

Original article

DOI:10.17323/1999-5431-2025-0-5-131-158

# FUTURE ECONOMIC AND SUSTAINABILITY IMPACTS OF OPEN DATA IN INSURANCE

**Narongsak Sukma<sup>1</sup>, Siriporn Yamnill<sup>2</sup>**

<sup>1,2</sup> Faculty of Social Sciences and Humanities,  
Mahidol University, Nakhonpathom, Thailand.

<sup>1</sup> Ph.D. Candidate, Doctor of Public Administration Program  
(Public Policy and Public Management), Faculty of Social Sciences  
and Humanities, Mahidol University  
narongsak.sukma@outlook.com; ORCID: 0000-0002-7632-2044

<sup>2</sup> Associate Professor, Lecturer, Faculty of Social Sciences  
and Humanities, Mahidol University  
siriporn.yam@mahidol.ac.th; ORCID: 0000-0003-0260-4732

**Abstract.** The insurance industry is undergoing a profound transformation driven by the integration of open data and digital technologies. This paper explores the multifaceted implications of these changes, focusing on economic efficiency, regulatory compliance, and long-term sustainability. By examining the interplay between digital transformation and public finance theory, we identify key challenges and opportunities that arise in this evolving landscape. Our findings highlight the need for robust regulatory frameworks that balance transparency with data privacy, fostering an environment conducive to innovation. This research not only underscores the transformative potential of digital initiatives in enhancing operational effectiveness, but also advocates for strategic policymaking that leverages open data to stimulate economic growth and social well-being. Ultimately, we envision a future where the insurance sector thrives through the harmonious integration of technology and data-driven practices, paving the way for a more resilient and efficient industry.

**Keywords:** open data, digital transformation, insurance sector, regulatory compliance, economic efficiency.

**For citation:** Sukma, N. and Yamnill, S. (2025) 'Future economic and sustainability impacts of open data in insurance', *Public Administration Issues*, 5, pp. 131–158. (In English). DOI:10.17323/1999-5431-2025-0-5-131-158

**Jel Classification:** G22, O33, O16, G28, L86.

## 1. Introduction

The insurance industry is at a pivotal crossroads, driven by rapid advancements in digital technology and the increasing availability of open data. As consumers demand more personalised and efficient services, insurance companies are compelled to adapt to these evolving expectations. This transformation is not just a trend; it represents a fundamental shift in the way insurance products are developed, risks are assessed, and claims are processed. Recent technological innovations, including artificial intelligence, blockchain, and data analytics, are reshaping traditional practices and enabling insurers to operate with greater agility and precision. However, this digital revolution also presents significant challenges, particularly in terms of regulatory compliance and data privacy. As the industry navigates these complexities, understanding the interplay between open data and public finance becomes crucial for fostering sustainable growth and innovation. However, the insurance sector is experiencing profound changes due to the pervasive impact of digital transformation. This change is driven by technological innovations, changes in regulatory frameworks, and evolving consumer expectations (Nicoletti, 2020; Gürsev, 2023). To navigate these changes effectively, it is imperative to understand the central role open data and public finance play in shaping the future of the insurance industry (Wainwright et al., 2023; Wiencierz and Lünich, 2022; Gao and Janssen, 2022). In this research article, we embark on a systematic exploration of the complex and dynamic insurance landscape, examining how the interplay of open data and public finance presents both challenges and opportunities. Additionally, the insurance industry, traditionally known for its risk-averse nature, is at the forefront of the digital revolution. Recent technological advances, including artificial intelligence, blockchain, and data analytics (Gürsev, 2023; Riasanow et al., 2021; Nam, 2018), have disrupted long-standing conventions. This transformation spans all aspects of the industry and affects product development, risk assessment, claim processing, and customer service. Additionally, the underlying motivation for this change is rooted in the drive of insurance companies to remain competitive, efficient, and customer-centric. Insurers are increasingly embracing technology to streamline their operations, offer customized services, and gain deeper insight into customer needs (Kumar and Oommen Philip, 2022; Lokesh et al., 2022). These improvements in efficiency, risk assessment, and customer experience are central to the attraction of digital transformation. Otherwise, Open Data in Facilitating Digital Transformation, characterised by its accessibility and usability, is a fundamental driver of the innovations that drive digital transformation (Sarfray et al., 2023, Ling et al., 2023).

Open data provides insurers with invaluable external datasets that refine risk models, improve product design, and improve pricing accuracy. Furthermore, the value of open data extends beyond operational enhancements. It empowers insurers to strengthen customer relationships, improve transparency, and contribute to the broader financial ecosystem. Open data promote collaboration and innovation, creating a foundation for sustainable and equi-

table progress within the insurance sector (Pan et al., 2023; Trinh et al., 2023). In addition, it is relevant to public administration in promoting and Regulating Digital Transformation. The role of public administration in guiding the digital transformation of the insurance sector is of paramount importance. Governments have a significant influence on promoting, regulating, and ensuring responsible technological adoption (Leviäkangas and Molarius, 2020). Public finance serves as the foundation for the resources and infrastructure required for insurers to thrive in the digital realm, while also safeguarding the interests of consumers and fostering a level playing field. Furthermore, regulatory frameworks and incentives designed by public authorities provide insurers with a clear path forward in their digital journey, focusing on ethical standards, data security, and equal access to financial services (Afjal, 2023). In tandem, public finance supports research and development initiatives, allowing insurers to adapt to emerging technologies and harness their potential (Almaqtari et al., 2023; Wang et al., 2023).

This article aims to explore the intricate relationship between digital transformation and open data within the insurance sector. We will examine the economic implications, regulatory frameworks, and sustainability considerations that arise from this convergence. By synthesising insights from various academic sources, we seek to illuminate the opportunities and challenges that lie ahead for insurers, regulators, and policy makers alike. By synthesising insights from various academic papers, such as Hoffmann (2021), *Entrepreneurial Design in Insurance Firms* and Bzhalava et al. (2022), *Global Digital Trends across Industries*, it offers a comprehensive understanding of the multifaceted aspects of digital change within the insurance industry. Furthermore, this article seeks to illuminate the pivotal role of open data in accelerating digital transformation. Drawing from Kamenjarska et al. (2022) (innovation capabilities and financial performance) and Blesa et al. (2020) (open data for actuarial work in insurance), we will examine the practical applications and potential benefits of open data in enhancing the efficiency and effectiveness of insurance operations.

In the following sections, we will first provide a comprehensive overview of the current landscape of digital transformation in the insurance industry. Next, we will dive into the role of open data in enhancing operational efficiency and effectiveness. Finally, we will discuss the implications for regulatory frameworks and public finance, ultimately envisioning a future where innovation and responsible governance coexist to drive the insurance sector forward.

