JPB REVIEW
INTERNATIONAL JOURNAL OF PROFESSIONAL BUSINESS REVIEW
ISSN: 2525-3654
OPEN ACCESS

AN EMPIRICAL ANALYSIS OF THE CAPABILITIES FOR DIGITAL TRANSFORMATION RESILIENCE IN SELECTED COUNTRIES

Lakshmi Chaitanya Datti[A], Mudiarasan Kuppusamy[B]

ARTICLE INFO

Article history:

Received 15 May 2023

Accepted 11 August 2023

Keywords:

Digital Transformation;
Resilience;
Capabilities;
Selected Countries;
Panel Data.

ABSTRACT

Purpose: The study examined the enabling capabilities of digital transformation resilience across 61 countries from 2013 to 2022.

Theoretical framework: This study draws on four theoretical perspectives: resilience theory, dynamic capabilities view, knowledge-based view theory, and diffusion of innovation theory. These theoretical lenses focus on how organizations can succeed in a changing environment.

Design/Methodology/Approach: This study used secondary data from the International Institute for Management Developments (IMD), the World Digital Competitiveness Ranking, and the World Intellectual Property Organization (WIPO) Global Innovation Index (GII). The data set analyzed included information from 61 countries between 2013 to 2022. Panel data regression was used to conduct the analysis.

Findings: The findings indicate that only knowledge capability has a significant relationship with digital transformation resilience technology, and future readiness was considered a non-significant enabler.

Research, practical & social implications: In the digital age, governments and industries must prioritize resilience by implementing policies, developing necessary skills, providing training activities, and investing in research and development.

Originality/Value: The originality of this study lies in its investigation of resilience capabilities with the new theoretical lens. Organizations must develop resilience capabilities, particularly in the realm of digital transformation. Digital transformation resilience pertains to an organization's capacity to adjust and react to changes in the dynamic environment using digital technologies.

Doi: https://doi.org/10.26668/businessreview/2023.v8i8.2627

UMA ANÁLISE EMPÍRICA DAS CAPACIDADES DE RESILIÊNCIA À TRANSFORMAÇÃO DIGITAL EM PAÍSES SELECIONADOS

RESUMO

Objetivo: O estudo analisou as capacidades facilitadoras da resiliência à transformação digital em 61 países de 2013 a 2022.

Estrutura teórica: Este estudo se baseia em quatro perspectivas teóricas: teoria da resiliência, visão de capacidades dinâmicas, teoria da visão baseada no conhecimento e difusão da teoria da inovação. Essas lentes teóricas concentram-se em como as organizações podem ser bem-sucedidas em um ambiente em mudança.

Design/Metodologia/Abordagem: Este estudo utilizou dados secundários do Instituto Internacional para o Desenvolvimento da Gestão (IMD), do Ranking Mundial da Competitividade Digital e do Índice Global de Inovação (GII) da Organização Mundial da Propriedade Intelectual (OMPI). O conjunto de dados analisado incluiu informações de 61 países entre 2013 e 2022. A regressão de dados do painel foi usada para conduzir a análise.

[A] *PhD in Management. University of Cyberjaya. Cyberjaya, Selangor, Malaysia.*
E-mail: lakshmidatti14@gmail.com Orcid: https://orcid.org/0009-0009-2519-786X
[B] *PhD in Management. University of Cyberjaya. Cyberjaya, Selangor, Malaysia.*
E-mail: drarasan@cyberjaya.edu.my Orcid: https://orcid.org/0000-0003-0502-2455

Constatações: As descobertas indicam que apenas a capacidade de conhecimento tem uma relação significativa com a tecnologia de resiliência de transformação digital, e a prontidão futura foi considerada um facilitador não significativo.
Investigação, Implicações Práticas e Sociais: Na era digital, os governos e as indústrias devem dar prioridade à resiliência, implementando políticas, desenvolvendo as competências necessárias, proporcionando atividades de formação e investindo em investigação e desenvolvimento.
Originalidade/Valor: A originalidade deste estudo está na sua investigação de capacidades de resiliência com a nova lente teórica. As organizações devem desenvolver recursos de resiliência, especialmente no campo da transformação digital. A resiliência da transformação digital pertence à capacidade de uma organização de ajustar e reagir a mudanças no ambiente dinâmico usando tecnologias digitais.

Palavras-chave: Transformação Digital, Resiliência, Recursos, Países Selecionados, Dados do Painel.

UN ANÁLISIS EMPÍRICO DE LAS CAPACIDADES DE RESILIENCIA PARA LA TRANSFORMACIÓN DIGITAL EN PAÍSES SELECCIONADOS

RESUMEN
Objetivo: El estudio examinó las capacidades facilitadoras de la resiliencia a la transformación digital en 61 países de 2013 a 2022.
Marco teórico: Este estudio se basa en cuatro perspectivas teóricas: teoría de la resiliencia, visión de las capacidades dinámicas, teoría de la visión basada en el conocimiento y teoría de la difusión de la innovación. Estas lentes teóricas se centran en cómo las organizaciones pueden tener éxito en un entorno cambiante.
Diseño/Metodología/Enfoque: En este estudio se utilizaron datos secundarios del Instituto Internacional para el Desarrollo de la Gestión (IMD), el World Digital Competitiveness Ranking y el Índice Mundial de Innovación (GII) de la Organización Mundial de la Propiedad Intelectual (OMPI). El conjunto de datos analizado incluyó información de 61 países entre 2013 y 2022. Para llevar a cabo el análisis se utilizaron datos de regresión de panel.
Hallazgos: Los hallazgos indican que solo la capacidad de conocimiento tiene una relación significativa con la tecnología de resiliencia a la transformación digital, y la preparación futura se consideró un facilitador no significativo.
Investigación, implicaciones prácticas y sociales: En la era digital, los gobiernos y las industrias deben priorizar la resiliencia mediante la implementación de políticas, el desarrollo de las habilidades necesarias, la provisión de actividades de capacitación y la inversión en investigación y desarrollo.
Originalidad/Valor: La originalidad de este estudio radica en su investigación de las capacidades de resiliencia con la nueva lente teórica. Las organizaciones deben desarrollar capacidades de resiliencia, especialmente en el ámbito de la transformación digital. La resiliencia a la transformación digital se refiere a la capacidad de una organización para adaptarse y reaccionar a los cambios en el entorno dinámico utilizando tecnologías digitales.

Palabras clave: Transformación Digital, Resiliencia, Capacidades, Países Seleccionados, Datos del Panel.

INTRODUCTION

Businesses have transformed significantly, using technology to increase production, streamline operations, and cut costs. Digital transformation is necessary for enterprises to increase operational effectiveness, enhance customer experiences, and stimulate growth (Wang et al., 2023). Amazon and Netflix have successfully implemented digital transformation, improved their operations, and remained competitive in a continually changing business environment (Banerji, 2022; Van, 2022). Global spending on digital transformation was USD 1.6 trillion in 2022 and is expected to reach USD 3.4 trillion by 2026 (IDC, 2023; Statista, 2023). Different types and levels of digital transformation occur, making it vital for businesses to adapt and respond quickly to changes through digital technologies (Kuppusamy and Datti,

2022; Datti and Kuppusamy, 2023). Resilience is crucial for organizations, as digital transformation is an ongoing process. Organizations must continuously innovate and adapt capabilities to maintain resilience in disruptions. Innovation strategies should integrate policies related to technology, IT investment, research, education, taxation, trade, procurement, intellectual property, and regulations (UNCTAD, 2023). Organizations should prioritize knowledge-building and invest in cutting-edge technologies like AI (artificial intelligence) and IoT (Internet of Things). Organizations must prioritize building a robust digital transformation to ensure their digital systems' security and reliability (Vaseashta and Lonete, 2021; Baloch et al., 2021). To be future-ready requires investing in research and development and keeping up with new technological developments. Specific capabilities such as knowledge, technology, and future readiness are necessary for digital transformation resilience through disruptions at both micro and macroeconomic levels (Kuppusamy and Datti, 2022; Datti and Kuppusamy, 2023).

