The Proceedings Ekonbiz 2024
ISBN: 978-99955-45-44-4
UDK: 004.65:[005.334:338.124.4 ...

Submitted: 19.04.2024.
Accepted: 07.05.2024.
Scientific criticism

THE IMPORTANCE OF INFORMATION SYSTEMS IN ACTUARIAL PRACTICE

Dijana Drakul
"Orao" A.D. za proizvodnju i remont, Bijeljina, BIH
dijanadr@gmail.com
ORCID: 0009-0006-5213-6454
Nataša Milovanović
"Orao" A.D. za proizvodnju i remont, Bijeljina, BIH
natasa0906@gmail.com
ORCID: 0009-0000-2813-7082
Divna Maksimović
JU Ekonomska škola, Bijeljina, BIH
divna.maksimovic@gmail.com
ORCID: 0009-0004-5938-7892

Abstract: *Information systems have become indispensable tools in actuarial practice due to their pivotal role in the analysis, interpretation, and prediction of financial risks. They play a crucial role, enabling actuaries to analyze vast amounts of data, identify patterns, and forecast future financial obligations. These systems are essential as they empower actuaries to make informed decisions regarding risk management and future financial obligations, such as pension plans and insurance. Through the utilization of information systems, actuaries can effectively assess financial risks, adjust management strategies, and provide relevant information to management and other stakeholders. This paper explores how actuarial practice utilizes information systems, emphasizing the importance of their role in decision-making and enhancing the financial stability of organizations. By analyzing existing information systems used in actuarial practice, we investigate their characteristics, advantages, and limitations.*

Keywords: *Actuarial science, actuary, information, systems, risk, management.*

JEL classification: *L86, G22*

1. INTRODUCTION

The primary role of insurance is to compensate policyholders when insured risks materialize. In order to fulfill its function, an insurer must ensure it has sufficient funds, based on collected premiums, to meet its obligations to policyholders at any given time without jeopardizing its liquidity.

Due to the importance of determining insurance premiums for both the insurance companies themselves and the policyholders who pay them, it is necessary to approach this task responsibly by utilizing statistical and accounting data processed with the help of information systems.

The paper analyzes the significance of information systems in processing data relevant for making insurance-related decisions, with a focus on the increasing involvement of artificial intelligence in modern society.

1.1. PROBLEM AND SUBJECT OF INVESTIGATION

The subject of the research paper is the application of information technology, large-scale data processing systems, and artificial intelligence in the field of insurance. It is important to focus on the work of actuaries in data processing to make correct decisions in determining premiums, ensuring the basic conditions of adequacy of tariff rates to minimize policyholders' expenses in the form of premiums while ensuring that the calculated premium covers insurer expenses and provides surplus income over expenditures.

1.2. RESEARCH OBJECTIVES

The research objectives are in line with the formulated problem and subject of investigation. The scientific objective is to examine the

significance of information technology and its application in insurance. The societal objective is to assess the challenges in the real insurance sector, including those faced by actuaries, and to identify any issues in implementing artificial intelligence. The contribution of this research will be reflected in evaluating the current state of the market, identifying the most important problems facing this field of insurance, and exploring possibilities for their resolution.

The first part addresses the fundamentals of actuarial science and information systems. The second part focuses on the various uses of information systems in actuarial science, while the third part is centered on the transformation of actuarial science through technological advancements.

The actuarial profession is one of the oldest occupations in the field of finance. The word "actuary" originates from the Latin word "actuarius," which referred to a clerk who kept records in the Roman Senate and was responsible for acts. Over time, this word has evolved from its etymological origins to acquire an entirely new meaning. Since the late 18th century, the term "actuary" has referred to professionals engaged in actuarial work in the modern sense of the word. (J. Kočović, M. Koprivica, D. Janković, 2018)

In all business domains, including insurance, informational support plays a crucial role. Actuarial tasks such as profitability calculations, tariff development, and reserve calculations require sophisticated information tools. Without adequate informational support, these tasks would be extremely difficult, if not impossible, to perform. This support encompasses everything from databases to specialized software tools designed specifically for actuaries.

