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Кваліфікаційна робота

освітній ступінь - бакалавр

на тему: «**ВПЛИВ ТЕХНОЛОГІЧНОГО РОЗВИТКУ ТА ДІДЖИТАЛІЗАЦІЇ НА СТРАХОВИЙ РИНОК УКРАЇНИ/ IMPACT OF TECHNOLOGICAL AND DIGITAL DEVELOPMENT ON INSURANCE SECTOR IN UKRAINE**»

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INTRODUCTION

Over the past two years, digitalization has emerged as a focal point and top priority for Ukraine, with its impact extending across all economic sectors in the country. Notably, digital solutions have been widely implemented in diverse areas such as banking and finance, agriculture and food production, and energy, among others. As a result, digital transformation is a crucial factor in ensuring the smooth functioning of society, influencing democratic engagement, education, and public services.

Insurance industry in Ukraine tends to apply the latest trends of digital development and create more new products for customers. For the insurance industry to assume a leadership role, it is imperative that innovation be driven by investment and collaboration.

In a concerted effort to facilitate the transition towards a sustainable future, prominent insurance companies and brokers are working together to bolster their offerings in terms of products, coverage, and capacity. They are already implementing comprehensive policies that cover a wide range of risks, from power installations to project interruptions and new channels of sale. Implementation of insurtech products to the company's operational activity is the main problem that leads to great costs and risks and determines **the relevance of this research topic**.

Considering the priority of this topic for evolution of the insurance industry there are a lot of researches of Ukrainian and western authors that presented certain methods to investigate the impact of implementing new products for the company. Insurtech implementations as a factor of developed company are considered in the studies of A. Sokolova, O. Tymoshenko, N. Sheludko, Y. Klapkiv, J. Sterman, M. Fethi, and many others.

The purpose of the research is to assess the impact of implementation of digital products to insurance company and find policies to increase it. To complete this goal, we provide solutions to the following **research tasks**:

1. literature review of different researches and approaches to the meaning of “digitalization” and how it affects the profitability;
2. identification of the main factors that increase of decrease the operational activity of the company while implementing digital services;
3. review of the foreign experience of the insurance market functioning and development;
4. assessment of the insurtech funding globally and its impact on technology growth using various statistical indicators and methods, including analytical equalization;
5. creating a dynamic hypothesis and simulating an explanatory system dynamic model of the process of implementing insurtech product (website) to the company using the main stages of system dynamics research;
6. performing model validation, behavioural and sensitivity analysis to build confidence in the model and create appropriate policies;
7. concluding main findings of the impact of implementing insurtech product to the company, and its affect on profitability, identification possible problems, and policies to improve the process and increase profitability using research results and global assessment.

The object of the research is insurance sector of Ukraine in the context of companies that implement new products.

The subject of the research is impact of technological and digital development on the insurance companies and its profitability.

The methods of the study that are used to achieve the goal are: comprehensive review (defining the meaning of “digitalization” and identifying its impact on the company); statistical (constructing a trend line for the share of personal insurance funding with a forecast, indicators of variation, analytical grouping, and analytical alignment; system dynamics (development a dynamic hypothesis for addressing the issue of implementing a new insurtech product to the company, creating an explanatory model that replicates the reference mode of behaviour, designing effective policies to mitigate the problem).

The informational basis of the study was conducted based on a wide range of information sources, including scientific textbooks on finance, scholarly articles by Ukrainian and foreign authors, data from official sources such as the State Statistics Service and the Ministry of Finance of Ukraine, as well as web portals like Statista. Also were used reports from international organizations and companies such as PwC, KPMG, and the World Bank, in addition to reports from the National Bank of Ukraine, the Tax Codes, and laws of Ukraine.

The practical significance of the results is that the results and policies concluded by this research may be used as a basis for the company to test the implementation of the insurtech product (in that case – website) and make an overview of the possible impacts on the costs and profit.

The novelty of the study. The research offers a novel contribution to the available theoretical and practical aspects by utilizing upgraded research methods to address new issues. Specifically, the application of the system dynamics method to this topic is a new and valuable approach that allows for a deeper understanding of the problem, including the incorporation of non-linearities. This method can also be recalibrated and utilized by other scholars to suit their interests of the research.

In the first chapter, on the basis of theoretical studies, the concepts of digitalization and other technologies are analyzed, and the factors and degree of influence of these concepts on the company's profitability are determined. In the second chapter, an analysis of the current state of the insurance market in Ukraine and the world during the implementation of other technology products is carried out. In the third chapter, on the basis of theoretical research and analysis of the current state, ways to improve the implementation of digitalization products and other technologies are proposed to increase the profitability of the company.

This paper has the following structure: 3 chapters, placed on 61 pages, conclusions, and a list of references used. The study contains 29 figures, 8 tables, and 5 appendices.

CHAPTER 1

THEORETICAL BASIS OF INSURANCE SECTOR FUNCTIONING IN UKRAINE

1.1 Definition of the digitalization in the Insurance Sector as an instrument of boosting the economic growth

Digitalization is not absolutely new word for insurance sector of Ukraine, as far as companies try to follow the latest trends to improve the product, attract new clients and make the shifts towards the developed technologic market.

Digitalization in the insurance sector refers to the use of digital technologies to improve the delivery of insurance services, automate processes, and enhance customer experience. It involves leveraging tools such as online platforms, artificial intelligence, blockchain, and machine learning to streamline operations, reduce costs, and improve efficiency.

Digitalization of the main business processes is a necessity for insurance companies that plan to reach new horizons, and for those companies that are going to maintain already taken market positions. In addition, digitalization in the insurance sector can contribute to the development of the broader digital economy in Ukraine. It can create new job opportunities, stimulate innovation, and enhance the competitiveness of the country's insurance industry in the global market.

The development of the digital transformation of the market of financial and insurance services is primarily driven by technological advancements that are revolutionizing the operations of the financial sector and transforming the way service providers interact with clients [54].

The evolution of development digitalized products all over the world (and in Ukraine as well) started long time ago. To describe each stage of implementation new technologies we can divide the process for 5 parts.

Table 1.1 - Evolution of digitalization of the market of financial and insurance services

Characteristics	Strategy	Organizational goal	System focus
Part 1: before 1960	Single distribution channel	Support processes	No system integration
Part 2: 1960-1980	Double distribution channel	Back-office processes	Partial internal system integration
Part 3: 1980-2010	Several sales channels	Front-office processes	Internal system integration
Part 4: 2010-2020	Cross-selling	Process provider	Integration of systems of external providers of financial services
Part 5: since 2020	Hybrid sales channels	Client-oriented processes	Integration of systems of external providers of nonfinancial services

Source: by the author based on data [42].

1. Internal digitalization (parts 1–3) The first area of InsurTech use was focused on internal processes, such as payment operations or portfolio management. In the early stages of IT development, banks and insurers focused on automating financial services processes to improve efficiency. Companies offered only one or later two channels (branch, consultant or insurance agent, ATM), and focused on support, later transformed into a back-office process.

2. Provider-oriented digitalization (part 4). A change in the focus of financial service providers towards the integration of providers takes place in the fourth part. To do this they were able to standardize the processes and functions of the applications. Outsourcing of business processes started from support areas, transforming to back-office areas such as payments, investments, credit processing in order to minimize wasted resources.

3. Customer-oriented digitalization (part 5) This area of other technology is focused on customers and their business processes, it changes the logic from the inside, shifting the focus from the insurance product to the customer's needs. Some distribution channels

may be considered outdated and partially overlap with the distribution of other financial products, which is due, for example, to their integration into consumer processes or tourism, travel, and the use of social networks. In fact, there is a change in the design of insurance and financial products or services [36].

Insurtech, by itself, is a use of technology that implemented by companies to innovate and improve insurance industry. The goal of insurtech is to use technology to increase transparency, improve access to insurance, and provide better service to clients.

To understand the technology improvement as an institutional and socio-economic phenomenon, the following aspects should be highlighted:

- the need for the digital changes and its role in the economic system,
- the institutional structure of the insurance technological products.

Concerning the need for the digital changes, we should consider the dynamic change of the service all over the world. It is an obligation for the company today to follow the latest improvements to hold the ranking position and attract new clients [4].

For better analysing we may group the main factors by advantages for client or company itself.

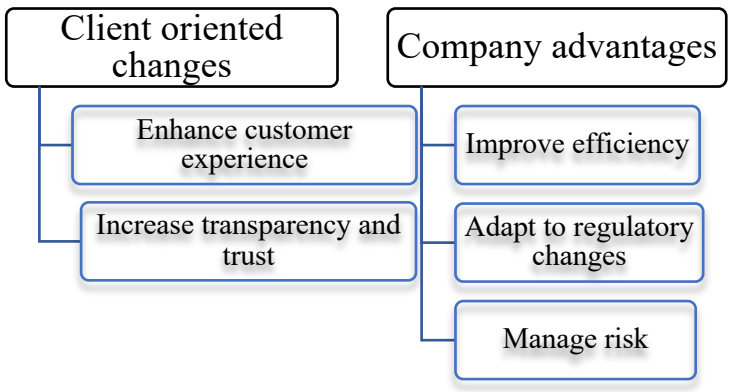


Figure 1.1 – Main advantages of insurtech for clients and company

Source: made by author based on data [58].

Improve efficiency: The insurance sector in Ukraine is currently characterized by manual processes, which can be time-consuming and costly. By implementing digital

technologies such as automation and artificial intelligence, insurers can streamline operations, reduce costs, and improve efficiency.

Enhance customer experience: Consumers are increasingly demanding more personalized and convenient insurance services. Digital technologies such as mobile applications and online platforms can provide customers with easy access to insurance products and services, as well as the ability to manage policies and claims more efficiently [23].

Increase transparency and trust: The use of blockchain technology can enhance transparency and trust in the insurance sector by providing a secure and immutable record of transactions. This can help to reduce fraud and improve accountability.

Manage risk: Digital technologies such as predictive analytics and machine learning can help insurers to better understand risk and make more accurate underwriting decisions. This can help to reduce losses and improve profitability.

Adapt to regulatory changes: The regulatory environment in Ukraine is evolving, with new laws and regulations being introduced to promote transparency and protect consumers. Digital technologies can help insurers to comply with these regulations and stay ahead of the curve [55].

The institutional structure of the insurance technological products can vary depending on the specific company and product. However, in general, the institutional structure of an insurtech product may involve several key players, including:

Insurtech company:

This is the company that develops and provides the technological product, such as a mobile app or online platform for insurance services.

Traditional insurance company:

In some cases, insurtech companies may partner with traditional insurance companies to provide insurance coverage and underwriting for their products.

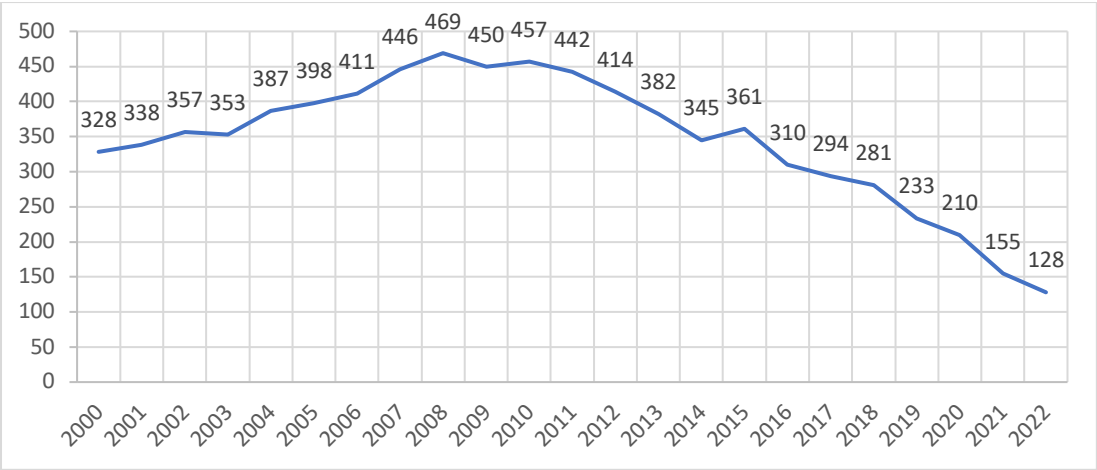


Figure 1.2 – Dynamics of insurance companies in Ukraine during 2000-2022

Source: made by author based on data [46].

Regulators:

Regulatory authorities oversee the insurance industry and may be involved in the approval process for new insurtech products.

In Ukraine, the regulation of insurtech is overseen by several government bodies, including the National Bank of Ukraine, the National Securities and Stock Market Commission, and the State Service for Financial Monitoring.

According to the information on the summary materials (UM) and additional summary materials (SUM) prepared by the State Financial Monitoring Service and submitted to the National Anti-Corruption Bureau of Ukraine from 01.01.2022 to 31.12.2022, was discovered the total amount of funds related to the commision of the crime is 6319.15 million hryvnias [43].

The regulatory environment for insurtech in Ukraine is still developing, but there are several key regulations that impact the industry, including:

- The Law of Ukraine "On Insurance": This law regulates the insurance industry in Ukraine, including the licensing and supervision of insurers and intermediaries.
- The Law of Ukraine "On Financial Services and State Regulation of Financial Services Markets": This law provides a framework for the regulation of financial services, including insurance, and establishes the regulatory authority of the

National Bank of Ukraine and the National Securities and Stock Market Commission.

- The Law of Ukraine "On Electronic Commerce": This law regulates electronic transactions and provides a legal framework for electronic signatures and electronic documents.
- The Law of Ukraine "On Personal Data Protection": This law regulates the processing and protection of personal data, which is particularly relevant for insurtech companies that collect and use customer data.
- The Law of Ukraine "On Prevention and Counteraction to Legalization (Laundering) of Proceeds from Crime, Financing of Terrorism, and Financing of Proliferation of Weapons of Mass Destruction": This law sets out requirements for financial institutions, including insurers, to prevent money laundering and terrorist financing [47].

Investors:

Insurtech companies may rely on external investors for funding and support, including venture capitalists, angel investors, and crowdfunding platforms.

