Chapter 11

Internal Controls and Insurance in Industry 5.0

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Abstract

Purpose: To systematically identify and critically analyse the challenges and opportunities for the development of internal controls in the insurance industry within the new technological revolution Industry 5.0.

Need for the study: Effective internal controls are essential for maintaining financial integrity, protecting policyholder interests and complying with regulatory requirements. Covering risk, the insurance industry helps to protect companies and households from financial losses resulting from adverse situations. Financial stability of these institutions is crucial for financial well-being of society, reinforced in the current period of technological revolution Industry 5.0.

Methodology: Detailed review of current literature and existing practices regarding traditional internal controls in the insurance industry including the framework analysis for further development related to a technological shift. We also use the impact analysis of Industry 5.0 characterised by the integration of novel technologies and cyber–physical systems that alters the landscape for internal controls.

Findings: The impact of Industry 5.0 on the insurance industry can be summarised in three areas: (1) changes in risk leading to changes in demand for insurance, (2) changes in internal processes and (3) changes in competition in the insurance industry. While insurance companies are complex institutions, developments in all these areas are closely linked to business

Business Challenges and Opportunities in the Era of Industry 5.0
Emerald Studies In Finance, Insurance, And Risk Management, 195–213

doi:10.1108/978-1-83549-676-320251011

success. We conclude that this technological shift could help insurers to reduce costs associated with previously manual and repetitive activities.

Practical implications: Adaptation of internal controls in insurance industry by technological innovations in Industry 5.0 could increase the transparency of financial integrity, following the increase in the protection of policyholders' interests.

Keywords: Internal controls; insurance industry; emerging risks; automation; artificial intelligence; blockchain; cyber–physical systems; Industry 5.0

JEL classifications: G2; M15; M42; O33

1. Introduction

An insurance industry is an important part of the economic system. By its fundamental role to cover risk, insurance companies help to protect companies and households from financial losses resulting from unknown and unpredictable adverse situations. Therefore, they have to manage risks of their clients on the one side, but they also need to manage risks related to their business operations (De Haan et al., 2015).

The financial crisis and financial scandals of the recent past highlight the financial vulnerability of insurance companies. Inappropriate investment decisions by insurers and the associated financial losses increase the demand on supervisory and regulatory bodies, as well as insurance companies, to pay attention to the strategic importance of good governance practices (Cappiello, 2020). These trends are reinforced in the current period of rapid technological development and following changes in the risk landscape.

In the prior stage of the industrial revolution, Industry 4.0, the extensive increase in the use and coverage of telecommunication networks and the Internet was a starting point of the technological revolution (Nicoletti, 2021). These interconnections and technological changes create a prerequisite for the establishment of a huge stream of Insurtech companies (as part of Fintech). Digitalisation, which brings an opportunity to reduce costs, attracts the interest of many insurers (and reinsurers). Further development and the birth of artificial intelligence (AI) led to the current phase of industrial development, Industry 5.0. This phase is associated with the convergence of advanced technologies and cyber–physical systems. Industry 5.0 is not a simple extension of Industry 4.0 but a significant advancement that enhances sustainability, personalisation and efficiency. This new paradigm presents new opportunities and challenges for the insurance industry, including in the area of internal controls.

In the insurance industry, internal controls are important processes for the resilience of insurance companies and the policyholder protection. In general, internal controls are the mechanisms designed to ensure the effective and efficient operation of business processes, including the reliability of financial reporting

and compliance with laws and regulations. According to the International Association of Insurance Supervisors (2019), effective internal controls are essential for maintaining financial integrity, complying with regulations and protecting the interests of policyholders. Failure of internal controls can lead to financial and non-financial losses for insurance companies and policyholders simultaneously. The recent examples of Allianz SE in Germany and fraud in its US fund units underline the need for well-established and operated internal controls. In 2022, Allianz has to pay more than USD 6 billion in criminal fines, restitution and forfeiture in a fraud case involving pension funds for teachers, bus drivers, engineers, religious groups and others (Reuters, 2022a). Following this case, German regulator BaFin requests Allianz to improve internal controls to prevent fraud (Reuters, 2022b). Even though financial losses can have a significant impact on the solvency of insurance companies, non-financial losses, in terms of reputation and trust, are even more important in the conventional insurance industry. Insurance, by its very nature, is based on trust, and insurance company management must take this into account in all its decisions and control systems.

