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Capsule Networks and Innovation Performance in Resource-Based Firms

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ABSTRACT

Resource-based enterprises face increasing pressure to address resource challenges amid global issues. This paper explores how digital transformation can enhance their sustainability, economic efficiency, and innovation performance. The authors propose a model combining a capsule network (CapsNet) with adaptive stochastic gradient descent optimization (ASGDO) to analyze the impact of digital transformation. The study involves data collection, preprocessing, and the development of an optimized CapsNet enhanced by ASGDO for performance prediction. The results, compared with existing methods, show that the proposed model achieves 95.5% accuracy, demonstrating its potential to significantly improve the performance of resource-based enterprises.

KEYWORDS

Adaptive Stochastic Gradient Descent Optimization (ASGDO), CapsNet, Digital Transformation, Innovation Performance, Resource-Based Enterprises

INTRODUCTION

In today's fast-evolving digital landscape, resource-based enterprises face increasing pressure to address initial resource challenges and global issues such as environmental sustainability and economic efficiency (Afaishat et al., 2022). Digital transformation is crucial for enhancing productivity, improving resource efficiency, and boosting innovation (Aljahdaly & Balubaid, 2020). Technologies like artificial intelligence (AI), the Internet of Things (IoT), and big data analytics can significantly reduce the environmental impact and resource waste of organizations. A data sharing platform powered by these technologies bridges the knowledge gap between the business and public sectors, accelerating innovation (Attaran & Attaran, 2020).

Automated data collection and processing through digital technology enhances the innovation efficiency of industrial firms, allowing for cost reduction and process optimization. IoT and digital components enable real-time monitoring and AI-enhanced production lines, providing a competitive edge through extensive data acquisition (Frankvijay, 2020). Standardizing technical knowledge sharing across product design teams can also reduce development costs (Kannadasan, 2022).

Traditional corporate activities have had significant negative environmental impacts, making the transition to green development essential (Katuu, 2020). China has successfully implemented various digital applications, such as digital monitoring and energy conservation, in line with its commitment to

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green development (Naseri & Momtazi, 2023). Despite the challenges, digital technology offers new opportunities for responsible growth, facilitating the efficient transfer of green innovation resources.

This study aims to analyze the impact of digital transformation on the performance of resource-based enterprises in China. By leveraging capsule networks (CapsNets) and adaptive stochastic gradient descent optimization (ASGDO), the research seeks to enhance the cognitive and intelligent capabilities of these enterprises. The proposed model will be compared with existing methods to evaluate its effectiveness, providing a robust framework for understanding and enhancing the performance of resource-based enterprises in the context of digital transformation.

LITERATURE REVIEW

Recent advancements in artificial neural networks have shown significant potential in simulating human cognitive processes. CapsNets represent a novel approach by using vector outputs to capture the instantiation parameters of objects, thus providing a more robust representation. The integration of ASGDO further enhances the learning process, making it more adaptive and efficient.

In today's rapidly evolving digital world, wealthy Chinese business enterprises face increasing pressures to address initial resource challenges while also responding to global issues such as environmental sustainability and economic efficiency. The integration of modern technologies at every level of business operations is crucial for enhancing workplace productivity and efficiency. Digital transformation provides a powerful means to achieve overall sustainable development, improve resource efficiency, and boost the innovation performance of these enterprises (Pawan & Rajan, 2022; Doerig et al., 2020; Hinton, 2023; Han et al., 2023).

Impact of Digital Technologies on Businesses

The rapid pace of technological change has made it imperative for wealthy Chinese business enterprises to adapt and innovate. Digital technologies, including AI, IoT, and big data analytics, can significantly reduce the environmental impact and resource waste of organizations. For example, AI and machine learning algorithms can optimize energy consumption, predict maintenance needs, and enhance supply chain management. A data-sharing platform based on digital technology helps bridge the knowledge gap between the business and public sectors, facilitating innovation by reducing the time between iterations and increasing the frequency with which new ideas are examined during product development (Khan & Abonyi, 2022; Rathore et al., 2021). Adopting digital technology that enables more automated data collection and processing has been shown to boost the innovation efficiency of industrial firms. By focusing on optimizing specific manufacturing process steps, businesses can improve innovation and reduce costs (Khalid, 2024; Teng et al., 2021; Tsolakis et al., 2022).

Environmental Sustainability and Resource Efficiency

Digital solutions not only enhance operational efficiency but also play a critical role in promoting environmental sustainability. The combination of IoT-enabled smart materials and digital components allows for the monitoring and control of the unique properties of objects and products, enabling the construction of AI-enhanced production lines and streamlining the manufacturing process (Tsolakis et al., 2023; El Jaouhari et al., 2023). The use of sensors and wireless technology in the workplace allows businesses to acquire vast amounts of information during the manufacturing process, providing a competitive advantage (Liu et al., 2023). Digital solutions facilitate the collection, mining, utilization, and sharing of data by firms' product development teams, leading to faster and more diverse product creation. Standardizing the sharing of technical knowledge across product design teams helps businesses to save money on product development (Lerman et al., 2022; Malagnino et al., 2021; Mohamed et al., 2024).