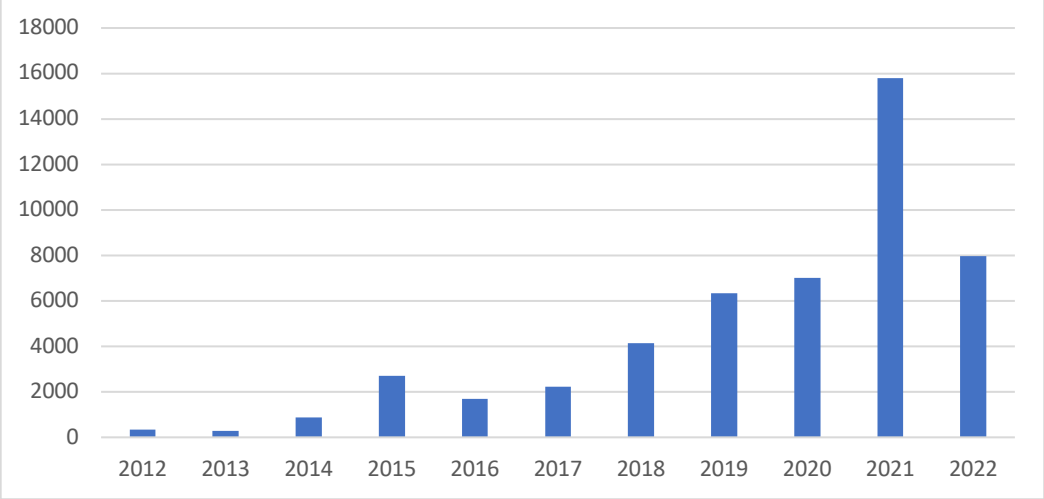


Figure 1.3 – Dynamics of investments in Insurtech during 2012-2022

Source: made by author based on data [68].

Customers:

The end-users of insurtech products, such as individual policyholders or business clients.

Service providers:

Insurtech companies may work with third-party service providers, such as technology vendors or data analytics firms, to develop and support their products.

All things considered above, we can assume that Ukraine is not an outsider of implementation new technologies to insurance sector.

1.2. Characteristics of ways of impact of technological development on Insurance Sector in Ukraine

Insurtech in Ukraine became a popular trend not so many years ago. There are a few reasons why Ukrainian companies and investors paid attention to this technology:

- increase of technological development and IT business;
- spreading social network technologies4;
- migration and changing the vector of money transfers;
- alternative ways to attract customers and ways of profit;
- COVID-19;
- russo-Ukrainian war.

In Ukraine, the digitalization of the insurance sector is viewed as a critical instrument for boosting economic growth. By improving access to insurance services, digitalization can help individuals and businesses manage risk, protect assets, and drive economic activity. Furthermore, the adoption of digital technologies can lead to increased productivity, reduced costs, and improved customer satisfaction.

In Ukraine insurtech is only on its developing stage. A lot of companies only start looking for ways of implementing the insurtech to the service. However, there is already a group of products that exist on the Ukrainian insurance market that implements more new trends [56].

The first one, and probably the most popular one, is Online insurance platforms. These platforms allow customers to purchase insurance policies online, without the need for in-person meetings or paper documents. Some examples of online insurance platforms

in Ukraine include Prestige, TAS, PZU Ukraine, Axa Ukraine, and Oranta. In 2018, the National Committee of Financial Services introduced the concept of "electronic contract of insurance", and all drivers were given the opportunity to buy a contract of insurance via the Internet. A year later, the Cabinet of Ministers allowed to confirm the availability of an insurance contract via a smartphone, and lately it became possible to sign the contract through the “Diya” application.

The second most popular insurtech products is Mobile app for insurance. The main functions of these apps are:

- the client's card or personal account, where he can get all the information,
- catalog of insurance company services,
- ordering an insurance policy online,
- a map with the location of the company's offices,
- chat with a consultant or an agent's emergency call button,
- information block with useful recommendations,
- company news,
- online document management,
- payment instruments, etc.

One more important insurtech product used in Ukraine is data analytics and AI-powered underwriting: Some insurtech companies in Ukraine are using data analytics and artificial intelligence (AI) to improve underwriting and risk assessment, which can help to provide more accurate pricing and improve efficiency [53].

Marketplaces are not the least way to use insurtech products. In response to the rising demand from B2B companies for marketplaces, InsurTech providers are opening the doors to new possibilities with embedded financial services and in particular trade credit insurance or financing support. While FinTech companies have already found multiple entry points to work with marketplaces over the last few years, insurance companies working at the cutting edge of digitalization are now empowering marketplaces to enable seamless, real-time 24/7 trade.

Financial institutions have shown a growing interest in investing in blockchain companies, particularly those focused on developing blockchain-based solutions for the financial sector. Some financial institutions have established dedicated venture capital funds to invest in blockchain startups and companies. Blockchain technology has the potential to revolutionize the financial industry by providing secure, transparent, and efficient systems for transactions, data management, and identity verification. Financial institutions recognize the potential benefits of blockchain technology and are investing in companies that are developing innovative solutions using this technology as far as it is one of the fintech products also used by insurance companies.

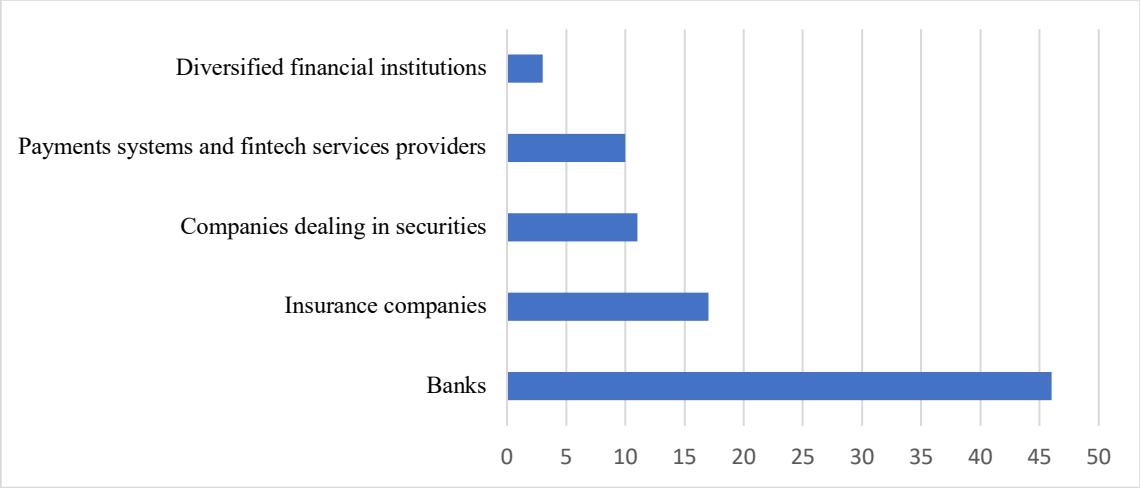


Figure 1.4 - Financial institutions' investments in blockchain companies 2019, by category

Source: made by author based on data [70].

According to data from BCG, global InsurTech funding hit the highest-ever mark of $7.5 billion in 2020. Apart from experiencing losses, the industry had to swiftly reinvent itself to deal in the wake of the pandemic. In Asia, countries like Singapore, China, and India have become the hotspots for many InsurTech startups.

The following benefits can be achieved using technology in the insurance industry:

- standardization of operations and products,
- cost reduction for companies, faster customer service throughout all stages,
- interactive communication with clients 24/7/365,
- improved fraud prevention and transaction security,

- higher quality insurance services thanks to cloud platforms that provide greater speed, flexibility, and scalability.

Standardization of operations and products means that some simple insurance products may become establishing consistent procedures and practices for conducting various tasks and developing. Understanding and harnessing the power of standardization, and examining the correlation between insurance, technology, and standards, will be pivotal to both the growth and long-term sustainment of InsurTechs and the broader insurance industry in these rapidly changing times.

Standards help insurers to provide competitive edge when adopting new technology, as it enables savings in integration and maintenance costs. With help of new adopted standards, organizations eliminate dependency and can easily migrate to new technology solutions and partners, effectively mitigating risks.

Using the website, company can provide the clients with limited, but still wide range of services. For example, there are some kinds of insurance products that can be sold on web pages or using apps:

- Personal Accident Insurance (PAI)
- mandatory “green card”
- liability insurance for weapon owners
- mandatory liability insurance for dog owners
- accident insurance
- travelers' insurance abroad + COVID-19
- insurance of foreigners from COVID-19

The typical procedure of signing the contract online is represented below.

Figure 1.5 – Scheme of contract signing

Source: made by author based on data: [15].

General information usually includes such fields as:

- Commencement of the contract
- Term of the contract
- End date of the contract
- Date of birth of insured person
- Information about insurance program

This page helps customers to look through the possible insurance programs, clarify the insurance conditions and check the price of the chosen insurance program. Usually, this introduction page depends on the type of product: for PAI there are also questions about the car, or if it is travelers' insurance the company needs to know the country the client travels to.

Standardization can also help to improve customer experience by making it easier for customers to understand and compare insurance products from different companies. By using standardized terminology and processes, insurers can make it easier for customers to compare different products and choose the one that best meets their needs. Despite the fact of different companies, designes and ways of intro page, the focus is the same because the contract should be similar to the signed in-person that is regulated.

Insurtech companies are using technologies such as artificial intelligence and automation to speed up claims processing. This means that customers can get their claims settled more quickly, reducing the time and hassle associated with the claims process. Each website has a page for claims and calls to the company that helps to prevent long time discussions and get the feedback faster [64].

An AI-driven virtual assistant known as an insurance chatbot can be programmed to enhance the experience of insurance customers by addressing their needs and enhancing communication between the insurance company and its clients.

According to statistical data, 44% of customers express their comfort in utilizing chatbots for insurance claims, while 43% favor using them to apply for insurance.

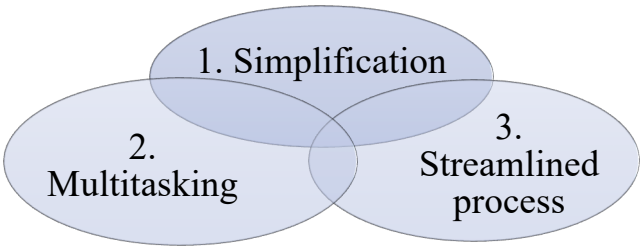


Figure 1.6 – Advantages of Chatbots

Source: made by author based on data [16].

The reason behind this preference is that chatbots leverage machine learning and natural language processing to engage in real-time conversations with customers. In turn providing:

1. 24/7 customer service
2. Meaningful interactions
3. Faster resolutions
4. Thorough processing

All mentioned above equals increased customer satisfaction. Moreover, Chatbots helped businesses to cut $8 billion in costs in 2022 by saving time agents would have spent interacting with customers.

Incorporating chatbots in the insurance industry offers numerous advantages. Firstly, chatbots simplify complex processes by making them more accessible and understandable. Additionally, chatbots are simple to set up and require only a one-time investment. They effectively simplify lengthy and complicated policy documents, fostering transparency and trust by promptly addressing common inquiries. Moreover, chatbots assist customers in real-time with tasks like filing claims, leading to instant customer satisfaction. This allows insurance companies to allocate more time and resources to enhancing overall efficiency and focusing on other areas of improvement.

Cost reduction as kind of impact of insurtech on companies itself is a very complex problem. The point of this assumption based on automation of processes and the use of digital channels that have reduced the need for physical infrastructure, leading to reducing overhead costs. However, the cost of technology and its implementation usually not the

cheapest way for the company. The cost of implementing insurtech solutions for an insurance company can vary significantly depending on the scope and complexity of the project [17].

Type of insurtech solution is one of the main factors that affects the costs. For instance, implementing a chatbot to improve customer service may be less expensive than developing a complex machine learning algorithm for risk assessment. The cost of developing and integrating the insurtech solution into the existing infrastructure of the company can be significant. Training the employees on the new insurtech solution and integrating it into the company's operations may require additional resources and time, leading to an increase in implementation costs. There are some ways how the company can deal with it:

- Training sessions
- On-the-Job Training
- Pilot projects
- Continuous learning

It's important to ensure that the training is relevant, engaging, and accessible, and that employees are encouraged to use the insurtech solution in their day-to-day work. The cost of maintaining and upgrading the insurtech solution should also be factored in, as new updates and features may be necessary to keep up with the evolving needs of the company and the market.

Costs of the implementation of insurtech for the company we can divide by software and hardware.

Table 1.2 – Classification of costs for implementing insurtech

Software Costs	**Hardware Costs**
License Fees	Computer Equipment
Subscription Fees	Network Infrastructure
Customization and Integration Costs	Storage Devices
Maintenance and Support Costs	Peripherals

Source: made by author based on data [59].

There is a very complex system of costs that companies spend for implementation of insurtech. Software costs are mostly fees and licenses for IT products or cloud storages. The cost of the license fee can vary based on the type of software and the number of users. Some software products require a subscription fee to access them, usually on a monthly or yearly basis. Moreover, if the software needs to be customized or updated, this procedure needs additional costs. In this case the company may pay even more to additional developers and consultants. Maintenance and support costs are ongoing expenses that may be required to keep the software running efficiently and address any issues that may arise.

Hardware costs are mostly physical expenses that company spends for equipment, desktops, laptops, routers, storage devices, etc. The cost of networking equipment such as routers, switches, and firewalls can vary based on the brand and the size and complexity of the network. By the way, also it is very important to consider the size of the company. The more employees – the more equipment company needs. The cost of peripherals such as printers, scanners, and monitors can vary based on the brand and features offered.

Contrarily, insurtech operates on a model that emphasizes minimal overhead and operational efficiency to generate revenue. While insurtech companies still earn income from clients, their aim is to minimize costs that can be automated or handled by chatbots. As a result of these reduced costs, insurtech companies often offer more competitive prices. It is crucial to acknowledge that the long-term benefits of adopting insurtech solutions, such as enhanced efficiency, improved customer experience, and increased profitability, can outweigh the initial costs related to implementation[19].

1.3 Experience of European countries while implementing digitalization to Insurance processes

All mentioned above types of insurtech products came to Ukrainian insurance market mostly because of worldwide trends and development of technologies. However, the COVID-19, and a few years later the war, made a huge impact on implementation

these products. It is easy to guess that because of quarantine a lot of people lost their jobs and part of them started working online at home. It was the first stage when insurance companies were managed to save clients without an ability to meet in person.