## 2. Literature review

### ***2.1. Public Finance Theory Related to Open Data and Digital Transformation***

Public finance theory plays a crucial role in shaping strategies to harness open data and facilitate digital transformation (Shoup, 2017; Ulbrich, 2013; Buchanan, 1960). This theory provides a framework for understanding how governments allocate resources for digitalisation initiatives and the financial aspects involved. For example, Pisoni (2021) highlights global digital trends across in-

dustries, emphasising the importance of recognising the budgetary considerations associated with implementing digital transformation. An understanding of public finance theory is fundamental in ensuring that governments can efficiently allocate resources to support these transformative endeavors. Furthermore, public finance theory guides policies that promote economic growth and civic engagement through open data (Leviäkangas and Molarius, 2020). Legal and regulatory considerations in open data and digital transformation, such as those discussed in (Bednarz and Manwaring, 2022), underscore the need to strike a balance between innovation and maintaining ethical and transparent data use. This understanding is essential for effective decision making for policymakers and organisations as they navigate the complexities of digital transformation in the public sector.

## ***2.2. Digital Transformation in the Insurance Sector***

The insurance sector is witnessing an era of radical transformation as it adapts to the digital age. This change is driven by various factors, including advances in technology and changes in customer expectations. Baranauskas (2021) delves into the modernisation of nonlife insurance in the Baltic region, highlighting the growing importance of digital platforms and customisation to meet customer demands effectively. The broader context of this transformation in the insurance sector is elucidated (Werth et al., 2020). It underscores the strategic imperative of digital transformation in the insurance industry, emphasising its influence on improving customer services, streamlined processes, and fostering innovation. However, digital transformation in insurance does not occur in isolation; rather, it is closely intertwined with broader public innovation and digitalisation efforts (Väyrynen et al., 2023). Furthermore, the success of these digitalisation initiatives depends on the synergy between the private and public sectors, creating a complex and multifaceted landscape. The importance of regulatory compliance and legal requirements in maintaining customer trust and data security is reinforced (Werth et al., 2020). Achieving success in digital transformation in the insurance sector requires navigating a dynamic landscape characterised by regulatory challenges and collaboration. Furthermore, the multifaceted nature of digital transformation in the insurance sector is further exemplified in various papers. Arias-Pérez et al. (2021) discuss the role of innovation capabilities and the importance of external collaboration in digitalization efforts. Stegmann and Liermann (2021) explore the transformation in banks and insurance, emphasising the essential role of IT fundamentals and in-depth business knowledge. As highlighted by Gallenstein et al. (2021), parametric insurance in agriculture demonstrates the feasibility of applying digitalisation to manage risk effectively. Additionally, the performance of digital transformation of a public insurance company is examined in (Pisoni, 2021) which sheds light on how these organisations embrace innovation to enhance services. The role of insurance brokers in improving customer orientation is explored (Reis et al., 2022), reflecting the importance of providing quality services and satisfying customer needs. The impact of the pandemic on insurance, as studied by Shevchuk et al. (2020), underscores the need for digital adapta-

tion, automation, and machine learning to streamline insurance processes. Furthermore, the importance of open data in actuarial work and risk assessment is evident (Blesa et al., 2020), which highlights the potential to improve premium rating and risk understanding. Finally, customer behaviour in the insurance sector is scrutinised in (Latorre Guillem, 2020), emphasising the importance of reducing customer dissatisfaction and complaints while improving services and reducing ambiguity.

### ***2.3. Open Data and Digital Transformation***

Open data is a driving force behind digital transformation in various industries, significantly impacting the insurance sector. Fung et al. (2018) explore the impact of the Chinese regulatory system, C-ROSS, on life insurers and the opportunities it presents. The concept of open data enables better risk assessment in the insurance industry, promoting transparency and efficiency (Planchet et al., 2022). Incorporating contextual data into risk assessment, as discussed by Blesa et al. (2020), leads to better understanding of risk, market expansion, and improved understanding of the market. These opportunities should be accompanied by measures that address privacy and security concerns associated with data use (Blesa et al., 2020). The transformative power of open data goes beyond insurance, benefiting numerous sectors (Leviäkangas and Molarius, 2020), the tangible benefits of open data are highlighted in various industries, including its influence on new businesses, job creation, and economic growth. However, to maximise these benefits, regulatory frameworks must strike a balance between promoting transparency and addressing concerns related to data privacy and ownership (Leviäkangas and Molarius, 2020). Additionally, developments and possible uses of AI and ML in the insurance and securities sector (Pum and Sukma, 2024; Sukma and Namahoot Chakkrit, 2024; Sukma and Namahoot, 2024).

### ***2.4. Challenges and Opportunities and Regulatory Aspects***

The path to digital transformation presents opportunities and challenges. Organisations face budgetary considerations as they implement digital initiatives, as emphasised by Eckert et al. (2022). Digital transformation initiatives, such as SILs, may have budgetary implications, but enhanced digital transformation achieved through these initiatives can significantly improve economic efficiency and effectiveness (Huang and Gao, 2023). However, it is vital to consider the regulatory and legal aspects that can impact the success of these initiatives. Regulatory compliance is especially important in the insurance sector, as discussed by Marano (2021), which explores the challenges and opportunities associated with IDD regulation and its alignment with digital transformation. Achieving economic efficiency and effectiveness while ensuring an equitable distribution of benefits is a key aspect of digital transformation (Huang and Gao, 2023). Implementing ecosystem-based health services, as highlighted by Jahn and Bohnet-Joschko (2022), not only has budgetary implications, but also contributes to long-term sustainability in healthcare and improves quality of care. Furthermore, governance plays a vital role in the digital transforma-

tion of banks and insurance, as elaborated by Lacombe and Jarboui (2023), ensuring a balance between innovation and regulation. The impact of cybercrime on the insurance industry, as investigated (Guzmán-Ortiz et al., 2020), underscores the need to improve understanding and improve cybersecurity to ensure long-term sustainability of the sector (Johri and Kumar, 2023). Furthermore, the adoption of online claim notification systems and digital insurance innovations, as described (Lang and Riegel, 2023), requires careful consideration of the cost implications and alignment with regulatory and legal compliance requirements.