The aim of this chapter is to systematically identify and critically analyse the challenges and opportunities for the development of internal controls in the insurance industry within the new technological revolution Industry 5.0. In the first section, we clarify the basic principles of internal controls in the insurance industry, highlighting their role in mitigating risks associated with networked systems, data integrity and new technologies. This discussion is followed by an analysis of how insurers can adapt and refine their internal control frameworks to address the complexities of Industry 5.0, including AI, blockchain and autonomous systems on traditional insurance models, challenging the industry to proactively address the evolving risk landscape. It is important to emphasise that these new technologies also bring new risks. In the insurance sector, new or so-called emerging risks are both the common denominator and the opportunity. As insurance companies provide protection against financial loss to their customers, new risks represent an opportunity to expand the range of products offered. On the other hand, new technologies are also affecting the way insurance companies operate. This chapter also discusses the evolution of the insurance industry in Industry 5.0, highlighting the new risks insurers face and the need for tailored insurance solutions. Strategies for integrating technological developments into insurance processes are explored, providing a blueprint for insurance organisations.

This chapter aims to contribute to ongoing dialogue between industry professionals, policymakers and academics regarding the sustainable and secure development of the insurance industry in the face of technological progress. In addition, this chapter has an ambition to contribute to scarce academic literature related to the effect of Industry 5.0 on insurance internal processes and controls.

2. The Framework of Internal Controls in the Insurance Industry

In the complex and highly regulated environment of the insurance industry, internal controls cannot be underrated as they serve as the base for achieving operational efficiency, regulatory compliance and financial integrity but also act as

the essential factor for maintaining stakeholder trust. As the insurance industry faces an ever-expanding range of new or transformed risks, ranging from market fluctuations to regulatory changes and increasing cybersecurity threats, robust internal controls are essential for mitigating these new challenges. These controls are crucial for mitigating risks associated with the industry's unique business processes, including underwriting processes to ensure risk assessment accuracy, the careful claims of management to prevent fraud and minimise losses or the strategic oversight of investment activities to optimise returns while maintaining prudent risk levels. Moreover, in a period characterised by complex examination and responsibility, effective internal controls demonstrate a commitment to transparency and governance excellence. They provide guarantee to regulators, investors and policyholders alike that the insurance company operates with integrity and diligence, fostering a resilient and trustworthy industry ecosystem.

2.1. Definition and Objectives of Internal Controls

Internal controls constitute an ongoing series of procedures and mechanisms overseen by an insurance company's board of directors, management and personnel, aimed at offering reasonable assurance of (Committee of European Insurance and Occupational Pensions Supervisors, 2003; Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2013):

- ensuring the effectiveness and efficiency of operations;
- upholding the reliability of both financial and non-financial data;
- establishing a robust framework for managing risks;
- adopting a prudent approach to business practices;
- ensuring compliance with applicable laws, regulations as well as internal policies and procedures.

The primary objective of internal control is to strengthen the internal operational landscape of the insurance company, thereby enhancing its ability to effectively manage both external and internal challenges (Hopkin, 2018). In addition, it serves as a mechanism to identify potential weaknesses or deficiencies in processes and structures, facilitating timely remediation and optimisation efforts.

From an accounting perspective, internal controls are an integral part of the three lines of a defence model developed by the Federation of European Risk Management Associations and the European Confederation of Institutes of Internal Accounting (2022) and revised in 2024 (The Institute of Internal Auditors, 2024). In this model, internal controls are present in all three lines. The first line is represented by management, which is responsible for managing operational activities. In this line, controls focus mainly on accountability. The second line focusses on identifying risks that arise in the normal course of business. This is supported by risk and compliance management, including internal controls. The final third line provides objective and independent assurance that the functions in the first two lines are operating effectively. This line also provides assurance to regulators and supervisors of the effectiveness of the organisation in its design

Fig. 11.1. Three Primary Objectives Achieved by Internal Controls in the Insurance Sector. *Source*: Authors.

and operation (Deloitte, 2020b). Following this approach, internal controls in the insurance sector are defined as the procedures and mechanisms put in place by an organisation to ensure the achievement of three primary objectives as shown in Fig. 11.1.

The COSO offers a universally acknowledged framework for internal controls, which underscores five fundamental components: control environment, risk assessment, control activities, information and communication, and monitoring activities (Arwinge, 2014; COSO, 2013). The following areas are key components of insurance companies' internal controls:

- *Underwriting and claims controls* play a key role in managing the risks associated with policy issuance and claims processing. Their primary goal is to guarantee that policies are delivered or extended only to qualified individuals and entities while also facilitating the accurate and prompt claims settlement. These controls are essential in maintaining the integrity of essential insurance operations by keeping eligibility criteria for policy issuance and ensuring the timely settlement of claims (Rejda & McNamara, 2017). Moreover, they highlight the critical role of underwriting controls in sustaining financial stability and fostering trust among consumers of insurance policies.
- *Financial controls and internal audit* in the insurance industry are encompassing protocols for precise financial reporting, maintenance of assets and preventing fraudulent activities (Hopkin, 2018). These controls are vital for approving the integrity and transparency of financial operations within insurance companies as well as assume a crucial role in assessing the sufficiency and efficacy of internal controls. By conducting independent evaluations, internal audits offer valuable insights into an insurer's risk management practices and control mechanisms. These assessments not only help identify areas for improvement but also reinforce confidence among stakeholders in the insurer's commitment to comprehensive governance and risk management practices.
- *Compliance controls* are helpful in upholding adherence to the numerous laws and regulations that govern the insurance sector, consumer protection, privacy

and solvency requirements. They serve as a precaution, ensuring that insurance companies operate within legal borders while prioritising the protection and rights of policyholders (Majuca, 2006). These controls not only mitigate compliance risks but also support the insurer's commitment to ethical conduct and regulatory compliance by encouraging trust and confidence among all stakeholders.

- *Information technology (IT) and cybersecurity controls* assume robust significance in today's digital landscape, where technology supports virtually all fragments of insurance operations. These controls are crucial for the maintenance of sensitive data and upholding the reliability of digital transactions (KPMG, 2020). As insurers continue to embrace digital innovation, the effectiveness of IT and cybersecurity controls becomes paramount in mitigating cyber risks and stimulating the resilience of insurance operations against growing threats in a constantly changing digital environment.
- Implementing robust *risk management controls* involves establishing a systematic approach to identification, analysis and mitigation of risks across all levels of the insurance company (Rejda & McNamara, 2017). By proactively addressing potential risks, insurance companies can enhance their resilience and adaptability in the competitive environment. Moreover, effective risk management not only defends against potential losses but also fosters a culture of informed decision-making and innovation, positioning the insurance company for long-term adaptation and competitiveness in an ever-changing business landscape.

2.2. Importance of Internal Controls in the Insurance Industry

In a changing economic environment, internal controls are a key concern for insurers. With technological innovations and evolving risk landscape, the insurance business is becoming more complex and riskier. Therefore, the insurance industry's internal control should be recognised as an opportunity to improve its performance for the internal environment of insurance companies as well as for the external perspective of stakeholders (Cappiello, 2020).

From an internal perspective, effective internal controls are the foundation of operational integrity within insurance companies and serve as a barrier against the complex range of risks that are prevalent in the industry. By establishing rigorous control mechanisms, insurers can mitigate financial losses resulting from errors, fraud or non-compliance with regulatory requirements. In addition, internal controls play an essential role in promoting operational excellence by streamlining processes, increasing efficiency and minimising operational disruption. Effective internal controls could also support the competitiveness in short and long terms (Cappiello, 2020).

Along with mitigating direct risks, internal controls also facilitate strategic decision-making by providing accurate and reliable data for informed analysis and data-driven decisions of insurance company management. By maintaining a robust control environment, insurers can effectively assess opportunities and allocate resources in line with their strategic objectives, thereby enhancing their

competitive advantage in the financial marketplace (Nicoletti, 2021). The direct link between internal controls and decision-making of the management points to the key role of effective internal control within a corporate governance (European Insurance and Occupational Pensions Authority (EIOPA), 2018).

From an external perspective, the robustness of internal controls directly influences stakeholders' perceptions of an insurer's reliability and trustworthiness. Policyholders, regulators and investors place a high value on the demonstration of effective internal controls, which they see as evidence of the insurer's commitment to sound governance and risk management practices. This, in turn, fosters confidence in the insurer, strengthens its reputation and positions it as a reliable partner in protecting policyholders' interests and maintaining the stability of the sector as a whole (Cappiello, 2020).

The insurance industry's internal control framework adopts a holistic strategy to mitigate operational, financial and compliance risks. As the industry continues to evolve, particularly with the introduction of advances such as Industry 5.0 technologies, the importance of these controls in driving sustainable growth and resilience remains paramount.

3. The Impact of Industry 5.0 on the Insurance Industry

The new era launched by Industry 5.0 is characterised by the integration of cutting-edge technologies with human-centred approaches in the workplace. It complements the established Industry 4.0 framework by explicitly leveraging research and innovation to facilitate the transition to a sustainable, human-centred and robust insurance industry (European Commission, 2024). This paradigm shift has significant implications for the insurance industry, affecting numerous aspects ranging from risk assessment methodologies to customer engagement strategies. This section explores the transformative impact of Industry 5.0 on the insurance industry, focussing on changes in risk profiles, operational processes and competitive dynamics.