The European insurtech market experienced a notably positive influence from the COVID-19 pandemic, as it propelled the emergence of new start-ups. Remarkably, despite the challenges posed by the pandemic, the region witnessed a record-breaking influx of investments in the insurtech sector throughout the year. The European insurtech market is segmented by business model and geography.

Table 1.3 – Segmentation of European Insurtech market

By business model	Carrier
	Enabler
	Distributor
By geography	United Kingdom
	Germany
	France
	Italy
	Switzerland
	Sweden
	Netherlands
	Other countries

Source: made by author based on data [7].

The insurance market in Europe is becoming fragmented due to the emergence of a significant number of new start-ups. The United Kingdom, Germany, and France are seeing a prominent increase in such start-ups. Wefox, Clark, Coya, Luko, GetSafe, SimpleInsurance, Omni: US, INZMO, Decado, FRISS, and Thinksurance are among the emerging players in the industry. Most of these insurtechs are currently in the seed stage, with only a few in the growth and maturity stage.

As a result, these companies are competing for seed funding from venture capitalists. The total value of the Insurtech industry in Europe is expected to continue to grow in the coming years, as more startups enter the market and traditional insurance companies

adopt new technologies to stay competitive. To compare the growth from 2016 to 2022, the combined enterprise value of the European insurtech start-ups has increased by four times from 2016, reaching EUR 17 billion.

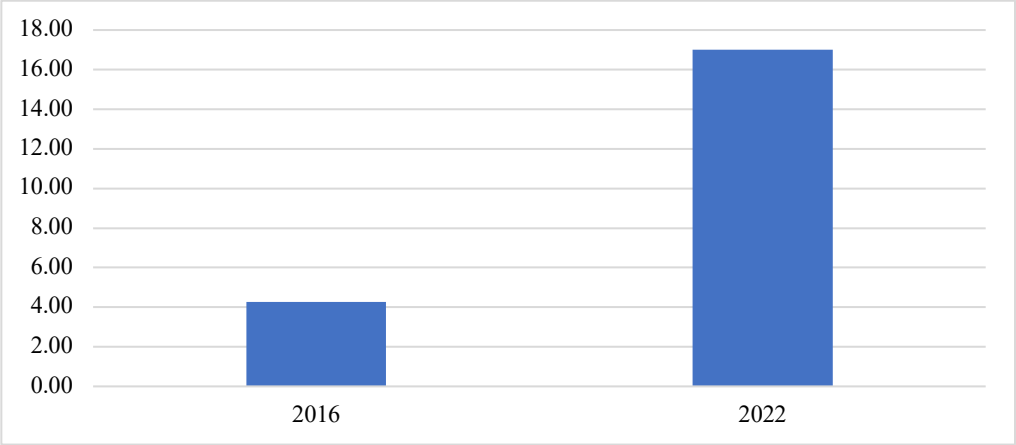


Figure 1.7 - Combined value of Insurtech (2016/2022), in Euro Billion

Source: made by author based on data [62].

The insurtech industry has been growing rapidly in recent years, with significant investment pouring into the sector.

According to a report by Accenture, in 2022, Insurtech investments in Europe reached €1.8 billion, despite the challenges posed by the COVID-19 pandemic. It is expected that this trend will continue in the coming years, as Insurtech companies continue to innovate and disrupt the traditional insurance industry.

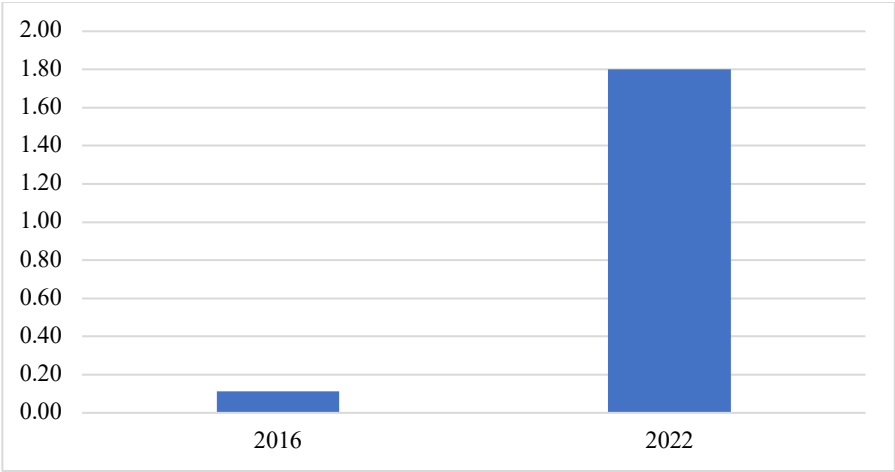


Figure 1.8 - VC investment in Insurtech (2016/2022), in Euro Billion

Source: made by author based on data [52].

Europe has shown great potential as a market for the growth of Insurtech firms. From 2010 until September 2022, there were a total of 293 new Insurtech companies established in the region, with the United Kingdom, Germany, and France accounting for 201 of them, constituting almost 70% of the total Insurtech firms in the area. In 2021, the Insurtech industry in Europe became the second most well-funded market in the world, trailing only the United States. In fact, Insurtech companies in Europe received 26.9% of the total capital invested in the sector, an increase from 15.6% in 2021.

All over the world in 2022 Q4, funding for InsurTech companies decreased significantly to its lowest level since Q1 2020, with a 57.0% quarter on quarter drop from $2.35 billion in Q3 to $1.01 billion. The number of InsurTech deals also decreased, reaching the lowest level since Q4 2020, with 106 deals in Q4.

Mega-round funding was hit particularly hard, experiencing an 89.7% quarter on quarter drop from $1.48 billion in Q3 to $153 million in Q4. However, there was a 46.5% quarter on quarter increase in funding for early-stage L&H InsurTechs, rising from $145.84 million in Q3 to $213.64 million in Q4. Furthermore, 70% of corporate InsurTech investments made by (re)insurers in Q4 were directed towards early-stage companies [12].

2022 was a truly global year for InsurTech investing with 1,528 international investors participating in 521 deals, raising a total of almost $8 billion ($7.9 billion). Investors from over 60 countries participated in this very significant year. There were more than 9,000 insurance companies operating in Europe. In terms of domestic companies, only around 300 companies were operating inside Europe.

There are many insurance companies operating in Europe, serving a diverse range of markets and customers. The largest insurance markets in Europe are the United Kingdom, Germany, and France, which together account for the majority of insurance premiums in the region. Other important insurance markets in Europe include Italy, Spain, and the Netherlands.

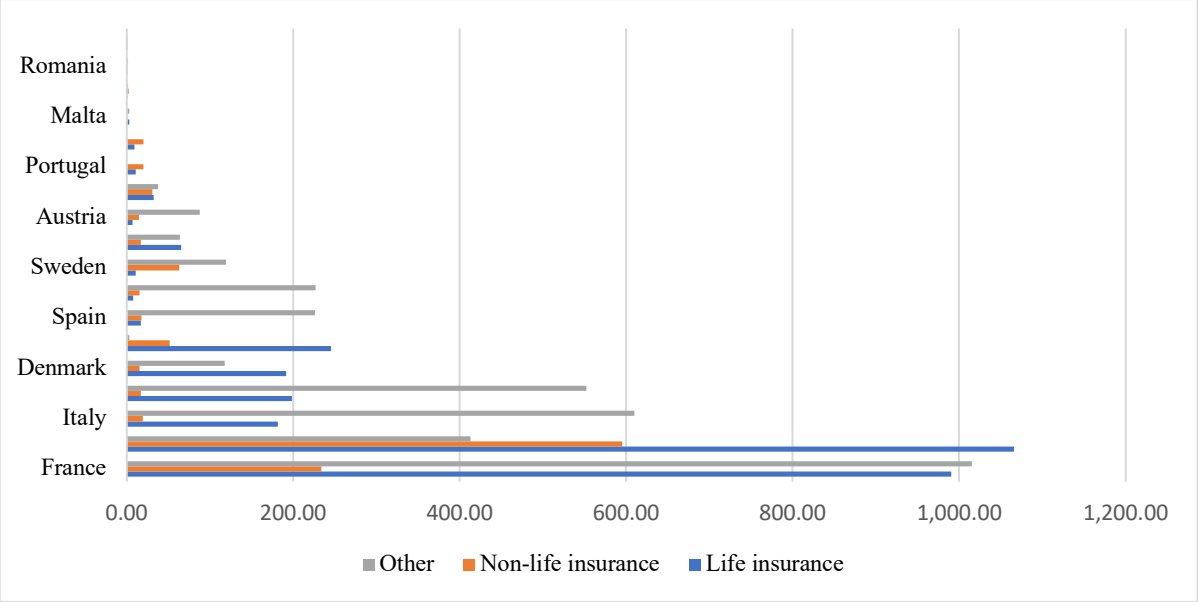


Figure 1.9 - Total investment insurance firms Europe 2022, by country and segment

Source: made by author based on data [66].

Insurtech startups face with underinvestment, if to compare to peers targeting industries of similar market size. Global insurtech funding decreased almost 50% in Q1 2022 compared to all-time-high in Q3 2021. Looking at Q2 so far, the insurtech market is back at pre-pandemic levels. Europe is closing the gap with the US which recorded a strong pullback. Asia's growth has been flat and Latam is starting to emerge. The funding environment has cooled off from the 2021 euphoria, but the industry still offers huge opportunities and is waiting for much disruption.

Insurtech startups have struggled to disrupt the traditional insurance industry, primarily due to challenges in underwriting and pricing, as well as distribution. Despite a focus on data-driven and personalized underwriting, many Insurtech challengers do not have a significant underwriting advantage compared to traditional insurers, leading to higher losses. This can be attributed to factors such as less mature underwriting, lack of scale and diversification, and risks associated with the distribution channel [24].

Many Insurtech firms have relied on a digital direct distribution (D2C) strategy, which involves bypassing intermediaries such as agents and brokers. However, this approach can be financially challenging, particularly as D2C is a high-cost acquisition strategy, especially in the current market environment.

Additionally, the distribution channel impacts the risk profile of customers acquired, further complicating matters for Insurtech startups.

Table 1.4 - Change in share price since listing of selected public insurtech

Insurtech company	Change in share price	Description of the company's activity
Lemonade	-31%	Lemonade is an Insurtech company that provides homeowners and renters insurance policies through an online platform.
Clover	-71%	Clover Health is a US-based Insurtech company that provides Medicare Advantage plans to seniors.
oscar	-85%	Oscar Health is a US-based Insurtech company that provides individual and family health insurance plans.
hippo	-88%	Hippo Insurance is a US-based insurtech company that provides homeowners insurance policies.
metromile	-91%	Metromile is a US-based insurtech company that provides pay-per-mile car insurance policies.
Root Insurance Co	-95%	Root Insurance is a US-based insurtech company that provides auto insurance policies.

Source: made by author based on data [35].

Monetary authorities in major countries worldwide are collaborating to advance financial technologies related to SupTech, primarily in reporting and data management. The Australian Securities and Investments Commission (ASIC) paved the way in 2015 by creating an innovation center to develop SupTech tools, followed by the Australian Prudential Regulation Authority's (APRA) adoption of the Data Transformations program (2017-2020) to overhaul how APRA collects, stores, and leverages data using SupTech solutions.

The German Federal Bank (DB) has also implemented a nationwide digitalization strategy that includes a banking supervision division to encourage SupTech growth.

The Central Bank of Thailand (BOT), the Hong Kong Monetary Authority, the Central Bank of Malaysia (BNM), and the Central Bank of the Philippines (BSP) have

similarly embraced this approach. Developed countries, such as the USA, Great Britain, and Singapore, were among the pioneers in establishing regulatory "sandboxes" that promote technological innovation.

To compare with the insurance distribution technology market in the United States continued to grow in 2020 and 2021, despite the pandemic. This growth was forecast to continue until 2026 when the market size is expected to reach 261.6 billion U.S. dollars. Insurance distribution technologies focus on improving the efficiency of an existing insurance industry model, as well as improving communications with clients and capabilities to implement automation processes.

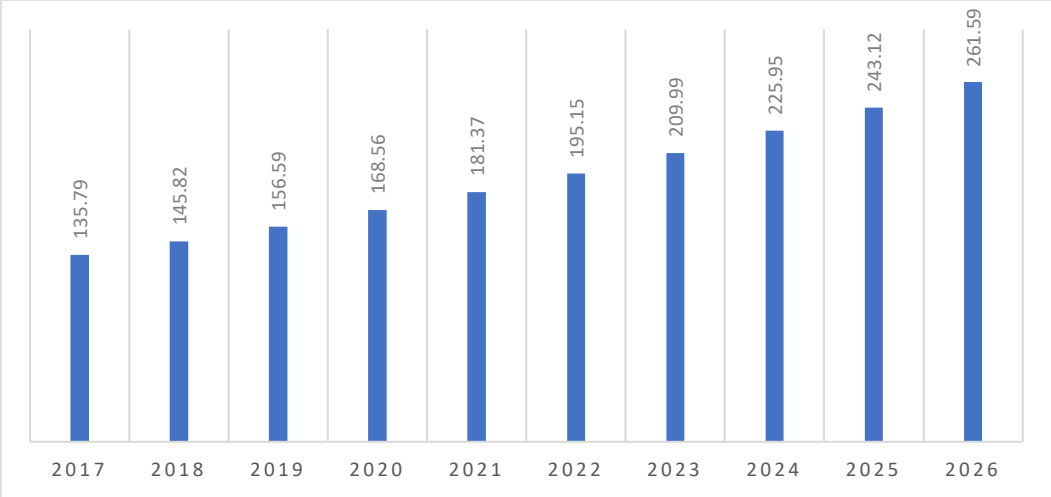


Figure 1.10 - Insurance distribution technology size in the U.S. 2017-2022, with forecasts to 2026

Source: made by author based on data [65].

While digitalization can offer numerous benefits, it also poses potential risks.

Cyber risks consider IT failures, whether caused intentionally or accidentally, can result in financial loss, reputation damage, or disruption. Addressing these risks requires the attention of board-level executives rather than just IT departments.

Cyber risks can be complex and ever-changing, and insurers are working to raise awareness of the various types and dangers they present. Additionally, insurers are actively engaged in risk prevention, and the range of cyber insurance coverage available has increased considerably in recent years, primarily in the US but also in Europe.

