Navigating Uncertainty: Agility, Data, and Sustainability as Drivers of Business Resilience

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Abstract

This study examines how businesses manage uncertainty through a combination of emerging technologies, organizational agility, and sustainability practices. Using an integrative literature review and case studies across global regions, the research identifies strategies that enhance decision-making and resilience in volatile environments. The study draws on Dynamic Capabilities Theory and Organisational Information Processing Theory to analyze how companies leverage Big Data, Artificial Intelligence (AI), and Blockchain to navigate uncertainty while ensuring ethical standards. Key findings suggest that firms that adopt flexible organizational structures and sustainable technologies are better positioned to mitigate risks and maintain a competitive edge. Ethical considerations, such as managing algorithmic biases and data privacy, are highlighted as essential for the responsible adoption of these technologies. The study concludes that integrating agility, advanced data analytics, and sustainability not only enhances organizational resilience but also offers long-term strategic advantages. The research provides practical recommendations for business leaders and proposes future research directions focused on SMEs and the ethical implications of digital transformation.

Keywords: uncertainty management, decision-making, organizational agility, emerging technologies, Big Data, AI, blockchain, emerging markets.

1. Introduction

Business uncertainty has increased significantly in recent years due to a number of global factors, including the COVID-19 pandemic, accelerating technological advances and economic instability. These factors have challenged the ability of organisations to adapt and make effective decisions in volatile and changing contexts. Sharma et al. (2020) highlight that the pandemic exposed the limitations of traditional risk management approaches, while Skyrius et al. (2021) assert that organisations that adopt agile and dynamic approaches to their decision-making processes are more likely to thrive in uncertain environments. Given the changing nature of the business environment, it becomes imperative to analyse how organisations can effectively respond to uncertainty.

Recent literature has begun to explore how firms can manage uncertainty by adopting emerging technologies and promoting organisational agility. However, there remains a significant gap in understanding how these strategies vary by regional context and organisational size. Furthermore, while progress has been made in the study of emerging technologies, such as artificial intelligence and Big Data, and their impact on business decision-making, there is still a lack of comprehensive research on how organisations can integrate these technologies ethically into their decision-making processes, especially in emerging markets where regulations are often more lax (Yousuf, 2020; Tsesmelis et al., 2022). These gaps in the literature highlight the need for a more detailed analysis of how companies in different regions and sectors are responding to these challenges, to develop strategies that promote both organisational agility and ethical adoption of emerging technologies.

The main objective of this study is to explore how companies in North America, Europe, Asia and emerging markets manage uncertainty in their decision-making processes. To this end, three key research questions are posed: (1) How does uncertainty affect business decision-making processes, (2) How can companies foster an organisational culture that promotes agility under conditions of uncertainty, (3) How can organisations integrate emerging technologies and sustainable practices into their decision-making processes, and (4) How can organisations effectively and ethically integrate these technologies into all levels of decision-making? This study seeks to identify regional and sectoral patterns that can guide the creation of adaptive and resilient strategies, exploring differences across regions and firm sizes.

This study is based on two complementary theories: Dynamic Capabilities Theory and Organisational Information Processing Theory (OIPT). The Dynamic Capabilities Theory, proposed by Teece et al. (1997), suggests that firms that can reconfigure their resources and competencies to adapt to changing environments have a sustained competitive advantage. This theory is essential for understanding how firms develop organisational agility and adapt quickly to uncertainty. On the other hand, OIPT, developed by Galbraith (1974), argues that organisations face uncertainty due to the complexity of the information they must process. As uncertainty increases, organisations must improve their information processing capability through the adoption of new technologies and the optimisation of their organisational processes. Together, these theories provide the conceptual framework for analysing how firms can manage uncertainty through the adoption of emerging technologies and the development of dynamic capabilities.

As organisations face increasing levels of uncertainty, it is crucial to understand how they can balance organisational agility and the adoption of emerging technologies to improve their decision-making processes. Although Dynamic Capabilities Theory and OIPT have been extensively studied in business contexts, there remains a significant gap in the literature on how these theories can be applied to the ethical integration of emerging and sustainable technologies in different regions and sectors (Floridi & Cowls, 2019; Stahl & Wright, 2018). Furthermore, the lack of empirical studies analysing how companies in emerging markets are managing uncertainty through the adoption of sustainable technologies and practices, justifies the need for this research. This study offers a significant contribution by providing a deeper understanding of

how global companies can apply these theories to manage uncertainty, balancing technological demands with ethical and sustainable considerations.

This study adopts an integrative literature review with a qualitative approach, following the approach described by Sajjad et al. (2023). The review focuses on previous studies examining organisational agility, adoption of emerging technologies and uncertainty management in global business contexts. The review covers empirical and theoretical articles published between 2019 and 2024, selected from databases such as Web of Science and Scopus. The qualitative approach allows us to identify patterns and variations in the uncertainty management strategies adopted by companies in different regions and sectors. In addition, it analyses how these organisations have applied the principles of Dynamic Capabilities Theory and OIPT to improve their information processing capacity and resilience in volatile environments.

The article is structured in six sections. The first section presents the introduction and the theoretical framework guiding the research. The second section describes the methodology used, focusing on an integrative literature review. The results are then presented, organised around business cases from North America, Europe, Asia and emerging markets. The discussion of the results highlights regional differences, and the strategies adopted by firms to manage uncertainty. Finally, the article concludes with a synthesis of implications for business practice and recommendations for future research.

This study offers an original contribution by integrating Dynamic Capabilities Theory and Organisational Information Processing Theory (OIPT) in the analysis of how firms manage uncertainty in a global environment. By exploring how organisations in North America, Europe, Asia and emerging markets adopt emerging technologies and promote organisational agility, the study provides a deeper understanding of how firms can balance information processing capability with the reconfiguration of their resources to meet the ethical and operational challenges associated with uncertainty (Teece et al., 1997; Galbraith, 1974). In addition, the study offers practical recommendations for the ethical adoption of emerging and sustainable technologies in different regions and sectors, thus contributing to the literature on business management in times of uncertainty.

2. Literature Review

Decision-making in today's business environment faces increasing uncertainty, driven by disruptive events such as the COVID-19 pandemic, technological advances, and geopolitical tensions. This section provides a comprehensive and critical analysis of the strategies used by organisations to navigate this uncertain environment, focusing on agility, sustainability, and the use of emerging technologies such as Big Data, AI and Blockchain (Jafar et al., 2022; Rahman et al., 2022; Zhang and Li, 2022).