Industry 5.0 represents the next evolutionary phase beyond the digital automation of Industry 4.0, emphasising collaboration between humans and smart systems and aiming for improvements in sustainability, personalisation and efficiency. It prioritises the well-being of workers at the heart of the production process, connecting new technologies to drive prosperity beyond mere job creation and economic growth, while respecting the planet's production constraints (European Commission, 2024). Technologies such as AI, the Internet of Things (IoT), blockchain and autonomous systems play a central role in this transition and offer new opportunities and challenges for the insurance industry.

The competitive dynamics of the insurance industry are being reshaped by Industry 5.0. Insurtech start-ups introduced by Industry 4.0 are leveraging emerging technologies to disrupt traditional insurance business models, offering innovative insurance products and additional services to meet consumer needs (KPMG, 2019). Established insurers are embracing digital transformation to remain competitive, investing in technology infrastructure and talent to remain agile and responsive in a rapidly changing market.

The innovative impacts of Industry 5.0 on the insurance sector is evident in several key areas: shifts in risk landscapes and insurance demand, adaptations in internal processes and controls and intensified competition within the insurance industry.

3.1. Changes in Risk and Demand for Insurance

Within the evolving Industry 5.0 ecosystem, changes in risk profiles and shifts in consumer demand for insurance products emerge as key points of focus, driving insurers to adapt and innovate in response to changing market dynamics.

First, Industry 5.0 emerges and transforms risks. As IoT devices flourish, interconnectedness and complexity of risks expands, and AI algorithms become more sophisticated. Therefore, insurers are faced with numerous emerging and transforming risks, ranging from cybersecurity vulnerabilities, labour disruption to intricate data privacy concerns (Allianz Global Corporate & Specialty, 2018). In response to these risks, insurers must innovate and develop tailored insurance solutions that address the evolving needs of businesses and individuals. Cyber insurance products, for instance, can provide coverage for losses arising from data breaches, ransomware attacks and other cyber incidents (Egan et al., 2019). Likewise, privacy liability insurance can help mitigate the financial impact of legal claims related to data privacy violations.

These changes also show a shift in consumer expectations. Increased interconnectivity and smart technologies lead to changing consumer expectations for personalised and flexible insurance products. Consumers seek insurance products that are tailored to their unique needs and preferences. They expect insurers to leverage data insights from IoT devices, wearables and other sources to offer personalised coverage options that align with their lifestyles and risk profiles. Furthermore, consumers claim for greater flexibility and transparency of their insurance policies. They expect intuitive digital platforms that enable them to purchase, manage and modify their policies conveniently and in real time. In response to these shifts, insurers must embrace digital transformation and prioritise customer centricity in their strategies to not only meet but exceed consumer expectations, which may increase loyalty of consumers and differentiation in an increasingly competitive marketplace.

3.2. Changes in Internal Processes and Controls

As Industry 5.0 revolutionises the operational landscape, the focus is on the examination that delves into how insurers are leveraging emerging technologies to enhance efficiency, transparency and risk management within their organisational frameworks.

Industry 5.0 has a substantial effect on operational efficiency. The adoption of Industry 5.0 technologies such as AI for predictive analytics and blockchain for secure, transparent transactions can significantly enhance operational efficiency and accuracy in claims processing and risk assessment. Blockchain technology appears as a game-changer in warranting secure and transparent transactions

within the insurance ecosystem. By use of decentralised ledgers and cryptographic protocols, blockchain enables insurers to securely record and verify transactions in real time (KPMG, 2019). This not only eliminates inefficiencies associated with manual record-keeping by intermediaries and reconciliation but also enhances trust and transparency among stakeholders. Moreover, the immutability and auditability inherent in blockchain technology mitigate the risk of fraud and enhance data integrity throughout the insurance value chain.

The enormous amounts of data generated by IoT devices and analysed through AI algorithms allow more informed and dynamic decision-making processes to support the data-driven decision-making (Nicoletti, 2021). This transforms traditional approaches to predictive analytics, enabling insurers to utilise the power of massive data sets to anticipate trends, identify patterns and make data-driven decisions with unprecedented speed and precision (KPMG, 2019). By using advanced machine learning (ML) algorithms, AI systems can automate complex tasks in insurance companies, such as risk modelling and underwriting, significantly reducing the time and resources required while simultaneously improving accuracy.

3.3. Competition in the Insurance Industry

In the era of Industry 5.0, the insurance sector finds itself among a dynamic landscape where market disruptions and strategic partnerships play a key role.