Insurers seeking to promote the growth of the EU's cyber-insurance market require access to anonymized data gathered under the General Data Protection Regulation (GDPR) and the Network Information Security Directive. Insurance Europe has created a template for GDPR breach notifications that is simple to use and allows for information to be compared across various industries. The gathered data would be anonymized yet detailed enough to be beneficial to insurers [50].

The risks posed by climate change and environmental factors can be divided into three categories: physical risks, such as the increased frequency and severity of natural disasters, as well as long-term trends such as rising global temperatures and sea levels; transition risks, which arise from the necessary actions needed to achieve carbon net-zero, including changes in government policies, business models, and the adoption of new technologies; and litigation risks, resulting from the failure of public and private entities to adequately address the climate crisis or disclose the extent of climate risks.

However, as is often the case, data is the critical factor, particularly limited and fluctuating data sets. Underwriting commercial insurance is particularly challenging because insurers typically rely on loss runs, which can result in underwriting blind spots for businesses that lack prior claims information or new businesses that have not been in operation long enough to file a claim.

In the last few years we have seen a new crop of digital products and services has entered the vocabulary of the insurance industry, such as usage-based insurance, peer-to-peer insurance, machine learning, assistant bots and the Internet of Things phenomenon. InsurTech permeates virtually every aspect of insurance - from customer service, products, underwriting and pricing, to marketing and distribution.

In terms of marketing and distribution, the InsurTech industry faces issues such as Internet marketing and promotional activities that sometimes provoke conditions that not all insurers can withstand. Not every market participant has enough resources to create such new solutions, a radical change in approach [69].

Conclusions to Chapter 1

The insurance industry's digitalization is rapidly increasing due to the need for innovative technologies to meet evolving customer demands. The millennial demographic, for instance, is a crucial customer segment that demands mobile applications to manage their assets and insurance products. This trend is likely to continue with the entrance of other Digital Natives, such as Generation Z, into the workforce. Moreover, there has been a surge in demand for greater convenience in product delivery and tailored premiums from all customers. Consequently, many insurance technology ("InsurTech") companies have emerged to address the growing demand for personalized, digital, and convenient insurance products.

However, companies should keep in mind possible risks and solve the upcoming issues quickly. The main risks concerning cyber attacks or unprotected data are ones of the most complex for companies [29].

Insurtech in Ukraine is on its developing stage, following steps by European countries. This process takes a lot of time, but even now we can see how many startups and insurtech products take place on the Ukrainian market. It has its own limitations because of war, at first, but at the same time it is one of the engines of progress. Regulation of insurtech development is also important.

In conclusion, insurtech is a rapidly growing industry in Ukraine, with numerous startups and established companies offering innovative solutions to the traditional insurance market. These Insurtech solutions are providing customers with better access to insurance products, improving the efficiency of claims processing, and enhancing the overall customer experience. As the industry continues to evolve and mature, it is expected to drive significant growth and transformation in the insurance sector in Ukraine. With a favourable regulatory environment and a large pool of skilled IT professionals, Ukraine is well-positioned to become a leading hub for Insurtech innovation in the region.

CHAPTER 2

ANALYSIS OF THE INSURANCE SECTOR DEVELOPMENT CONCERNING AN IMPACT OF DIGITALIZATION ON MARKET

2.1 Informational basis and methodological principles of the study of impact of digitalization on Insurance Sector

To analyse the current situation and development on the insurance market of Ukraine were chosen more statistical research methods. These indicators, such as relative indicators, averages, quadratic coefficient of variation, were implied to characterize the state of investments in insurtech and find the possible trend of its future development in the future. In this research was analysed financial activity for insurtech companies worldwide by defining the linear function and mathematical forecast with the assumption of extrapolation and statistical method of analytical alignment. Analytical alignment encompasses several different options available in placing the analytical model in relationship to itself and other analytical elements.

As was already mentioned above, the quadratic coefficient of variation was used in this research. The main absolute and relative indicators characterizing the variation include variation range, average linear deviation, dispersion, mean square deviation, coefficient of variation, etc. In order to show how much, on average, the individual values of the characteristic deviate from their average value we use a simple form of the quadratic deviation, as it reflects the value of the deviation in a percent:

$$\sigma = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}}, \qquad (2.1)$$

where x_i – an individual value of a parameter in a specific period (year);

x – mean;

n – quantity of periods (years).

To carry out this kind of comparisons, as well as when comparing characteristics in several populations with different arithmetic averages, a relative indicator of variation is used - the quadratic coefficient of variation. The quadratic coefficient of variation is the percentage ratio of the mean square deviation to the arithmetic mean value of the characteristic that was used to make conclusions about the stability of the chosen parameter:

$$V_\sigma = \frac{\sigma}{x} * 100\%, \quad (2.2)$$

To analyse the series of financial activity for insurtech companies was applied a method of analytical alignment. The essence of analytical alignment of dynamic series is that the actual levels of the series are replaced by aligned levels calculated on the basis of a certain straight line or curve, chosen on the assumption that it most accurately reflects the general trend of the phenomenon.

The trend is defined by a linear function:

$$y = \alpha + bt, \quad (2.3)$$

To solve the equations of the analytical curves in most cases, the method of least squares (MLS) is used, which provides the smallest sum of squares of the deviations of the actual levels from the aligned (theoretical) levels, to find the parameters α and b, – also use the method of simplified alignment, in which the sum of all values of t should be zero:

$$\begin{cases} \alpha = \frac{\sum y}{n}; \\ b = \frac{\sum yt}{\sum t^2}; \end{cases}, \quad (2.4)$$

where α – theoretical value of series when $t = 0$;

n – quantity of groups (years);

b – absolute increase.

However, except for main statistical research methods there is a system dynamics approach that was applied to create a model. System Dynamics is a computer-based

mathematical modelling approach that aims to improve decision making in complex systems by using a feedback systems theory-based simulation methodology. It is a useful tool for analyzing dynamic systems, including socio-economic, managerial, political, public health, physical, natural, and ecological systems.

The modelling language is intuitive and common across various fields, making it ideal for interdisciplinary work. Similar to Systems Thinking, System Dynamics has a holistic and causality-driven approach to understanding the relationships between variables within a system, but it quantifies these relationships to develop a view of the system's behaviour over time using computer simulations. To analyze the problem of this research, it is essential to adopt holistic approaches to address the issues that arise in this dynamic and ever-evolving environment. To tackle such challenges, the System Dynamics approach equips us with the necessary tools and methods [44].

In the mid-1950s, Professor Jay Forrester of the Massachusetts Institute of Technology (MIT) developed System Dynamics. In 1956, Forrester became a professor at the newly established MIT Sloan School of Management. His primary objective was to find ways to apply his scientific and engineering expertise to address the fundamental factors that influence the success or failure of businesses [26].

John Sterman, a contemporary System Dynamicist who continued Forrester's work at MIT, extended the use of System Dynamics in his book "Business Dynamics." System Dynamics has proven to be applicable in various fields such as population, agriculture, ecological systems, and economic systems. These areas are often strongly interconnected, and system dynamics helps to analyze their interactions. In this research the system dynamics was applied to analyze the impact of digitalization and online platforms of insurance companies on their profitability.

The process of modelling in System Dynamics comprises several stages. However, the actual modelling process may vary depending on the problem's nature and the modeler's style. Experts have noted that System Dynamic modelers typically follow several stages during the modelling process. For example, Wolstenholme (1990) visualized the modelling process as consisting of three stages, while Richardson and Pugh

(1981) identified seven stages. Randers (1980), Sterman (2000), Roberts et al. (1983), and Sushil (1993) categorized the System Dynamics modelling process into four, five, and six stages, respectively. Although the classification of the modelling stages may differ, the primary stages remain consistent, as shown in Table 2.1.

Table 2.1 – Dynamic of stages development of system dynamics modelling processes

<table>
<tr><th>Richardson dan Pugh (1981)</th><th>Robert et. al (1983)</th><th>Wolstenholme (1990)</th><th>Sushil (1993)</th><th>Sterman (2000)</th></tr>
<tr><td>Problem Definition</td><td>Problem Definition</td><td rowspan="2">Construction Diagram Analisys</td><td>Identification and Problem Definition</td><td>Problem Articulation</td></tr>
<tr><td>System Conceptualization</td><td>System Conceptualization</td><td>System Conceptualization</td><td>Hypothesis dynamic</td></tr>
<tr><td>Model Formulation</td><td>Model Representation</td><td rowspan="3">Phase Simulation (stage 1)</td><td>Model Formulation</td><td>Model Formulation</td></tr>
<tr><td>Behaviour model analysis</td><td>Behaviour model</td><td rowspan="2">Simulation and Validation</td><td>Test and Validation</td></tr>
<tr><td>Model Evaluation</td><td>Model Evaluation</td><td></td></tr>
<tr><td>Policy Analysis</td><td rowspan="2">Policy Analysis and Implementation Model</td><td rowspan="2">Phase Simulation (stage 2)</td><td>Policy analysis</td><td rowspan="2">Policy and Evaluation Formulation</td></tr>
<tr><td>Implementation Model</td><td>Implementation</td></tr>
</table>

Source: by the author based on data [45].

The key components of System Dynamics diagrams are feedback loops, accumulation of flows into stocks, and time delays. Causal loop diagrams are useful for visualizing the structure and behaviour of a system and analyzing it qualitatively. However, to conduct a more comprehensive quantitative analysis, a causal loop diagram must be converted into a stock and flow diagram.

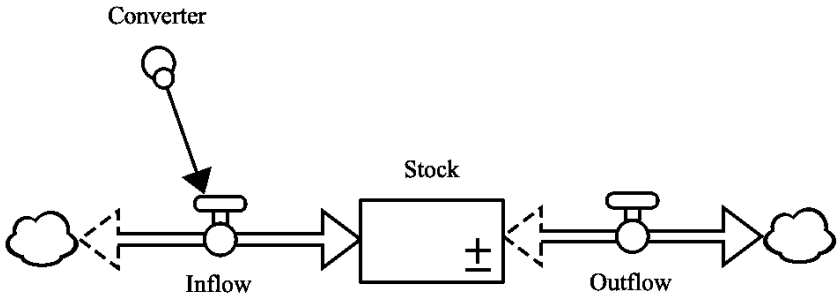


Figure 2.1 – main elements of causal loop diagrams used in Stella Architect

Source: by the author based on data [39].

Stock and flow models allow for quantitative examination and analysis of the system and are often developed and simulated using computer software.

To identify the problem as the first stage of system dynamic research, we should pay attention to key point and interests of both stakeholders and clients who use digital products.

There are already certain major changes in the market as a result of worldwide spread of technologies. Moreover, there are potential risks and challenges that insurers face because of digitalization. In this research we will concentrate on the value of the implementation for the company and its short-term and long-term impact on its profitability. Conventional insurance policies are no longer suitable due to the growth of the digital economy and the need for personalized services. This has resulted in the emergence of insurtech companies that are bringing a digital transformation to the industry, compelling established players to reconsider their approaches. Nevertheless, insurtech firms are encountering substantial hurdles of their own.

Except for stakeholders, there is a huge impact of digitalization on customer behavior and expectations. This also may lead to changes in company's strategy to follow the last trends. To analyze the mentioned above we have to provide more statistical and system dynamics methods to understand how insurers are leveraging digital technologies to improve their operational efficiency, reduce costs, and enhance the customer experience.

2.2 Research of dynamics of digital technology implementations to the Insurance sector

To start with the overview of the current state of insurtech market worldwide we have mention that for the last 5 years the amount of insurtech companies rapidly increased. Incumbents have been slow to adjust to the demands of modern consumers, whether it involves simply facilitating digital distribution for improved customer experiences, utilizing alternative data to enhance underwriting and establish equitable pricing, or even taking the lead in product innovation.

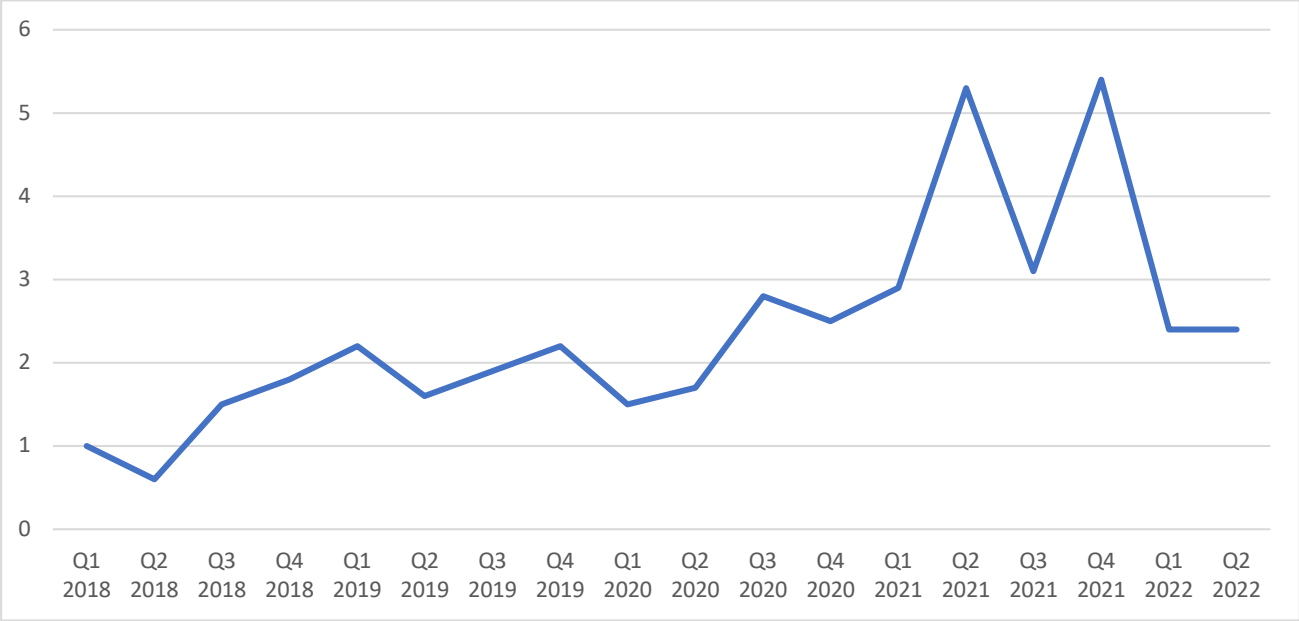


Figure 2.2 – Financing activity for insurtech companies worldwide from the first quarter of 2018 to the second quarter of 2022 (in billion U.S dollars)

Source: by the author based on data [60].