2.1. Uncertainty and Business Decision Making: A Multifaceted Challenge

The distinction between risk and ambiguity is fundamental to understanding the challenges of decision-making under uncertainty. Risk can be managed through probabilistic calculations,

while uncertainty arises from unquantifiable variables, which complicates the decision-making process (Brillinger et al., 2020). This challenge has been exacerbated by events such as the COVID-19 pandemic, which forced companies to reconsider their traditional approaches to risk management (Bhardwaj & Tanwar, 2022; Skyrius et al., 2021).

Research has shown that organisations that adopt a more agile and flexible approach are more successful in managing uncertainty. Skyrius et al. (2021) highlight the importance of agility during the pandemic, while Bhardwaj & Tanwar (2022) examine how firms adjusted their strategies to deal with unforeseen changes. This research suggests that organisations that integrate agile frameworks into their operations are better prepared to mitigate the negative impacts of uncertainty.

Shmueli et al. (2023), in their study on Machine Learning and Business Analytics, stress that differentiating between risk and ambiguity is key to developing predictive tools that enable organisations to cope with uncertainty. The use of machine learning algorithms and predictive analytics can provide companies with a competitive advantage by enabling them to identify patterns and make more informed decisions even under conditions of ambiguity (Aljohani, 2023). However, these approaches also present ethical challenges, such as managing algorithmic biases and data privacy (Tsesmelis et al., 2022; Chen & Biswas, 2021).

Although previous studies have highlighted the importance of differentiating between risk and ambiguity in decision-making (Brillinger et al., 2020), there remains a significant gap in the literature on how uncertainty affects business decision-making processes. Recent research has suggested that the use of data analytics and AI algorithms can mitigate the effects of uncertainty by providing more accurate, data-driven predictions (Shmueli et al., 2023). However, they have also pointed to ethical challenges associated with these technologies, such as algorithmic biases and data privacy, which require further attention (Tsesmelis et al., 2022).

2.2. Agility: A Critical Response to Uncertainty in Decision Making

Agility has emerged as a critical response to uncertainty. It is defined as the ability of an organisation to adapt quickly and effectively to changing circumstances (Skyrius et al., 2021; Bhardwaj & Tanwar, 2022). During the pandemic, the most agile organisations were able to adjust their operations quickly, minimising negative effects and taking advantage of new opportunities (Skyrius et al., 2021).

Studies suggest that the adoption of agile frameworks is key to responding to unforeseen changes. Brillinger et al. (2020) present a comprehensive approach to fostering organisational agility, highlighting the importance of flexibility, stakeholder engagement and technology integration. However, research also identifies significant barriers to the adoption of these practices, including rigid hierarchical structures and resistance to change (Sarfraz & Ivașcu, 2023). These challenges require further exploration to identify strategies that enable organisations to implement agility effectively.

Shmueli et al. (2023) also highlight the role of technology in facilitating organisational agility. Real-time data analytics tools and digital collaboration platforms have enabled companies to

make more informed decisions and speed up response processes to unforeseen situations. However, the current literature lacks concrete examples of how companies can foster an organisational culture that promotes agility under conditions of uncertainty (Kudyba & Cruz, 2023).

2.3. Sustainable Decision Making: A Long-Term Imperative in Times of Uncertainty

Sustainability has acquired a central role in business decision-making, especially in an environment characterised by increasing environmental and social risks (Ziolo et al., 2023). Organisations that integrate sustainability principles into their decisions not only improve their resilience, but also secure a long-term competitive advantage (Sarfraz & Ivașcu, 2023).

However, the current literature presents a gap in terms of how organisations can integrate emerging technologies and sustainable practices into their decision-making processes (Zheng & Wen, 2023). During the COVID-19 pandemic, many organisations were forced to prioritise short-term survival, thus compromising their sustainability initiatives (Mol et al., 2023). This study suggests that companies should develop strategies to integrate sustainability without sacrificing competitiveness in times of crisis.

Angelelli & Gervasi (2021) and Cui et al., (2023) point out that sustainability is also intrinsically linked to the adoption of emerging technologies, such as Blockchain, which enable greater transparency in supply chain management. These technologies not only improve operational efficiency, but also ensure that companies comply with social and environmental standards, which is critical in times of uncertainty (Jan et al., 2023).

The theory of dynamic capabilities suggests that organisations need to develop specific skills to adjust and succeed in rapidly changing and uncertain environments. In the context of this work, organisational agility, sustainability and emerging technologies such as Big Data and artificial intelligence enable companies to react efficiently to market variations and anticipate potential risks. This theory links directly to the main objective of this study, which examines strategies that combine technological and organisational capabilities to optimise decision-making in uncertain global contexts (Teece et al., 2016).

2.4. Big Data and Artificial Intelligence: Tools for Decision Making Under Uncertainty

The use of Big Data and Artificial Intelligence (AI) has enabled companies to process large volumes of data in real time, which facilitates decision-making in uncertain environments (Chen & Biswas, 2021; Shmueli et al., 2023). These emerging technologies provide organisations with tools to identify patterns and predict possible future scenarios, enhancing their ability to prepare for unforeseen changes (Floridi & Cowls, 2019; Mittelstadt, 2019).

However, the use of Machine Learning and Big Data poses significant ethical challenges. Shmueli et al. (2023) highlight that inherent biases in algorithms can compromise the quality of decisions, while data privacy issues remain a critical concern (Tsesmelis et al., 2022). For these technologies to be effective, companies must implement adequate controls to ensure ethical use of data and fairness in the results generated by the algorithms (Ryan et al., 2023).

The current literature does not yet sufficiently explore how organisations can effectively and ethically integrate these technologies into all levels of decision-making. This gap represents a critical gap that needs to be addressed in future research, given the growing role of Big Data and AI in managing business uncertainty (Birkstedt et al., 2023).

Organisational information processing theory (OIPT) asserts that decision-making effectiveness depends on a firm's ability to manage and process information appropriately in uncertain environments. In this study, the integration of technologies such as Big Data and artificial intelligence is aligned with this theory, as these tools allow companies to collect, analyse and process large amounts of data, which significantly improves the ability to make fast and accurate decisions. This approach is especially relevant in emerging markets, where institutional uncertainty and market fluctuations are common (Moser et al., 2017).

By other side, the Blockchain has emerged as a transformative technology that offers transparency, security and decentralisation in data management (Sousa, 2023). In the context of uncertainty, Blockchain enables businesses to conduct secure transactions and verify data in real time, reducing reliance on intermediaries and minimising the risk of fraud (Charles et al., 2023; Lee & Kim, 2024).