Pull or push factors can be the driving force behind a nation’s digital transformation. Pull factors refer to an organization’s demand, while push factors arise from socioeconomic, ICT, and crisis disruptions. For example, countries like Sri Lanka and Pakistan face severe economic crises resulting in power outages, food and gasoline shortages, and high inflation. Information and technological disruptions, like the recent cyberattack on Colonial Pipeline Company, can also impact digital transformation. This attack resulted in a pipeline shutdown that supplies 50 percent of the East Coast’s gasoline (Bloomberg, 2021). Governments can create policies that support digital infrastructure development, skill building, public service delivery, and entrepreneurship to reduce the negative impact of socioeconomic and ICT disruptions. By fostering an environment that promotes digital transformation, governments can help businesses and individuals adapt to economic shifts and achieve long-term growth and sustainability (Nambisan et al., 2019). Digital transformation requires ongoing investments and resilience to respond to changes in the business environment by using digital technologies. Organizations must innovate, integrate new technologies, streamline processes, and train & develop skills to remain resilient. Education, regulations, financial investments, secure technological frameworks, adaptive attitudes, business agility, and IT integration are essential for productivity growth, innovation, and societal well-being. Implementing these capabilities fully realizes the potential of digital transformation while harnessing its potential through disruptions.

To achieve digital transformation, several factors must be considered, including research, education, regulations, financial investment, secure technological framework, and adaptive attitudes. Having digital transformation resilience is crucial for countries to increase economic stability, create jobs, and attract investment. Countries can remain resilient during disruptions by implementing business agility, IT integration, and a seamless digital environment. However, more research must be conducted on resilience capabilities and their corresponding theories. Cross-sectional and longitudinal data research is necessary to understand how variables are related over time. The researcher has selected countries based on their IMD World Digital Competitiveness ranking to address this gap.

This study draws on four theoretical perspectives: resilience theory, dynamic capabilities view, knowledge-based view theory, and diffusion of innovation theory. These perspectives all focus on how individuals and organizations can succeed in changing circumstances. Resilience, dynamic capabilities, knowledge-based view, and diffusion of innovation all emphasize the importance of adapting to disruptions and improving organizational performance.

THEORETICAL FRAMEWORK

Digital Transformation

The first industrial revolution changed rural lifestyles and led to the rise of dangerous working conditions in urban industries. Larger companies became competitive in international trade, which meant the end of older labor practices. Child labor was prevalent in the textile industry. Britain's textile industry evolved from a "cottage industry" to efficient, mechanized production with the help of inventions like the spinning jenny and power loom (Watt, 2003; Siennicka et al., 2017). The iron industry also embraced new technologies, including steam-powered locomotives and boats. The second industrial revolution brought new products, labor forces, transportation, communication, and technological advancements. Economic growth was unstable, and corporations fought to control industries (Lele and Goswami, 2017; Sung, 2018). The third industrial revolution transformed mechanical technology into digital electronics, leading to green structures, electric vehicles, and distributed manufacturing advancements. It relied on microelectronics and the internet, improving the global economy's efficiency with significant inventions like semiconductors, microprocessors, and the world wide web (Taalbi, 2019; Lee and Lee, 2021). This revolution impacted several industries and significantly changed society, trade relations, and technological advancements, with innovations like the

internet, social media, big data, e-commerce, mobile phones, and cloud computing (Taalbi, 2019; Mhlanga, 2020). The fourth industrial revolution merges physical assets and digital technologies, resulting in adaptable and data-driven organizations. This has led to the development of smart factories, where production is automated primarily, and communication happens through a single network (Philbeck and Davis, 2018; Kayembe and Nel, 2019). Digital devices in production allow for easier and faster equipment documentation. The industrial Internet of Things enables autonomous actions and information exchange.

Digitization creates a digital version of physical objects. Social media revolutionized communication and led companies to form digital teams to manage social and mobile channels. Digitalization improves processes with technology, while digital transformation modifies business processes using electronic tools (Nambisan et al., 2019). It is essential for growth, quality, and sustainability. Digital transformation is an unstoppable, irreversible, and fast process that requires leadership, strategy, and organizational culture changes. The emergence of new digital technologies drives it and affects customer experience, business models, and processes. The digital economy has accelerated economic innovation through Internet infrastructure and knowledge development. Digital transformation has altered paradigms, with networks and platforms at the center. Corporations, governments, and consumers now drive innovation. Communication about innovations is crucial (Zaki, 2019; Lee and Lee, 2020). Digital transformation enables mass customization, reduced production costs, and new business models. It also affects how people work, creating new employment opportunities. Digital transformation presents an opportunity to transform the work environment through online activities (Schwertner, 2017; Beverungen et al., 2022). Consumption is shifting from ownership to sharing, with the sharing economy expanding globally. It is shifting from tangible to intangible assets, centered on the individual and experience. Consumer values are evolving, prioritizing user experience over profits.

Digital transformation changes the economy, creates new opportunities, increases inequality, and leaves many behind. The firms at the forefront of technology dominate the market and gain the most returns (Saha et al., 2022). Digital transformation is essential for businesses to stay competitive and innovative. It involves using digital technologies like AI, big data analytics, internet technologies, digital platforms, digital ecosystems, information and communication technology, and digital services. Digital transformation has significantly impacted companies at a macroeconomic level, allowing for cross-border collaboration and the emergence of platform business models (Kim and Kim, 2019). It has also brought about

changes in both business and general education. Digital transformation can benefit companies on a firm level by allowing them to expand their reach internationally by establishing e-commerce and social media channels, improving their global strategies, and fostering entrepreneurship (Saha et al., 2022; Ahmed et al., 2023). It also allows businesses to gain a competitive edge through knowledge acquisition, sustainability, and improved competitiveness. Digital transformation involves using ICTs to improve business relationships and enhance operations with tools such as IoT, digital ecosystems, and robot technology (Bertello et al., 2022; Sirait et al., 2023). AI can improve the consumer experience individually, while micro foundations provide resources for efficiently utilizing internal and external knowledge.

Resilience

Incorporating economic, social, and environmental factors in adaptive environmental management is essential. The "resilience framework" aims to improve resilience and stability through an "ecosystem engineering" approach. Resilience is becoming increasingly important in rural and community development policies (Sippel et al., 2015). It can help mitigate the psychological effects of traumatic events, and social support can enhance resilience. Events, networks, education, resources, and community participation can impact resilience. Community resilience involves adapting to new or challenging circumstances through social support and communication during crises. It is assessed using tools like the Community resilience scale and consists of economic, cultural, environmental, and social capital (Roberts et al., 2015; Rahman et al., 2017; Lee and Chen, 2021). Access to broadband internet and digital devices can improve quality of life and have social and economic benefits. However, connectivity speed, digital literacy, and attitudes toward technology can affect digital engagement. Digital inclusion plans help ensure that socially excluded individuals have the resources and understanding to use digital technology (Ponzanesi, 2019; Benitez et al., 2022). Developing a digital engagement and resilience framework can help assess the challenges and achievements of the digital economy and improve community resilience.

Disruption Context

Over the past 50 years, economically developed nations have shifted from manufacturing to services as a source of wealth. People now work in banks, software companies, and colleges instead of factories. The information age has increased social freedom

and equality (Henfridsson and Mathiassen, 2014; Millenson, 2018). Digital transformation occurs through pull and push factors, including crises that make the change necessary (Datti and Kuppusamy, 2023). Three types of disruptions lead to digital transformation at a country level: socioeconomic policy-driven, information and communication technology-driven, and crises-driven.

Socioeconomic policy driven

The two schools have different approaches to studying consumer behavior and the labor market. Social economics examines how social behavior and economics interact within a community, which involves analyzing economic decisions and government policies (Li et al., 2022). It is important to note that the global economy can be affected by debt crises in one country, as was seen during the 2007-2008 financial crisis (Batool and Sahi, 2019). Digital transformation changes economies and societies but presents challenges like inequality and policy issues. Countries like Sri Lanka and Pakistan are experiencing severe economic crises due to a scarcity of necessities and low foreign exchange reserves (Mishara, 2023). Policymakers must find a balance between reaping the benefits of digitalization and addressing these challenges.