New market entrants leveraging Industry 5.0 technologies may disrupt traditional insurance models, introducing innovative products and services that cater to evolving consumer needs. These disruptors, armed with cutting-edge tools like AI, IoT and blockchain, are pioneering innovative solutions tailored to meet the ever-evolving demands and preferences of today's consumers (Naylor, 2017). As they introduce novel products and services that prioritise convenience, customisation and transparency, traditional insurers are compelled to adapt quickly or risk being left behind in an increasingly competitive and dynamic market environment (Cappiello, 2020).

Strategic partnerships between traditional insurers and tech companies or start-ups are becoming increasingly dominant as the insurance industry holds the transformative potential of Industry 5.0 technologies. By cooperating with innovative tech firms, insurers gain access to pioneering solutions and expertise, enabling them to enhance their insurance product offers, modernise processes and improve customer experiences (KPMG, 2019). These partnerships foster a symbiotic relationship wherein insurers leverage their industry knowledge and consumer base, while tech partners provide the technological prowess and agility needed to drive innovation and stay ahead in a rapidly evolving market landscape.

4. Adapting Internal Controls in Insurance Industry for Industry 5.0

Adapting internal controls and modernising the line of defence is an inevitable step in a reaction to changing environment. Efforts to limit reactive, labour-intensive

and manual controls are evident in the insurance industry, with the goal of more proactive, insight and data-driven internal controls (Deloitte, 2024). Industry 5.0 offers technological tools that could help in this transformation.

AI, robotic process automation (RPA) and blockchain and smart contracts represent the generation of information and communication innovations of Industry 5.0 usable for adapting internal controls in the insurance industry (see e.g. Association of Chartered Certified Accountants, 2022; Deloitte, 2020b, 2024; PwC, 2019). These technological innovations and their cooperation could offer possibilities for a strategic revision of internal controls to mitigate the potential of emerging risk effectively. Below, we briefly explain these technologies and define the possible ways of integration of these technological developments into insurance internal control processes.

The boom in the use of AI technology, following increases in computing power and data storage capacity, also has implications for the insurance industry's internal processes and internal controls. AI offers the potential not only to understand but also to process, interpret and learn (Russell & Norvig, 2018). Together with ML and deep learning (DL), these technologies could 'mimic human cognitive functions, including learning, problem solving and decision-making' (Obaydin et al., 2023, p. 2). According to the Swiss Re Institute (2023), development of AI is increasing the speed, reach and affordability of automation and predictive power together with saving the costs and improving efficiency.

However, it is important to have high-quality data for high-quality AI processing. In the insurance industry, vast amounts of data could be obtained through the IoT. The IoT 'includes devices and objects whose state can be changed via the Internet, with or without the active involvement of individuals' (Marano & Noussia, 2020, p. 50). In addition, insurance companies could use these real-time data recorded by devices and sensors for risk monitoring. For example, data generated by devices installed for maintenance or performance monitoring could be used by insurance companies to activate preventive measures and early warnings (Zurich Insurance Group, 2022). The vast amount of data generated and their real-time nature increase the need for its processing and visualisation, for which AI is a suitable technology. AI can analyse vast amounts of structured and unstructured data and identify patterns (Obaydin et al., 2023). The immediate availability of detailed data and their rapid processing by AI algorithms provides actionable insights to dynamically revise internal controls in real time (Deloitte, 2020a).

Leveraging IoT devices data and AI for enhanced risk detection and management offer advanced capabilities for real-time risk detection and management. This could help organisations gain risk insights to prevent or reduce the likelihood of loss or the loss itself and save time and effort for risk managers by helping to identify the cause of the problem rather than just the symptom (Zurich Insurance Group, 2022). AI performs actions that previously required human intelligence, supporting a transformation in risk assessment, fraud detection and claims handling by improving the accuracy and efficiency of internal controls. This also represents an opportunity for internal controls to increase the frequency of, for example, auditing. For example, according to KPMG (2022), the future of internal controls will lead to continuous real-time auditing and control with 100%

audit coverage in comparison to current shorter audit frequency using small random samples. Similarly, AI and automation could lead to transferring majority of audit and control work from primarily manual to data, analytical and automation with concise and visualised reporting.

Another Industry 5.0 innovation with an impact to internal controls of insurance companies is process automation. RPA is defined as

> preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management. (Hofmann et al., 2020, p. 100)

In the case of internal controls, RPA could reduce both repetitive tasks and the risk of human error in internal controls, which could lead to improved data accuracy (PwC, 2019). With RPA, insurance companies can digitise error-prone manual processes that incur additional costs and internal controls. Every activity at every stage of the process, as well as all data, has a digital audit trail. This reduces errors and improves the quality of processes. Automation could be used across all lines of defence (PwC, 2019).