Thanks to the development of computer technology and the integration of stochastic actuarial models with modern financial theory, actuarial science has undergone revolutionary changes, accompanied by changes in the actuarial profession. (J. Kočović, M. Mitrašević, 2010)

The value of an information system is not limited to computer technologies. Information systems have been present even before the emergence of computers and information technologies. With the advent of computers and the advancement of information technologies, the role of information systems in actuarial science has gained importance. It is crucial for different parts of the system to communicate and exchange information for the system to function efficiently. The efficiency of any system depends on the quality of its information support. The higher the quality of the information system, the greater the efficiency of the system, as it enables better communication among different parts of the system.

Actuaries play a crucial role in insurance companies, constantly assessing risks. To perform this task, actuaries have access to the company's information system. They determine the price of insurance products, calculate reserves, and strive to cover all damages that policyholders may incur in the future. Their main concern is the solvency of the company and finding ways to reduce risks. Additionally, they calculate profitability and form an optimal investment portfolio for the company using the law of large numbers and probability theory. Actuaries work with large datasets covering a sufficiently long time period. Such datasets are provided by information systems through a unified database within the insurance company, as well as data from institutions such as the Statistical Office and the Insurance Agency.

For many years, the insurance sector has been reluctant to change, proving to be one of the most conservative sectors. This was also due to the entry barriers represented by strict regulation, the complexity of the products offered and large capital requirements (M. Boyer and S.M. Nyce, 2011).

In recent years, digitalization has been assigned an increasingly significant role as a means of improving the design, development, and distribution of innovative insurance products and services through new digital platforms, ecosystems, and other digital distribution channels. There is a wide range of practices in the market, and the level of digitalization can vary significantly from one insurance company to another and can develop rapidly. (P. Hielkema, 2024)

Over the past decade, digital technology has become a driving force in the development of society and the global economy, causing radical changes in socioeconomic processes through its digitization. Digitalization now encompasses almost all aspects of human life. Furthermore, technologies are transforming digital ecosystems across all industries. They enhance and create new financial services to better meet the growing demands of clients. (D. Pauch, A. Bera, 2022)

Observing the changes in the digital world that affect society as a whole, we realize that we should rethink the degree of digitalization. Some processes, even despite technological advancements, are not or should not be digitized due to the high costs of such activities or the need for customers to break away from practices that function quite well and to which they are accustomed and attached. Digitalization also poses the risk of data leakage or loss, especially

personal data. Insurers are required to ensure the protection of personal data, as well as in cases of irregularities, as they are exposed to penalties, lawsuits, loss of customer trust, and damage to reputation. (A. Chojan, J. Lisowski, and P. Manikowski, 2022)

2. TYPES OF INFORMATION SYSTEM USAGE IN ACTUARIAL SCIENCE

The introduction of information systems in actuarial science represents a crucial step towards enhancing efficiency, precision, and risk management in insurance. These systems enable process automation, analysis of vast amounts of data, and prediction of future events, providing actuaries with powerful tools for making informed decisions. Through integration with other actuarial tools and systems, information systems become the foundation for a holistic approach to actuarial functions.

New, advanced tools are available that enable the processing and utilization of big data in ways that were not previously possible. These tools include data management capabilities and computer techniques such as predictive analytics and advanced algorithms that have significantly increased the speed and capacity of data storage. With rapid advancements in data availability and the development and expansion of advanced data analysis techniques, the insurance industry's interest in big data analysis opportunities is growing proportionally.

The first component of a digital strategy is the use of new technologies and their strategic role. Companies were able to describe which new technologies they wanted to apply in the future. (W. Becker, O. Schmid, 2020)

Most insurance companies are working in partwith old IT systems and need further investments to prepare people and systems for the digital world. Moreover, insurers need to define the future work environment for their employees and sales representatives (sales process, sales tools, etc.). (M. Eling and M. Lehmann, 2018)

The following will discuss various uses of information systems in actuarial science, highlighting how they contribute to improving insurance practices.

