Digital Business Innovation in 21st- Century Thailand

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Abstract

This qualitative research aims to study the characteristics of digital business innovation in 21st century Thailand. In addition to the content analysis methods used to identify trends and patterns in the data obtained and evaluate content performance insights and content customization, a content management system was employed to test and verify new business ideas and innovations and content creation and curation. The credibility of the data was analyzed with an inductive analysis method combined with comparative event analysis for a triangular check. All the findings point to the same direction. The body of knowledge discovered was repeatedly proven, a sufficient condition to conclude that the information obtained was true. The research results revealed that digital business innovations consist of artificial intelligence and machine learning technology, the internet of things, blockchain, cloud computing, digital marketing, augmented reality, virtual reality, big data, and 3D printing.

Keywords: AI, IoT, Digital Business, Digital Innovation, Cloud Computing, Digital Thailand

1. Introduction

Digital business innovation, which broadly speaking, refers to new and emerging technologies, strategies, and practices that are transforming the way companies operate in the digital age, such as artificial intelligence (AI), the internet of things (IoT), and blockchain (Andal-Ancion, Cartwright, & Yip, 2003; Jitvirat, 2018a; Jitvirat, 2018b), has the potential to be a key driver of growth in Thailand through the creation of new sectors of activities, the improvement of productivity of existing industries, and novel solutions to social and environmental challenges such as poverty, health care, and climate change (Jitvirat, 2018b; Jitvirat, 2022c; NSTDA, 2017). It can also contribute to the promotion of entrepreneurship by fostering a culture of innovation and investment in R&D (Jitvirat, 2018d; NECTEC, 2016) and therefore help to reduce costs, increase efficiency, and enhance product and service quality, thereby making Thai businesses more competitive in the global market (Jitvirat, 2022a, Jitvirat, 2022b). Innovation and the development of new technologies and approaches have the potential to shape the future of Thailand in several ways. To begin with, they are driving the digital transformation of Thailand's economy. The focus is on developing new technologies and promoting the adoption of digital solutions (Jitvirat, 2018e; Jitvirat, 2019). These include government-led initiatives such as Thailand 4.0 policy, which aims to transform Thailand into a high-income knowledge-based economy (The Secretariat of The Prime Minister, 2017). This includes initiatives such as the development of the Eastern Economic Corridor (EEC), whose objective is to create a hub for technology and innovation in Eastern Thailand (Eastern Economic Corridor (EEC) Office, 2019). Innovation is also shaping the development of smart cities in Thailand. The focus in this case is on utilizing technology to improve the quality of life of people. Moreover, innovation is driving the transformation of Thailand's healthcare system. The goal is to promote digital health solutions and improve access to healthcare for all citizens through initiatives such as the development of a telemedicine system and digital health platforms. (National Digital Health Agency (NDHA), 2022).

In addition, innovation is shaping Thailand's approach towards sustainability. The focus is on promoting green technology and sustainable development through, for example, the development of renewable energy and the promotion of circular economy practices (NXPO, 2021a) as well as expansion of smart farming (OPSMOAC, 2021). Finally, innovation is driving the transformation of Thailand's educational system. Efforts center on promoting digital literacy and Science Technology Engineering Mathematics (STEM) education and includes initiatives such as innovation development and entrepreneurship programs at universities and high schools (NXPO, 2021b). Clearly, digital business innovation has the potential to shape Thailand's future. However, the extent of the country's digital transformation largely depends on Thailand's digital transformation policies and the government and business levels of involvement (Jitvirat, 2018e; Jitvirat, 2019). While there is no lack of vision and goodwill, the key is for action to match the vision and capitalize on the enthusiasm and energy which these projects have galvanized. To understand the future digital business models envisioned in Thailand, it is necessary first to develop a solid grasp of the range of innovations available as a whole, which is precisely what this paper seeks to do. So far, only some of these innovations have been studied separately in the context of Thailand and many of them have only been studied from particular perspectives (e.g., Imprasert, 2022; Polsamak, 2021; Wongtha, 2020) Specifically, this research aims to explore the main characteristics of digital business innovation in 21st-century Thailand. The focus is on the digital technology of the future. It seeks to address the following research questions: What does digital business innovation in 21st-century Thailand in terms of cutting-edge digital technology consists of?