The benefits of automating internal processes and controls could include a reduction in the time and effort required to ensure compliance, real-time risk detection compared to much less frequent audits, the ability to uncover the root causes of problems compared to just solving the symptoms, following the increase in the speed of data-driven decision-making (Deloitte, 2024). Automation could also help to build offensive and proactive risk management compared to more defensive and reactive risk management. Control bodies could incorporate insight, oversight and foresight for better action in the present (Deloitte, 2024). Automated internal control processes could also increase control resilience, meaning that insurance companies could be able to identify and assess risks, as well as implement and monitor appropriate types and amounts of controls at the right time (Deloitte, 2024). All of these steps could lead to better allocation of financial and human resources and focus on more strategic and revenue-generating objectives (Deloitte, 2024). For example, the report of McKinsey & Company (2017) claims automation can reduce the costs associated with claims by up to 30%.

Industry 5.0 is also defined by increase in frequency of using a blockchain. Blockchain technology is defined as

> a mutualised multi-master state machine replication system that enables new forms of distributed software architecture where agreements on shared state for decentralised and transactional data can be established in a network of peers. (Tasca, 2019, p. 273)

Blockchain technology offers a secure, transparent framework for transactions that could significantly improve data integrity and reduce fraud risks (Brophy, 2020).

In the insurance industry, blockchain technology has a relevant application in underwriting and pricing of products, their sales and distribution, the management of product and claims processing (Popovic et al., 2020). Smart contracts represent the most usable feature of blockchain for the insurance industry. According to Tasca (2019, p. 281), a smart contract is a 'legal contract that can self-execute, self-enforce, self-verify and also self-limit the contractual performance'. For insurers, the automation of contracts through smart contracts can help in the automatic verification of the policyholder and the contract, which can significantly shorten the resolution of the contract. The external verification of the contract also helps to reduce the need for resolution (Tasca, 2019, p. 273). These benefits can be used to create more robust internal controls in insurance companies (COSO, 2020).

Blockchain and smart contracts provide a distributed, decentralised, resilient and transparent approach to data that could help create an effective environment by, for example, recording transactions with minimal human intervention (Popovic et al., 2020). This technology promotes the visibility of transactions and the availability of data, creating a new way to effectively communicate financial information to key stakeholders (COSO, 2020). The detailed information available through blockchain and smart contracts could contribute to the efficiency of active monitoring and increase the trust of stakeholders. When a transaction is validated through blockchain technology, it is permanent, and the transaction can't be changed without compromising the entire chain (PwC, 2019). Once a transaction is on the blockchain, many internal controls become easier. From both a regulatory and external audit perspective, blockchain technology offers a simplification because it allows direct transactions between counterparties through a decentralised ledger. There is no need for a central authority (PwC, 2019).

Adapting internal controls for Industry 5.0 in an insurance company is a complex endeavour that requires a strategic combination of technological integration, organisational cultural transformation and collaborative innovation. In addition to technological transformation, cultural and collaborative transformations are also necessary for the successful adaptation of internal controls. New technologies are significantly changing the processes in insurance companies, affecting the working environment and the skills required by employees, creating new roles and resulting in new conflicts and trust issues. Insurance companies need to focus on the experience of employees and consumers by promoting an organisational culture of technology innovation and adoption (PwC, 2019). This organisational strategy could also support collaboration and stakeholder engagement. Building partnerships with technology companies, regulators and other stakeholders is important to create sustainable solutions and succeed in the highly competitive insurance industry in Industry 5.0.

4.1. AI-Driven Claims Processing as an Example of Adaptation of Internal Controls in Industry 5.0

AI-driven claims processing could help to improve the speed and accuracy of claims processing, leading to higher customer satisfaction, lower error rates, increased transparency and the prevention of insurance fraud. In particular, AI

could help improve back-end processes and develop new coverage for uninsurable risks (Swiss Re, 2023). Swiss Re's AI model, called Flight Delay Compensation, can predict flight delays and in the event of a delay, consumers who have purchased flight delay insurance with their airline ticket do not need to file a claim and are automatically paid immediately. This AI model, which uses 200 million records of historical data, has a built-in pricing engine to adjust rates (Swiss Re, 2023). Another example includes data from IoT sensors (via smartphones, smart homes or smart cars) and their real-time assessment that can alert the insurance company when a potential claim has occurred. This could reduce the allocation of resources and save costs in performing repetitive administrative tasks, including initial information gathering and reporting (AON, 2023). Access to rich real-time data creates an opportunity to reduce fraudulent claims. A patent developed by an Italian start-up could help detect the driving style and reduce fraudulent claims in car accidents. The AI-based technology records the front panorama of a vehicle and, based on these data, is able to identify the driving style. The recorded data could also be used to identify the course of an accident (Swiss Re, 2023). The video is recorded from the moment the engine starts and the real-time data are encrypted and uploaded to the cloud. In the cloud, the video is reassembled into individual frames and processed. All private information is deleted to comply with data protection regulations (e.g. General Data Privacy Regulation in European Union). The anonymised video could be used in the event of a claim to reveal the dynamics of the accident, as well as in the control and audit process (Swiss Re, 2023).