Information and communication technology driven

ICT significantly impacts society, affecting daily life and economic growth. While it offers many opportunities, it also creates issues for businesses and society. Data breaches are a significant threat to data protection, with cybercrime costing businesses trillions annually (Mbuyisa and Leonard, 2017; Bieser and Hilty, 2018). Adopting technology comes with difficulties, such as talent shortages and technological glitches. Developing countries face ICT challenges, but governments can use policies to attract investment. A theoretical foundation is needed for consistency and effectiveness in implementing ICT policies.

Crises driven

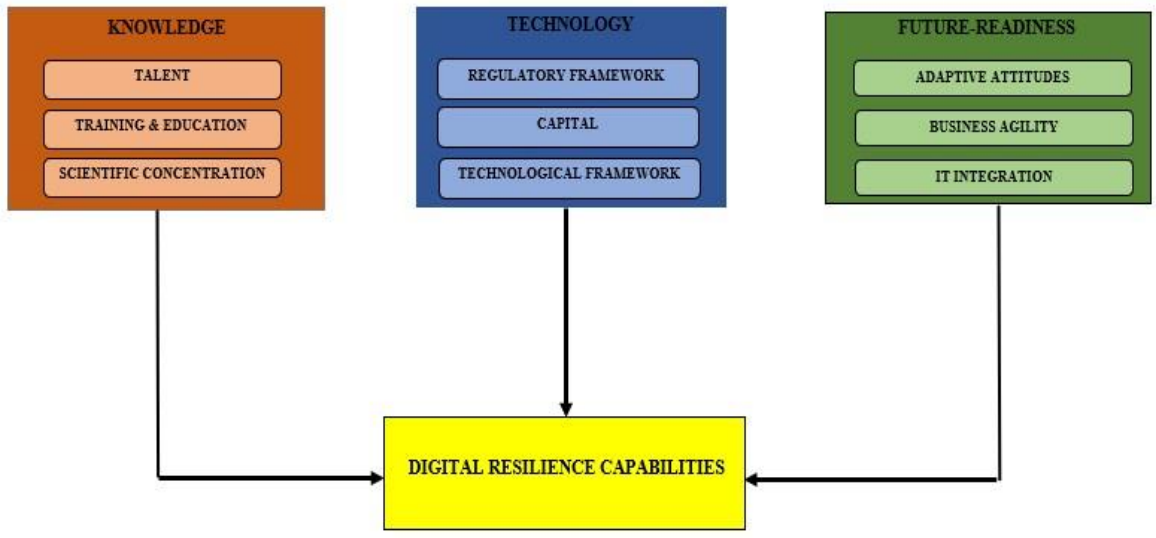
Climate change is a primary concern for researchers due to its impact on human and economic society. In the past, natural catastrophes such as earthquakes, tsunamis, and hurricanes have caused significant economic losses (Botzen and Deschenes, 2019; Esterwood and Saeed, 2020; Seddighi et al., 2021). Natural disasters significantly impact a nation's economy, often causing infrastructure damage and hindering a company's ability to produce

goods. This can lead to reduced productivity, slower economic development, and increased income inequality and poverty. Covid-19 has also significantly impacted the global economy, leading to de-globalization and an increased focus on digitalization (OECD, 2022). Developing countries have benefited from digitalization efforts, with businesses and educational institutions shifting towards virtual channels. Governments are also exploring emerging digital technologies such as blockchain, 5G infrastructure, and AI (Bordot, 2022).

Capabilities

The ability of a country to adapt to changes and come up with innovative solutions is known as digital resilience. This quality is crucial for competitiveness and is influenced by national values, culture, history, and institutions. Companies can gain an edge by embracing new technologies and methods to innovate (Kuo et al., 2022; Kamboj et al., 2022). To stay ahead, businesses must be proactive and continuously experiment to anticipate future trends. Digital technology can help improve efficiency and services. For a country to remain resilient, it must prioritize investment in knowledge, technology, and future readiness.

Figure 1. Digital Resilience Capabilities



Source: Prepared by Author (2021)

Knowledge

Knowledge is dynamic and involves synthesizing different types of information. Companies can remain competitive by combining explicit and tacit knowledge. Technology is vital in managing knowledge flows, and knowledge sharing drive innovation (Collins, 2019; Balaz et a., 2021). Knowledge infrastructures generate and spread accurate information,

challenging false beliefs. Investing in human capital increases productivity, economic growth, and non-economic benefits like health and well-being (Silva et al., 2019; Evers, 2020; Dahiyat et al., 2023). Skilled migration can add to a country's human capital, and digital competencies are crucial for competitiveness in the digital economy. Successful digital transformation requires specific talents, education, and a focus on science.

Talent

Each person has unique skills and talents that can be used to achieve objectives. Talent is vital to businesses and the economy. A talent-driven economy requires investment in education, training, and social assistance (Parilla and Liu, 2021; Shayrine and Venugopal, 2023). Postsecondary education and training are essential for the employment market. Talent deployment is crucial and involves setting up rules and practices to use skills effectively (Thomas et al., 2021; Parilla and Liu, 2021). Strategies can be used to close the talent gap and foster local talent. Nations must provide opportunities for continual learning to attract and maintain talent for economic development.

Training and education

Education and human resource development are essential for economic growth. They build human capital through education, training, and skill development, resulting in increased lifetime earnings and productivity (Sofyan and Abdullah, 2022). Education is a valuable resource for companies, allowing them to produce goods and services that can be sold. Employee training benefits employers and employees, enhancing job satisfaction, profitability, and productivity (Dwivedi et al., 2020; Shahzad et al., 2021). Education can also enhance a country's capacity for innovation and disseminate knowledge necessary for economic progress – a nation's economy profits from a well-educated workforce, which can perform critical thinking tasks more efficiently.

Scientific concentration

Investments in higher education, research and development, and information and communication technologies are crucial for long-term growth in knowledge economies. Expenditure on tertiary education and R&D, as well as ICT investments, are used to measure spending by governments, businesses, and individuals. R&D intensity is measured by gross domestic R&D expenditure and reflects variations in economic structures (Xu et al., 2021).

These indicators are used in growth accounting studies, attributing an economy's growth to increased productivity and factors such as capital and labor. Organizations investing in database integration often need to pay more attention to the importance of knowledge-based capital (Singh et al., 2021). However, research and development, data analytics, and managerial practices can significantly boost productivity and growth. These areas are crucial investments for a company's success.

Technology

The digital economy is characterized by cloud computing, distributed computing, the Internet of Things, and big data technology. This technology has revolutionized the marketplaces, with ICT expanding to include social media, mobile apps, cloud platforms, data analytics, search engines, and AI (Wang et al., 2021). These technologies have touched almost every aspect of modern life, from work and entertainment to travel. They have also made remote working more accessible, providing more job opportunities. Digital technology has enabled flexible working arrangements, online access to education and knowledge, and improved communication. It has increased machine intelligence and efficiency, resulting in lower costs for goods and services (Teece, 2018; Borowski, 2021). Developing technologies like broadband is essential for reducing information asymmetry and promoting innovation. The electronics sector serves as the foundation of the digital economy, and nations are implementing programs to boost their digital sectors. Traditional methods of assessing ICT capital may only partially reflect the impact of digital technologies spread. Technology integration, including business digitization and e-commerce, can benefit various industries and nations (Anderson et al., 2018). A supportive regulatory framework, capital, and the current technological landscape are crucial to foster technology development.

Regulation framework

Business innovation is crucial for companies as it helps them expand, gain recognition, and create new products. It can also improve working conditions and safety precautions. Poorly implemented regulations can harm a company's viability and industry (Udriyah et al., 2019). Regulations need a framework to assess their action's fairness, effectiveness, and efficiency, which can pinpoint areas for improvement and reduce compliance expenses. The framework also fosters community trust and helps evaluate regulator effectiveness. Regulators are government agencies that manage regulations. They safeguard the economy, society, and

people (Wang et al., 2018; Hashmi and Alam, 2019). A framework for regulations helps businesses carry out their duties safely and effectively, benefiting everyone and reducing resources.