The relationship between D&O insurance and digital transformation in Chinese listed companies (Subiyakto et al., 2023), highlights the financial implications of adopting entrepreneurial design and adhering to regulatory and legal compliance standards. The role of fintech innovations in payments and financing (Anifa et al., 2022), emphasises the importance of regulatory compliance in ensuring the economic and technological advancement of the finance sector. The digitisation of the government in Denmark, as explored by Huang et al. (2023), underscores the importance of aligning digitalization initiatives with regulatory and legal compliance requirements. Furthermore, open government data initiatives and the promotion of open data practices, as discussed (Fasnacht and Fasnacht, 2018) and (Jethani and Leorke, 2021), provide benefits such as economic growth, civic engagement, and reduced government costs. However, these advantages should be balanced with privacy and ownership concerns and the need to ensure that open data initiatives adhere to legal and regulatory requirements. The impact on corporate environmental performance, as outlined (Wang et al., 2022), explores the complex relationship between social insurance burdens and environmental performance, highlighting the role of innovation and digital transformation in modulating these effects.

In conclusion, digital transformation efforts must navigate challenges and opportunities while complying with regulatory and legal aspects. The interaction between budgetary considerations, regulatory compliance, and long-term sustainability is integral to the success of these initiatives in various sectors. Achieving a balance between innovation and regulation is crucial for organizations and industries that undergo digital transformation.

### ***2.5. Critical analysis of the existing literature, highlighting gaps***

In summary as shown in Table 1, while the existing literature provides valuable information on the relationship between open data, digital transformation, and public finance in the insurance sector, several gaps remain. Future research should focus on empirical studies that assess the long-term impacts of digital initiatives, evaluate the effectiveness of regulatory frameworks, and explore the ethical implications of open data usage. In addition, understanding customer preferences and the role of public finance in fostering innovation will be crucial to advance the field. By addressing these gaps, researchers can contribute to a more nuanced understanding of the challenges and opportunities that lie ahead for the insurance industry in the digital age.

Table 1

**Critical analysis of the existing literature, highlighting gaps**

Subject	Key Findings	Gaps in Research	Areas for Further Exploration
Economic Efficiency	Digital tools improve operational efficiency and reduce costs	Lack of empirical evidence on long-term impacts on profitability and market competitiveness.	Longitudinal studies that evaluate the sustained economic benefits of digital initiatives.
Regulatory Frameworks	Regulatory frameworks can encourage ethical standards and data security	Limited examination of the effectiveness of these frameworks in practice	Evaluation of real-world compliance challenges and best practices in all jurisdictions
Open Data Practices	Open data improves actuarial work and decision making	Insufficient research on ethical implications and privacy concerns of open data usage	Investigation of ethical frameworks for responsible use of open data in insurance
Customer-Centric Approaches	Consumers expect seamless digital experiences and personalised offerings	Limited understanding of how customer expectations vary between demographics and regions	Research on diverse customer needs and the impact of AI on engagement and satisfaction
Public Finance and Innovation	Public finance can support digital transformation initiatives	Lack of empirical studies on the relationship between public funding and insurance innovation	Exploration of public finance's role in stimulating innovation, especially in developing economies

**Source:** Compiled by the authors (- hereafter, unless otherwise indicated).

### 3. Materials and methodology

This academic article employs a key document analysis method that refers to (Owino, 2023), primarily focusing on physical documents such as journals and books, to delve into specific details about the criteria used to select articles related to the challenges and complexities of open data and Digital Transformation in the context of the insurance industry as presented in Figure 1. It seeks to reveal trends and their use in the insurance sector, specifically addressing the challenges and opportunities posed by government policies to promote economic growth and societal well-being. The insurance industry, like many others, is undergoing a significant transformation driven by the era of digital and data technology. Open data and digital transformation have emerged as central themes in this evolving landscape, presenting both challenges and opportunities for insurers and policymakers. This article undertakes a meticulous exploration of these dynamics with the aim of providing valuable insights to industry stakeholders and researchers. To conduct this comprehensive analysis, the author initiated a meticulous search for documents that address critical issues related to Open Data, Digital Transformation, and their intersection with the insurance sector. Key search terms included “Open Data”, “Digital Transformation”, and “Insurance”. The search was carried out across prominent research databases,

including ScienceDirect, Scopus, Google Scholar, and ResearchGate, known for their comprehensive repository of academic literature. The initial search yielded a substantial collection of 297 articles.

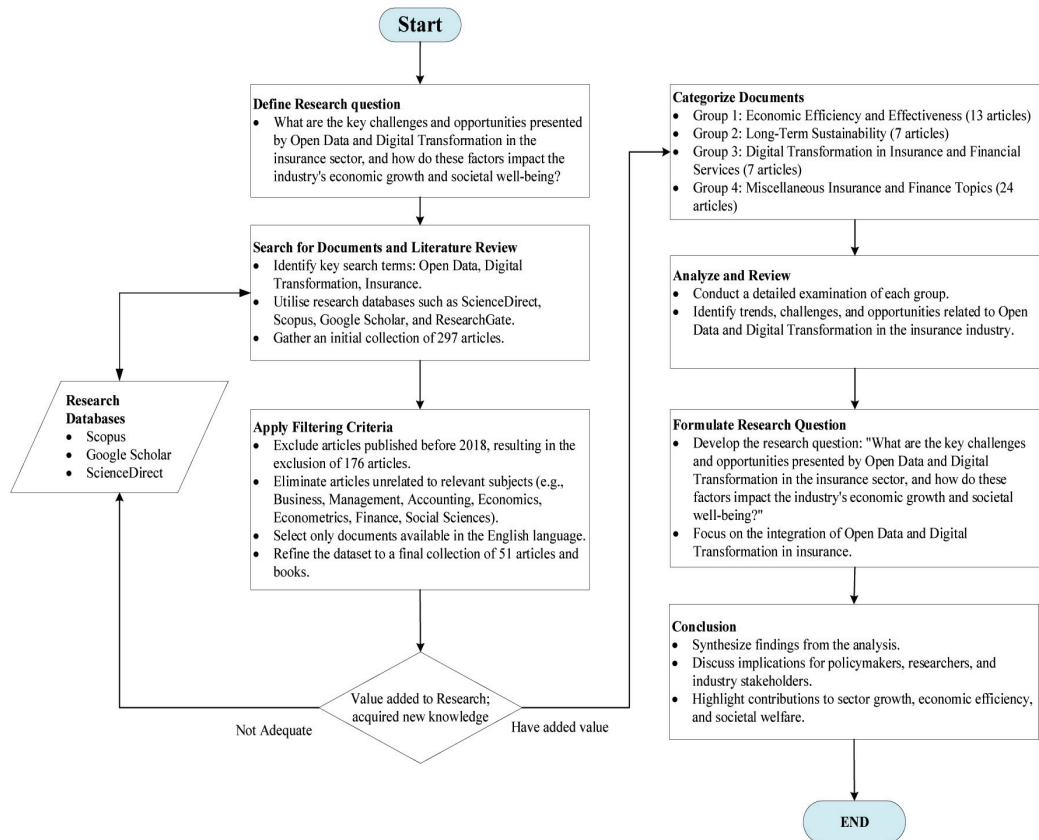


Figure 1. Article identification flow chart.