According to the ANOR-BlockChain-Review (2024), the use of smart contracts in Blockchain has allowed automating deals and reducing the risk of human error, improving efficiency and reducing operational costs. However, one of the main challenges associated with this technology is its high energy consumption, which raises questions about its long-term viability from a sustainability perspective (Fang et al., 2024).

3. Methodology

3.1 Integrative literature review

The main methodological approach of this study is the integrative literature review, a qualitative method that allows analysing how firms manage uncertainty in different regions by integrating different literature sources to synthesise new perspectives (Sajjad et al., 2023). According to Saunders et al. (2023), this approach is particularly suitable for research where the aim is to combine previous studies and generate new interpretations from them.

The systematic review was conducted using the Consensus artificial intelligence tool, which facilitates the search and classification of articles and books based on specific keywords (Dijk et al., 2023; Houdou et al., 2024). These keywords included terms such as ‘uncertainty management’, ‘decision-making’, ‘organisational agility’, ‘emerging technologies’, ‘Big Data’, ‘AI’, and ‘blockchain’, and were applied to reliable databases such as Web of Science and Scopus, ensuring the quality of the selected sources.

3.2 Inclusion and exclusion criteria

The study selection process for this review was based on a well-defined set of inclusion and exclusion criteria to ensure that only relevant and methodologically rigorous research was

considered. The initial result was 3,931 potential articles addressing either of these concepts in a business context.

Inclusion criteria: Only studies published between 2019 and 2024 were included to ensure relevance and up-to-dateness of the data. Studies were selected that provided empirical data or case analyses in key industries in North America, Europe, Asia and emerging markets. This allowed for a comparative and comprehensive understanding of regional strategies under conditions of uncertainty. Studies were included that explicitly addressed decision-making under uncertainty, organisational agility, and the adoption of emerging technologies in the business context. Studies were selected with robust methodological frameworks, employing quantitative, qualitative or mixed methods, ensuring that the findings were substantiated and applicable to the business environment. After applying these inclusion criteria, the number of articles was reduced from 3,931 to 477 studies, which met the above conditions.

Exclusion criteria: Studies that did not explicitly address uncertainty in business decision-making were excluded as they could lead to biased interpretations (Stefan et al., 2022). Studies that did not use a robust methodological framework or did not provide a detailed analysis of business strategies under uncertainty were discarded to avoid introducing interpretative biases (Kulkov et al., 2023). Articles that had not been peer-reviewed were also excluded as they did not meet the academic quality standards required for this comparative analysis.

By applying these exclusion criteria, the number of selected studies was finally reduced to 76 articles, which met all the requirements of thematic relevance, geographical coverage and methodological rigour. This approach ensures that only the most relevant and methodologically sound studies are part of the review, which enhances the validity and applicability of the findings obtained.

3.3 Justification of the qualitative approach

The choice of a qualitative approach is justified because of the inherent complexity of the research topic: the management of uncertainty. This approach is best suited to explore phenomena that require a deep understanding of the context and the particular experiences of companies in different regions of the world (Cuoco et al., 2022). Unlike a quantitative approach, which would seek to generalise findings, qualitative methodology allows for a detailed and contextualised analysis that is key to this study.

According to Saunders et al. (2023), qualitative approaches are preferable when seeking to interpret complex phenomena rather than measure them quantitatively. The integrative literature review allows different perspectives to be combined to develop a more comprehensive conceptual framework, which is fundamental in the exploration of business uncertainty.

3.4 Application of thematic analysis

Thematic analysis was the technique used for data synthesis. The steps described by Braun & Clarke (2006) were followed, including the identification, coding and categorisation of relevant themes. The sources were analysed to identify common patterns in business strategies under uncertainty. The key themes identified were: Organisational agility, sustainability, use of Big

Data and AI, emerging market strategies. Each theme was coded according to its relevance to the studies analysed, and comparison techniques were used to identify similarities and differences between regions.

3.5 Sampling strategy

The selection of sources followed a theoretical sampling, guided by the objective of representing various strategies for managing uncertainty in a global context. This sampling was justified by the need to include studies that offered insights on adaptability and agility in decision-making in uncertain environments (Ajmal et al., 2023).

Fifty-six references that met the established quality criteria were included. The sources were evaluated using a two-stage approach: a preliminary review to assess thematic relevance, followed by an in-depth critical evaluation that determined the specific value of each source to the research (Riley et al., 2023; Stefan et al., 2022).

3.6 Reproducibility and transparency

To ensure the reproducibility of the study, all phases of the review process, from the keyword search to the evaluation of the sources, were documented. This documentation ensures that the process can be replicated by future researchers, which reinforces the transparency and rigour of the research (Lin et al., 2024).

4 Results and Discussion

This study explores how companies in North America, Europe, Asia and emerging markets manage uncertainty, with a focus on three key questions: the impact of uncertainty on decision-making processes, the promotion of organisational agility, and the integration of sustainability and emerging technologies. The strategies adopted vary according to regional context and company size, suggesting that approaches need to be adaptive and sensitive to the specific environment in which they operate. Across all regions, patterns of resilience are observed that respond to economic fluctuations and changes in the regulatory environment.

4.1 Impact of Uncertainty on Business Decision-Making Processes

The management of uncertainty in decision-making processes varies considerably depending on the regional and sectoral context. Companies face specific challenges related to economic instability, regulatory changes and rapid technological evolution. This study focused on analysing how companies in North America, Europe, Asia and Emerging Markets have developed strategies to cope with these uncertainties, providing new insights to contrast the findings with existing literature and to provide additional perspectives. The ability of organisations to cope with uncertainty depends to a large extent on their ability to develop dynamic capabilities and process information efficiently. According to the Dynamic Capabilities Theory, firms that can reconfigure their resources and competencies have a sustained competitive advantage in uncertain environments. In turn, the Organisational Information Processing Theory (OIPT) suggests that decision-making effectiveness is related to the ability of firms to process

large volumes of information in complex and changing environments. The results of this study are discussed below in relation to both theories, as well as the approaches adopted in North America, Europe, Asia and Emerging Markets.

4.1.1 The effect of uncertainty on business decision-making processes

The results of this study indicate that companies in North America have made extensive use of emerging technologies such as Big Data and AI to manage uncertainty, especially in the supply chain. IBM and Walmart have implemented predictive analytics tools that allow them to anticipate potential disruptions and proactively adjust their operations. These findings confirm Shmueli et al. (2023), which highlights how predictive analytics contributes to organisational resilience. However, our results reveal that these technologies not only enhance resilience, but also increase operational flexibility in the face of sudden variations in demand, an aspect that offers a more dynamic view of risk management not as comprehensively addressed in previous studies.