Capital

To achieve high productivity, businesses need to focus on the critical variables of production, which include capital, labor, and entrepreneurship. Capital goods can be boosted through technology, and saving encourages investment to benefit the business (Helo and Hao, 2019; Olsen and Tomin, 2020). Automation can help increase productivity while freeing up personnel for other tasks. In the current "new normal," effective communication channels are crucial, and technology can also aid in emergency preparedness (Strinati et al.,2019; Shin and Kang, 2020). With the help of technology, businesses can operate remotely, manage crises, and increase profits. Therefore, good decision-making and effective use of technology are critical for success.

Technological framework

In the business world, technology infrastructure plays a critical role in facilitating the management and operation of enterprise IT services. Businesses can achieve profitable growth by utilizing the cloud while delivering exceptional user experiences (Sittig and Singh, 2020). Infrastructure as Code (IaC) opens new possibilities for rapid and adaptable innovation (Massaro, 2022). The unique ability of information technology to adapt, innovate, and respond sets it apart from other workplace cultures. To fuel innovation, businesses require strategic and intelligent infrastructure, though cloud adoption is still in its stages due to technical architecture needs ((Piriou et al., 2021). Cloud readiness can be influenced by organizational strategy, IT architecture, and workforce mindset. Companies must have a tailored plan that aligns with their business objectives and modern infrastructure to benefit from technology fully (Li et al., 2019; Shao et al., 2020).

Future Readiness

The digitization of business has transformed all aspects of corporate administration. Companies must prioritize organization, culture, employees, and digital environment to stay ahead. Success requires a pioneering mindset and continuous employee training. In Industry 4.0, digitization is critical for competitiveness. Technology is the foundation of business agility,

which is essential for success. Leaders must commit to desired business goals and incorporate stakeholder feedback and continuous digital transformation to achieve agile transformation (Gridwichai and Sriviboon, 2020). The Future-readiness factor assesses how well-prepared an economy is for digital change and combines business agility, adaptive attitudes, and IT integration. Adopting digital technologies requires specific attitudes, and companies must prioritize business agility to seize new opportunities.

Adaptive attitudes

Digital adaptability is essential for businesses to stay competitive and achieve success. Digital flexibility allows for the reaction and revision of objectives and methods, making it a valuable indicator of success (Almenara et al., 2022). Collaboration between creative and management departments is crucial for creating a successful digital adoption plan that aligns with new business models and technological developments (Desveaux et al., 2019; Palad, 2022).

Business agility

Agile development involves short cycles and minimal overhead, allowing for frequent product enhancements and fast iterations. Business agility extends this approach throughout the organization, enabling companies to respond quickly to changing market conditions and customer needs (Saqqa and Sawalha, 2020). This leads to increased innovation and higher profits, making it essential for success in today's unpredictable business world.

IT integration

Technology advances productivity and economic growth by allowing for more output with fewer resources and expanding global market reach. Automation and digital advancements shift labor demand towards higher-level skills (Hossain et al., 2020). Technology also helps businesses run more efficiently and manage production processes, saving time and money.

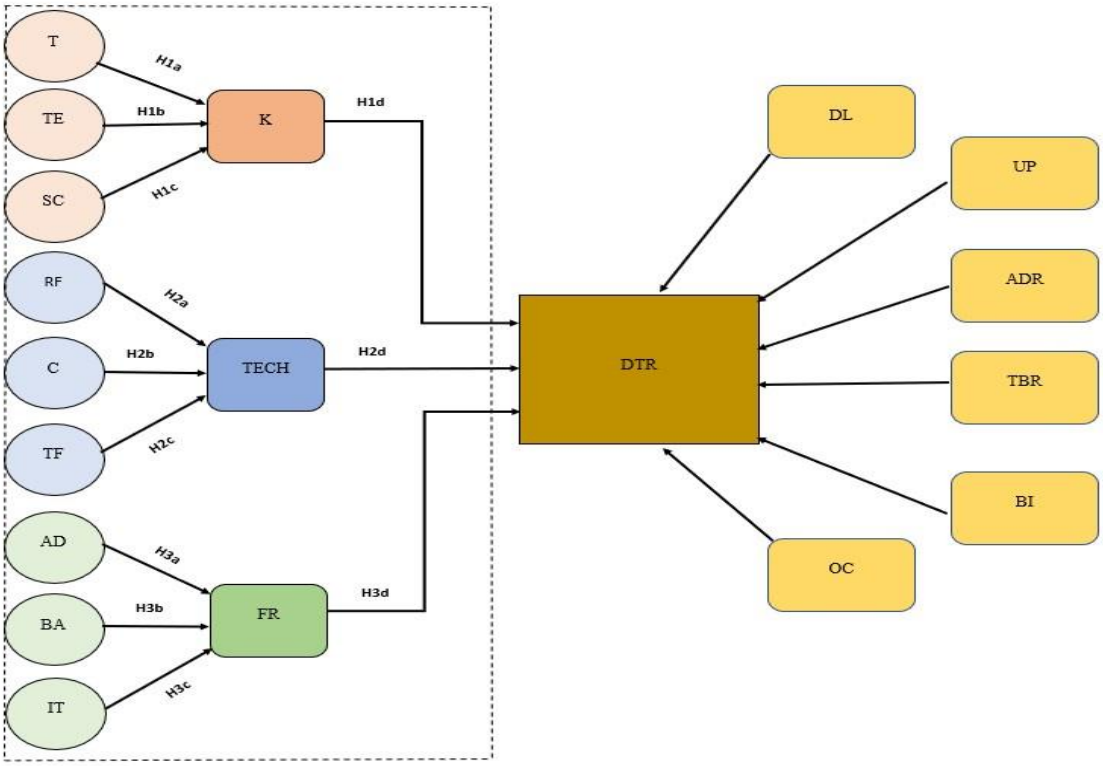
Theoretical Lens

Resilience involves managing internal stress and external challenges, recovering, and maintaining adaptive behavior (Masten, 2014). To overcome disruptions, organizations must have dynamic capabilities. The modern economy requires companies to prioritize organizational learning and culture for greater strategic adaptability. Knowledge is a crucial

factor that enables companies to respond quickly to changes (Waizeneggr et al., 2020). Roger's diffusion of innovation theory helps us understand the adoption and rejection of new technology (Rogers, 2010). Resilience, dynamic capabilities, knowledge-based, and diffusion of innovation focus on how individuals and organizations can adapt and thrive in changing contexts. They emphasize the importance of building the capacity to cope with disruptions, utilizing resources and capabilities, sharing knowledge, and adapting to new technologies.

The core function of digital transformation resilience is digital engagement, divided into six categories: digital literacy & skills, uptake, access to digital resources, technology as a barrier, broadband/existing infrastructure, and creative outputs. These categories are measured using 35 criteria, and their correlation affects digital transformation resilience. Digital literacy and skills play a significant role in determining an organization or economy's digital transformation resilience, while technology as a barrier can significantly hinder it. As the environment changes, the role of different assets may shift in terms of their capacity to produce expected value.

Figure 2. Conceptual framework



The Independent variables: *Talent (T), Training & Education (TE), Scientific Concentration (SC), Knowledge (K), Regulatory Framework (RF), Capital (C), Technological Framework (TF), Technology (Tech), Adaptive Attitudes (AD), Business Agility (BA), IT integration (IT), Future-readiness (FR),* and the dependent variables: *Digital transformation resilience (DTR), Digital Literacy/skills (DL), Uptake (UP), Access to Digital Resources (ADR), Technology as a Barrier (TBR), Broadband Infrastructure (BI), Creative Output (OC)*
Source: Prepare by Author (2021)

METHODOLOGY

To conduct this research, secondary data from reputable sources such as the International Institute for Management Developments (IMD), the World Digital Competitiveness Ranking, and the World Intellectual Property Organization (WIPO) Global Innovation Index (GII) is employed. The data is easily accessible on IMD's website (www.imd.org) and WIPO's website (www.wipo.int). The IMD World Digital Competitiveness (WDC) ranking evaluates how countries utilize digital technology and its effects on government processes, business models, and society (IMD, 2023). The Global Innovation Index (GII) provides insight into a country's innovation performance and policy responses for improvement (WIPO, 2023). These sources are widely recognized and are essential to economic policymaking.