To refine the dataset, the author implemented a series of filtering criteria. First, articles published before 2018 or not related to the chosen subject areas, Business, Management, Accounting, Economics, Econometrics, Finance and Social Sciences, were eliminated. Furthermore, the selection process required only documents available in English to be considered. As a consequence of this stringent filtering process, 176 articles were excluded. The final dataset, consisting of 51 articles and books, was carefully curated for in-depth analysis and review of the literature. The 51 selected articles and books were classified into four distinct groups to facilitate a systematic analysis of the challenges and opportunities associated with Open Data and Digital Transformation in the insurance domain. Group 1: Economic Efficiency and Effectiveness (13 articles) – This group is dedicated to exploring the intricate relationship between Open Data, Digital Transformation, and Economic Efficiency and Effectiveness within the insurance sector. Group 2: Long-term sustainability (7 articles) – These articles explore the role of Open Data and Digital Transformation in promoting long-term



sustainability in the insurance industry. Group 3: Digital Transformation in Insurance and Financial Services (7 articles) Focusing on Digital Transformation, this group addresses its implications on both insurance and broader financial services. Group 4: Miscellaneous Insurance and Finance Topics (24 articles) – This group encompasses a wide range of miscellaneous topics in insurance and finance that are influenced by Open Data and Digital Transformation.

Also, Table 2 is a categorisation of these 51 selected articles and books that lay the foundation for a comprehensive exploration of the challenges and opportunities inherent in Open Data and Digital Transformation within the insurance sector. By understanding these nuances, policymakers, researchers, and industry stakeholders can make informed decisions that contribute to the sector's growth (Sukma and Leelasantitham, 2022d; Sukma and Leelasantitham, 2022b), economic efficiency, and societal welfare. This study serves as a valuable resource for shaping the future of the insurance industry in an increasingly data-driven world. By the way, from the literature review, we have formulated a research question that specifically focuses on Open Data and Digital Transformation in the insurance sector: What are the key challenges and opportunities presented by Open Data and Digital Transformation in the insurance sector, and how do these factors impact the industry's economic growth and societal wellbeing? This research question delves into the challenges and opportunities arising from the integration of Open Data and Digital Transformation within the insurance industry, with a particular emphasis on their effects on economic growth and societal well-being.

Table 2

### List of selected articles

Ref.	Economic Efficiency	Long-Term Sustainability	Digital Transformation	Business in Insurance	Research Focus & Gaps/ Opportunities	Findings
(Huang and Gao, 2023)	X	-	X	-	SILs impact on digital transformation in enterprises	SIL accelerates digital transformation by improving labor protection.
(Zhang et al., 2023)	X	-	X	-	Impact of digitalisation policy in China on SMEs' finance	Digitalisation is more effective in alleviating SMEs' financing constraints.
(Lang and Riegel, 2023)	X	-	X	-	Factors Influencing the Adoption of online claim notification	Perceived usefulness, ease of use, digital mindset, and severity of damage event impact adoption.
(Hoffmann, 2021)	X	-	-	X	Importance of entrepreneurial design in insurance firms	The case study highlights the value of entrepreneurial design principles and practical skills in fintech.

Ref.	Economic Efficiency	Long-Term Sustainability	Digital Transformation	Business in Insurance	Research Focus & Gaps/ Opportunities	Findings
(Baranauskas, 2021)	X	-	-	X	Digital Transformation in the Baltic non-life insurance market	Research explores digital insurance platforms and customisation. Combined frameworks are necessary.
(Woodard, 2016)	X	-	-	X	Data-Driven Transformation in the British car insurance industry	The transformation was designed to improve processes, reduce costs, and provide customised products and services.
(H Rubin et al., 2023)	X	-	X	-	Global digital trends across industries	Research maps emerging business areas and technological trends.
(Bzhalava et al., 2022)	X	-	-	X	Impact of cybercrime on insurance industry	The lack of data on cyber risks poses challenges. Mandatory reporting could improve understanding.
(Riasanow et al., 2021)	X	-	-	X	D&O insurance and digital transformation in Chinese-listed companies	D&O insurance negatively influences digital transformation.
(Cremer et al., 2022)	X	-	-	X	Fintech Innovations in payments and financing	Fintech innovations are transforming financial services, and regulatory frameworks play a role.
(Schou and Hjelholt, 2018)	X	-	X	X	Digital technologies in the insurance industry	AI and cloud computing transform the industry with interdependencies.
(Huang et al., 2023)	X	-	X	X	Impact of digital transformation on job performance in Peruvian insurance	Digital transformation positively impacts customer service and task performance.
(Subiyakto et al., 2023)	X	-	X	X	Digital transformation in the insurance sector	The digital transformation is transforming the insurance sector, with challenges posed by BigTech.
(Anifa et al., 2022)	X	-	X	-	Ag-Analytics platform for agricultural finance researchers	The platform aims to improve the transparency, validation, and research community.
(Pisoni, 2021)	X	-	X	-	Digital transformation in platform ecosystems	The study examines the similarities of digital transformation in platform ecosystems.
(Lacombe and Jarbouï, 2023)	X	-	X	-	Governmental digitalisation in Denmark	The study explores the political implications of government digitalization.

Ref.	Economic Efficiency	Long-Term Sustainability	Digital Transformation	Business in Insurance	Research Focus & Gaps/ Opportunities	Findings
(Jahn and Bohnet-Joschko, 2022)	X	-	X	-	Digital Transformation Performance of a public insurance company	The study examines the progress of digital transformation and the constructs that influence it
(Eckert and Osterrieder, 2020)	X	-	X	-	Digital Transformation in an Italian insurance company	The company embraces innovation through internal and external means
(Guzmán-Ortiz et al., 2020)	X	-	X	-	Governance in digital transformation of banks and insurance	Research identifies the maturity of IT governance within digital transformation projects
(Werth et al., 2020)	X	-	X	-	Transformation of health insurers into ecosystem-based health service companies	Health insurers partner with healthtech companies for value-added services
(Marano, 2021)	-	X	X	X	Digital applications, customer satisfaction	Digital apps enhance customer satisfaction, critical investment costs critical
(Eckert et al., 2022)	-	X	X	X	open innovation, financial innovation, management practices	Dynamic, innovative management required for growth
(Fasnacht and Fasnacht, 2018)	-	X	X	X	Role of InsurTech in insurance	InsurTech promotes technology empowerment insurance strategies
(Jethani and Leorke, 2021)	-	X	X	X	Strategic orientation toward digitalisation and innovation capability	Digitalization's Impact on innovation capability in emerging markets
(Shevchuk et al., 2020)	-	X	X	X	Digital transformation and firm performance	Evolution of Digital Configurations and their sustainability
(Planchet et al., 2022)	-	X	X	X	Digital Transformation in banking, challenges, and focus areas	Impact of digital transformation in banks, acting entities, and challenges
(Väyrynen et al., 2023)	-	X	X	X	Digital transformation starting points and challenges	Leveraging technology in digital transformation and the importance of collaboration
(Liu et al., 2023)	-	X	X	X	Regulation, digital transformation, and distribution risks	Exemption of ancillary intermediaries impacts distribution risks
(Wang et al., 2022)	-	X	X	X	Open data, government initiatives	Benefits of open data in various industries