In Europe, companies face a different uncertainty, mainly linked to environmental and sustainability regulations. Danone has implemented advanced carbon footprint monitoring systems to comply with increasingly stringent regulations without sacrificing its competitiveness. The findings are in line with those of Mol et al. (2023), who highlight the importance of sustainability as a tool to mitigate regulatory uncertainty. However, our results suggest that this integration of sustainability also becomes a long-term competitive advantage, a nuance that broadens the perspective on the benefits of these practices in the European context.

In Asia, the study found that economic and political uncertainty has driven the adoption of lean production systems. Companies such as those in the textile sector in China use these approaches to respond nimbly to fluctuations in material costs and demand. While this finding is consistent with that proposed by Kovács (2020), our results highlight that the adoption of technologies such as AI has also enabled firms such as Huawei to optimise their supply chains, increasing not only operational efficiency but also their ability to adapt to regulatory changes. This result presents an evolution in the approach to operational flexibility by integrating technological advances that have not been sufficiently addressed in previous research on the region.

In Emerging Markets, such as Latin America, companies have opted for diversification strategies to mitigate economic uncertainty. Grupo Bimbo has expanded its operations geographically to reduce exposure to localised economic shocks. This finding reinforces the results of Oxford Economics (2022), which underlines the importance of diversification in volatile environments. However, our study also reveals that diversification not only protects against economic risks, but also improves companies' ability to adapt to political and social changes, which enriches the understanding of the effectiveness of this strategy in emerging markets.

4.1.2 Fostering an agile organisational culture under conditions of uncertainty

The development of an agile organisational culture has proven to be an effective response to uncertainty, and approaches vary considerably across regions. In North America, companies such as Starbucks have implemented decentralised decision-making models, which allowed

them to adjust quickly to regulatory and demand changes during the COVID-19 pandemic. These results corroborate Ling & Tam (2022), who argue that decentralisation promotes adaptive capacity. However, our findings go further by indicating that decentralisation also strengthens the trust and autonomy of local teams, an element that has been less developed in the literature.

In Europe, companies have adopted digital agility strategies to manage uncertainty. Zalando, for example, has used real-time analytics to adjust its inventories to meet demand in a volatile market. These results align with Salmela et al. (2022), but our research highlights how integrating agility with sustainability not only improves responsiveness, but also strengthens firms' competitive position, an aspect that needs more attention in the current literature.

In Asia, the adoption of emerging technologies, such as AI and Big Data, has enabled companies such as Huawei to not only optimise their operations, but also adapt quickly to regulatory and policy changes. These findings extend Zhang et al. (2022) by demonstrating that technology integration not only improves operational efficiency, but also enhances the ability to adapt to multiple forms of uncertainty.

In Emerging Markets, firms have embraced agility by decentralising decision-making. This has allowed them to adjust to regulatory and economic uncertainty, a strategy that, as Suárez & Hoyos (2023) point out, has been key to improving organisational performance in highly volatile markets. However, our findings suggest that this agility depends not only on organisational structure, but also on a corporate culture that fosters adaptability and innovation, an approach less explored in previous studies.

4.1.3. Integration of emerging technologies and sustainable practices

The integration of emerging technologies and sustainable practices has proven to be critical to managing uncertainty. In North America, Google has led the way by combining the use of Big Data with a commitment to sustainability, achieving energy efficiency improvements in its data centres. These results confirm Aljohani (2023), but our findings point out that this combination not only improves sustainability, but also offers sustainable competitive advantages, an approach that enriches the current discussion on the impact of emerging technologies.

In Europe, companies such as Siemens have combined Internet of Things (IoT) technologies with sustainability strategies to optimise their industrial processes and manage economic uncertainty. This is in line with Ionaşcu et al. (2022), although our findings suggest that the combination of technology and sustainability also provides a framework for meeting regulatory requirements more efficiently and proactively, something that has not been sufficiently discussed in the current literature.

In Asia, companies such as Samsung have used Big Data to optimise their production processes and reduce their carbon footprint. These results are in line with Chen & Biswas (2021), but this study adds that the integration of emerging technologies also allows Asian companies to lead in sustainability, which reinforces their competitiveness in a global market increasingly oriented towards responsible practices.

In Emerging Markets, companies like Embraer have adopted both emerging technologies and sustainable practices, reducing their environmental impact while navigating economic and regulatory uncertainty. This confirms Embraer's (2021) proposition, although our results highlight that the combination of technology and sustainability not only mitigates risks, but also enhances the reputation and positioning of companies in more regulated international markets.

4.1.4. Ethical integration of technologies in decision making

The ethical use of emerging technologies remains a significant challenge, but one that is necessary to maintain trust and transparency in decision-making processes. In North America, companies such as IBM have implemented controls to mitigate the risks associated with algorithmic biases and data privacy. This confirms Ryan et al. (2023), but our findings add an additional dimension by noting that these controls also strengthen consumer trust and transparency in decision-making, which has been less explored in previous studies.

In Europe, the adoption of Blockchain has been a key strategy to improve transparency in supply chain management, ensuring compliance with environmental regulations. This is in line with Jan et al. (2023), but our research highlights that the use of Blockchain also reduces the risk of fraud and increases operational efficiency in highly regulated environments.

In Asia, companies such as Huawei have faced ethical challenges in implementing AI, particularly in mitigating bias in algorithms. These findings expand on Zhang & Li (2022), highlighting how internal audits of algorithms are critical to ensure fairness in automated decision-making.

In Emerging Markets, the main ethical challenge relates to the protection of consumer data in a less stringent regulatory environment. This is in line with Sousa (2023), but our findings highlight the need to balance the adoption of emerging technologies with the implementation of adequate controls to comply with international regulations, which adds a layer of complexity that has not been sufficiently discussed in the literature.

The results of this study confirm different findings from previous studies. Firstly, it confirms the findings of Bigliardi & Filipelli (2022), who showed that integrating of sustainability into innovation strategies drives business success by enhancing competitive advantage. Secondly, it confirms the findings of Han & Zhang (2022), as companies that adopt sustainable technological innovations, such as green development and circular economy, are better positioned to succeed, because sustainability-driven innovation reduces operating costs and improves long-term profitability. Also, it confirms the findings of Nenni et al., (2024), who found that when innovation is aligned with sustainability objectives, it results in enhanced competitiveness and economic success across different regions and industries.

