivity in the digital age. It has been widely adopted across primary, secondary, and tertiary industries, streamlining production, management, and service processes to improve efficiency and economic

performance [46].

Regional coordinated development is a cornerstone of high-quality growth, a prerequisite for common prosperity, and a key element in advancing Chinese-style modernization. The rapid progress of digital technology has revolutionized inter-regional factor flows and resource allocation [43]. High-quality development is the primary task in building a modern socialist society, while the digital economy—a new economic paradigm characterized by high innovation, strong permeability, and broad coverage—generates spillover, agglomeration, and leading effects [34]. In the digital economy era, "data + algorithms + computing power" dominate the high end of the value chain, serving as the core force driving innovation and high-quality economic growth [35].

Emerging digital technologies, as the core driver of the digital economy, exhibit a significant positive impact on high-quality development (Ren Zhuanzhuan & Deng Feng, 2021) [6]. They reshape production and business models, enhance resource allocation efficiency, reduce transaction costs through disintermediation, and ensure transparency, thereby improving socioeconomic efficiency (Yi Xianrong et al., 2019) [7]. Digital technology substantially boosts total factor productivity (TFP) and serves as a catalyst for industrialization. Therefore, accelerating its integration with the real economy is crucial to prevent economic "hollowing-out," foster industrial growth, and establish a policy-supported "accelerator" for digital innovation (Wang Youwen & Dong Shengzhong, 2021) [8].

3.3. Digital Technology and Manufacturing

Digital technology is a key driver of TFP growth in manufacturing, providing favorable conditions for industrial development and optimizing resource allocation. Deepening the integration of digital technology with manufacturing is essential for enhancing competitiveness and achieving high-quality development [36].

Under the trend of digital-real integration, merging the digital economy with manufacturing is a critical pathway for industrial upgrading [37]. Digital innovation significantly improves green TFP in manufacturing, exhibiting a nonlinear relationship with a single threshold effect based on environmental regulation intensity. Below the threshold, digital innovation strongly promotes green TFP growth, whereas its effect diminishes beyond the threshold [38].

Digital technology enhances manufacturing productivity by altering value creation methods, improving efficiency, expanding value carriers, and strengthening value capture capabilities (Lü Tie & Li Zaichi, 2021) [9]. While it serves as a new engine for TFP growth, its impact varies across industries, and mismatched applications may waste resources (Chen Nan & Cai Yuezhou, 2021; Liu Pingfeng & Zhang Wang, 2021) [10–11]. Additionally, digital tools like big data and cloud computing significantly boost innovation efficiency, with spillover effects amplified by higher technological levels (Du Chuanzhong & Jiang Ying, 2022) [12].

3.4. Digital Technology and Innovation & Entrepreneurship

Digital technology breaks traditional boundaries in innovation and entrepreneurship, interlinking production activities, industries, and enterprises. It enables precise demand analysis, fosters creativity, and accelerates entrepreneurial processes [28].

While digital technology reduces entry barriers and risks for entrepreneurs, its openness also increases uncertainty (Cai Li, 2019) [1]. It directly and indirectly enhances innovation performance, mediated by employee participation (Wang Haihua & Du Mei, 2021) [13]. However, disparities exist, with state-owned and large enterprises benefiting more due to digital resource advantages (Wen Huwei & Wang Shengyun, 2022) [14]. Regional "digital divides" persist, particularly between eastern/central and western China [32].

3.5. Digital Technology and Carbon Peaking/Carbon Neutrality

Achieving "dual carbon" goals relies on digital-driven innovation. Digital technology facilitates energy restructuring, industrial transformation, and market potential activation [29].

Its integration into energy and environmental sectors enables emission reduction, though challenges remain in carbon footprint monitoring (Liu Jingling & Chen Yanying, 2021; Chen Xiaohong et al., 2021) [2–3]. AI-powered zero-carbon energy systems (CES) demonstrate efficiency improvements [39].

3.6. Digital Technology and Social Governance

Digital transformation, driven by AI, blockchain, and big data, reshapes governance structures and enhances public participation [44]. Challenges include fragmented platforms and talent shortages, necessitating investments in digital infrastructure and skill development [30–31].

4. Conclusion

Human society has now entered the digital age, where digital technologies have become deeply intertwined with all aspects of production and daily life. Foundational tools such as big data, cloud computing, and artificial intelligence are emerging as new engines for economic growth. Research on digital technologies has proliferated in recent years, with increasingly refined perspectives and methodologies. Current studies predominantly employ a combination of qualitative and quantitative approaches to examine the societal and productive impacts of digital technologies, focusing on six key areas: (1) industrial structure optimization, (2) high-quality economic development, (3) deep integration with manufacturing, (4) innovation and entrepreneurship enhancement, (5) support for dual carbon goals, and (6) empowerment of social governance [45].

Building on this foundation, several critical research directions emerge:

First, while existing literature provides substantial coverage of digital technology's role in manufacturing development and industrial restructuring, significant gaps remain in other domains. Particularly underexplored are two high-impact areas: (a) the mechanisms through which digital technologies facilitate carbon peaking/neutrality goals, and (b) their transformative potential (and accompanying challenges) in social governance systems. These represent vital avenues for future scholarly inquiry.

Second, current research exhibits a pronounced emphasis on digital technology's positive impacts while largely neglecting its disruptive challenges. The rapid evolution of digital capabilities has created an adaptation gap - neither individuals, enterprises, nor governments can immediately assimilate these innovations. The protracted process of transforming cutting-edge digital solutions into universally

accessible technologies warrants systematic investigation. This "creative destruction storm," with its complex socioeconomic ramifications, constitutes a crucial yet understudied phenomenon.

The tension between technological acceleration and societal adaptation capacity suggests the need for new theoretical frameworks that account for implementation lags, skill mismatches, and institutional inertia. Future research should particularly examine: (1) the temporal dimension of digital technology diffusion, (2) barriers to equitable technology access, and (3) mitigation strategies for disruption-induced inequalities. Such investigations would provide critical insights for policymakers navigating the digital transition.

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