2.1. PROCESS AUTOMATION

Process automation involves using information systems to automate routine tasks such as data collection, processing, and analysis, as well as premium calculation and reserving. Process automation in actuarial science utilizes information systems and software to speed up routine tasks and enhance efficiency. This includes automating data collection and processing, premium and reserve calculations, as well as risk analysis. Through automation, actuarial processes become less susceptible to human errors and can be executed more quickly and efficiently. This technology enables actuaries to focus on analyzing complex scenarios and making key decisions, rather than spending time on administrative tasks.

Automation can also contribute to increasing the accuracy of actuarial assessments and adapting to changing market conditions and regulations. Through integration with other actuarial tools and systems, process automation becomes the foundation for effective risk management and business optimization for insurance companies.

2.2. RISK ANALYSIS

Information systems are used to analyze various types of risks, such as financial risk, mortality risk, health risk, and others, using advanced analytical tools and models. Risk analysis in actuarial science is a key component in assessing the likelihood and consequences of potential events. Risk is defined as uncertainty about the occurrence of a future event. In situations of uncertainty, there is doubt about our ability to accurately predict the future outcomes of our actions. (J. Kočović, T.R. Antić, M. Koprivica, P. Šulejić, 2021)

Using information systems and statistical tools, actuaries identify and assess various types of risks, including financial, operational, and others. This analysis enables insurance companies to understand potential losses and take appropriate measures to manage them. Actuaries study historical data, develop risk models, and conduct simulations to predict future scenarios. Risk analysis also involves assessing the probability of different events occurring, as well as their financial implications. Through this understanding, insurance companies can adjust their risk management strategies and minimize potential losses. This analysis is continuously updated to take into account changing market conditions and new information.

2.3. MODELING

Using information systems for the development and application of actuarial models that aid in risk assessment, premium calculation, reserving, and other actuarial functions is essential. Modeling in risk analysis is a key process used to develop

mathematical or statistical models to predict potential scenarios and their impacts on the organization. Actuaries utilize various types of models, including those used to assess events and their consequences, simulations, and optimization, to better understand risks and their business implications. These models are applied to different types of risks, such as financial, operational, actuarial, and others, to identify and quantify potential threats. Model development involves identifying relevant factors and variables, as well as quantifying them within the model to simulate possible outcomes. By using historical data to validate models, actuaries verify the accuracy and reliability of their predictions. Modeling enables actuaries to forecast future scenarios and assess the probability of certain events, allowing organizations to better understand their exposure and develop effective risk management strategies. Through continuous improvement and validation of models, organizations can increase the reliability and usefulness of their risk analyses, contributing to more efficient risk management and achieving business objectives. (Ida Panev, Marin Kaluža, 2022)

2.4. DATA MANAGEMENT

Data management in risk analysis is a key process that involves collecting, storing, processing, and analyzing various types of data relevant to risk assessment and management. Actuaries must ensure that errors in premium estimation often arise precisely due to inadequate data management used in calculations, data system vulnerabilities, their untimely availability, inadequate statistical grouping, inconsistencies with the basic assumptions of the methodology, and others. Often, errors can occur in the case of a small amount of data, short time series of data (e.g., not all damages have occurred), as well as poor data quality. Actuaries are aware that a premium assessed based on such inadequate data may be underestimated and will further imply incorrect management decisions, which may lead to the insolvency of the insurance company.

Actuaries use information systems and sophisticated tools for data processing to effectively manage large amounts of information. This includes data on policyholders, insurance policies, financial transactions, and other relevant information. The key aspect of data management is ensuring the accuracy, completeness, and reliability of the data to make risk analyses as precise as possible. Additionally, actuaries must also ensure the privacy and security of data in accordance with relevant laws and regulations. Data management enables actuaries to identify patterns, trends, and key risk factors based on available information. Through effective data management, organizations can better understand their exposures and develop risk management strategies tailored to their specific needs. This may involve adjusting product offerings, optimizing portfolios, or developing new business strategies. Ultimately, efficient data management enables organizations to make the right decisions, minimize risks, and achieve their business goals.