5. Challenges for Internal Controls in Insurance Industry in Industry 5.0

Like any innovation, Industry 5.0 is a source of risks and challenges. On the one hand, by embracing technological advances and adopting a human-centric approach, insurers can achieve new levels of efficiency, resilience and customer satisfaction, setting themselves up for success in the digital age. On the other hand, there are risks to be considered when adopting technological innovations for the internal controls of insurance companies. These issues can be related to specific technology but also to business strategy and culture, processes, regulation and financial costs. A prerequisite for successfully adapting to the digital revolution is to understand not only the opportunities but also the threads that these technologies present (McKinsey & Company, 2017).

Successfully adapting an insurance company's internal controls to technological revolution means understanding the impact of such innovation on return on investment (ROI). Therefore, the costs associated with the investment must be calculated and considered. There are several types of costs associated with these changes. First, the direct investment in software and hardware and investments linked to integration with the existing system have to be considered. For example, integrating blockchain into existing information and communication infrastructures of financial institutions poses significant challenges due to the differences in interface design. This could lead to data inconsistencies and security vulnerabilities generating additional financial and non-financial costs (Peters & Panayi, 2016).

The human workforce will also need to be adapted to use a new technology, and in this case, there may be costs for employees with different skills or for the training of current employees (Deloitte, 2024). New technology may require a review of workflow processes, which will incur additional costs. Maintaining the quality and robustness of the system by maintaining the security, integrity and privacy of the revised system will also require additional expenditure (Nicoletti, 2021). Other costs may be related to compliance with regulatory requirements and potential losses that must be incurred as a result of non-compliance. All these costs, as well as additional case-specific costs, need to be carefully calculated and considered in the decision-making process.

Insurance companies by its nature accumulate enormous amounts of data. Industry 5.0 enlarges the possible data sources. New sources of detailed data and their automated analysis represent another risk issue in the process of adapting internal controls in insurance companies to Industry 5.0. First, the quality of the data obtained represents another risk element. In automated processes, high-quality data engineering and high-quality algorithms may not deliver the expected results if the data are of low quality. The cost of developing algorithms should not be underinvested in data engineering. The cost of expenditure could conflict with the organisation's strategic priorities. However, the long-term benefits need to be considered (Swiss Re Institute, 2023). Non-financial challenges relate to data integrity, interpretability and trust. In addition, the revision of processes due to their scale is likely to require approval from a supervisory body. For example, Swiss Re tested the Monetary Authority of Singapore's fairness assessment methodology in 2022. The assessment found that males may be disadvantaged in predictive digital underwriting for life insurance compared to female customers with similar actuarial risk (Swiss Re Institute, 2023).

Industry 4.0 exponentially increases new types of data, often personal and non-financial in nature including the number of clients' private data that can be recorded and used by the insurance company (Swiss Re Institute, 2023). Collection of detailed data about policies and policyholders as well as internal business data emphasise the necessity of data privacy. Many devices connected within the IoT pose a vulnerability as these devices are mainly represented by sensors with low or no security mechanisms, creating a risk of hacking and data compromise (PwC, 2019). Insurers are obligated to reinforce their data governance and cybersecurity measures to protect sensitive information and adjust their internal controls.

Industry 5.0 is characterised by the synergy of cyber–physical systems. The complexity of cyber–physical systems leads to complex risks arising from the integration of cyber and physical systems in insurance operations, including vulnerabilities and data integrity issues. Internal controls need to reflect these risks, which requires sophisticated mechanisms to ensure reliability and security. Ansari et al. (2020) define three types of error sources arising from cyber–physical systems that pose a challenge to internal controls. These error sources are related to three areas, that is, errors associated with cyber systems (e.g. software errors, algorithmic errors, etc.), errors associated with the physical system (e.g. mechanical or electrical failures, etc.), human errors (e.g. errors due to misunderstanding,

carelessness, misuse, etc.) and errors associated with the combination of the introduced sources. For example, human–machine interaction is associated with a higher prevalence of errors than isolated machine systems without human interaction (Stowers et al., 2017).