In all regions analysed, uncertainty management has been addressed through a combination of organisational agility, sustainability and emerging technologies. While these strategies are common across geographies, their implementation varies significantly according to local conditions and company size. Large corporations in North America and Asia have leveraged digital transformation and emerging technologies to mitigate uncertainty, while in Europe and

emerging markets, the emphasis is on sustainability and organisational resilience. Sousa (2023) explains that technologies such as blockchain allow companies not only to improve operational efficiency, but also to ensure compliance with sustainability standards, which is especially relevant for those operating in markets with high volatility.

Moreover, the results of this research align with the key tenets of Dynamic Capabilities Theory, which argues that organisations that are able to reconfigure their resources in an agile and efficient manner are better able to adapt to uncertainty (Teece et al., 2016). In both North America and Asia, firms have demonstrated that the flexibility to adjust their processes through the adoption of emerging technologies has been critical to mitigating the effects of uncertainty, confirming the importance of dynamic capabilities to sustain competitive advantage in uncertain markets.

On the other hand, the Organisational Information Processing Theory (OIPT) is also confirmed in the results, as companies that have implemented advanced systems to manage large volumes of information have demonstrated a greater ability to make accurate decisions in highly volatile environments (Galbraith, 1973). The use of Big Data and AI in North America, as well as the integration of sustainability technologies in Europe, exemplify how a robust ability to process information improves organisational responsiveness to rapid and complex change.

4.2 Practical Implications

4.2.1 Implications for Entrepreneurs in High Uncertainty Environments

Entrepreneurs operating in highly uncertain environments must adopt strategies that balance organisational agility with the ethical and efficient use of emerging technologies. Companies in North America, such as IBM and Walmart, have demonstrated that the implementation of Big Data and AI enables improved risk forecasting and supply chain optimisation. However, a key issue for entrepreneurs is to develop not only predictive capabilities, but also flexible adaptive capabilities. This suggests that companies should empower their teams to respond quickly to market fluctuations by implementing decentralised decision-making models that promote agility at the local level, as Starbucks did.

Moreover, in Europe, the combination of sustainability and technology has proven to be a strategic pillar. Companies such as Danone have implemented advanced carbon footprint monitoring systems that comply with environmental regulations, without sacrificing competitiveness. For entrepreneurs, this means that sustainability should not be seen as an additional cost, but as a strategic investment that builds long-term resilience while responding to consumer expectations. Integrating sustainability with technology not only ensures regulatory compliance, but also strengthens the competitive position in increasingly regulated markets.

In Asia, on the other hand, the adoption of technologies such as AI has enabled companies such as Huawei to streamline their processes and adapt quickly to regulatory and policy changes. Entrepreneurs in this region can learn from these examples and invest in technologies that enable operational flexibility beyond simple cost optimisation. The key is to develop agile systems that can reconfigure quickly in the face of regulatory uncertainty.

Finally, in Emerging Markets, such as Latin America, geographic diversification has proven to be an effective strategy to mitigate economic uncertainty. Companies such as Grupo Bimbo have expanded their operations to reduce exposure to localised risks. Entrepreneurs in these markets should consider not only geographic diversification, but also operational diversification, developing multiple lines of business that allow them to cushion the effects of economic and political instability.

4.2.2 Implications for researchers

For researchers, this study presents a number of opportunities to further explore the intersection between organisational agility, sustainability and emerging technologies in contexts of high uncertainty. The literature has begun to address these issues independently, but there is a significant gap in research exploring how these factors interact with each other in different regions.

In North America, future research could focus on the long-term impact of decentralisation on decision-making and how this practice affects organisational resilience. The case of Starbucks provides a basis for exploring how local autonomy can increase resilience in the face of sudden shocks.

In Europe, studies on the integration of sustainability with technology require further exploration. Researchers can take a closer look at how companies manage to balance regulatory compliance with technological innovation, and how these strategies can be replicated in other sectors. In addition, the role of the Internet of Things (IoT) in compliance is an emerging area that deserves additional attention.

In Asia, the rapid adoption of advanced technologies raises questions about the sustainability of these practices. Future research could examine how companies balance technological growth with increasing demands for social and environmental responsibility. There is also a need to investigate how changing regulations affect the ability of firms to continuously innovate in uncertain environments.

Finally, in Emerging Markets, researchers can focus on how small and medium-sized firms can adopt strategies similar to those of large corporations, such as Grupo Bimbo, to mitigate economic and political uncertainty. In addition, it is crucial to study the factors that facilitate or inhibit the adoption of emerging technologies in these markets, considering infrastructure and capital constraints.

4.3 Future Research Directions

This study has identified several areas that require further research attention. First, there is a need to explore how small and medium-sized enterprises (SMEs) can apply the same agility and sustainability strategies that have proven effective in large corporations, especially in contexts where access to advanced technologies is limited. Given that many SMEs lack the resources to adopt technologies such as Big Data or Blockchain, research should focus on developing accessible and scalable frameworks that allow them to implement these practices without compromising their financial stability.

Secondly, the barriers and enablers to the adoption of emerging technologies in Emerging Markets should be investigated. While large corporations in these regions, such as Grupo Bimbo, have managed to mitigate uncertainty through diversification, SMEs face significant obstacles. Research should analyse what economic, regulatory and technological conditions enable smaller companies to successfully adopt emerging technologies and sustainable practices.

In addition, it is critical to explore the long-term impact of digital transformation on business resilience. Future research can focus on how the integration of Big Data and AI affects not only short-term operations, but also the ability of companies to cope with global crises such as the COVID-19 pandemic. A key area of research is how companies can balance automation with ethical decision-making, ensuring that technologies do not exacerbate issues of inequality or algorithmic bias.

Finally, research should continue to explore the ethical implications of adopting emerging technologies in decision-making processes, especially with regard to data privacy and biases in AI algorithms. This is a topic that has not yet been sufficiently researched, despite its growing importance in a data-driven world. Developing regulatory frameworks to guide the ethical adoption of these technologies is an urgent priority for researchers and policymakers.

5 Conclusions

This study has provided a comprehensive analysis of how companies deal with uncertainty in their decision-making processes, highlighting the importance of integrating emerging technologies, organisational agility and sustainability as key pillars to ensure resilience in volatile environments. It confirms that the use of Big Data and Artificial Intelligence (AI) has been key to improving predictability and mitigating risks, as argued by Shmueli et al. (2023), who underline that these technologies offer organisations advanced analytical and disruption response capabilities.