2. Literature Review
- *New Trends Shaping Business*
The world is constantly changing and evolving. So is the business landscape (Liguori & Pittz, 2020). Some of the trends that are shaping future businesses include:

- *Changing Consumer Behaviors:* The rise of e-commerce and changing consumer preferences will continue to shape business models. Companies that can effectively engage with their customers online and personalize their offerings are likely to be more successful (Morabito, 2014).

- *Globalization:* The world is becoming more connected, and businesses must adapt to operate in an ever-increasing global marketplace. Companies that can effectively adopt different cultures, languages, and regulatory frameworks have a competitive advantage (Zeibote, Volkova, & Todorov, 2019).

- *Workforce Diversity: As society* becomes more diverse, businesses must adapt to ensure that their available workforce reflects the community they are serving. Companies that foster diversity and inclusion are better positioned to attract and retain top talent (Chaudhry, Paquibut, & Tunio, 2021).

- *Sustainability:* With growing concerns about climate change and environmental degradation, sustainability will become an important consideration for businesses (Kolling, Ribeiro, & de Medeiros, 2022). Companies that adopt sustainable practices and reduce their carbon footprint are in a better position to attract customers and investors who value environmental responsibility (Dirican, 2015).

In response to changing social trends and technological advancements, companies need to anticipate changes in the market, adapt to new trends, and innovate (Moktadir et al, 2020). This requires them to analyze the business environment to make informed decisions about their strategies, investments, and resource allocation (Sia, Soh, & Weill, 2016). This also requires them to identify potential opportunities and threats and adjust their operations accordingly in order to remain competitive and sustainable (Goyal, Sergi, & Esposito, 2019).

- Digital Transformation

Digital transformation is the process of adopting digital technology to automate and streamline business processes (Kraus et al, 2021). It is already changing the way business is done (Ismail, Khater, & Zaki, 2017). It helps companies leverage digital technology to create new business models, increase revenue streams, and improve customer experience (Kotarba, 2018). For example, a retailer\ with traditional brick-and-mortar stores may undergo digital transformation by implementing cloud-based inventory management systems, using data analytics to optimize prices and promotions, and offering mobile payment options to customers. A retailer may also build mobile apps that allow customers to browse and purchase products from their smartphones and use an omnichannel strategy that combines online and offline sales channels (Ziyadin, Suieubayeva, & Utegenova, 2020). In addition, a retailer can leverage social media and influencer marketing to engage with customers (Remane et al., 2017). These digital business strategies can help retailers generate new revenue and expand their customer base. Companies that have failed to embrace digital technologies will face challenges in their future competitiveness and survival (Bertoni et al., 2022).

- Digital Businesses

Broadly speaking, a digital business is a company that mainly operates through digital channels using digital technology to provide products or services to customers (Senyo, Liu, & Effah, 2019). In other words, core operations of the company such as marketing, sales, customer support, and supply chain management proceed online, typically through an e-commerce platform, or other digital platforms (Chen et al., 2021; Senyo et al., 2019). Digital businesses are generally more streamlined than traditional ones (Davidovici-Nora, 2014). Moreover, since they can collect and analyze large amounts of data in real time, they are able to quickly adapt to market changes, make informed decisions and improve operational efficiency (Berghaus & Back, 2016). This also enables digital businesses to offer customers a more personalized experience because businesses can use data and analytics to better understand their needs and preferences (Kreutzer, Neugebauer, & Pattloch, 2017).

- Digital Business Innovation

Digital business innovation refers to new and emerging technologies, strategies, and practices that are transforming the way companies operate in the digital age (Andal-Ancion et al., 2003). Digital business innovation is leading to significant changes in the business landscape, making companies competitive (Morabito, 2016) and meeting the evolving needs of customers in the digital age (Gupta, Mejia, & Kajikawa, 2019). These innovations are driving digital transformation and helping companies to create new business models, improve operational efficiency and enhance the customer experience (Loureiro, Guerreiro, & Tussyadiah, 2021; Nwankpa, Roumani, & Datta, 2022). Examples of digital business innovation include:

- *Artificial Intelligence*: AI refers to the development of intelligent machines capable of performing tasks that typically require human intelligence, such as image recognition, speech recognition, decision-making, and language translation (Di Vaio et al., 2020). It also includes machine learning natural language processing computer vision and robotics (Akerkar, 2019).