Ref.	Economic Efficiency	Long-Term Sustainability	Digital Transformation	Business in Insurance	Research Focus & Gaps/ Opportunities	Findings
(Arias-Pérez et al., 2021)	-	X	X	X	Digital adaptation, automation, machine learning	Automation and Machine Learning for streamlining insurance processes
(Dehnert, 2020)	-	X	X	X	Using open data for risk assessment	Open data allow for better risk assessment for insurance
(Liermann and Stegmann, 2021)	-	X	X	X	Role of digital transformation in public innovation	Digital innovation and public-private cooperation
(Stegmann and Liermann, 2021)	-	X	X	X	Impact of social insurance on corporate environmental performance	Complex relationship between social insurance burden and environmental performance
(Kamenjarska et al., 2022)	-	X	X	X	Impact of Innovation Capacity on financial performance	Role of Innovation in strategic planning and profitability
(Blesa et al., 2020)	-	X	X	X	Utilising open data for insurance actuarial work	Enhancing the premium rating and identifying market opportunities
(Leviäkangas and Molarius, 2020)	-	X	X	X	Impact of open government data on economic growth	Industries benefiting from open government data
(Omrani et al., 2022)	-	X	X	X	Efficiency Analysis with network data envelopment analysis	Applying nonlinear calculations to measure efficiency
(Bednarz and Manwaring, 2022)	-	X	X	X	Technological advancements in insurance and legal challenges	Risks of excessive data collection and transparency issues
(Baumann et al., 2019)	-	X	X	X	Role of Insurance Companies in responsible technology	Ethical and Socioeconomic Implications of semi-autonomous technology
(Roberts et al., 2023)	-	X	X	X	Big data in health insurance and risk analysis	Use of cognitive mapping and MACBETH for risk analysis
(Gallenstein et al., 2021)	-	X	X	X	Use of parametric insurance in the agricultural sector	Feasibility of using the combined weather index for risk assessment
(Reis et al., 2022)	-	X	X	X	Comparison of customer orientation in insurance brokers and banks	Value of advisory services provided by brokers
(Seo et al., 2021)	-	X	X	X	Application of the DFSS model in addressing customer complaints	Reduction of costs in resolving complaints

Ref.	Economic Efficiency	Long-Term Sustainability	Digital Transformation	Business in Insurance	Research Focus & Gaps/ Opportunities	Findings
(Hemrit and Benlagha, 2020)	-	X	X	X	Impact of insurance premiums on non-oil GDP	Influence of premiums on non-oil sector growth
(Fung et al., 2018)	-	X	X	X	Impact of C-ROSS on Chinese life insurers	Effects on product mix, asset allocation, and solvency
(Nagy et al., 2020)	-	X	X	X	Factors influencing life insurance demand	Impact of loss aversion and online technology usage
(Nam, 2018)	-	X	X	X	Consumer willingness to pay for blockchain and smart contracts	Willingness to pay for blockchain and the average WTP
(Fernandes and Ferreira, 2023)	-	X	X	X	Decision Support System for health insurance risk analysis	Combining Cognitive Mapping and MACBETH for transparency
(Prokopchuk et al., 2020)	-	X	X	X	Feasibility of using the combined weather index for insurance	Benefits of index insurance products
(Latorre Guillem, 2020)	-	X	X	X	Customer behavior and complaints in insurance	Reducing customer dissatisfaction and complaints
(Chang et al., 2022)	-	X	X	X	Customer orientation of insurance brokers	Comparison of brokers and banks in Spain

#### 4. Findings

This research reveals several key findings that underscore the transformative potential of open data and digital transformation within the insurance sector. First, the integration of open data practices has been shown to significantly enhance risk assessment and underwriting processes, allowing insurance companies to make more informed decisions and tailor products to meet specific customer needs. Additionally, the study highlights the critical role of digital transformation in fostering customer-centric innovations, such as personalised insurance offerings and the use of AI-driven tools, which are essential for improving customer engagement and satisfaction. Additionally, research identifies substantial ethical and privacy challenges associated with the use of open data, highlighting the need for robust governance frameworks to ensure responsible data practices. This focus on ethical implications is particularly relevant in an era where consumer trust is paramount. Furthermore, the findings illustrate the interconnection of public finance theory and digital transformation, suggesting that strategic alignment of financial policies can facilitate technological advancements and drive economic growth within the industry.

In the realm of public finance theory and its interplay with digital transformation, this discourse elucidates the fundamental role of public finance theory in providing a framework for governments to strategically allocate resources for digitalisation initiatives. Specifically, the need to understand the intricate aspects of budgetary considerations is underscored as paramount for the effective realisation of digital transformation (Bzhalava et al., 2022). Furthermore, public finance theory is demonstrated as a guiding force in the formulation of policies that actively foster economic growth and civic engagement through the leveraged utilisation of open data, a prime example of which is encapsulated in the insights from (Leviäkangas and Molarius, 2020). The fundamental significance of legal and regulatory compliance in the context of open data and digital transformation is palpably illuminated, emphasising its pivotal role in maintaining an ethical and transparent trajectory of data usage, as discussed (Bednarz and Manwaring, 2022). Within the realm of the insurance sector's digital transformation, the contours of this transformation are revealed as being deeply influenced by the relentless march of technology and the evolving expectations of the customer base. The pivotal role of digital platforms, customisation, and innovation is highlighted, as exemplified in the detailed discourse of (Baranauskas, 2021; Werth et al., 2020).