Sustainability has emerged as an essential component in contemporary business strategies, aligning with the findings of Mol et al. (2023), who emphasise that the integration of sustainable practices not only complies with environmental regulations, but also enhances long-term competitiveness. This study reinforces that perspective, demonstrating that sustainability and the adoption of advanced technologies, far from being separate approaches, must be integrated to generate organisational resilience.

From a theoretical framework, the results confirm the applicability of the Dynamic Capabilities Theory, which argues that organisations that are able to reconfigure their resources in response to uncertainty are better positioned to survive and thrive in volatile environments (Teece et al., 2016). Firms that have demonstrated a greater ability to adapt quickly to sudden changes, by adopting new technologies or diversifying their operations, exemplify the key tenets of this theory. Similarly, the Organisational Information Processing Theory (Galbraith, 1973) is validated in this study, as firms that have invested in systems to manage large volumes of

information show a greater ability to make informed and agile decisions in the face of uncertainty.

An important conclusion of this study is that ethics must be at the heart of any technology implementation. Challenges related to data privacy and algorithmic bias are crucial issues that organisations must proactively address. The findings suggest that companies that have implemented strict controls to manage these risks not only comply with legal regulations, but also strengthen trust and transparency in their operations, as highlighted by Ryan et al. (2023).

Therefore, companies operating in highly uncertain environments should focus on three key aspects: (1) adopting emerging technologies to improve predictive and operational capabilities, (2) fostering an agile organisational culture that enables rapid and flexible responses to unexpected changes, and (3) integrating sustainable practices as a strategic component to ensure resilience and long-term competitiveness. This approach provides a solid foundation for future research and offers valuable lessons for business leaders navigating increasingly uncertain environments.

5.1 Limitations

This study has several limitations that must be considered when interpreting the results. Firstly, it is mainly based on a literature review, which implies a reliance on secondary sources. Although recent and reliable studies have been used, such as Shmueli et al. (2023) and Mol et al. (2023), the lack of access to primary data limits the ability to fully generalise the findings, particularly in the case of smaller firms, which may not have access to the advanced technologies mentioned.

In addition, the focus of the study was on certain geographic areas and sectors, which may have overlooked important dynamics in less represented industries or regions. Although general patterns have been identified, sectoral differences and their specific impacts on the adoption of sustainable technologies and practices were not addressed in depth, which limits the applicability of the results in certain business contexts.

Another relevant aspect is the time horizon covered by the review, which focused on recent studies from 2019 to 2024. While this ensures the timeliness of the data, it may have excluded valuable information from earlier periods that could offer lessons on uncertainty management across different economic or technological crises.

Finally, the study does not delve sufficiently into the barriers faced by small and medium-sized enterprises in adopting emerging technologies. These firms often face infrastructure and capital constraints, which impede the implementation of the strategies mentioned above. Therefore, more research is needed on the specific challenges these organisations face in uncertain environments, as well as on the scalable solutions they could adopt

WORKS CITED

Accounting for Sustainability. (n.d.). Home page. Accounting for Sustainability. https://www.accountingforsustainability.org/en/index.html

Aljohani, A. (2023). Predictive Analytics and Machine Learning for Real-Time Supply Chain Risk Mitigation and Agility. Sustainability. https://doi.org/10.3390/su152015088.

Ajmal, S., Ashfaq, R., & Saleem, K. (2023). Uncertainty Based Optimal Sample Selection for Big Data. IEEE Access, 11, 6284-6292. https://doi.org/10.1109/ACCESS.2022.3233598.

Angelelli, M., & Gervasi, M. (2021). Aware adoption of artificial intelligence and big data: a value framework for reusable knowledge. arXiv preprint arXiv:2110.11482. https://www.researchgate.net/publication/355518088_Aware_Adoption_of_Artificial_Intelligence_and_Big_Data_a_Value_Framework_for_Reusable_Knowledge

Awan, U., Kanwal, N., Alawi, S., Huiskonen, J., & Dahanayake, A. (2021). Artificial intelligence for supply chain success in the era of data analytics. The fourth industrial revolution: Implementation of artificial intelligence for growing business success, 3-21. https://link.springer.com/chapter/10.1007/978-3-030-62796-6_1

Bhardwaj, S., & Tanwar, S. (2022). Pandemic and post-pandemic impact on business. Asian Journal of Management, 13(4). https://doi.org/10.52711/2321-5763.2022.00015

Bigliardi, B., & Filippelli, S. (2022). Sustainability and open innovation: Main themes and research trajectories. Sustainability, 14(11), 6763. https://doi.org/10.3390/su14116763

Birkstedt, T., Minkkinen, M., Tandon, A., & Mäntymäki, M. (2023). AI governance: themes, knowledge gaps and future agendas. Internet Research. https://doi.org/10.1108/intr-01-2022-0042.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Brillinger, A. S., Els, C., Schäfer, B., & Bender, B. (2020). Business model risk and uncertainty factors: Toward building and maintaining profitable and sustainable business models. Business Horizons, 63(1), 121-130. https://doi.org/10.1016/j.bushor.2019.09.009

Bouchard, J., Tremblay, M., & St-Pierre, J. (2022). The role of digital technologies in enhancing agility in North American manufacturing. Journal of Manufacturing Technology, 33(5), 457-474. https://doi.org/10.1016/j.jmtt.2022.05.012

Charles, D., Kaur, J., & Singh, R. (2023). Blockchain in supply chain management: A comprehensive review. Journal of Business and Technology, 28(2), 89-112. https://doi.org/10.1016/j.jbt.2023.02.004

Chen, T., & Biswas, M. (2021). AI-Driven Big Data Analytics: A New Frontier in Decision-Making Under Uncertainty. Journal of Business Research, 131, 215-223. https://doi.org/10.1016/j.jbusres.2020.09.045

Cui, Y., Gaur, V., & Liu, J. (2023). Supply Chain Transparency and Blockchain Design. Management Science. https://doi.org/10.1287/mnsc.2023.4851.

Cuoco, A., Arcadi, P., Figura, M., Piervisani, L., Alvaro, R., Vellone, E., & Durante, Á. (2022). Designing and Conducting Qualitative Research across countries and cultures: challenges for inclusiveness and rigor. European journal of cardiovascular nursing. https://doi.org/10.1093/eurjcn/zvac067.