- *The Internet of Things:* The internet of things refers to a network of connected devices that can exchange data and communicate with each other (Westerlund, Leminen, & Rajahonka, 2014). It is used to create smart products and services, optimize supply chain management, and enhance the customer experience (Preety & Kpereobong, 2021).

- *Blockchain*: Blockchain is a distributed digital ledger technology that enables secure transactions (Queralta et al., 2023). It provides a safe, transparent, and decentralized alternative to the traditional financial system and protection against intrusion without the need for an intermediary. Blockchain technology has the potential to revolutionize the way transactions are made (Khan et al., 2023).

- *Cloud Computing*: Broadly, cloud computing can be defined as the delivery of computer services (Abdalla & Varol, 2019). It includes server storage, databases, software, and other resources, on the internet and allows users to access these resources as needed, without the need for on-site infrastructure or technical expertise (Stock et al., 2014).

- *Digital Marketing:* Digital marketing refers to the use of digital channels such as search engines, social media, email, mobile apps, and other digital platforms to promote products or services to potential customers (Alwan & Alshurideh, 2022). Digital marketing techniques generally consist of a combination of paid and organic methods. Digital marketing is becoming increasingly important for businesses of all sizes and industries, as consumers spend more time online and use digital channels to research, compare, and purchase products and services (Kingsnorth, 2022). Effective digital marketing strategies can help businesses reach their target audience, increase brand awareness, drive website traffic, and generate leads and sales (Wuisan & Handra, 2023).

- *Small, Mid-size, Big Firms and Digital Innovation*

Digital innovation is transforming all businesses, be they small, medium, and large (Crupi, et al., 2020; Nambisan, Wright & Feldman, 2019). While the specific strategies and technologies used may vary widely depending on the size and industry of the business, the main goal remains the same: to take advantage of digital innovation to increase competitiveness, improve operational efficiency, and deliver value to customers (Gil-Gomez, et at., 2020). Digital innovation can impact their respective business operations as follows:

- *Small Businesses* – Digital innovation provides small businesses with new opportunities to compete with larger corporations (Akpan, Udoh, & Adebisi, 2022) and helps them reach a wider audience through digital marketing channels, (Chen et al., 2021) and build an online presence and engage with customers on various digital platforms (Mendling, Pentland, & Recker, 2020). Small businesses can leverage digital tools and technologies to streamline their operations, automate processes, and improve performance (Winarsih, Indriastuti, & Fuad, 2021). For example, mobiles can help them manage their offices, inventory, and customer relationships more efficiently. Digital innovations can also open up new markets and revenue streams for small businesses by enabling e-commerce capabilities and expanding their customer base beyond geographical boundaries (Akpan et al., 2022; Scuotto et al., 2017).

- *Mid-size Businesses* – Mid-size businesses often face challenges expanding their operations and remaining agile and competitive. Digital innovation can help them overcome these challenges by optimizing business processes, increasing productivity, and improving customer experience (Delgado et al., 2019). Mid-size businesses can also leverage advanced analytics and data-driven insights to make informed business decisions (Liopis-Albert, Rubio, & Valero, 2021), identify market trends (Priyono, Moin, & Putri, 2020), improve internal communications and facilitate teamwork (Yang et al., 2022), and personalize the offer of digital tools such as

customer relationship management (CRM) project management software and collaboration platforms (Delgado et al., 2019; Matt & Rauch, 2020).

Additionally, they can explore emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and blockchain to build a competitive advantage in their industry (Gurgu et al., 2019).

- *Large Business*es – Digital innovation is often a key strategy for large enterprises to stay at the forefront of their industries as they can leverage their vast resources and scale to adopt advanced technologies, invest in R&D, collaborations, and acquisitions to drive digital transformation, and build complex digital ecosystems (Akter et al., 2022; Senyo et al., 2019). For instance, they can leverage big data analytics to gain insights into customer behavior (Chae, 2019), optimize supply chain management (Coskun-Setirek & Tanrikulu, 2021), and improve operational efficiency (Akter et al., 2022). They can also adopt automation, robotics, and AI to improve their production processes and quality control (Goel & Gupta, 2020). In addition, digital innovation has enabled large companies to explore new business models such as subscription-based services and platform ecosystem (Rohn, et al., 2021). In summary, digital business innovation helps small businesses grow and compete; mid-size ones, scale and adapt, and large ones drive innovation and maintain market leadership.