The increasing use of new technologies and pervasive digitalization have a significant impact on customer expectations, which was particularly evident following the risk of the pandemic (Covid-19). Key factors shaping modern customer expectations include constant connectivity to the online world, the ubiquity of social media, and the availability of technology for speech and image recognition. (D. Pauch, A. Bera, 2022)

2.6. PREDICTIVE ANALYTICS

Predictive analytics in risk analysis involves using data, statistical algorithms, and machine learning to forecast future events and identify potential risks. Actuaries employ advanced models and data analysis techniques to identify patterns and trends that may indicate future scenarios. This analysis includes gathering large amounts of data, such as historical loss data, demographic data, and financial data, to identify factors that may influence risk occurrence. Through the application of predictive analytics, actuaries can assess the likelihood of certain events occurring, as well as their potential financial implications. This enables organizations to take appropriate measures to protect against potential losses and optimize their operations. A key aspect of predictive analytics is continuously updating models and analyses based on new data and changing market conditions. Through these analyses, organizations can better understand the dynamics of risk and adjust their risk management strategies in response to changes in the environment. Predictive analytics also enables organizations to identify new business opportunities and optimize their business processes based on predicted trends and potential risks.

2.7. INTEGRATION WITH OTHER SYSTEMS

Integration of information systems with other actuarial systems and tools to ensure coordination and compatibility in operation

Integration with other systems in risk analysis involves the process of connecting information systems, software tools, and other technological platforms to enable efficient exchange of data and information. Actuaries use integration with other

systems to access various data sources and tools necessary for risk analysis. This integration may involve linking internal systems of insurance companies with external data sources, such as databases of regulatory bodies or financial institutions. Through integration, actuaries can access a wide range of information and resources necessary for assessing different types of risks and effectively managing them. An important aspect of integration with other systems is ensuring compatibility and interoperability between different platforms and systems. This enables the exchange of data and information without the need for manual interventions or data format conversion. Through integration with other systems, actuaries can enhance their risk analyses and develop comprehensive risk management strategies tailored to the specific needs of the organization. This integration also allows organizations to leverage the latest technological tools and resources to improve their operations and gain a competitive advantage in the market.

3. TRANSFORMATION OF ACTUARIAL SCIENCE THROUGH TECHNOLOGICAL ADVANCEMENTS

Transformation of actuarial practice through the implementation of information systems represents a crucial step towards modernizing and enhancing the insurance industry. With rapid technological advancement and increasing amounts of generated data, actuaries are increasingly relying on sophisticated technological tools to more efficiently analyze risks and make informed decisions. This transformation not only enables actuaries to address future challenges in insurance adequately but also paves the way for innovative approaches in risk management and providing better service to clients.

Digital transformation in insurance requires an innovative business model focused on customer needs, more connected products and services, new technologies, and real-time data. Clients also increasingly expect almost real-time interaction with insurers for submissions and claims, especially for customer care. (S. Radwan, 2019)

3.1. AUTOMATING PROCESSES

Process automation in actuarial practice is a key strategy for improving efficiency and accuracy in data processing and decision-making. By using advanced information systems and software tools, actuaries can automate routine tasks such as data collection, cleansing, and analysis, freeing up time for more complex analysis and strategic planning. This approach not only reduces the risk of human error but also speeds up processes, enabling insurance companies to respond more quickly to market changes. Implementing automation can also result in reduced operational costs, improved operational efficiency, and increased overall competitiveness of the company. However, it is important to note that automation requires careful planning and implementation to ensure that processes remain accurate, reliable, and adaptable to changing market needs and regulatory environments.