This research analyzes data from the IMD WDC data set between 2013-2022. The IMD WDC ranking comprises 65 countries, but this research has examined 61 countries. Unfortunately, *Taiwan, Russia, Ukraine, and Venezuela* are not included in this study. Taiwan and Venezuela were not part of the WIPO GII data set between 2013-2022, while Russia and Ukraine's data needed to be more reliable to include in 2022. Additionally, Russia and Ukraine's global economic disruption played a role in their exclusion from the study. To conduct the analysis, panel data regression was employed using E-views software.

RESULTS AND DISCUSSION

The original data consists of the three subfactors for each factor. Due to high multicollinearity in subfactors, some are rejected, and a new evolution data set is created. In which the knowledge subfactors comprise training & education and scientific concentration, the average of these ranks created new data for knowledge as "Knowledge-New." The technology subfactors comprise the capital and technological framework; the average of these ranks created a new dataset for technology as "Technology-New." The future-readiness subfactors are business agility and adaptive attitudes. The average of these ranks created a new dataset of future-readiness as "Future-readiness New." The dependent variable consists of the average of the ranks of newly evolved data of knowledge, technology, and future readiness. The evolution data has 61 countries as the original dataset and the time series from 2013-2022. The primary focus of the analytical approach in this research is to estimate the effects of the selected independent variables, namely *knowledge, Technology, and Future-readiness.* The effects of the independent variables on the dependent (*Digital Transformation Resilience)* were

analyzed using panel data regression. If the obtained p-value is statistically significant at the 5 percent level (p-value < 0.05), then accept the null hypothesis and reject the alternative hypothesis.

Table 1. Panel Data Regression Results

Independent variable	Dependent variable	P-value	R-Square	Durbin-Watson
Talent	Knowledge	-	-	-
Training and Education	Knowledge	0.000	0.928	1.6
Scientific concentration	knowledge	0.000	0.928	1.6
Regulatory Framework	Technology	-	-	-
Capital	Technology	0.000	0.958	1.8
Technological Framework	Technology	0.000	0.958	1.8
Adaptive attitudes	Future readiness	0.000	0.967	1.9
Business agility	Future readiness	0.000	0.967	1.9
IT Integration	Future readiness	-	-	-
Knowledge	Digital transformation resilience	0.050	0.979	2.0
Technology	Digital transformation resilience	0.303	0.979	2.0
Future-readiness	Digital transformation resilience	0.306	0.979	2.0

Source: Prepared by Author (2023)

Knowledge

From the above Table 1, the panel data regression is performed with fixed effects on the evolved knowledge data with the subfactors' training & education and scientific concentration. Each of the subfactors has its hypothesis. The acceptable range for the Durbin-Watson ranges between (1.5 to 2.0). The Durbin-Watson statistics from the above showcase the value (1.6528), so the autocorrelation in the data is acceptable. For the autocorrelation in the data, Durbin-Watson statistics are taken into account. The R- Squared in the above regression is 92% of the variability observed in the regression model. The interpretation of r-squared is how well the regression model explains observed data.

H_1: Talent does not have a significant effect on the knowledge

The talent is rejected in the evolution data since there is high multicollinearity in the talent.

H_0: Training and education have a significant effect on the knowledge

The training and education are statistically significant to the knowledge and have a high relationship. The p-value (0.000) is less than the significance value, so accept the null hypothesis and reject the alternative hypothesis.

H_0: Scientific concentration has a significant effect on the knowledge

The scientific concentration is statistically significant to the knowledge and has a high relationship. The p-value (0.000) is less than the significance value, so accept the null hypothesis and reject the alternative hypothesis.

H_0: Knowledge has significance on Digital transformation resilience

From Table 1 above, the knowledge is statistically significant to digital transformation resilience and has a relationship. The p-value (0.050) is less than the significance value, so accept the null hypothesis and reject the alternative hypothesis.

Technology

From Table 1 above, the panel data regression with a random effect model is performed on the evolved technology data with the subfactors' capital and technological framework. Each of the subfactors has its hypothesis. The acceptable range for the Durbin-Watson ranges between (1.5 to 2.0). The Durbin-Watson statistics from below showcase the value (1.811), so the autocorrelation in the data is acceptable. For the autocorrelation in the data, Durbin-Watson statistics are taken into account. The R- Squared in the above regression is 95% of the variability observed in the regression model. The interpretation of r-squared is how well the regression model explains observed data.

H_1: Regulatory framework does not have a significant effect on the technology

The random effects regression outcome shows that the alternative hypothesis is accepted, and the null hypothesis is rejected. Since there is high multicollinearity in the regulatory framework, the regulatory framework is rejected in the evolution data.

H_0: Capital has significance on technology

The capital is statistically significant to the technology and has a high relationship. The p-value (0.000) is less than the significance value, so accept the null hypothesis and reject the alternative hypothesis.

H_0: Technological framework has significance on technology

The technological framework is statistically significant to the technology and has a high relationship. The p-value (0.000) is less than the significance value, so accept the null hypothesis and reject the alternative hypothesis.

H_1: Technology does not have significance on Digital transformation resilience

The technology is statistically insignificant to the digital transformation resilience and has no relationship. The p-value (0.303) is higher than the significance value, so accept the alternative hypothesis and reject the null hypothesis.

Future-Readiness

From Table 1 above, the panel data regression with a random effect model is performed on the evolved future readiness data with the subfactors' business agility and adaptive attitude. Each of the subfactors has its hypothesis. The acceptable range for the Durbin-Watson ranges between (1.5 to 2.0). The Durbin-Watson statistics from below showcase the value (1.930), so the autocorrelation in the data is acceptable. For the autocorrelation in the data, Durbin-Watson statistics are taken into account. The R- Squared in the above regression is 96% of the variability observed in the regression model. The interpretation of r-squared is how well the regression model explains observed data.

H_0: Adaptive attitudes have significance on future-readiness

The adaptive attitude is statistically significant to future readiness and has a high relationship. The p-value (0.000) is less than the significance value, so accept the null hypothesis and reject the alternative hypothesis.

H_0: Business agility has significance on future-readiness

The business agility is statistically significant to the future-readiness and has a high relationship. The p-value (0.000) is less than the significance value, so accept the null hypothesis and reject the alternative hypothesis.

H_1: IT integration does not have significance on future-readiness

The random effects regression outcome shows that the alternative hypothesis is accepted, and the null hypothesis is rejected. Since there is high multicollinearity in the IT integration, the IT integration is rejected in the evolution data.

H_1: Future readiness does not have significance on Digital transformation resilience

The future readiness is statistically insignificant to the digital transformation resilience and has no relationship. The p-value (0.306) is higher than the significance value, so accept the alternative hypothesis and reject the null hypothesis.

DISCUSSION

To effectively respond to digital transformation, it is crucial to prioritize acquiring knowledge and skills. This promotes innovation and adaptability, improves global competitiveness, and creates new job opportunities while preventing displacement. Investing in education and training programs can result in a more knowledgeable and skilled population capable of solving complex issues (Dutta et al., 2020). Acquiring education helps individuals understand complex concepts, while specialized training provides skills necessary for success in specific professions or industries. Scientific concentration can bring numerous benefits to a

country, including encouraging innovation and technological advancements (Leonardi, 2021). This can lead to economic growth and development while addressing societal issues related to health, energy, and the environment by producing knowledge and solutions.