3. Research Methodology

This qualitative research used Content Analysis together with a Content Management System (CMS). Content Analysis was utilized to identify trends and patterns in the data, and identify content performance insights, and content customization. The CMS was then applied to test and validate new business ideas and digital innovations (Gay, 2019; Kumar et al., 2022; Salleh et al., 2022; Vidmar, Marolt, & Pucihar, 2021). As one of the research tools used in this study, the CMS consisted of WordPress, Squarespace, Wix, and Shopify. Record forms were also utilized to collect information from the Internet. They contained codes and annotations that help organize the data gathered from observations. A third research tool was keywords such as Google Keyword Planner, Google Trend, and Ubersuggest.

- *Data Collection*

Data collection was divided into the following three phases:

- *March 2017-October 2022:* Data was collected from domestic and international research articles, academic journals, conferences, and documents about digital business innovation entrepreneurship. The focus was on online or digital business entrepreneurs who use digital technology innovation and, on their characteristics and behaviors and the challenges they face.

- *February 2019-December 2022:* The researcher collected data from more than 250 domestic and international case studies with specific innovative digital technology adoption at their core. They provided additional insights into the experiences, strategies, and challenges faced by these innovative digital business entrepreneurs and valuable stories and real-life examples.

- *March 2019-December 2022:* During this period data was collected using CMS to develop websites linked to various digital platforms, both domestically and abroad, to test and validate the concept of digital innovation in practice.

- *Data Analysis*

The data obtained from the record form and the CMS were analyzed together using inductive analysis and event comparative analysis and their credibility verified by a triangular audit method. The results strongly suggested that the information was going in the same direction. Since the body of knowledge discovered was proven repeatedly, the level of confidence in the information received could be deemed to be high and a necessary and sufficient condition to conclude that it reflected the truth.

4. Findings

Findings on the characteristics of digital business innovation pertain to the following items: (i) artificial intelligence and machine learning, (ii) the internet of things, (iii) blockchain, (iv) cloud computing, (v) digital marketing, (vi) augmented reality, (vii) virtual reality, (viii) big data, and (ix) 3D printing. Although for didactic purposes, they are discussed separately, they are often used simultaneously to achieve a particular objective and reinforce one another.

(i) Artificial Intelligence and Machine Learning

Artificial intelligence (AI) and machine learning (ML) can be used to automate business processes, improve efficiency, personalize customer experience, and analyze large volumes of data to uncover insights and improve decision-making. They can be applied to digital businesses in the following ways:

- *Human Resources*: AI and ML can be used to automate human resource management tasks. This gives HR professionals more time to focus on tasks at a higher level. Moreover, automated workforce planning helps organizations plan for future workforce needs and avoid skills gaps.

- *Personalization*: AI and ML can be used to analyze customer data and automatically provide personalized recommendations, promotions, and ads, to create a personalized experience tailored to the needs and preferences of each customer, thereby increasing customer satisfaction and loyalty.

- *Customer Service:* AI-powered chatbots can automatically serve customers 24/7, improve response times and reduce the workload for human agents, which not only increases customer satisfaction and loyalty, but also helps organizations reduce customer service costs and improve efficiency by handling large volumes of customer inquiries without human intervention.

- *Supply Chain Optimization:* AI and ML can also be used to automatically optimize supply chains by providing real-time insights, forecasting demand, and identifying opportunities for improving efficiency and reducing waste. This enables organizations to improve profitability while providing better service to their customers.

- *Quality Control:* In conjunction with supply chain optimization, AI and ML can help to automate the improvement of quality control and provide real-time insights to reduce defects and improve product quality.

- *Predictive Maintenance:* In addition, AI and ML can be used to automatically predict when a machine or equipment might need maintenance. This can help organizations avoid unplanned downtime and reduce maintenance costs and ensure that maintenance is performed when required as opposed to according to a fixed schedule.

- *Fraud Detection*: Furthermore, AI and ML technologies are powerful tools that can be used to automatically detect fraudulent transactions and prevent financial losses by analyzing large amounts of data and identifying patterns that are difficult for humans to detect.

(ii) Internet of Things

IoT technologies are increasingly being used in digital businesses to improve operational efficiency, increase productivity, enhance customer experience, and create new revenue streams. They have the potential to transform digital businesses in a variety of ways that include:

- *Inventory Management:* IoT sensors can be used to track inventory levels, providing real-time inventory level visibility, streamlining supply chain operations, reducing costs, and minimizing waste, in short, helping businesses manage their inventory more efficiently.