#### ***4.1. Public Finance Theory and Digital Transformation***

Public finance theory serves as a cornerstone in the architecture of government policies and strategies for the digital transformation of sectors, including the insurance industry. It provides governments with a framework to strategically allocate resources for digitalisation initiatives, fostering economic growth and civic engagement. This discourse has reinforced the need for a comprehensive understanding of budgetary considerations in the context of digital transformation, a key determinant of success. The insights from various articles highlight the paramount importance of financial planning, resource allocation, and cost management in the effective implementation of digitalisation projects (Bzhalava et al., 2022). Equally vital is the role of public finance theory in the formulation of policies aimed at promoting economic growth and civic engagement through open data initiatives (Leviäkangas and Molarius, 2020). The analysis demonstrates that open data practices are not only tools for transparency, but also catalysts for economic growth, job creation, and cost reduction. However, these advantages should be balanced with privacy and ownership concerns and the need to ensure that open data initiatives adhere to legal and regulatory requirements (Bednarz and Manwaring, 2022). As such, public finance theory informs the fundamental tenets of efficient budgetary management and policy formulation for digital transformation, marking the path toward achieving economic efficiency and effectiveness in the public sector (Huang and Gao, 2023).

#### ***4.2. Digital Transformation in the Insurance Sector***

The insurance sector is undergoing a profound transformation driven by technological advancements and evolving customer expectations. This transformation underscores the crucial role of digital platforms, customisation, and innovation.

(Baranauskas, 2021; Werth et al., 2020) shed light on the transformative nature of the insurance sector and underscore the urgency of industry players to embrace digital platforms and innovative solutions to meet the dynamic demands of customers effectively. In this evolving landscape, public-private sector collaboration emerges as an essential element of success. (Väyrynen et al., 2023) reinforces the need for synergy between both sectors to navigate the complex challenges of digital transformation, emphasising that their interaction shapes the future of the insurance industry. Additionally, regulatory compliance and legal requirements are fundamental to maintaining the trust of stakeholders and safeguarding data security. The comprehensive analysis of (Werth et al., 2020) highlights the crucial role of legal compliance in digital transformation, particularly in maintaining data integrity, privacy, and trust.

### ***4.3. Open Data and Digital Transformation***

Open data emerge as a powerful catalyst for digital transformation across industries, with a significant impact on the insurance sector (Ekundayo et al., 2023). (Fung et al., 2018) highlights the transformative influence of open data in revolutionising risk assessment, catalysing transparency, and improving operational efficiency. This powerful tool improves the industry's ability to assess and understand risks effectively while facilitating market expansion and deeper insights into market dynamics (Blesa et al., 2020). The transformative potential of open data transcends the insurance sector and benefits numerous industries. (Leviäkangas and Molarius, 2020) underscores the tangible benefits of open data in various sectors, including its potential to foster new businesses, job creation, and economic growth. However, the transformative potential of open data should be accompanied by measures to address privacy and security concerns associated with data usage. The insights from (Leviäkangas and Molarius, 2020) echo the necessity of regulatory frameworks that strike a delicate balance between promoting transparency and addressing legitimate concerns about data privacy and ownership.

### ***4.4. Challenges and Opportunities and Regulatory Aspects***

In the journey towards digital transformation, challenges and opportunities emerge as central facets of the discourse. Organisations face budgetary considerations as they embark on digital initiatives, as emphasised (Eckert et al., 2022). The analysis shows that while digital transformation initiatives may pose budgetary implications, the enhanced digital transformation they bring about can significantly improve economic efficiency and effectiveness, as substantiated (Huang and Gao, 2023). However, these efforts must be undertaken with a firm commitment to regulatory compliance. Regulatory compliance is especially vital in the insurance sector, as discussed (Marano, 2021), which delves into the challenges and opportunities associated with IDD regulation and its alignment with digital transformation. The core objective of achieving economic efficiency while ensuring an equitable distribution of benefits is a recurring theme that epitomises the essence of digital transformation (Huang and Gao, 2023). Furthermore, governance plays a cru-

cial role in digital transformation within the insurance sector (Lacombe and Jarboui, 2023) and elaborates on the importance of governance, emphasising its role as the fulcrum for balancing innovation with regulation. The impact of cybercrime on the insurance industry, as investigated (Guzmán-Ortiz et al., 2020), underscores the need for a comprehensive understanding of cyber risks and enhanced cybersecurity to ensure the sector's long-term sustainability. As highlighted in various articles, unwavering compliance with regulatory and legal requirements is essential for various digital innovations, such as online claim notification, entrepreneurial design, and fintech (Subiyakto et al., 2023; Lang and Riegel, 2023; Anifa et al., 2022).

Alignment with regulatory and legal compliance is equally crucial in the context of governmental digitalisation initiatives, as articulated (Huang et al., 2023). Open government data initiatives and the promotion of open data practices, discussed in (Jethani and Leorke, 2021; Fasnacht and Fasnacht, 2018), present numerous advantages, such as economic growth and civic participation. However, these advantages should be balanced with concerns about privacy and data ownership and the need to ensure that open data initiatives adhere to legal and regulatory requirements. Furthermore, the complex relationship between social insurance burdens and corporate environmental performance, as outlined (Wang et al., 2022), highlights the role of innovation and digital transformation in modulating these effects.

Lastly, the study proposes a preliminary framework to measure the economic impact of digital transformation initiatives, including key performance indicators (KPIs) that can help insurance companies evaluate the effectiveness of their digital strategies. Collectively, these findings contribute to a deeper understanding of the dynamics at play in the insurance sector and provide actionable insights for industry stakeholders and policymakers aiming to navigate the complexities of digital transformation and open data utilisation.

## 5. Discussions

These articles collectively emphasise the transformative nature of this sector and the paramount importance of public-private sector collaboration in navigating the complex landscape for success, as iterated (Väyrynen et al., 2023). It is also highlighted that regulatory compliance and adherence to legal requirements are the foundation for maintaining the trust of stakeholders and protecting data security in the digital age, as substantiated (Werth et al., 2020). The role of open data as a driving force behind digital transformation, extending its profound impact across various industries, especially in the insurance sector, comes to the fore. The discourse, (Fung et al., 2018), underscores the pivotal influence of open data in revolutionising risk assessment, catalysing transparency, and elevating operational efficiency within the insurance domain. Further nuances of the discussion encapsulate the integration of contextual data into risk assessment, facilitating a more nuanced and comprehensive understanding of risks, while simultaneously providing impetus for market expansion and deeper insights into market dynamics, as expounded (Blesa et al., 2020).