Governments worldwide invest in research and development to advance scientific progress. The US has several initiatives, including the 21st Century Cures Act, National Robotics Initiative, CARES Act, and National AI Initiative Act (National Science Foundation, 2020). Other countries like China and Israel are also increasing their R&D investments. Kazakhstan, Israel, and Sweden prioritize education with hybrid learning methods. In the US, policies encourage tech investments, while Luxembourg has PIC and LFF investment funds. Norway has implemented a "Strategy for AI" and a "Digitalization Strategy for the Public Sector." Singapore, South Korea, and Taiwan significantly invest in digital transformation, while Switzerland and Germany prioritize digital education, research, and business development (Jing, 2019; Smart City Singapore, 2020).

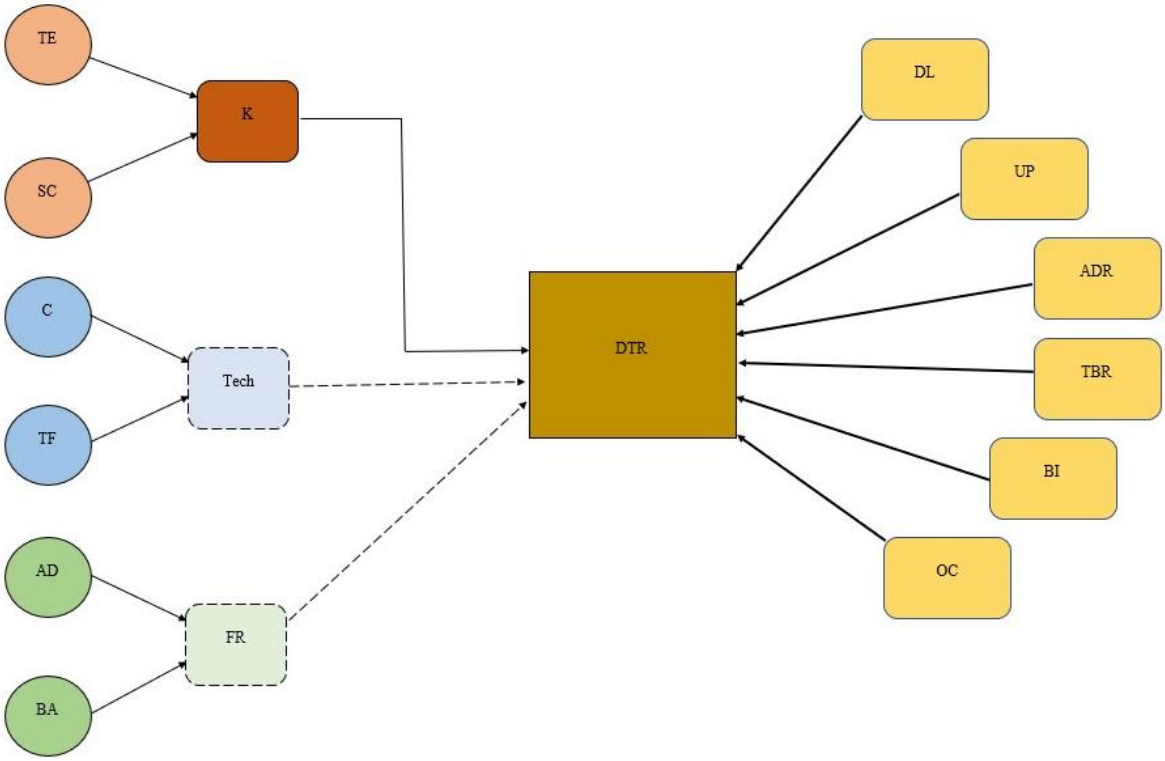
Theoretical Implications

To adapt to changing environments, several theories provide frameworks. Resilience theory is crucial for digital transformation, emphasizing the capacity to cope with disruptions, adjust to new technology, and create risk-reduction measures. The dynamic capability view is essential for organizations to adapt to digital transformation. Knowledge-based view highlights the importance of creating, sharing, and utilizing knowledge to foster innovation and create long-term competitive advantages. By adopting a knowledge-based view, companies can quickly respond to changes, make informed decisions, and remain competitive (Waizeneggr et al., 2020). Digital transformation can enhance productivity, create job opportunities, improve public services, and establish countries as leaders in the global digital economy. It can also foster the development of new products and services, increase market reach, and personalize customer experiences. Digital change positively affects individuals by expanding remote employment and educational opportunities, promoting skill growth, and providing access to the digital economy.

Resilience capabilities enable individuals and organizations to navigate uncertainties and complexities, while openness to change positively impacts economic development (Kuppusamy and Datti, 2023). Diffusion of innovation theory includes awareness of the adoption process, removing obstacles, promoting the innovation ecosystem, encouraging digital literacy, and developing supportive legislation and infrastructure (Rogers, 2010). By fostering

resilience and embracing change, we can unleash the transformative potential of digital technologies for equitable growth, sustainable development, and enhanced quality of life.

Figure 3. Evolved Theoretical Framework



The Independent variables: *Talent (T), Training & Education (TE), Scientific Concentration (SC), Knowledge (K), Regulatory Framework (RF), Capital (C), Technological Framework (TF), Technology (Tech), Adaptive Attitudes (AD), Business Agility (BA), IT integration (IT), Future-readiness (FR),* and the dependent variables: *Digital transformation resilience (DTR), Digital Literacy/skills (DL), Uptake (UP), Access to Digital Resources (ADR), Technology as a Barrier (TBR), Broadband Infrastructure (BI), Creative Output (OC)*
Source: Prepared by Author (2023)

Practical Implications

Governments are crucial in promoting digital transformation and ensuring it can withstand challenges. To achieve this, they must take proactive measures such as enhancing policies, investing in infrastructure, developing skills, implementing cybersecurity measures, promoting collaboration and inclusivity, and establishing effective planning and response mechanisms. Industries also significantly impact digital transformation resilience and should prioritize resilience capabilities as a strategic imperative to succeed. This can be achieved through training programs focusing on digital skills and cybersecurity measures, prioritizing data protection, and promoting innovation and business agility. Furthermore, academia is essential in examining the academic impacts of resilience capabilities in the context of digital transformation. Academic institutions can enhance digital transformation resilience by integrating resilience capabilities into curricula, conducting research, and investing in

infrastructure and resources. By pursuing these endeavors, students can acquire the necessary skills and generate valuable insights that inform practical applications and policy decisions, ultimately leading to a robust digital transformation.

CONCLUSION

In today's world, businesses need to embrace digital transformation to succeed. This transformation can be driven by an organization's needs or unexpected crises. To remain resilient, businesses must adapt to changes by utilizing digital technologies. Additionally, countries must have strategic capabilities to respond to disruptions caused by economic, technological, or health crises. This study found that knowledge capability has a more significant impact on digital transformation resilience than technology or future readiness. Therefore, governments, industries, and academia must take proactive steps to prioritize digital transformation resilience capabilities during disruptions. This can be achieved by enhancing policies, investing in education and employee training, promoting innovation, and conducting academic research. Academia can also play a crucial role by integrating resilience capabilities into curricula, investing in digital skills, and conducting research.

REFERENCES

Ahmed, D. A., Ibrahim, M. A. and Saeed, Y. J. (2023) “The Role of Information Management Systems in the Implementation of the Digital Economy Development Strategy”, *International Journal of Professional Business Review*. São Paulo (SP), 8(5), p. e01419. doi: 10.26668/businessreview/2023.v8i5.1419 .

Al-Saqqa, S., Sawalha, S. and AbdelNabi, H., 2020. Agile software development: Methodologies and trends. *International Journal of Interactive Mobile Technologies*, *14*(11).

Baloch, M.A., Ozturk, I., Bekun, F.V. and Khan, D., 2021. Modeling the dynamic linkage between financial development, energy innovation, and environmental quality: does globalization matter?. *Business Strategy and the Environment*, *30*(1), pp.176-184.

BANERJI, H., 2022. Investigation into the Dynamics of Digital Transformation Process & Implementation Strategy for Smes. *Available at SSRN 4030571*.