3.2. DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE IN ACTUARIAL SCIENCE

Data analytics and artificial intelligence are increasingly becoming key factors in the transformation of actuarial practice. Through the application of advanced data analysis techniques, actuaries are able to gain deeper insights into complex risks and make informed decisions about managing them. Artificial intelligence, including machine learning and deep learning techniques, enables actuaries to predict future events and identify patterns that would otherwise remain undiscovered. These technologies not only improve efficiency and accuracy in actuarial practice but also open doors to innovative approaches in risk management and providing better service to clients. Considering the rapid technological advancement and the growing volumes of data being generated, data analytics and artificial intelligence are becoming indispensable tools for actuaries striving to remain competitive in the dynamic insurance sector.

CONCLUSION

The role of information systems in actuarial practice is becoming increasingly significant as the insurance industry faces growing challenges and demands for fast, accurate, and efficient risk management. This paper has explored various aspects and forms of using information systems in actuarial practice, highlighting their crucial role in improving efficiency, accuracy, and risk management. We have examined how information systems enable process automation in actuarial practice, reducing the need for manual intervention and allowing actuaries to focus on analyzing complex scenarios and making strategic decisions. This process automation contributes to increased productivity and efficiency, which is crucial for insurance companies aiming to remain competitive in the market. We have also explored how information systems facilitate analysis of large volumes of data and prediction of future events. By using sophisticated algorithms and machine learning techniques, actuaries can better understand complex risks and make more accurate assessments, contributing to better risk management and informed decision-making.

Additionally, we have investigated the significance of integrating information systems with other actuarial tools and systems. Integration enables a holistic approach to actuarial functions, contributing to better coordination and more efficient management of data and information.

In essence, information systems play a crucial role in the transformation of actuarial practice, enabling insurance companies to be more efficient, accurate, and innovative in addressing increasing challenges and market changes. This is a time of great change in the insurance industry, and information systems are key to achieving success in this dynamic environment.

REFERENCES

[1] Becker, W., Schmid, O., (2020): The right digital strategy for your business: an empirical analysis of the design and implementation of digital strategies in SMEs and LSEs, Business Research

[2] Boyer, M. and C.M. Nyce, (2011): Market growth and barriers to entry: Evidence from the title insurance industry.
Insurance Risk Manage.

[3] Chojan, A., Lisowski J. and Manikowski, P., (2022): Digitalization trends in insurance and their impact on the functioning of the insurance market entities. Poland: Insurance Review 1/2022

[4] Pauch, D., Bera, A., (2022): Digitization in the insurance sector – challenges in the face of the Covid-19 pandemic. 26th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES 2022)

[5] Panev, I. and Kaluža, M., (2022): Modeliranje podataka i procesa, Rijeka

[6] Kočović, J. and Mitrašević, M., (2010): "Uloga i značaj aktuara za uređenje tržišta osiguranja". Ekonomska politika i razvoj, Jovanović Gavrilović, B., Rakonjac-Antić, T. (ed.). Beograd: Ekonomski fakultet, Univerzitet u Beogradu

[7] Kočović, J., Koprivica, M., Janković D., (2018): Edukacija aktuara u funkciji razvoja tržišta osiguranja. Sarajevo: SorS – 29-Susret osiguravača i reosiguravača Sarajevo

[8] Kočović, J., Antić, T.R., Koprivica, M., Šulejić, P., (2021): Osiguranje u teoriji i praksi. Beograd: Ekonomski Fakultet Beograd

[9] Hielkema, P., (2024): The trend towards the increasing digitalisation of the insurance sector, The EUROFI Magazine

[10] Eling, M. and Lehmann, M., (2018): The Impact of Digitalization on the InsuranceValue Chain and the Insurability of Risks The Geneva Papers

[11] Radwan, S. M., (2019): The Impact of digital Technologies on Insurance Industry in light of digital transformation
Available online:
https://aqabaconf.com/images/uploads/The_Impact_of_digital_Technologies_on_Insurance_Industry_.pdf (pristupljeno 17.04.2024)