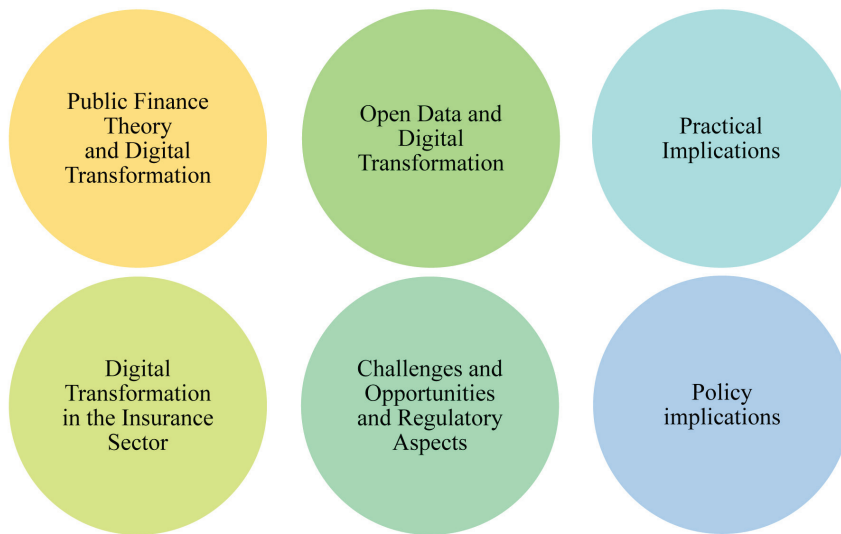
It is imperative to elucidate that this transformative potential of open data is inextricably linked with regulatory frameworks that strike a delicate balance between the imperatives of transparency and addressing legitimate concerns about data privacy, as discussed (Leviäkangas and Molarius, 2020). In the arena of challenges and opportunities entwined with regulatory aspects, budgetary considerations emerge as a pivotal challenge for entities navigating the complex terrain of digital transformation, as stipulated (Eckert et al., 2022). The potential for enhanced economic efficiency and effectiveness that digital transformation promises, exemplified in the revelations of (Huang and Gao, 2023), serves as an attractive opportunity for various sectors.

However, it is palpably clear that adherence to regulatory compliance standards represents a linchpin for the triumphant realisation of these digital initiatives, an aspect emphasized (Marano, 2021). The core objective of ensuring economic efficiency while simultaneously fostering an equitable distribution of benefits is a recurring theme, echoing the essence of digital transformation efforts, as reinforced (Huang and Gao, 2023).

Furthermore, governance assumes a critical role within digital transformation narratives, primarily as an instrument for striking the delicate balance between innovation and regulation. This crucial role is distinctly delineated in the narratives of (Lacombe and Jarboui, 2023). The overarching importance of cybersecurity and a comprehensive understanding of cyber risks is indisputable, particularly for the preservation of long-term sustainability within the respective sectors.

Given these points, this imperative is explicitly underscored in the detailed discussion presented (Guzmán-Ortiz et al., 2020). The need for unwavering compliance with regulatory and legal requirements forms the cornerstone for the successful implementation of various digital innovations within the context of distinct articles, such as online claim notification, entrepreneurial design, and fintech, as substantiated (Subiyakto et al., 2023, Lang and Riegel, 2023, Anifa et al., 2022), respectively. The alignment with regulatory and legal compliance is equally salient within the purview of governmental digitalisation initiatives, as articulated (Huang et al., 2023). The multiple advantages and concerns engendered by open government data initiatives are detailed, with a distinct focus on economic growth, civic engagement, and the attendant concerns of privacy and data ownership, as discussed (Jethani and Leorke, 2021, Fasnacht and Fasnacht, 2018).

In particular, Figure 2 is the expansion of the discourse to encompass the complex relationship between social insurance burdens and corporate environmental performance, with a specific emphasis on the modulating role played by innovation and digital transformation, as delineated (Wang et al., 2022). In summary, the overarching tenet of the narrative reverberates with the need to harmonise innovation with regulation, concomitant with the unwavering commitment to regulatory compliance and adherence to budgetary considerations. This harmonious balance is instrumental in the achievement of the twin goals of economic efficiency, effectiveness, and long-term sustainability in the era of digitalisation.



*Figure 2: Summary of findings and discussions*

### **5.1. Practical implications**

The practical implications that arise from this extensive analysis are numerous and transformative. For enterprises and organisations embarking on digital transformation initiatives, a deep understanding of budgetary considerations is imperative. This discourse emphasises the importance of prudent financial planning, resource allocation, and cost management to ensure the seamless implementation of digitalisation projects. It is evident that the insights derived from this discussion highlight the paramount importance of financial planning, resource allocation, and cost management in the effective implementation of digitalisation projects (Bzhalava et al., 2022). Additionally, the practical importance of regulatory compliance and compliance with legal requirements is crucial. Organisations should prioritise robust mechanisms for data security and privacy to instill trust and confidence among stakeholders. Enhancing cybersecurity measures, as highlighted (Guzmán-Ortiz et al., 2020), is an actionable strategy to strengthen the resilience of digital infrastructure against the growing threat of cybercrime. Furthermore, the insights from (Baranauskas, 2021, Werth et al., 2020), which elucidate the transformative nature of the insurance sector, offer a practical direction for industry players. Embracing digital platforms, customisation, and innovation becomes not just an option, but a strategic imperative. As the sector grapples with the challenges and opportunities presented by digital transformation, practitioners are encouraged to invest in cutting-edge technologies and tailor their services to meet evolving customer expectations. Parametric insurance, as illustrated (Gallenstein et al., 2021), serves as an example of how practical strategies can be implemented to manage risks effectively. By employing such innovative approaches, insurance companies can improve risk assessment and expand their market footprint. Furthermore, the practical implications of open data are pivotal as they offer a roadmap for harnessing their transformative potential across various industries. Incorporating contextual data into risk

assessment, as expounded (Blesa et al., 2020), becomes an actionable strategy for insurance companies.

### **5.2. Policy Implications**

The policy implications emanating from this extensive discourse are instrumental in guiding governments and policy makers as they formulate regulations and strategies to facilitate open data and digital transformation. First, governments must align their digitalisation policies with the theory of public finance theory. This involves efficient allocation of resources and formulation of policies that stimulate economic growth and civic participation through open data initiatives. As elucidated (Leviäkangas and Molarius, 2020), the promotion of open data practices not only fosters economic growth, but also reduces government costs. Policymakers should prioritise creating an enabling environment for the implementation of open data initiatives by striking a delicate balance between transparency and data privacy concerns. Regulatory frameworks must be designed to ensure data privacy and ownership while simultaneously reaping the economic benefits of open data. In the context of public-private collaboration, policymakers should actively facilitate partnerships that harness the synergistic capabilities of both sectors. These collaborations can drive innovation, improve public services, and promote economic growth. Furthermore, in terms of implications for the insurance sector, the policy underscores the need for a robust regulatory framework that addresses the specific challenges and opportunities presented by digital transformation. Regulatory compliance and legal requirements should be the cornerstone of these policies to protect data security and privacy. Furthermore, governments should encourage insurance companies to embrace digital platforms, customisation, and innovation by offering incentives and creating conducive regulatory environments. Policies that promote the adoption of parametric insurance, as illustrated (Gallenstein et al., 2021), can improve risk assessment in the insurance sector. Policymakers should facilitate the integration of contextual data in risk assessment by incentivising the use of such data in premium rating and risk identification. This approach can lead to a more transparent and efficient insurance sector.