Delechat, C. C., Melina, G., Newiak, M., Papageorgiou, C., & Spatafora, N. (2024). Economic Diversification in Developing Countries: Lessons from Country Experiences with Broad-Based and Industrial Policies. ISSN: 2616-5333

Deloitte. (2023). 2023 Manufacturing industry outlook. Deloitte Insights. https://www2.deloitte.com/content/dam/Deloitte/us/Documents/energy-resources/us-2023-outlook-manufacturing.pdf

DeVon, H. A., Block, M. E., Moyle-Wright, P., Ernst, D. M., Hayden, S. J., Lazzara, D. J., Savoy, S. M., & Kostas-Polston, E. (2007). A psychometric toolbox for testing validity and reliability. Journal of Nursing Scholarship, 39(2), 155-164. https://doi.org/10.1111/j.1547-5069.2007.00161.x

Dijk, S., Brusse-Keizer, M., Bucsán, C., Palen, J., Doggen, C., & Lenferink, A. (2023). Artificial intelligence in systematic reviews: promising when appropriately used. BMJ Open, 13. https://doi.org/10.1136/bmjopen-2023-072254.

European Commission. (2023). 2023 Strategic Foresight Report: Sustainability and wellbeing at the heart of Europe's open strategic autonomy. https://commission.europa.eu/strategy-and-policy/strategic-foresight/2023-strategic-foresight-report_en

European Environment Agency. (n.d.). Home page. European Environment Agency. https://www.eea.europa.eu/en

Fang, Y., Zhou, Z., Dai, S., Yang, J., Zhang, H., & Lu, Y. (2024). PaVM: A Parallel Virtual Machine for Smart Contract Execution and Validation. IEEE Transactions on Parallel and Distributed Systems, 35, 186-202. https://doi.org/10.1109/TPDS.2023.3334208.

Floridi, L., & Cowls, J. (2019). A unified framework of five principles for AI in society. Harvard Data Science Review. https://doi.org/10.1162/99608f92.8cd550d1

Galbraith, J. R. (1974). Organization design: An information processing view. Interfaces, 4(3), 28-36. https://doi.org/10.1287/inte.4.3.28

Grupo Bimbo. (2018). Grupo Bimbo investor presentation: 1Q18. https://grupobimbo-com-custom01-assets.s3.amazonaws.com/s3fs-public/Grupo-Bimbo-Investor-Presentation-1Q18.pdf

Han, X., & Zhang, J. (2022). Business model innovation paths of manufacturing oriented towards green development in digital economy. International Journal of Environmental Research and Public Health, 19(24), 6454. https://doi.org/10.3390/ijerph192416454

Houdou, A., Badisy, I., Khomsi, K., Abdala, S., Abdulla, F., Najmi, H., Obtel, M., Belyamani, L., Ibrahimi, A., & Khalis, M. (2024). Interpretable Machine Learning Approaches for Forecasting and Predicting Air Pollution: A Systematic Review. Aerosol and Air Quality Research. https://doi.org/10.4209/aaqr.230151.

Ionașcu, I., Ionașcu, M., Nechita, E., Săcărin, M., & Minu, M. (2022). Digital transformation, financial performance and sustainability: Evidence for European Union listed companies. Amfiteatru Economic, 24(59), 94-109. https://doi.org/10.1016/j.sustain.2021.11.034

Jafar, R., & Meilvidiri, W. (2022). Decision Making Under Uncertainty Market During Covid-19. Journal of Developing Economies. https://doi.org/10.20473/jde.v7i1.21243.

Jan, A., Salameh, A., Rahman, H., & Alasiri, M. (2023). Can blockchain technologies enhance environmentally sustainable development goals performance in manufacturing firms? Potential mediation of green supply chain management practices. Business Strategy and the Environment. https://doi.org/10.1002/bse.3579.

Kovács, G. (2020). Combination of Lean value-oriented conception and facility layout design for even more significant efficiency improvement and cost reduction. International Journal of Production Research, 58(10), 2916-2936.

Kudyba, S., & Cruz, A. (2023). Understanding project success involving analytic-based decision support in the digital era: a focus on IC and agile project management. Journal of Intellectual Capital. https://doi.org/10.1108/jic-03-2022-0054.

Kulkov, I., Kulkova, J., Rohrbeck, R., Menvielle, L., Kaartemo, V., & Makkonen, H. (2023). Artificial intelligence - driven sustainable development: Examining organizational, technical, and processing approaches to achieving global goals. Sustainable Development. https://doi.org/10.1002/sd.2773.

Lee, S., & Kim, J. (2024). Opportunistic Block Validation for IoT Blockchain Networks. IEEE Internet of Things Journal, 11, 666-676. https://doi.org/10.1109/JIOT.2023.3287166.

Li, Y., Diabat, A., & Lu, C. C. (2020). Leagile supplier selection in Chinese textile industries: a DEMATEL approach. Annals of Operations Research, 287(1), 303-322.

Lin, Y., Zheng, R., Wu, F., Zeng, N., Li, J., & Tao, X. (2024). Blockchain-driven framework for financing credit in small and medium-sized real estate enterprises. Journal of Enterprise Information Management. https://doi.org/10.1108/jeim-01-2023-0032.

Ling, F., & Tam, J. (2022). Agility of facilities management organizations during the COVID-19 pandemic: lessons learnt for future pandemics. Facilities. https://doi.org/10.1108/f-02-2022-0032.

Malodia, S., Dhir, A., Alshibani, S., & Christofi, M. (2023). Born global: Antecedents and consequences of innovation capabilities. Asia Pacific Journal of Management, 1-34. https://doi.org/10.1007/s10490-023-09909-1

Mittelstadt, B. (2019). Principles alone cannot guarantee ethical AI. Nature Machine Intelligence, 1(11), 501-507. https://doi.org/10.1038/s42256-019-0114-4

Mol, M., Rabbiosi, L., & Santangelo, G. (2023). Should I Stay or Should I Go? How Danish MNEs in Russia Respond to a Geopolitical Shift. AIB Insights. https://doi.org/10.46697/001c.68337

Moser, R., Kuklinski, C., & Srivastava, M. (2017). Information processing fit in the context of emerging markets: An analysis of foreign SBUs in China. Journal of Business Research, 70, 234-247. https://doi.org/10.1016/j.jbusres.2016.08.015

Musani, P. (2023, October 25). Decking the aisles with data: How Walmart's AI-powered inventory system brightens the holidays. Walmart Global Tech. https://tech.walmart.com/content/walmart-global-tech/en_us/blog/post/walmarts-ai-powered-inventory-system-brightens-the-holidays.html

Nenni, M. E., Di Pasquale, V., & Boyer, J. (2024). The complicated relationship between innovation and sustainability: Opportunities, threats, challenges, and trends. Sustainability, 16(9), 3524. https://doi.org/10.3390/su16093524

Oxford Economics. (2022). Geographic diversification in private equity markets. https://www.oxfordeconomics.com/resource/geographic-diversification-in-private-equity-markets/

Poole College of Management. (2022, February 2). How Big Data can bolster your company's risk management. NC State University. https://ra.poole.ncsu.edu/blog/2022/02/how-big-data-can-bolster-your-companys-risk-management/

Rahman, M., Abdelfattah, F., Bag, S., & Gani, M. (2022). Survival strategies of SMEs amidst the COVID-19 pandemic: application of SEM and fsQCA. Journal of Business & Industrial Marketing. https://doi.org/10.1108/jbim-12-2020-0564.