As we can see from the graph above, the financial activity of insurtech companies worldwide has positive trend. Market is growing and more and more companies become new business sharks in the field of insurtech.

However, insurtech funding experienced a significant decline in Q4 2022, with a 57% drop from US$2.35bn in Q3 to US$1.01bn. This was coupled with a low number of deals, with only 106 deals in the last three months of the year, the lowest in two years.

Additionally, the number of mega-rounds, where companies raise at least US$100mn in fresh capital, fell by nearly 90% from US$1.48bn in Q3 to just US$153mn in Q4. Throughout the year, insurtech funding decreased by 50% from US$15.8bn in 2021 to US$7.98bn in 2022. The United States led in insurtech dealmaking with 238 deals, followed by the United Kingdom (35 deals), France (27 deals), and India (26 deals) [11].

These figures highlight the challenging economic conditions that insurtechs are confronting when attempting to secure new funding. In the face of high inflation and interest rates, the possibility of a recession in certain markets, and economic uncertainty sparked by a growing cost-of-living crisis in various countries, investors have become more cautious. The challenges faced by insurtechs, investors, and risk partners in 2022 have led to a more pragmatic approach towards the industry, resulting in hardship for many individual companies.

In response, some insurtechs have been compelled to make tough decisions, such as reducing their workforce or, in more severe cases, closing down entirely. The number of active insurtech businesses has decreased significantly, from nearly 3,000 globally at the end of 2019 to an estimated 2,050 at present. This demonstrates the substantial impact of the economic environment on the insurtech sector.

As we head into 2023, insurers will need to adopt a strategic approach when selecting which markets, products, and customers to focus on. It will be important to reposition portfolios to unlock and redeploy capital, especially in the volatile economic climate. By carefully considering where to concentrate their efforts, insurers can increase their chances of success and better navigate the challenges ahead [21].

In 2022, public insurtech companies in the data and analytics subsector had estimated revenue multiples of 5.7, indicating that their enterprise values were 5.7 times greater than the revenue they generated. On the other hand, insurtechs that operate in the IT and BPO services subsector had estimated revenue multiples of only 1.6 in the same year.

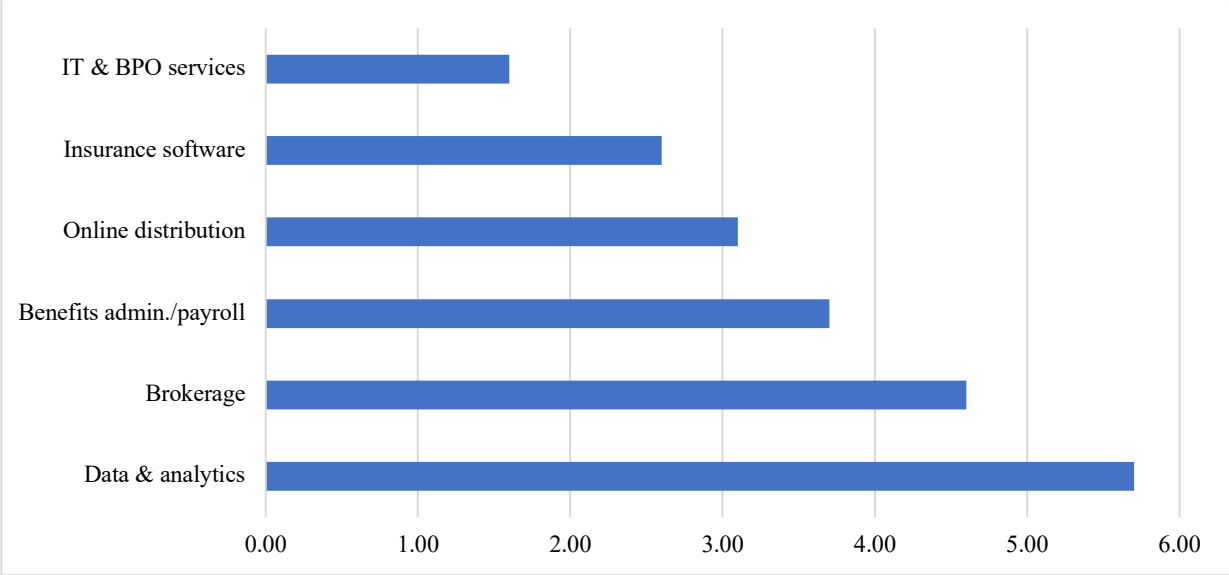


Figure 2.3 – Estimated revenue multiple of public insurtech companies worldwide in 2022, by subsector

Source: by the author based on data [34].

2021 was a record year for insurtech funding globally and the most funded area was personal insurance, which accounted for approximately half of the total amount raised. In the first half of 2022, insurtech funding dropped to 4.6 billion U.S. dollars, down from 17.2 billion U.S. dollars in 2021.

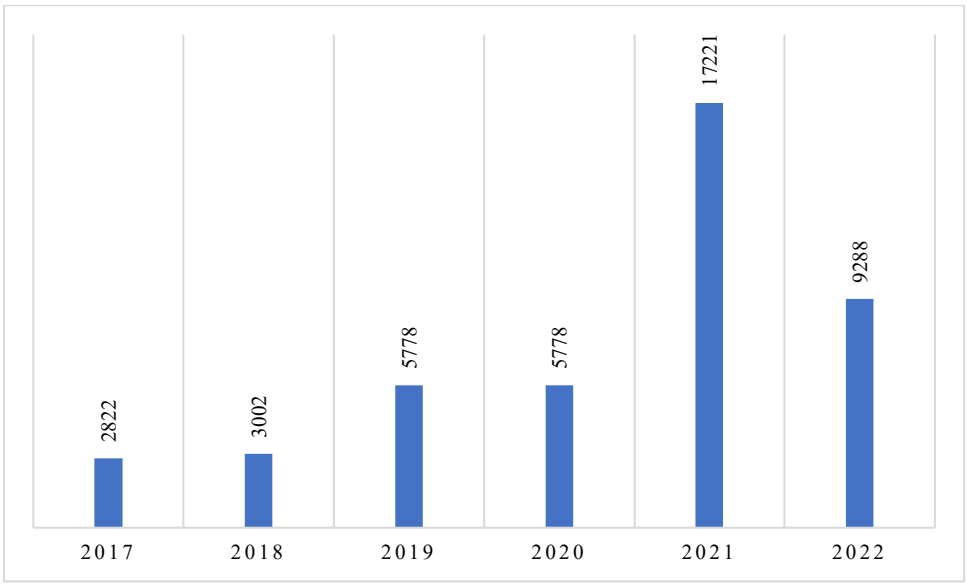


Figure 2.4 – Insurtech funding dynamics (billion U.S. dollars) in years 2017-2022

Source: by the author based on data [34].

In 2022, the estimated revenue multiples for public insurtech companies in the data and analytics subsector was 5.7, indicating that their enterprise values were 5.7 times higher than their generated revenue. Conversely, insurtech operating in the IT and BPO services subsector had a lower estimated revenue multiple of only 1.6 in the same year.

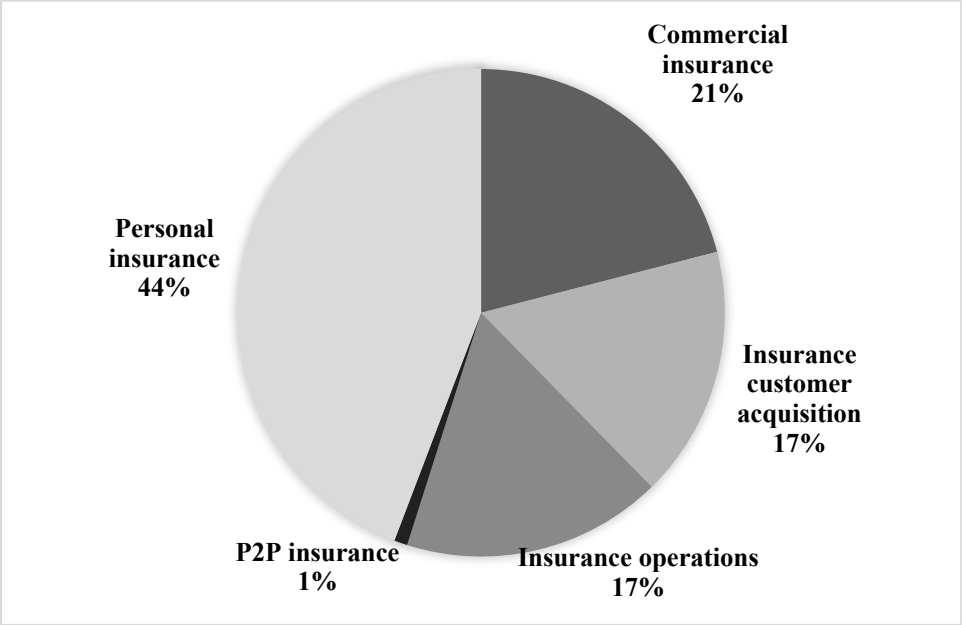


Figure 2.5 – Value of insurtech funding worldwide from 2017 to 2022, by category (in million U.S. dollars)

Source: by the author based on data [34].

Case of personal insurance that takes a huge place in the structure of funding to insurtech is very important to Ukraine as well. As was previously discussed in Chapter 1, in Ukraine personal insurance takes the leading positions in implementation of insurtech. Thus, we can make a conclusion that Ukraine follows the latest world trends of insurtech while using it through the most progressive channels. Next after personal insurance the great part of funding belongs to commercial insurance. The least part of funding belongs to P2P insurance as for 2022.

These areas are seen as having the potential to improve insurance processes, such as underwriting, claims processing, and fraud detection, making them more efficient, accurate, and cost-effective. Additionally, insurtech companies that offer innovative products and services, such as usage-based insurance, peer-to-peer insurance, and on-demand insurance, have also attracted significant investment in recent years.

Table 2.2 – Characteristics of dynamics of insurtech funding worldwide by categories in the years 2019–2022

Category	Year	Funding (million U.S. dollars)	Absolute growth (million U.S. dollars)	Rate of increase	Growth rate, %	The absolute value of 1% of the growth (million U.S. dollars)
Commercial insurance	2019	684	X	X	X	X
	2020	793	109	1.159	15.94%	6.840
	2021	3,969	3,176	5.005	400.50%	7.930
	2022	1,948	-2,021	0.491	-50.92%	39.690
Insurance customer acquisition	2019	550	X	X	X	X
	2020	978	428	1.778	77.82%	5.500
	2021	1,269	291	1.298	29.75%	9.780
	2022	1,550	281	1.221	22.14%	12.690
Insurance operations	2019	2,036	X	X	X	X
	2020	1,731	-305	0.850	-14.98%	20.360
	2021	3,385	1,654	1.956	95.55%	17.310
	2022	1,602	-1,783	0.473	-52.67%	33.850
P2P insurance	2019	232	X	X	X	X
	2020	496	264	2.138	113.79%	2.320
	2021	438	-58	0.883	-11.69%	4.960
	2022	82	-356	0.187	-81.28%	4.380
Personal insurance	2019	2,276	X	X	X	X
	2020	1,780	-496	0.782	-21.79%	22.760
	2021	8,160	6,380	4.584	358.43%	17.800
	2022	4,106	-4,054	0.503	-49.68%	81.600
Total	2019	5778	X	X	X	X
	2020	5778	0	1.000	0.00%	-
	2021	17221	11443	2.980	198.04%	86.955
	2022	9288	-7933	0.539	-46.07%	-201.624

Source: by the author based on data [34].

In 2022 there is huge increase in total insurtech funding to all categories. As we can see from the table above, amount increased almost two times since 2019. However, in certain sectors in 2022 we see decrease of more than 50%. For example, in P2P insurance funding in 2022 decreased for more than 81% that is a great manifestation of the situation on the market.

Personal insurance also faced with a decrease in funding for 49.68% in 2022. This sector follows the same trend as other categories such as insurance operations and commercial insurance. On the other hand, insurance customer acquisition still shows the

positive trend in funding, as we can see this category funding increased for 22.14% in 2022. Prospect data that aims at targeting consumers who are actively seeking to purchase a particular insurance product forms the basis of effective customer acquisition [38].

Before 2022 that was very hard for insurance markets all over the world funding was raising for a few years. The overall positive trend may be explained by several reasons:

- Technological advancements: insurtech companies are leveraging the latest technological innovations such as artificial intelligence, machine learning, and big data analytics to improve the efficiency and accuracy of their operations.
- Changing customer expectations: Consumers today expect fast and convenient digital experiences, and insurtech companies are meeting this demand by providing user-friendly platforms that offer quick and easy access to insurance products.
- Disruptive potential: insurtech startups have the potential to disrupt the traditional insurance industry by offering new and innovative products and services that challenge the status quo.
- Growing market opportunity: The insurance industry is massive and continues to grow, providing a significant market opportunity for insurtech companies to capture a share of the market.
- Investor interest: As insurtech companies have demonstrated their ability to provide innovative solutions and disrupt the traditional insurance industry, investors have become increasingly interested in funding these startups, leading to a surge in funding over recent years [34].

However, the unexpected decrease in 2022 also has some reasons and can be explained by some market factors. Despite the challenges faced by insurtech companies such as reduced funding rounds, lower valuations, and a drop in deals, this environment may offer opportunities for potential buyers seeking to acquire insurtech startups at a discounted price [40].

Based on analysis of estimated revenue multiple of public insurtech companies and companies that use insurtech products (mostly in personal insurance) we can make a

conclusion that the insurtech industry is evolving primarily due to changing customer expectations for uninterrupted service, regardless of time and place. The availability of large datasets and technological tools to manage, navigate, and leverage them is now coinciding with these expectations and requirements [8].

Implementation of digital platforms, websites or apps for selling the insurance product means funding to personal insurance that helps to reduce operational costs and increase profitability. It is crucial for Ukraine to improve the personal insurance strategy in case of implementing insurtech products to follow the worldwide markets.

Using the method of analytical equalization we can predict the possible funding in personal insurance in years 2023-2025, assuming extrapolation of possible events. Hence, we calculate the share of personal insurance funds for previous years as a relative indicator of the structure. Since the absolute increase in the calculated share is stable, the trend is determined by a linear trend: $\gamma = \alpha + bt$ *(2.3)*. The method of least squares is employed to solve the equations of analytical curves, enabling the determination of parameters α and b.