Compliance with regulatory requirements and evolving standards is another challenge in adapting internal controls to Industry 5.0. Insurance is a highly regulated industry in terms of consumer protection. Rapidly evolving technology standards and regulatory requirements and their implementation pose a challenge for insurers. For example, in the case of implementation of blockchain technology, international regulations that do not always align with decentralised models raise concerns about jurisdiction and legal enforceability for insurance companies (Zohar, 2015). Similarly, a key challenge for the application of AI in the internal control of insurance companies is the black box nature of AI (PwC, 2019). AI optimises and streamlines internal control processes. Many repetitive tasks, such as data entry, can be automated using AI-driven workflows (Obaydin et al., 2023). As the responsibility in these systems shifts from humans to machines, these risks include algorithmic biases and decision-making errors (Allianz Global Corporate & Specialty, 2018). The comprehensibility of AI models could be supported by the further development of explainable artificial intelligence (XAI). XAI could be helpful in developing transparency, interpretability and explainability (Owens et al., 2022).

The evolution to Industry 5.0 presents both significant challenges and opportunities for the insurance industry's internal controls. Insurers that successfully navigate these complexities, leveraging advanced technologies while ensuring robust risk management and regulatory compliance, will be well-positioned to thrive in this new era. The integration of AI, automation or blockchain into internal controls offers opportunities to improve operational efficiency, transparency and responsiveness to emerging risks. As the industry continues to evolve, fostering a culture of continuous innovation and strategic adaptation will be key to maintaining effective and resilient internal control systems.

6. Conclusion

Internal controls are an important element of corporate governance in the insurance industry. They should help insurers to improve their performance in any situation (favourable and unfavourable), to achieve strategic objectives and business plan and to mitigate internal and external risks. Through all of these tasks, internal controls create value for the insurance company (Cappiello, 2020). The next stage of the industry revolution also has an impact on the implementation of internal controls. New technologies offer many opportunities to innovate internal controls and processes. This could lead to increased efficiency and reduced costs. However, as with any innovation, these trends also pose risks and challenges for insurers, which they need to be aware of before adapting internal controls.

Using a detailed review of current limited literature and existing practices regarding traditional internal controls in the insurance industry including the framework analysis for further development related to a technological shift, we

systematically identify and critically analyse the challenges and opportunities for the development of internal controls in the insurance industry within the new technological revolution Industry 5.0. We also use the impact analysis of Industry 5.0 characterised by the integration of novel technologies and cyber–physical systems that alters the landscape for internal controls.

As we explore the implications of Industry 5.0 for insurance internal controls, it's clear that traditional risk management frameworks must undergo a paradigm shift to effectively address the evolving risk and opportunity landscape. With the advent of Industry 5.0, insurers face new risks, including increased cybersecurity threats, data privacy concerns and the complexity of managing interconnected ecosystems enabled by IoT devices.

To meet these challenges, proactive insurers must adopt innovative risk management approaches that leverage advanced technologies and data analytics. AI, for example, offers immense potential to enhance risk assessment capabilities by analysing vast amounts of data in real time, identifying patterns and predicting future trends with unprecedented accuracy. By AI-driven insights, insurers can proactively identify and mitigate risks, enabling more informed decision-making and strategic planning of management.

Similarly, blockchain technology offers transformative opportunities to improve internal controls within the insurance industry. Its inherent characteristics of immutability, transparency and decentralisation can significantly improve data integrity and security, particularly in areas such as claims processing and policy administration. Through blockchain-enabled smart contracts, insurers can automate and streamline processes, reducing administrative overhead and minimising the risk of error or fraud. In addition, the spread of IoT devices introduces new complexities in managing risks related to consumer data privacy and security. Insurers need to establish robust protocols and guarantees to protect sensitive customer data collected from connected devices. Implementing encryption mechanisms, access controls and regular security audits are essential steps to ensure data integrity and maintain consumer trust in an increasingly interconnected world.

In summary, successfully integrating Industry 5.0 technologies, such as AI, blockchain, IoT and the concept of synergy between cyber and physical systems, into internal control frameworks is a crucial step towards improving operational efficiency, mitigating risk and fostering resilience in the transforming insurance industry. By embracing innovation and adopting forward-thinking strategies, insurers can position themselves at the forefront of Industry 5.0, driving sustainable growth and delivering value to stakeholders in an ever-evolving digital landscape.

Acknowledgement

This research was supported by the Slovak Research and Development Agency under Grant APVV-20-0338 'Driving forces of economic growth and survival of firms in the sixth K-wave'.

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