Ramos, E., Patrucco, A., & Chávez, M. (2021). Dynamic capabilities in the “new normal”: a study of organizational flexibility, integration and agility in the Peruvian coffee supply chain. Supply Chain Management: An International Journal, 26(2), 169-185. https://doi.org/10.1108/SCM-12-2020-0620.

Riley, R., Ensor, J., Hattle, M., Papadimitropoulou, K., & Morris, T. (2023). Two-stage or not two-stage? That is the question for IPD meta-analysis projects. Research synthesis methods, 14, 903 - 910. https://doi.org/10.1002/jrsm.1661.

Sajjad, A., Eweje, G., & Raziq, M. (2023). Sustainability leadership: An integrative review and conceptual synthesis. Business Strategy and the Environment, 32(1), 12-29. https://doi.org/10.1002/bse.3631 https://doi.org/10.1002/bse.3631.

Salmela, H., Baiyere, A., Tapanainen, T., & Galliers, R. (2022). Digital Agility: Conceptualizing Agility for the Digital Era. J. Assoc. Inf. Syst., 23, 8. https://doi.org/10.17705/1jais.00767.

Sarfraz, M., & Ivaşcu, L. (2023). Sustainable Management and Leadership Practices for Enhancing Business Performance. International Journal of Organizational Leadership. https://doi.org/10.33844/ijol.2023.60361

Saunders, M., Lewis, P., & Thornhill, A. (2023). Research Methods for Business Students (9th ed.). Pearson.

Sharma, P., Leung, T., Kingshott, R. P. J., Davcik, N. S., & Cardinali, S. (2020). Managing uncertainty during a global pandemic: An international business perspective. Journal of Business Research, 116, 188-192. https://doi.org/10.1016/j.jbusres.2020.05.026

Shi, Y., Zhang, T., & Jiang, Y. (2023). Digital economy, technological innovation, and urban resilience. Sustainability, 15(12), 9250. https://doi.org/10.3390/su15129250

Shmueli, G., Bruce, P. C., Yahav, I., Patel, N. R., & Lichtendahl, K. C. (2023). Machine Learning for Business Analytics: Concepts, Techniques, and Applications with Analytic Solver Data Mining. Wiley.

Skyrius, R., Krutinis, M., Nemitko, S., Valentukevice, J., Gulbinovic, N. A., & Sanosianaite, M. (2021). Informing Agility in the Context of Organizational Changes. Informing Science: International Journal of an Emerging Transdiscipline, 24, 19-30. https://doi.org/10.28945/4789

Sousa, M. (2023). Blockchain as a driver for transformations in the public sector. Policy Design and Practice, 6, 415 - 432. https://doi.org/10.1080/25741292.2023.2267864.

Stahl, B. C., & Wright, D. (2018). Ethics and privacy in AI and big data: Implementing responsible innovation. IEEE Security & Privacy, 16(3), 26-33. https://doi.org/10.1109/msp.2018.2701164

Suárez-Gómez, E.D., & Hoyos-Vallejo, C.A. (2023). Scalable agile frameworks in large enterprise project portfolio management. IEEE Access. doi: 10.1109/ACCESS.2023.3312728

Stefan, A., Lengersdorff, L., & Wagenmakers, E. (2022). A Two-Stage Bayesian Sequential Assessment of Exploratory Hypotheses. Collabra: Psychology, 8(1), 401-415. https://doi.org/10.1525/collabra.40350

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal, 18(7), 509-533.

Teece, D., Peteraf, M. A., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. California Management Review, 58(4), 13-35. https://doi.org/10.1525/cmr.2016.58.4.13

Tsesmelis, M., Dolamic, L., Keupp, M. M., David, D. P., & Mermoud, A. (2022). Identifying emerging technologies and leading companies using network dynamics of patent clusters: A cybersecurity case study. Journal of Technology Transfer. https://doi.org/10.48550/arXiv.2209.10224

Vanichchinchai, A. (2022a). The effects of the Toyota Way on agile manufacturing: An empirical analysis. Journal of Manufacturing Technology Management, 33(8), 1450-1472. https://doi.org/10.1108/JMTM-02-2022-0053

Vanichchinchai, A. (2022b). The Toyota way: Adopting lean and agile manufacturing processes from the Toyota production system. Strategic Direction, 38(12), 33-34. https://doi.org/10.1108/SD-10-2022-0131

Xiao, Suping & Zhou, Ping & Zhou, Lin & Wong, Sike. (2024). Digital economy and urban economic resilience: The mediating role of technological innovation and entrepreneurial vitality. PLOS ONE. 19. 10.1371/journal.pone.0303782.

Yousuf, H. & Zainal, A. Y. (2020). Quantitative approach in enhancing decision making through big data as an advanced technology. Advanced Science and Technology Journal, 5(5), 109-116. https://doi.org/10.2139/ssrn.4193992

Zhang, J., & Li, H. (2022). The Impact of Big Data Management Capabilities on the Performance of Manufacturing Firms in Asian Economy During COVID-19: The Mediating Role of Organizational Agility and Moderating Role of Information Technology Capability. Frontiers in Psychology, 13, 833026. https://doi.org/10.3389/fpsyg.2022.833026.

Zheng, S., & Wen, J. (2023). How Does Firm-Level Economic Policy Uncertainty Affect Corporate Innovation? Sustainability, 15(7), 6219. https://doi.org/10.3390/su15076219

Zioło, M., Bąk, I., & Spoz, A. (2023). Incorporating ESG risk in companies' business models: State of research and energy sector case studies. Energies, 16(4), 1809.