In conclusion, this in-depth analysis underscores the practical and policy implications of open data and digital transformation in the domains of public finance theory and the insurance sector, as shown in Table 3. Practitioners are encouraged to embrace prudent budgetary planning, regulatory compliance, and collaboration between the public and private sectors to ensure the successful implementation of digital initiatives. Policymakers, on the other hand, should align their policies with public finance theory, prioritise open data practices, and design regulatory frameworks that promote data privacy and ownership while stimulating economic growth. Furthermore, the insurance sector can benefit from policies that encourage innovation, digital platforms, and the adoption of parametric insurance to improve risk assessment and premium ratings. This holistic approach is instrumental in shaping a future where open data and digital transformation coexist harmoniously, fostering economic efficiency, effectiveness, and long-term sustainability (Lu et al., 2023; Brohman et al., 2023; Sukma and Leelasantitham, 2022c; 2022a).

Table 3

### Practical, policy implications, best practices and suggestions for further research

Role	Practical Implications	Policy Implications and Best Practices	Suggestions for Further Research
Insurance Practitioners	Understand the transformative impact of digital platforms, customisation, and innovation. Invest in cutting-edge technologies and tailor services to meet evolving customer expectations. Embrace innovative approaches such as parametric insurance for effective risk management	Encourage insurance companies to embrace digital platforms, customisation, and innovation through incentives and conducive regulatory environments. Promote the adoption of parametric insurance for improved risk assessment. Facilitate the integration of contextual data into risk assessment for more accurate premium ratings	Explore the impact of emerging technologies such as blockchain and AI on the insurance sector. Investigate the potential challenges in implementing parametric insurance and strategies to overcome them
Insurance Regulators	Prioritise robust mechanisms for data security and privacy to instill trust and confidence among stakeholders. Improve cybersecurity measures to protect against the growing threat of cyber-crime	Develop a robust regulatory framework that addresses the specific challenges and opportunities presented by digital transformation. Regulatory compliance and legal requirements should be central to these policies	Investigate the effectiveness of current regulatory frameworks in protecting data privacy and security in the insurance sector. Explore best practices on international insurance regulation to inform policy improvements
Insurance Customers	Expect a seamless and user-centric digital experience. Benefit from the improved efficiency and effectiveness of insurance services	None specified	Research customer satisfaction and preferences about digital insurance services. Explore the impact of customer-centric technologies, such as chat-bots and personalised insurance offerings
Insurance Companies	Embrace digital platforms, customisation, and innovation to remain competitive and meet evolving customer expectations. Explore innovative approaches such as parametric insurance for effective risk management	Invest in cutting-edge technologies and tailor services to meet evolving customer expectations. Use parametric insurance to improve risk assessment and expand market footprint	Investigate the impact of digital transformation on the workforce within insurance companies. Research strategies to encourage innovation and digital adoption in traditional insurance firms
Government and Policy-makers	Encourage public-private collaboration to harness the potential of digital transformation. Prioritize open data practices while protecting data privacy and ownership. Facilitate partnerships that drive innovation, improve public services, and promote economic growth	Align digitalisation policies with public finance theory, ensuring efficient resource allocation, and policies that stimulate economic growth and civic participation through open data initiatives. Strike a balance between transparency and data privacy in regulatory frameworks. Encourage public-private collaborations to drive innovation, improve public services, and promote economic growth	Examine the economic and social impacts of open data initiatives in various sectors. Explore the role of governments in promoting digital literacy and inclusion for all citizens

## 6. Conclusion

This comprehensive analysis highlights the intricate interplay of open data and digital transformation within the insurance sector, framed by the principles of public finance theory. The landscape is characterised by unprecedented change and adaptation, compelling organisations, regulators, and policymakers to navigate the complexities of innovation, regulation, and fiscal responsibility. The multifaceted nature of digital transformation underscores the relentless progression into the digital age, where embracing digital platforms, customisation, and innovation is essential for competitiveness and responsiveness to evolving customer demands. Furthermore, this evolution is not an isolated phenomenon; it is deeply interconnected with broader collaborations between the public and private sectors. The environment is dynamic and multifaceted, transcending traditional business models and regulatory frameworks. Furthermore, this analysis sets the groundwork for several practical and policy implications. Organisations pursuing digital transformation must prioritise financial planning, resource allocation, and cost management to ensure successful project implementation. Establishing robust mechanisms for data security and privacy is crucial to fostering trust among stakeholders and protecting sensitive information. Also, the adoption of cutting-edge technologies and services tailored to meet customer expectations is vital for insurance companies. For example, parametric insurance serves as a practical strategy for effective risk management, showcasing the potential benefits of innovative solutions. Similarly, the use of contextual data for risk assessment can lead to more accurate premium ratings and risk identification.

However, on the policy front, governments and regulators must align their digitalisation strategies with the core tenets of public finance theory, facilitating efficient resource allocation and policies that promote economic growth through open data practices. They play a critical role in creating an enabling environment for open data initiatives, balancing transparency with data privacy. Policymakers should actively promote public-private partnerships that take advantage of the strengths of both sectors. Additionally, robust regulatory frameworks specific to the insurance sector must be developed to protect data security and privacy while incentivising innovation and encouraging the adoption of digital platforms and customisation.

In conclusion, this research underscores the pivotal role of open data and digital transformation in reshaping the insurance sector, revealing significant opportunities and challenges. The findings emphasize the need for insurance companies to adopt innovative technologies and customer-centric approaches to improve operational efficiency and meet changing consumer expectations. Moreover, integrating public finance theory offers a valuable framework for policymakers to allocate resources effectively and develop regulatory frameworks that balance transparency with data privacy. This study also highlights the ethical considerations surrounding data usage, advocating for strong governance structures to maintain consumer trust. By proposing a preliminary framework to measure the economic impact of digital initiatives, this research contributes

to the ongoing discourse on the intersection of technology and finance in the insurance industry. Ultimately, the insights gained from this study not only inform industry practices but also establish a foundation for future research exploring the dynamic relationship between digital transformation and economic growth in the insurance sector.

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The article was submitted: 20.10.2024;  
approved after reviewing: 15.11.2024;  
accepted for publication: 08.03.2025.