- *Supply Chain Optimization*: IoT sensors can also be used to track goods and deliveries in real-time, giving businesses better visibility and control over various aspects of their supply chains and enabling them to make better decisions to improve supply chain efficiency, reduce costs, and increase customer satisfaction.

- *Predictive Analytics:* IoT data can be analyzed using machine learning algorithms to identify patterns and trends and predict future outcomes. This enables companies to gain insights into various aspects of their operations and optimize processes for better business results.

- *Remote Monitoring and Predictive Maintenance:* Remote monitoring involves the use of sensors and other connected devices, to collect information about the performance of equipment, machinery, or other assets; in real-time. It helps businesses increase productivity and reduce costs.

- *Smart Buildings:* IoT can be used to create smart buildings by integrating IoT-connected devices and sensors into the building system, thereby increasing energy efficiency convenience, safety, and operational efficiency, and steadily improving occupant experience.

- *Customer Experience*: IoT sensors can be used by smart retailers, smart hotels, and smart homes to collect and analyze information about customer behavior, preferences and personalize customer experience.

(iii) Blockchain

Blockchain technology enables safe and transparent transactions between parties without the need for intermediaries. It has been part of creating a new form of digital currency. Blockchain can be used in the following ways:

- *Digital Identity Verification:* Blockchain technology can be used to create a decentralized digital identity system. It provides secure and transparent identity verification, which is particularly useful in situations where traditional forms of identification may not be available or may not be reliable and increases trust and confidence in online transactions.

- *Supply Chain Management*: Blockchain technology can also be used to create a tamper-proof record of all transactions in the supply chain. This not only provides transparency but also ensures that all parties involved in the supply chain can verify the authenticity and origin of products. The result is more responsive and responsible supply chains.

- *Implementation of Smart Contracts*: Moreover, blockchain technology can be used to facilitate the implementation of smart contracts, i.e., self-executing contracts with the terms of the agreement written directly into the code. This enables parties to reach secure and transparent deals without the use of intermediaries, which can help reduce costs, increase efficiency, and provide greater access to financial services to individuals and businesses worldwide.

- *Digital Asset Transfer*: Finally, Blockchain technology can be used to transfer digital assets such as cryptocurrencies, tokens, or even digital collectibles transparently and securely without passing through intermediaries.

(iv) Cloud Computing

Cloud computing has become an essential component of business management as it helps to store and access data and applications via the internet instead of on a local server, improves interoperability, increases flexibility, reduces IT costs, and enables businesses to scale their IT

infrastructure quickly and easily. Cloud computing can help support business growth and improve efficiency in many ways, which include:

- *Collaboration*: Cloud computing enables teams to collaborate more efficiently by providing a shared platform for accessing and working on documents and projects, allowing team members to access their work from anywhere, anytime with an internet connection. Remote teams can work together seamlessly, even if they are in different time zones. This helps improve communication within the organization and provides flexibility.

- *Cost-Effectiveness:* Moreover, cloud computing can help businesses reduce IT costs by eliminating the need to purchase expensive hardware and software, and providing a pay-as-you-go model that allows flexibility, and more cost control; all of which key benefits that can add value to a firm's operations.

- *Scalability*: Cloud computing also enables businesses to quickly and easily scale up or down their IT infrastructure as their needs change, which can help reduce costs and improve efficiency by paying only for the resources that are needed at any given time.

- *Data Management*: In addition, cloud computing can improve data management backup, sharing, security, and analysis by providing a secure, reliable, and scalable platform for business data management.

- *Agility*: Furthermore, cloud computing helps businesses respond quickly to changing market conditions and customer needs, by providing a flexible and agile platform for application development and deployment.

- *Security:* Finally, cloud computing provides a secure platform for storing and managing data, with built-in security features such as encryption, access control, and backup. This can help reduce the risk of data breaches and other security threats.

(v) Digital Marketing

The most effective digital marketing strategy is one tailored to specific business goals, target audience, and industry. It is therefore critical for companies to regularly review and adjust their digital marketing strategies based on performance metrics and changes in the digital landscape, guidelines, and strategies they use to promote their products, services, or brands. The following is a list of the various ways digital channels can be used as part of a company's digital marketing strategy:

- *Social Media Marketing:* One type of digital marketing that has become essential to promote a product or service, build brand awareness, engage and interact with audiences, and drive website traffic and conversions is social media marketing, which involves the use social media platforms. It also requires a strategic approach to planning, creating, distributing, and measuring social media content and campaigns.