Table 2.3 – Method of analytical equalization for forecasting the share of personal insurance funding

Year	Share of personal insurance in insurtech funding, (γ),%	t	$\gamma * t$	t^2	γ_t
2017	32.03	-3	-96.10	9	47.67
2018	58.93	-2	-117.86	4	52.33
2019	39.39	-1	-39.39	1	48.95
2020	30.81	1	30.81	1	47.46
2021	47.38	2	94.77	4	50.33
2022	44.21	3	132.62	9	49.78
At all	252.75	0	4.85	28	296.53

Source: by the author based on data [34].

We find the parameters α and b to determine the equation of the trend curve using the system of equations. For a calculation we implement the data from table 2.3 to formula 2.4 and calculate the required values:

1) $\alpha = \frac{252.75}{6} \approx 42.13$;

2) $b = \frac{4.85}{28} \approx 0.17$.

So, the equation of the linear trend of the share of personal insurance in insurtech funding is $\gamma_t = 42.13 + 0.17t$ *(2.5)*. Based on these calculations we may conclude that on average over the observed 6 years the share of personal insurance funding was 42.13%, while it grew by an average of 0,17 annually. With an assumption of extrapolation, the forecasted value for the share of personal insurance funding will be: 2023 – $\gamma_4 = 42.82\%$, 2024 – $\gamma_5 = 42.99$, 2025 – $\gamma_6 = 43.16\%$. The graphical representation of data, which includes forecasted values illustrated in Figure 2.6 below, may not perfectly reflect real-life situation. However, the graph demonstrates the average development of a key value for research purposes.

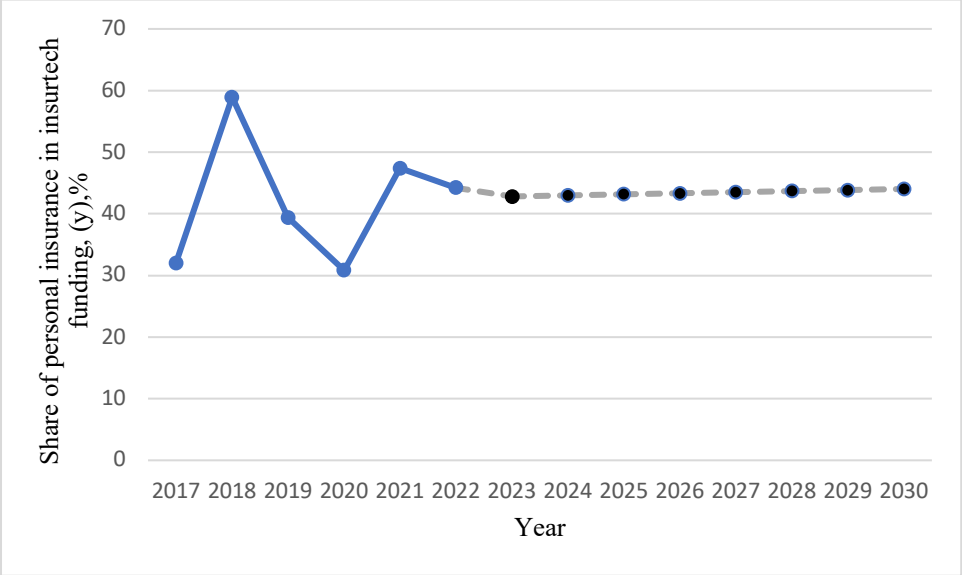


Figure 2.6 – Trend line of the share of personal insurance funding with a forecast

Source: by the author based on data [34], *Table 2.3.*

Based on results obtained from the calculations above we can conclude that on average share of personal insurance funding is about 43%. This value means that almost the half of all funding goes to the investments in personal insurance that takes leading position both all over the world and Ukraine. War in Ukraine increases the amount of investments in digital platforms for personal insurance and B2B contracts because nowadays it is the only way to find clients and sign new contracts.

Quadratic deviation on historical time series based on formula 2.1 is σ = 0,105 or 10,5%, that is, the average share of personal insurance funding deviated from the average by 10.5%.

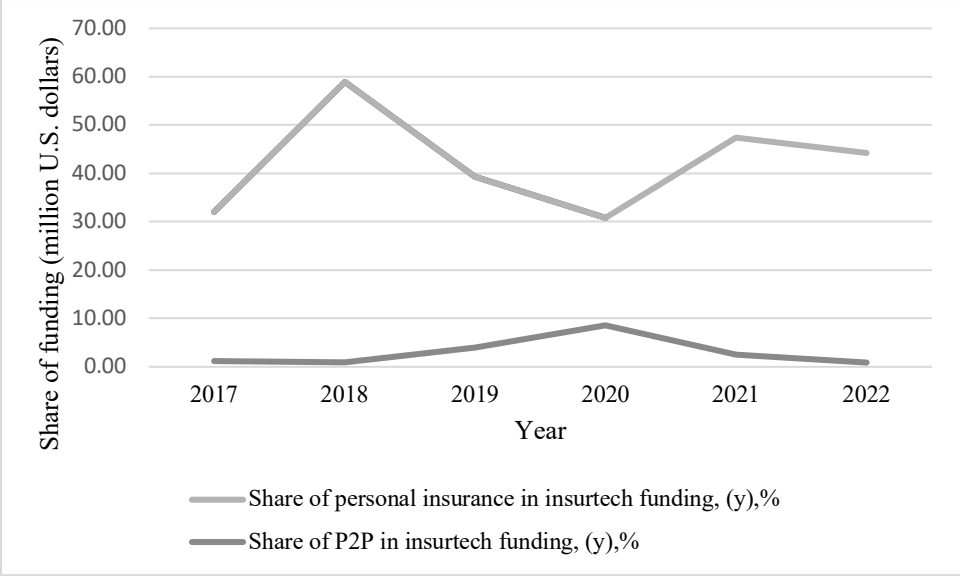


Figure 2.7 – The dynamics of the share of personal insurance and P2P funding in years 2017–2022

Source: by the author based on data [34]

Figure 2.8, below, shows the same statistical series for the P2P insurance funding over the same horizon, which graphically has a value of 1% to 8% for a given period, which is a much lower than personal insurance, but also popular in Ukraine. The quadratic deviation for this indicator is equal to 0.0297, or 2.97%. That is, the average share of P2P insurance funding deviated from the average by 2.97%. To compare the stability of these series, the corresponding quadratic coefficients of variation according to formula 2.2 are calculated:

1) $V_{\sigma(PI)} = \frac{0.105}{0.421} * 100\% = 24.93\%$;

2) $V_{\sigma(P2P)} = \frac{0.0297}{0.03} * 100\% = 97.7\%$

Hence, $V_{\sigma(PI)} < V_{\sigma(P2P)}$, then the dynamics of the share of own revenues in σ(PI) insurtech funding was more stable (fewer deviations) than P2P insurtech funding.

Results obtained above confirm the Ukrainian insurtech strategy while companies ubiquitously implement personal insurance to their operational activity. The full-scale invasion, despite the number of challenges, also creates opportunities for insurtech companies to innovate and offers new solutions to address the unique challenges faced by individuals and businesses in the region.

For example, insurtech companies develop products that provide coverage for damage caused by military actions or help individuals and businesses navigate the complex legal and bureaucratic landscape during the war.

Insurtech funding can have a significant impact on the profitability of a company. In general, insurtech companies require significant capital investments to develop and scale their products and services. This is because the insurance industry is highly regulated and requires significant resources to comply with regulatory requirements, build technology platforms, and develop sophisticated risk models.

When an insurtech company raises funding, it can use the capital to invest in product development, marketing, and operations. This can help the company scale its business and generate revenue more quickly, which can ultimately lead to higher profitability.

However, it is important to note that funding alone is not enough to guarantee profitability. Insurtech companies must also develop sustainable business models and strategies that can generate consistent revenue streams and manage risks effectively. Additionally, competition in the insurtech industry is fierce, and companies must continue to innovate and adapt to changing market conditions in order to remain profitable over the long term [42].

One of the main purposes of this research is to identify the factors that affect the profitability of the insurance company while implementing insurtech products. It can

explain the possible advantages for the insurance companies and show how it affects not only the chosen company but the whole market as well. To analyze the described problem for collecting data was chosen the Ukrainian Insurance Company Prestige PrAT [16].

"Insurance Company "Prestige" was founded in July 2012, registered as a financial institution in August. In 2012-2021, the company obtained 25 licenses for the right to carry out insurance activities, created a methodological base that includes more than 50 insurance products. Active operational activity of the company began in December 2012.

In 2018, the company launched online sales through the website, and from now on, clients of the Prestige Insurance Company can quickly purchase policies anywhere. Since 2018, the Prestige Insurance Company has been launching campaigns in Google Ads, Google Business, Facebook Business Suite, Facebook Ads Manager and corporate social media pages FACEBOOK, "Prestige Insurance Company", on Instagram and " Insurance company "Prestige" on LinkedIn. From 2018 to 2021, the company was a member of the "Insurance Business" association - an association of insurance market participants.

In 2019, the company developed and implemented the Prestige Insurance Comprehensive Information System, which provides front- and back-office support for insurance contracts [25]. All in all, we can conclude that Prestige Insurance Company is a good example of implementation several insurtech products to its operational activity.

As was already mentioned above, the first and the most important factor of successful implementation of insurtech product is profitability of the company. We focus on the 5-year period since the website of the company was created (2018-2023 years). The point is since the company implemented website as one more sale channel clients of the company divided by “online clients” and “offline clients”.

Hence, creation of website assumes the change in structure of clients: Offline clients decrease while Online increase. The model shows endogenous factors of the system that influences the behaviour. No market impact is considered because we assume that the behaviour caused by the system itself that is our focus.

In purpose of understanding the system was created the reference mode of behaviour the main system indicators [63].

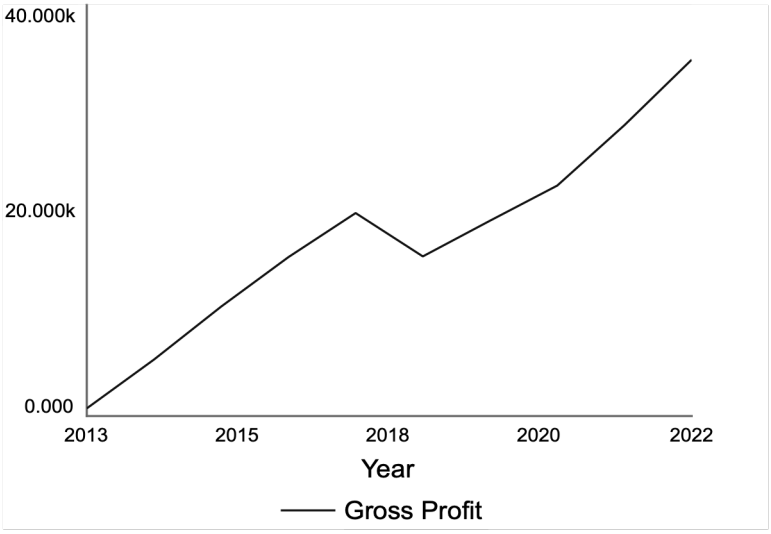


Figure 2.8 – Gross Profit of Prestige Insurance Company in years 2013–2022 – reference mode of behavior for a model

Source: by the author based on data [34]

The assumed behaviour of Online clients is S-shape, that is caused by fast growth in the first months and slow one in the last ones. The growth rate decreases as we increase the number of clients and then start losing a certain rate of people who did not like our service [31].

2.3 Dynamic hypothesis and validation testing of the research through the application of system dynamics

The aim of the research is to create a simplified model of the process described as the problem by simulating the main ways of reducing net costs while implementing the digital platform (website as kind of insurtech product) and increasing profit.

The purpose of this model is to define the mechanisms that affect the client's satisfaction and willingness to sign the contract in our company. The proposed model also shows how the behaviour of the clients changes with the creation and development of website that helps both company and clients to save time and money. The research is grounded on experience as in the insurance field of Ukraine and literature about the System Dynamics approach to modelling similar problems [1].

The following causal loop diagram represents the main relations that cause the model behavior:

Figure 2.9 – Causal Loop Diagram

Source: by the author in Stella Architect.

Old School (R1) represents the simple market principle of satisfaction of product (service in our case). Active clients who choose the offline insurance by their subjective criterias become the part of Offline clients stock. However, there is still a group of people who will choose offline service no matter what. In Ukraine to this group we can relate people of age over 50, who mostly do not use smartphones, people who live near the office, and people who have their own personal preferences about communication while signing the contract offline.

Time Savers (R3) represents the same principle but for Online clients. Adoption of online users takes time, money, and a huge part of IT-specialists work. The main difference between R1 and R3 lies in the mechanism of increasing the number of reinsured clients: If I like the way of Online insurance - I will do it again no matter what. The most valuable thing in our lives is time. It takes around 10 minutes for the client to sign the contract online. You do not have to go to the office, to stay in a queue, to meet people but just to take your smartphone and sign the contact.

IT-support tribute (B1) relates to the specific way of impact on Price through costs. The more Online clients we have - the more salesforce we need to serve them - the higher our costs for salesforce that are the part of total costs of the company. The next steps are easy to follow as far as our Gross Profit depends on the difference between Income and Costs. Net costs that affect the increase in Price strongly depend on total costs, so the higher costs - the higher price - the less people will choose us. The increase (or decrease) in total costs through salaries and other costs for salesforce depends on the time to hire/fire the staff as far the the more time the company spends for it, potentially the loss of clients will be bigger.

White collar payments (B2) represents the same relation as *B1*. As we already know there are still some people who choose offline service and we hire (and fire) the staff for them. The rate of staff for Offline clients is higher than for Online because to sign contracts in office with clients expects more staff than to develop the Web Site and hire some staff who will accept complaints. Obviously, costs for Offline salesforce per one client will be higher and so the stronger impact on Price and adoption new clients will make.