Batool, A. and Sahi, A., 2019. Determinants of financial performance of insurance companies of USA and UK during global financial crisis (2007–2016). *International Journal of Accounting Research*, *7*(1), pp.1-9.

Benitez, J., Arenas, A., Castillo, A. and Esteves, J., 2022. Impact of digital leadership capability on innovation performance: The role of platform digitization capability. *Information & Management*, *59*(2), p.103590.

Bertello, A., Battisti, E., De Bernardi, P. and Bresciani, S., 2022. An integrative framework of knowledge-intensive and sustainable entrepreneurship in entrepreneurial ecosystems. *Journal of Business Research*, *142*, pp.683-693.

Beverungen, D., Hess, T., Köster, A. and Lehrer, C., 2022. From private digital platforms to public data spaces: implications for the digital transformation. *Electronic Markets*, *32*(2), pp.493-501.

Bieser, J.C. and Hilty, L.M., 2018. Assessing indirect environmental effects of information and communication technology (ICT): A systematic literature review. *Sustainability*, *10*(8), p.2662.

Bloomberg, J., 2018. Digitization, digitalization, and digital transformation: confuse them at your peril. *Forbes. Retrieved on August*, *28*, p.2019.

Bordot, F., 2022. Artificial intelligence, robots and unemployment: Evidence from OECD countries. *Journal of Innovation Economics & Management*, (1), pp.117-138.

Borowski, P.F., 2021. Digitization, digital twins, blockchain, and industry 4.0 as elements of management process in enterprises in the energy sector. *Energies*, *14*(7), p.1885.

Botzen, W.W., Deschenes, O. and Sanders, M., 2019. The economic impacts of natural disasters: A review of models and empirical studies. *Review of Environmental Economics and Policy*.

Cabero-Almenara, J., Guillén-Gámez, F.D., Ruiz-Palmero, J. and Palacios-Rodríguez, A., 2022. Teachers' digital competence to assist students with functional diversity: Identification of factors through logistic regression methods. *British Journal of Educational Technology*, *53*(1), pp.41-57.

Collins, H., 2019. *Tacit and explicit knowledge*. University of Chicago press.

Dahiyat, S.E., Khasawneh, S.M., Bontis, N. and Al-Dahiyat, M., 2023. Intellectual capital stocks and flows: Examining the mediating roles of social capital and knowledge transfer. *VINE Journal of Information and Knowledge Management Systems*, *53*(1), pp.11-42.

Desveaux, L., Soobiah, C., Bhatia, R.S. and Shaw, J., 2019. Identifying and overcoming policy-level barriers to the implementation of digital health innovation: Qualitative study. *Journal of medical Internet research*, *21*(12), p.e14994.

Dutta, G., Kumar, R., Sindhwani, R. and Singh, R.K., 2020. Digital transformation priorities of India's discrete manufacturing SMEs–a conceptual study in perspective of Industry 4.0. *Competitiveness Review: An International Business Journal*.

Dwivedi, Y.K., Hughes, D.L., Coombs, C., Constantiou, I., Duan, Y., Edwards, J.S., Gupta, B., Lal, B., Misra, S., Prashant, P. and Raman, R., 2020. Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life. *International journal of information management*, *55*, p.102211.

Esterwood, E. and Saeed, S.A., 2020. Past epidemics, natural disasters, COVID19, and mental health: learning from history as we deal with the present and prepare for the future. *Psychiatric quarterly*, *91*, pp.1121-1133.

Evers, G., 2020. The role of university-industry interaction in regional industrial development: Research collaborations and graduate human capital as complementary university-industry knowledge transfer channels.

Girdwichai, L. and Sriviboon, C., 2020. Employee motivation and performance: Do the work environment and the training matter?. *Journal of Security & Sustainability Issues*, *9*.

Hashmi, R. and Alam, K., 2019. Dynamic relationship among environmental regulation, innovation, CO2 emissions, population, and economic growth in OECD countries: A panel investigation. *Journal of cleaner production*, *231*, pp.1100-1109.

Helo, P. and Hao, Y., 2019. Blockchains in operations and supply chains: A model and reference implementation. *Computers & Industrial Engineering*, *136*, pp.242-251.

Henfridsson, O., Mathiassen, L. and Svahn, F., 2014. Managing technological change in the digital age: the role of architectural frames. *Journal of Information Technology*, *29*(1), pp.27-43.

Hossain, M.A., Zhumabekova, A., Paul, S.C. and Kim, J.R., 2020. A review of 3D printing in construction and its impact on the labor market. *Sustainability*, *12*(20), p.8492.

IMD, 2023. World digital competitiveness ranking. Available at: https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-digital-competitiveness-ranking/ [Accessed in May 2023].

Jing, B.J., 2019. Cybersecurity as a Sine Qua Non of Digital Economy: Turning Taiwan into a Reliable Digital Nation?. *DISINFORMATION, CYBERSECURITY, & ENERGY CHALLENGES*.

Kamboj, S., Matharu, M., Lim, W.M., Ali, F. and Kumar, S., 2022. Consumer adoption of green hotels: understanding the role of value, innovation, and involvement. *Journal of Hospitality Marketing & Management*, *31*(7), pp.819-849.

Kayembe, C. and Nel, D., 2019. Challenges and opportunities for education in the Fourth Industrial Revolution. *African Journal of Public Affairs*, *11*(3), pp.79-94.

Kim, S.B. and Kim, D., 2020. ICT implementation and its effect on public organizations: The case of digital customs and risk management in Korea. *Sustainability*, *12*(8), p.3421.

Kuo, F.I., Fang, W.T. and LePage, B.A., 2022. Proactive environmental strategies in the hotel industry: Eco-innovation, green competitive advantage, and green core competence. *Journal of Sustainable Tourism*, *30*(6), pp.1240-1261.

Lakshmi Chaitanya Datti and Mudiarasan Kuppusamy, 2022. A Conceptual Argument on the Digital Resilience Capability within the Developing and Developed countries. *International Journal of Advanced Business Studies, 1(1).*

Lee, J. and Lee, K., 2021. Is the fourth industrial revolution a continuation of the third industrial revolution or something new under the sun? Analyzing technological regimes using US patent data. *Industrial and Corporate Change*, *30*(1), pp.137-159.

Lee, S.H. and Chen, Y.J., 2021. Indigenous knowledge and endogenous actions for building tribal resilience after typhoon soudelor in northern taiwan. *Sustainability*, *13*(2), p.506.

Lele, U. and Goswami, S., 2017. The fourth industrial revolution, agricultural and rural innovation, and implications for public policy and investments: a case of India. *Agricultural Economics*, *48*(S1), pp.87-100.

Leonardi, P.M., 2021. COVID-19 and the new technologies of organizing: digital exhaust, digital footprints, and artificial intelligence in the wake of remote work. *Journal of Management Studies*, *58*(1), p.249.

Li, G. and Roongruang, P., 2022. Design of pitch control software infrastructure based on collaborative filtering algorithm. *Scientific Programming*, *2022*.

Massaro, A., 2022. Information technology infrastructures supporting Industry 5.0 facilities.

Masten, A.S., 2014. Global perspectives on resilience in children and youth. *Child development*, *85*(1), pp.6-20.

Mbuyisa, B. and Leonard, A., 2017. The role of ICT use in SMEs towards poverty reduction: A systematic literature review. *Journal of International Development*, *29*(2), pp.159-197.

Mhlanga, D., 2020. Industry 4.0 in finance: the impact of artificial intelligence (ai) on digital financial inclusion. *International Journal of Financial Studies*, *8*(3), p.45.

Millenson, M.L., 2018. *Demanding medical excellence: Doctors and accountability in the information age*. University of Chicago Press.

Mudiarasan Kuppusamy, and Lakshmi Chaitanya Datti, 2023. A Trend Analysis on Digital Transformation Resilience Capability: The Case of Malaysia. *Information Management and Computer Science (IMCS), 6(1) pp. 01-04.*

Nambisan, S., Wright, M. and Feldman, M., 2019. The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. *Research Policy*, *48*(8), p.103773.