- *Pay-Per-Click (PPC) Advertising*: This type of digital advertising displays paid advertisements on search engines, social media platforms, and other digital channels to drive traffic and conversions. PPC advertising can be a highly effective way for businesses to generate leads and sales. However, it can be a costly and complicated process. Many businesses choose to work with a digital marketing agency or a PPC management software to help them optimize their campaigns and maximize their return on investment.

- *Content Marketing:* This type of digital marketing creates and distributes valuable relevant and consistent content to attract, educate, and retain a clear target audience and build brand awareness. The key is to choose the right content format that resonates with the audience and aligns with the marketing goals. Content marketing can take many forms, depending on the type of content, target group, and marketing goals.

- *Email Marketing:* This type of digital marketing involves sending commercial messages to a group of people via email. The message may be in the form of a newsletter, promotional email, sales email, or other types of content. Email marketing can help to build relationships with customers and potential customers, and drive customer action and be a cost-effective tool for building brand awareness. It also encourages engagement.

- *Mobile Marketing:* This type of digital marketing involves promoting a product, service, or brand through mobile devices such as smartphones and tablets. With the increasing use of mobile devices, mobile marketing has become an essential component of many digital marketing strategies.

- *Video Marketing:* This type of digital marketing involves using video content to show and promote a product or service, engage, and educate viewers, and generate brand awareness. It is about creating and distributing video content on platforms like YouTube, Instagram, and Facebook, among others.

- *Influencer Marketing:* This type of digital marketing strategy is used by companies that wish to collaborate with individuals who have a large following on social media or other digital platforms in order to promote their products or services to the audience.

- *Affiliate Marketing*: This is a type of digital marketing strategy whereby companies pay commissions to affiliates to promote their products or services and drive traffic or sales to their website. There are different types of affiliate marketing programs. Their commission rates and payment methods will vary depending on the program selected (pay-per-sale, pay-per-click, and pay-per-lead, program terms).

- *Marketing Automation:* Software can be used to automate repetitive marketing tasks such as email campaigns, social media posts, and lead generation. Several types of marketing automation are available to improve efficiency and streamline a firm's marketing efforts. All of them facilitate marketing efforts, save time and resources, and enhance customer engagement and conversions.

- *Search Engine Optimization:* Search engine optimization can be used to improve website visibility in search engine results and attract more traffic and potential customers. However, optimizing a website's content and structure to rank higher on search engine result pages (SERPs) for relevant keywords is a complex and ever-evolving process that requires an in-depth understanding of search engine algorithms and consumer behavior.

(vi) Augmented Reality

Digital businesses can leverage augmented reality (AR) to improve customer experience, increase brand awareness, promote engagement, and differentiate themselves from competitors. Specifically, AR technology can be used in the following ways:

- *In-Store Navigation:* AR can be used to guide customers in stores by overlaying virtual reality with real-world data via mobile or wearable devices, making it easier to navigate and find products, and leading to higher customer satisfaction and sales.

- *Virtual Product Showcases:* AR can be used to create virtual product showcases that allow customers to explore and interact with products in a virtual environment and help them better understand the product and its features.

- *Virtual Try On:* AR enables customers to virtually try on products such as clothing, makeup, eyewear, and accessories before making a purchase decision. This helps them make more informed purchasing decisions and reduces product returns while also providing a unique and engaging shopping experience.

- *Interactive Ads:* AR can be used to create interactive ads that engage customers by overlaying real-world virtual data across mobile or wearable devices. As a unique and attractive way to promote a product or service to a target audience, it can lead to higher brand awareness and sales.
- *Interactive Product Manuals:* AR can be used to create interactive product guides by overlaying real-world virtual data that customers can access via smartphone or tablet. This can help customers better understand the features and functionality of the product.
- *Personalized Product Recommendations:* AR can be used to provide personalized product recommendations to customers by analyzing customer needs and then overlaying virtual reality with real-world data via mobile or wearable devices. This can lead to higher customer satisfaction and sales.