The digitalized (B6) is defined as impact on decision of offline service through the satisfaction from Online service. With the impact of Online service development the rate of people who choose offline insurance is decreasing. It is an obvious part of digitalization the company because if you hear that your friends like the online service, you like the Web Site and it is too far for you to come to the office - you will definitely choose online insurance. This loop is the main mechanism that changes the structure of Offline - Online

clients connecting their causes. This way people who were insured Offline may change their preferences and so change the way of insurance. The assumption here is that our clients will get high satisfaction from Online service, will communicate with each other and decrease the level of Offline clients.

Here we go again No1,2 (B3, B4) represents the relation between the satisfaction of service of both Online and Offline clients and decision to go away and not to choose the reinsurance. The point is, the system provides the rate of people who want to be reinsured caused by its structure (satisfactions, service, etc) but we still have people who do not like our service at all and want to change the Insurance company. There is a delay of 12 months - the time of contract duration over which clients make the decision whether they want to be reinsuranced or not. These people do not just leave the system, they come back to Potential clients who may come back in a few years, but go through the marketing process again.

More clients - lower price (R2) is defined by the Price that changes mostly through the Net Costs. This means that the more clients we have - the lower Net costs - the lower the Price will and so more clients will choose us. The function of satisfaction of price means a lot for the marketing process for clients, so this loop always takes part in increasing (or decreasing) the number of our Active clients and so the Gross Profit.

Market capture (B5) represents the decreasing number of our Potential clients because of increasing the Active. The whole process of insurance starts with the demand for it. The Population of Ukraine is about 41.83 million people. What is important to say, people under 1 year old can not be insuranced as an Insurance of Life and can not sign any other contracts so we have to kick them out. Also there are a lot of people who have contacts in other companies. All things considered, there is a limited quantity of Potential clients.

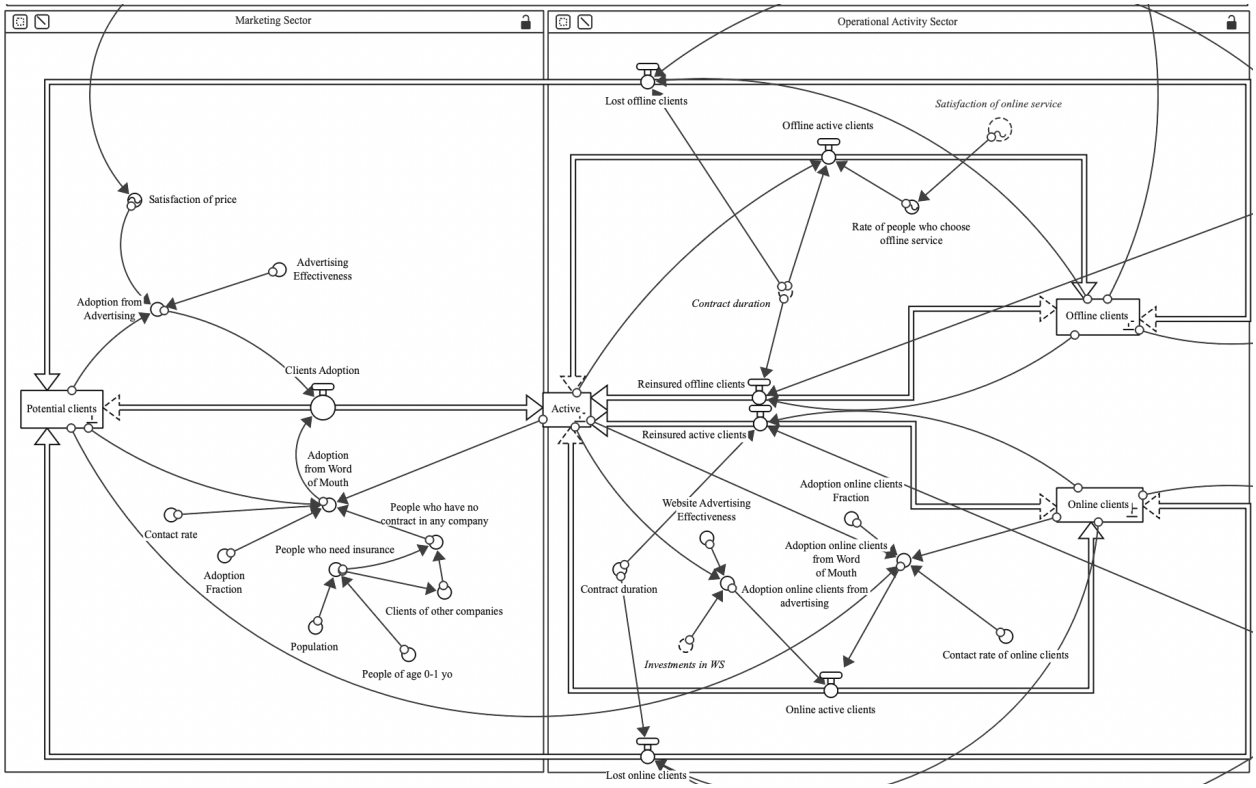


Figure 2.10 – Marketing and Operational Activity sectors of the system dynamics model

Source: by the author in Stella Architect.

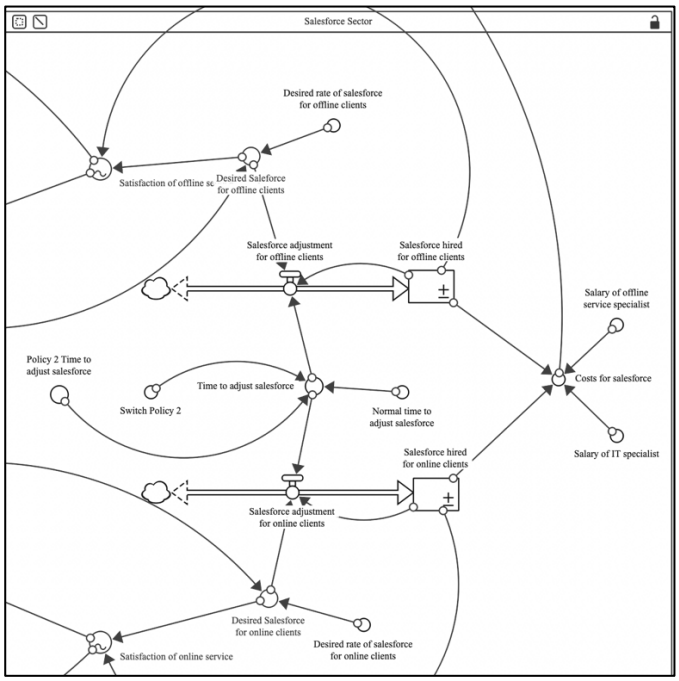


Figure 2.11 – Salesforce sector of the system dynamics model

Source: by the author in Stella Architect.

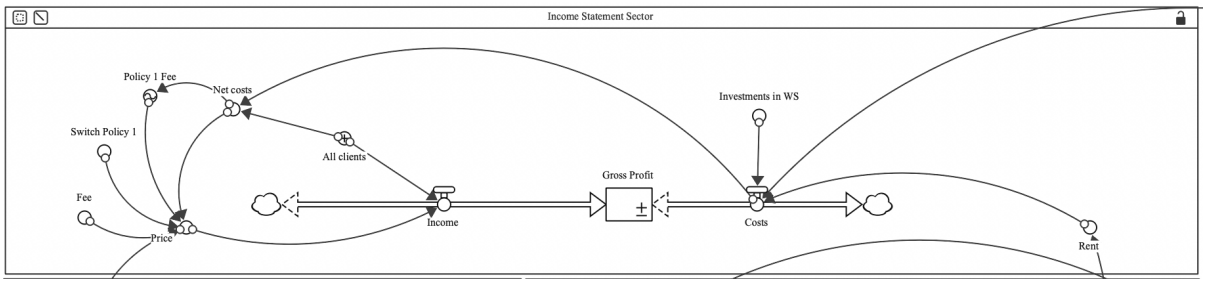


Figure 2.12 – Income Statement sector of the system dynamics model

Source: by the author in Stella Architect.

The separate three main sectors of the model are presented in Figures 2.9– 2.12 and the full model is shown in appendix A. The main idea of the model is to include the whole process of client's adoption since marketing strategy to receivable income. The model also includes the reinsurance process because this part is also inalienable in insurance company. As on the 1st January statistics of National Bank of Ukraine says that gross insurance premiums are equal to 39,615.7 million UAH [49].

Validation tests, including those conducted by Barlas [6], were carried out to establish trust in the model and its simulation outcomes. Chapter 3 highlights particular findings of sensitivity analysis. The model's reliability is further bolstered by its ability to closely replicate historical data behaviour modes. Additionally, exogenous variables predominantly draw from dependable data sources such as the Ministry of Finance of Ukraine, the State Statistics Service of Ukraine, and the World Bank. Proper model documentation was created in accordance with established guidelines:

1. Structure confirmation - model validation is the process performed to define whether the model is the similar representation of the behavior of the system. The model structure was developed based on feedback loops described in the previous section [5].

2. There are a lot of further possible development of the model structure, but exactly this report represents limited system structure and its mechanisms that are relevant to the investigation of this problem.

3. Parameter confirmation - Considered this case, the purpose of the model is to describe the broad representation of the structure of clients in the Insurance company with its impact on profit.

4. Dimensional consistency - the model is defined as dimensionally consistent, so as all parameters have a “real-world” meaning.

5. Extreme conditions and sensitivity tests - performed extreme condition tests represented that the model produces expected and reasonable behavior.

The purpose of the Basic scenario is to reproduce accurately the behavior of the reference mode. The key indicators of the model behavior are Gross Profit and Active clients. Active clients is the stock of the model that represents the sum of Offline and Offline clients, so to look at the structure of clients more detailed it is more relevant to look at them separately.

As was mentioned, it is one of the model aims to consider the mechanisms that change the structure of clients of selected Insurance company. Researching the case of the proposed model were found factors that lead to change in the client’s preferences in choice of way of Insurance. The graph in Figure 2.13 (below) shows the simulation results of the baseline scenario meant to reproduce the reference mode of company’s profit.

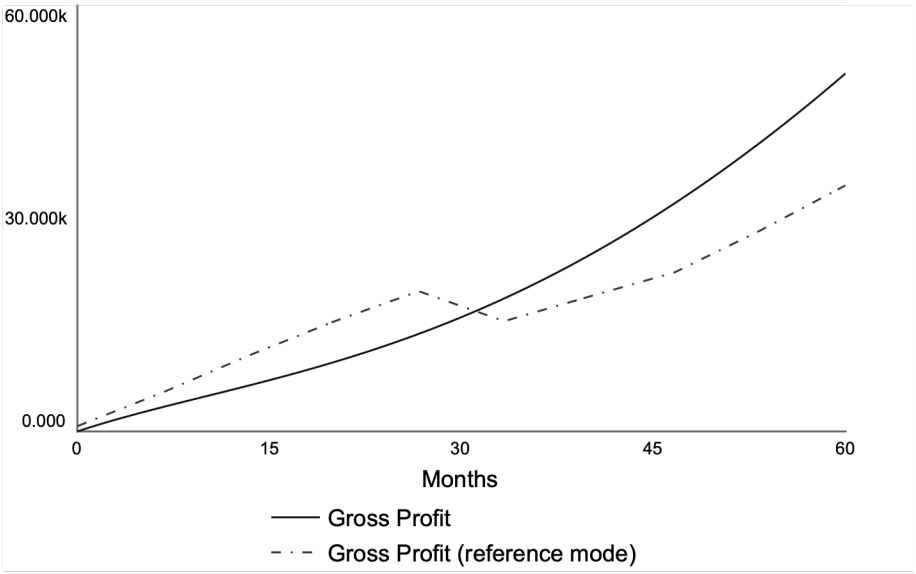


Figure 2.13 – Reference mode replication results in the basic simulation

Source: by the author in Stella Architect

The graphs displayed in Figure 2.14 depict the replication of several other variables for which dependable historical data was obtainable.

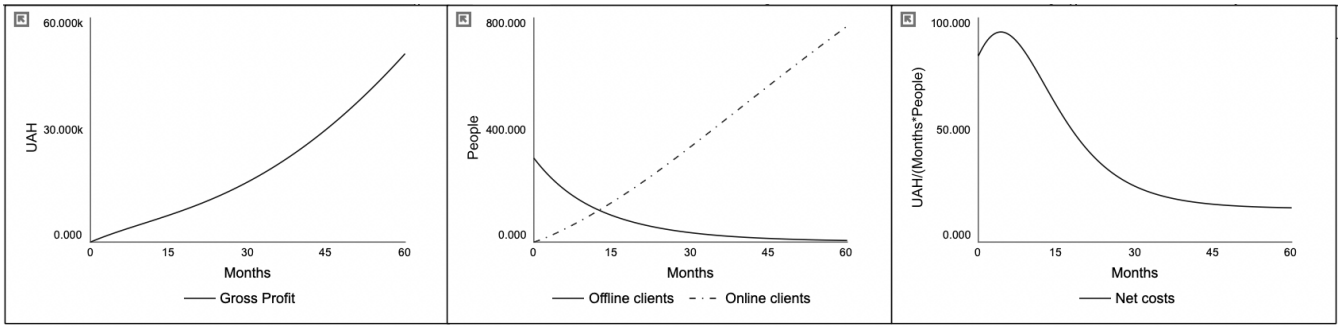


Figure 2.14 – Key variables' behaviour in the baseline simulation

Source: by the author in Stella Architect

The graphs above represent the similar behavior as assumed according to the reference mode. The Gross Profit increases exponentially despite the fact of loss of Offline clients. This kind of behavior happens because the costs per one Online client (their amount increases) are much lower than per one Offline client (who decrease). The structure of Online-Offline clients is also quite accurately represents the assumption. Offline clients decrease while Online increase exponentially, that means that our marketing strategy and other factors work well. Concerning the Net Costs, in the first months they increase because we still have high costs for Offline clients, but later when they decrease to a certain level, as we have low costs for Online clients who are our main group [2].

As was mentioned above, in the first 7 months the reinforcing *R2* (More clients - lower Net Costs) and balancing *B2* (White collars payments) leads to the behavior we can observe on Figure 2.13. The point is we lose clients, because as you can see from the graphs above, the decreasing rate of Offline clients is higher than the rate of growth for Online clients.