Olsen, T.L. and Tomlin, B., 2020. Industry 4.0: Opportunities and challenges for operations management. *Manufacturing & Service Operations Management*, *22*(1), pp.113-122.

Palad, J.B., 2022. Strategies for Improving Organizational Efficiency, Productivity, and Performance through Technology Adoption. *Journal of Management and Administration Provision*, *2*(3), pp.88-94.

PARILLA, J. and LIU, S., 2021. Talent-driven economic development.

Philbeck, T. and Davis, N., 2018. The fourth industrial revolution. *Journal of International Affairs*, *72*(1), pp.17-22.

Ponzanesi, S., 2019. Migration and mobility in a digital age:(Re) mapping connectivity and belonging. *Television & New Media*, *20*(6), pp.547-557.

Rahman, A., Sakurai, A. and Munadi, K., 2017, February. Indigenous knowledge management to enhance community resilience to tsunami risk: lessons learned fromSmongtraditions in

Simeulue island, Indonesia. In *IOP Conference series: earth and environmental science* (Vol. 56, p. 012018). iop Publishing.

Roberts, B.H., 2015. The third industrial revolution: Implications for planning cities and regions. *Work. Pap. Urban Front*, *1*(1).

Rogers, E.M., 2010. *Diffusion of innovations*. Simon and Schuster.

Saha, T., Sinha, A. and Abbas, S., 2022. Green financing of eco-innovations: is the gender inclusivity taken care of?. *Economic Research-Ekonomska Istraživanja*, *35*(1), pp.5514-5535.

Schwertner, K., 2017. Digital transformation of business. *Trakia Journal of Sciences*, *15*(1), pp.388-393.

Seddighi, H., Salmani, I., Javadi, M.H. and Seddighi, S., 2021. Child abuse in natural disasters and conflicts: A systematic review. *Trauma, Violence, & Abuse*, *22*(1), pp.176-185.

Shahzad, A., Hassan, R., Aremu, A.Y., Hussain, A. and Lodhi, R.N., 2021. Effects of COVID-19 in E-learning on higher education institution students: the group comparison between male and female. *Quality & quantity*, *55*, pp.805-826.

Shayrine, H. and Venugopal, P. (2023) " The Impact of Talent Recognition on the Intention to Stay in Work Context: Empirical Overview", *International Journal of Professional Business Review*. São Paulo (SP), 8(6), p. e01839. doi: 10.26668/businessreview/2023.v8i5.1839.

Shin, H. and Kang, J., 2020. Reducing perceived health risk to attract hotel customers in the COVID-19 pandemic era: Focused on technology innovation for social distancing and cleanliness. *International Journal of Hospitality Management*, *91*, p.102664.

Siennicka, M., Ulanowska, A. and Rahmstorf, L., 2017. First Textiles: The Beginnings of Textile Production in Europe and the Mediterranean. *First Textiles*, pp.1-272.

Silva, V.L., Kovaleski, J.L. and Pagani, R.N., 2019. Technology transfer and human capital in the industrial 4.0 scenario: A theoretical study. *Future Studies Research Journal: Trends and Strategies*, *11*(1), pp.102-122.

Singh, S.K., Mazzucchelli, A., Vessal, S.R. and Solidoro, A., 2021. Knowledge-based HRM practices and innovation performance: Role of social capital and knowledge sharing. *Journal of International Management*, *27*(1), p.100830.

Sippel, L.M., Pietrzak, R.H., Charney, D.S., Mayes, L.C. and Southwick, S.M., 2015. How does social support enhance resilience in the trauma-exposed individual?. *Ecology and society*, *20*(4).

Sirait, H., Rosalina, S. S. and Sari, E. (2023) "The Impact of Digital Innovation on Economic Growth", *International Journal of Professional Business Review*. São Paulo (SP), 8(6), p. e01842. doi: 10.26668/businessreview/2023.v8i6.1842.

Sittig, D.F. and Singh, H., 2020. COVID-19 and the need for a national health information technology infrastructure. *Jama*, *323*(23), pp.2373-2374.

Sofyan, D. and Abdullah, K.H., 2022. Scientific developments in educational innovation research in Indonesia and Malaysia: a scientometric review. *International Journal of Educational Innovation and Research*, *1*(1), pp.42-51.

Sonia Mishra, 2023. Pakistan's economic crisis. Available at: https://news.umich.edu/pakistans-economic-crisis/ [Accessed on March, 2023]

Statista, 2023. AI market spending worldwide 2020, by segment. Available at: https://www.statista.com/statistics/755331/worldwide-spending-on-cognitive-ai-systems-segment-share/#:~:text=AI%20market%20spending%20worldwide%202020%2C%20by%20segment&text=In%202021%2C%20the%20global%20artificial,reaching%20327.5%20billion%20U.S.%20dollars

Strinati, E.C., Barbarossa, S., Gonzalez-Jimenez, J.L., Ktenas, D., Cassiau, N., Maret, L. and Dehos, C., 2019. 6G: The next frontier: From holographic messaging to artificial intelligence using subterahertz and visible light communication. *IEEE Vehicular Technology Magazine*, *14*(3), pp.42-50.

Sung, J., 2018. The fourth industrial revolution and precision agriculture. *Automation in Agriculture: Securing Food Supplies for Future Generations*, *1*.

Taalbi, J., 2019. Origins and pathways of innovation in the third industrial revolution. *Industrial and Corporate Change*, *28*(5), pp.1125-1148.

Teece, D.J., 2018. Profiting from innovation in the digital economy: Enabling technologies, standards, and licensing models in the wireless world. *Research policy*, *47*(8), pp.1367-1387.

Thomas, C.E., Gastin, P.B., Abbott, G. and Main, L.C., 2021. Impact of the talent development environment on the wellbeing and burnout of Caribbean youth track and field athletes. *European Journal of Sport Science*, *21*(4), pp.590-603.

Udriyah, U., Tham, J. and Azam, S., 2019. The effects of market orientation and innovation on competitive advantage and business performance of textile SMEs. *Management Science Letters*, *9*(9), pp.1419-1428.

UNCTAD, 2023. Technology and Innovation Report 2023. Available at: https://unctad.org/tir2023#:~:text=The%20report%20assesses%20countries'%20preparedness,activity%20and%20access%20to%20finance [Accessed on May, 2023]

van Es, K., 2022. Netflix & Big Data: The Strategic Ambivalence of an Entertainment Company. *Television & New Media*, p.15274764221125745.

Vaseashta, A. and Ionete, R., 2021. Technology Accelerator Network Modality to Promote Innovation Ecosystem in Materials Science for Energy and Environment. In *23rd International Conference New Cryogenic and Isotope Technologies for Energy and Environment, Băile Govora, Romania*.

Waizenegger, L., McKenna, B., Cai, W. and Bendz, T., 2020. An affordance perspective of team collaboration and enforced working from home during COVID-19. *European Journal of Information Systems*, *29*(4), pp.429-442.

Wang, D., Zhou, T. and Wang, M., 2021. Information and communication technology (ICT), digital divide and urbanization: Evidence from Chinese cities. *Technology in Society*, *64*, p.101516.

Wang, J., Liu, Y., Wang, W. and Wu, H., 2023. How does digital transformation drive green total factor productivity? Evidence from Chinese listed enterprises. *Journal of Cleaner Production*, p.136954.

Watt, M., 2003. Textile Production in Europe: Printed, 1600–1800. *Heilbrunn Timeline of Art History*.

WIPO, 2023. Global Innovation Index 2022. Available at: https://www.wipo.int/global_innovation_index/en/2022/ [Accessed in May 2023].

Xu, J., Liu, F. and Shang, Y., 2021. R&D investment, ESG performance and green innovation performance: evidence from China. *Kybernetes*, *50*(3), pp.737-756.

Zaki, M., 2019. Digital transformation: harnessing digital technologies for the next generation of services. *Journal of Services Marketing*.