(vii) Virtual Reality
Virtual reality (VR) technology can be used to deliver unique and engaging immersive and interactive experiences to customers, employees, and other stakeholders. It can also be used to increase efficiency and productivity and improve collaboration and communication. The following list highlights some of the ways VR technology can be used in digital businesses:

- *Marketing and Advertising:* VR technology is a powerful marketing and advertising tool that can deliver a realistic and engaging experience to consumers. It can be used to create interactive advertising and marketing campaigns that engage customers and increase brand awareness.
- *Training* and Education Use: VR technology can be used to create training and education programs for employees and other stakeholders. This is especially useful for industries that require on-the-job training. It can increase efficiency.
- *Product Demos:* VR technology can be used to create virtual product demonstrations that provide unique and realistic ways for customers to experience the product. This can lead to higher customer engagement, satisfaction, and sales.
- *Remote Collaboration Use:* Since VR technology facilitates remote collaboration and communication between employees and stakeholders and is especially useful for teams working in different locations or time zones, it has the potential to revolutionize remote collaboration by allowing people to work together in virtual environments, regardless of their physical location.
- *Virtual Events Use*: VR technology has the potential to create memorable virtual events that engage customers and stakeholders in immersive and interactive experiences and make it possible to reach a wider audience while reducing the costs associated with physical activities.
- *Design and Prototyping Use*: VR technology can be used to create 3D models and prototypes of products and services and enable stakeholders to experience and evaluate them in a virtual environment before production. Together with 3D printing, it is another powerful tool to build, test, and customize products in a virtual environment before releasing them to the market.
- *Data Visualization Use:* VR can be a powerful tool for visualizing data in three-dimensional space as it enables users to explore and analyze complex data sets realistically and interactively.

(viii) Big Data
Big Data technology can have a significant impact on digital businesses as it provides a wealth of insights and opportunities for growth. By leveraging these insights, companies can stay

ahead of competitors, improve operational efficiency, and provide a better customer experience. The following are some of the ways Big Data can be used in digital businesses:

- *Innovation*: Big Data can be a powerful tool for innovation. For one, it helps firms gain insights into customer behavior and preferences, identify new markets, and develop new products. In addition to creating new value for customers, it can also increase operational efficiency and drive growth and competitiveness.

- *Operational Efficiency:* Big Data technology can help to optimize business operations, such as supply chain management, inventory management, and logistics by analyzing inventory level data, demand forms, and transport routes and identifying opportunities to save costs and improve operations, enabling businesses to reduce costs, enhance productivity and gain a competitive advantage.

- *Predictive Analytics*: Predictive models can be developed to forecast trends, identify potential risks, and inform business decisions, all of which contributing to staying ahead of competitors and make more informed decisions about strategy and investment.

- *Customer Analytics:* Big Data technology can be used in customer analytics to analyze massive amounts of data and gain insights into customer behavior and preferences, create a personalized experience, and improve customer loyalty.

- *Personalization:* The customer data analyzed can be used by companies to create personalized experiences for customers and tailor their offerings to the unique needs and interests of each of them. This helps to create targeted and personalized experiences that drive engagement, loyalty, and revenue.

(ix) 3D Printing

3D printing technology, also known as additive manufacturing, is the process of creating a 3D object from a digital file by adding layers of material to the desired shape. 3D printing technology is used in a variety of ways to improve efficiency, reduce costs and enhance innovation. These include:

- *Cost Reduction:* 3D printing technology can reduce costs associated with materials waste and operation management by simplifying design and prototyping. It has the potential to revolutionize the way businesses design, manufacture and distribute products and therefore further improve efficiency, reduce costs, and promote innovation.

- *Rapid Prototyping:* 3D printing technology helps companies quickly and easily prototype new products and test and improve designs before investing in expensive tooling and manufacturing processes. It has become an essential tool for businesses looking to accelerate product development timelines, reduce costs, and improve collaboration between teams and stakeholders.

- *Customized Products*: 3D printing technology helps companies create customized products based on the specific needs of each customer.

- *Spare Parts*: 3D printing technology helps companies produce spare parts as required, reduce the need to stock them, and shorten the waiting time for repairs.

- *Tooling*: 3D printing technology can be used to create jigs, fixtures, and other tool components. This reduces production time and costs associated with traditional tooling processes.

- *Productivity*: By changing the way, a company designs, manufactures, and delivers its product, 3D printing technology has the potential to significantly increase a firm's productivity and competitiveness.

5. Discussion, **Conclusion, and Recommendations**

Innovation is critical to business, especially with today's proliferation of digital technologies. It helps companies remain competitive and adapt to rapidly changing market conditions and customer needs (Jitvirat, 2022a; Morabito, 2016; Nwankpa et al., 2022). Innovation can take many forms, ranging from the development of new products and services to taking advantage of emerging technologies such as artificial intelligence and blockchain. It can also involve finding new ways of becoming more efficient doing business, such as adopting agile methods or using cloud computing solutions (Pagani, 2013; Palmie et al, 2022; Ramdani, Rothwell, & Boukrami, 2020). Businesses that fail to innovate run the risk of becoming irrelevant and losing market share to more innovative competitors. As a matter of fact, today, innovation is not the only a priority, it is also necessity for survival and growth (Dellermann, Fliaster, & Kolloch, 2017; Jitvirat, 2018c; Kraus et al, 2022). AI and ML technologies have become essential tools for businesses. They can automate business processes, reduce the need for manual labor and increase efficiency. They can also analyze vast amounts of data and provide insights and recommendations to help businesses make better decisions (Fahle, Prinz, & Kuhlenkötter, 2020; Nuseir et al., 2021). The Internet of things can collect data which can be used to gain insights into how products are being used, how devices work, and how business operations can be optimized. It can automate production and supply chain processes as well as customer service and maintenance and help businesses save money (Magomedov, Bagov, & Zolkin, 2020; Sestino et al., 2020).

Blockchain technology has become an indispensable tool for businesses looking to improve the security, transparency, efficiency, and reliability of their operations (Pal, Tiwari, & Haldar, 2021; Rajnak & Puschmann, 2021). Cloud computing has revolutionized the way businesses do business by providing many benefits. It allows businesses to easily scale up or down their computing resources as needed, without having to invest in expensive hardware. Flexibility can scale cost savings by working together with data disaster recovery and operational security (Abdalla & Varol, 2019; Sunil, Khadri, & Sachin, 2020). Digital marketing is critical for businesses today as the number of internet users keeps increasing and technologies and programs related to digital marketing continues multiplying (Denga, Vajjhala, & Rakshit, 2022; Olazo, 2022). AR and VR technologies have the potential to change the way entrepreneurs do business by providing new and innovative tools to engage customers, train employees, develop new products development and achieve cost savings as technology continues to evolve and is becoming more accessible. We can expect to see more and more entrepreneurs, take advantage of AR and VR to drive their businesses forward (Jayawardena et al., 2023; Leone, Pietronudo, & Dezi, 2022). Big data is a valuable resource a well that can provide insights into customer behavior, market trends, and operational efficiency, improve operations, and make informed decisions thanks to data analytics tools, giving firms a competitive advantage in their respective industries (Ogbuke et al., 2022; Papadopoulos & Balta, 2022; Sahoo, 2022). 3D printing technology has the potential to revolutionize the way people design, produce, and organize. By investing in 3D printing technology and exploring new applications, businesses can gain a competitive edge and benefit from the versatility that 3D printing offers (Chaney, Gardan, & De Freyman, 2022; Cui et al., 2022).

- Conclusion

In today's digital age, technology plays a transformative role in almost every aspect of our lives. Businesses that do not adapt to the digital era are at a risk of becoming obsolete as being part of the digital innovation process helps organizations stay relevant, meet changing customer expectations, and take advantage of emerging opportunities. That digital business innovation is essential for organizations to grow can be overstated. Crafting business innovation strategies will help them create new business models, products, services, and processes that will drive growth, efficiency, and help them deliver a superior customer experience and gain a competitive advantage. In short, it will help them unlock new growth opportunities and address the challenges of a rapidly evolving business landscape.

- Recommendations

The following recommendations for further research can be made:

- An in-depth study of each variable should be undertaken to expand the results as some new technologies are being developed and have not yet been widely used. Since there will undoubtedly be new digital technologies in the coming year, and since technology changes rapidly, it is important that such studies be conducted on a regular basis in the future.
- Since ethical and responsible digital innovation and use are likely to be even more crucial that they presently are, given the rapid emergence of new AI applications, further studies should explore the ethical issues involved and their importance for business innovation and management.
- This study was not industry-specific but further studies could be. Conducting research in particular sectors will expand knowledge of digital business innovation and provide insights that can inform organizations, policymakers, and educational institutions on how to drive successful digital transformation.

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