From month 7 to 30 the loops *B6* (Digitalized) and *R3* (Time savers) become the main factors of behaviour of the structure, as far as we see the increasingly increasing number of Online clients and increasingly decreasing number of Offline clients. These loops become dominating only when the number of Online clients is big enough to start the decrease of Net costs. *R3* and *B6* influenced by Satisfaction of Online service, that leads to increase in reinsurance Online clients and vice versa to decrease in reinsurance

of Offline clients. That is why the number of Offline clients decrease a lot and Online satisfied clients come again to continue the contract. That is why the Gross Profit continues increasing [22].

In months 30 to 60 where we can see that mostly balancing loops become dominating. The increase of Online clients becomes not so fast because of feedback loop *B1* (IT-support tribute). The more Online clients we have, the more staff we need. Sure that the rate of Salesforce hired for Online clients is not so high as for Offline.

On the other hand, the Salary of IT-specialists is higher than of common agents who sign contracts with Offline clients. The higher the costs for salesforce - the higher the total costs - the higher the price - the less number of clients we may attract.

The next important mechanism is the loops *B3*, *B4* (Here we go again №1,2). They represent the number of lost clients who did not like the service at all and do not want to continue the contract for reinsurance. These loops (especially *B3*) restrain the increase of clients because of the loss of some people every 12 months.

B5 (Market capture) takes part in the formation of behavior on the graphs above as well. The idea is the more Potential clients we insure - the less Potential clients we have. Simple mechanism built on the assumption that we have a limited number of people we may insure. The number of Potential clients is limited by the Population, Number of people who may need the insurance at all, Clients of other Insurance companies, and people we lost and who do not like our company.

R1 (Old school) determines the number of people who may still be reinsured from Offline clients. As was mentioned above, there are still some people who will prefer Offline insurance and do not want to change their preferences neither for Online service nor for other companies.

All things considered, the model accurately represents the reference mode and shows logical and representative behavior of defined assumptions.

Conclusion to Chapter 2

The following wave of digitalization certainly made a great impact on Ukrainian insurance market. This chapter employs statistical methods to examine the present condition and advancement of the insurance market, along with the financial performance of insurtech firms worldwide. The findings indicate that the insurtech sector is progressing mainly due to evolving customer demands for seamless service, irrespective of time and location.

One of the main factors of impact on developing insurtech is funding. The more we invest – the more receive. The previously obtained results affirm the Ukrainian insurtech strategy, as companies are widely integrating personal insurance into their operational activities. Despite numerous challenges, this widespread adoption presents opportunities for insurtech firms to innovate and devise fresh solutions to tackle the distinct difficulties confronted by individuals and enterprises in the region. For instance, insurtech companies are developing products that offer coverage for losses incurred due to military actions or assist individuals and businesses in navigating the intricate legal and bureaucratic framework during times of war.

Based on the historical data was boult a system dynamics model that examines the mechanisms that alter the client structure of the selected insurance company. The study of the proposed model has identified factors that contribute to the alteration of clients' preferences in selecting an insurance method. The Net Costs is a crucial variable for the company that is going to be reduced because of sales through the website or app, despite the fact of first hard months when the Total Costs will increase.

Adopting digital platforms, websites, or applications for selling insurance products can aid in reducing operational expenses and enhancing profitability. In the event of implementing insurtech products, it is imperative for Ukraine to enhance its personal insurance strategy in line with global markets.

CHAPTER 3

POLICY DESIGN AND IMPLEMENTATION AS CRUCIAL FACTORS FOR DIGITALIZATION DEVELOPMENT IN UKRAINE

3.1. Model based sensitivity analysis and overview of the key findings

Sensitivity analysis is a critical step in system dynamics modeling because it allows for the identification of key parameters that significantly affect the behavior of the model. By testing the system with different parameter values and observing how the outputs change, analysts can gain insights into the underlying mechanisms that govern the system's behavior.

In particular, sensitivity analysis can help to identify the most critical parameters that require the greatest attention when trying to improve the performance of the system. It can also provide insights into potential intervention points that may help to improve the system's performance or mitigate risks. Additionally, sensitivity analysis can help to identify limitations and potential sources of error in the model, which can be refined and improved through further data collection and model development.

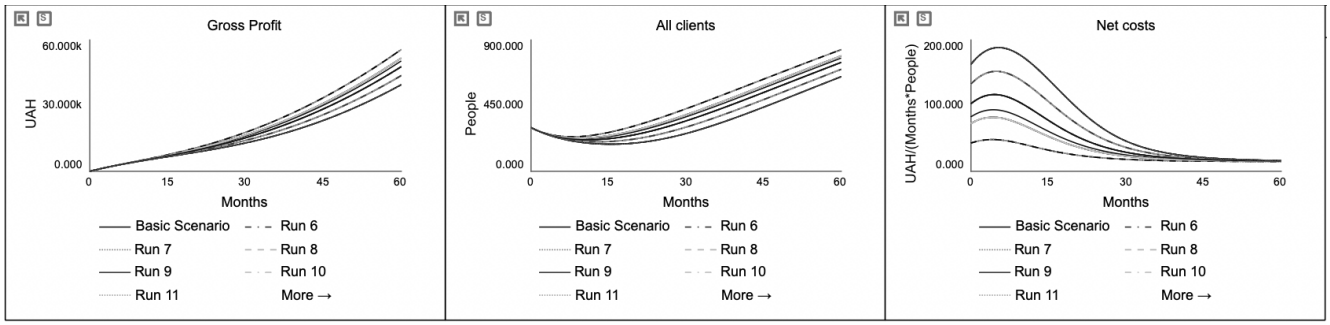
The model’s sensitivity to all parameters and table functions was tested previously on Basic Scenario. For the constant parameters in all the sensitivity runs, was used Incremental Distribution, Latin Hybercube sampling (5 runs).

To analyze table functions the table of values was changed and simulated. In the following section only those found sensitive parameters will be represented. The system underwent sensitivity analysis on all parameters to identify potential intervention points and address limitations in the model.

The process involved running the model multiple times (5 runs in this case), with each run utilizing a different value of a chosen parameter within a defined range and reasonable distribution. By observing whether the behaviour or numerical values of key

parameters in the system changed during these runs, it was possible to determine the level of sensitivity of the system to changes in a particular parameter. A larger variation in the behaviour and values of key parameters indicates a greater sensitivity of the system to changes in that parameter. Limitations of the model are discussed later.

The graphs below demonstrate both numerical and behavioural sensitivity to variations of Desired rate of Salesforce for Offline and Online clients (Figure 3.1). The point is, for Offline clients there are more initially spent costs than for Online clients. It is one of the main parameters in this model because it affects the sector of Salesforce.



Number of runs: 50
Parameter: Desired rate of Salesforce for Offline clients
Distribution: Uniform
Range: 0.05 – 0.2 (dimensionless)

Figure 3.1 – Sensitivity analysis results for a share of the Desired rate of Salesforce for Offline clients

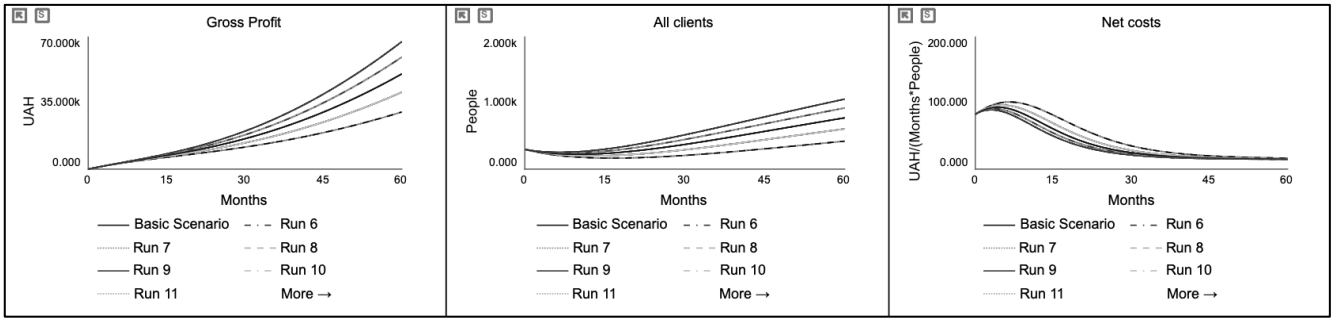
Source: by the author in Stella Architect

As we can see from the graphs above, the model is sensitive to this parameter. The rate of Salesforce for Offline clients affects the loop *B*2 (White collars payments) that leads to increase of Costs and increase of Price as we can confirm from the Sensitivity test [41].

Another parameter that affects the model is amount of investments in website (or any digital flatform that provides the channel for sales. It is quite obvious that it is one of the crucial elements of the marketing strategy and operational activity of the company. Investments in a website can significantly impact operational activities because a website can serve as a primary point of contact between a company and its customers [57]. A

well-designed and functional website can enhance customer experience and satisfaction by providing easy access to information, products, and services. By contrast, a poorly designed website can frustrate customers and lead to lost sales or increased support requests. This can result in additional costs associated with customer service and decreased operational efficiency.

Furthermore, investments in website infrastructure can improve internal operations by streamlining workflows and reducing manual processes. For example, a website with a user-friendly interface can facilitate order processing, inventory management, and customer relationship management. This can reduce errors and delays, improve overall efficiency, and ultimately lead to increased profitability [33].



Number of runs: 50
Parameter: Investments in website
Distribution: Uniform
Range: 100 – 300 ($)

Figure 3.2 – Sensitivity analysis results for a share of the Investments in website

Source: by the author in Stella Architect

As we can see from the graphs above, the model is very sensitive to this parameter. This happens because the main part of our clients are Online clients who come to us through website. So, the more we invest - the more clients we get.

Appendix C provides more sensitivity analysis results for other parameters that seem important in system structure. The model is sensitive to the Satisfaction of Price as well, that is logically correct because the higher the Satisfaction of Price of our Potential clients - the more clients we will get. On the other hand, the model is more or less does not sensitive to the Satisfaction of service for both Online and Offline clients, except for All

clients. This happens because the Satisfaction of Online clients leads to increase in client's reinsurance, so we assume that only part of clients will be changed. Also, it can be explained by the loop $R1$ that reduces the number of Offline clients and so we have a few people to reinsure from Offline clients. So, their satisfaction is not so important in this case because the main part of our clients are Online.

Although the model successfully achieved its primary objective, there are certain limitations that must be considered when using it presently and, in the future, especially for the purposes of expansion or further investigation.

In order to concentrate on one exact problem the model does not include such factors as consumer expectations, indirect network effects, and platform strategies [27]. Secondly, the model does not provide the high accuracy with the numerical point of reference mode, as far as was built and calibrated according to my experience and literature [20]. Finally, there are still some factors that can be missed because of the psychological factor of a client's behavior. We can not fully predict it because it is too hard to measure and make some assumptions [14].

The model's construction and calibration involved the aggregation of all insurance companies in Ukraine, and this may result in some companies being treated as outliers, leading to model outcomes and policies that may not be applicable to them. The model's aggregation represents one of the most significant assumptions, and additional assumptions can be found throughout the text and model documentation. Furthermore, there may be other assumptions that were made and several potentially significant factors that were either excluded from the model or not explicitly mentioned:

- Company's only costs are wages and investments in website, that may represent a significant portion of a company's expenses. However, there are often other costs associated with running a business, such as materials, rent, utilities, equipment, and marketing, among others.
- The demographic part of the model does not include immigration and emigration processes in the country, as well as current updates of population.

- Lack of data. There is a lack of data in the field of insurtech development in Ukraine, some delay and adjustment times were calibrated in the model (refer to documentation, appendix B). Most of the financial historical data including the profit of the company and costs collected is available for the full year of 2022 and the beginning of 2023. However, some other indicators in the model are not available on reliable sources for 2021 and later.
- Current political and economic situation in Ukraine, including recent war crimes, could pose significant challenges to modelling the real state of insurance market accurately.

3.2 Policy suggestions and recommendations for better technology implementation

In order to simulate the effects of selected policy decisions over the long term, a new policy structure must be incorporated into the model. One approach to this is to add converters that function as "switches" for policy implementation. These converters would allow the user to switch policies on and off as needed, enabling access to both the baseline simulation and the simulation after policy implementation.

The "switch" function in the model can only take on a value of either 0 or 1. When the switch is "on" and equal to 1, the value of the corresponding parameter will be set to the desired value specified by the policy. This is because the other part of the equation will be multiplied by 0 and will not be active when the switch is on.

The policy proposed in the model refers to increase of investments in website as far as it means developing and implementing insurtech technologies. As was mentioned above, Investments in website is one of the most sensitive parameters of the model, hence it makes a great impact on model results.

Investing in a company's website can have a positive impact on its profitability in several ways.

- Increased Visibility: By investing in search engine optimization (SEO) and online advertising, a company's website can become more visible to potential customers. This increased visibility can lead to more website traffic and ultimately more sales, thereby increasing profits [51].
- Improved User Experience: A well-designed website that is easy to navigate and provides useful information can improve the user experience and encourage visitors to stay on the site longer. This can lead to higher engagement, more repeat visits, and ultimately more sales [48].
- Cost Savings: A website can also help a company save money by reducing the need for traditional advertising, such as print or broadcast media. By promoting the website through digital channels, a company can reach a larger audience at a lower cost [61].
- E-commerce: Investing in an e-commerce platform can allow a company to sell products or services online, which can increase sales and profits. This is particularly relevant in the current environment, where many consumers are choosing to shop online rather than in-person [28].
- Analytics and Insights: A company's website can provide valuable data and insights into customer behavior, preferences, and needs. By analyzing this data, a company can make informed decisions about its marketing and sales strategies, which can ultimately increase profits [30].

However, it's important to note that simply spending a lot of money on a website does not guarantee increased profits. It's essential to invest in the right areas, such as SEO, user experience, and e-commerce functionality, and to continually track and analyze website performance to ensure that it's delivering the desired results.

By implementing the policy using Switch to the model we make new simulation that shows the impact of increased investments. This will also change equations for parameters that are affected by policies (formula 3.1 below).

Investments in Website = initial_investments + (SWITCH_policy * Policy Investments), *(3.1)*

where the Policy Investments increased by 50% compared to initial investments.

The "switch" has only two possible values, 0 or 1. Therefore, if the "switch" is turned on and has a value of 1, the parameter value will be equal to the desired value as the other part of the equation will be multiplied by 0 and will not affect the result. When the “switch” is off (equals 0), initial values are assumed in the simulation (Basic Scenario). The simulated behaviour with active policies is presented below (Figures 3.3–3.4).

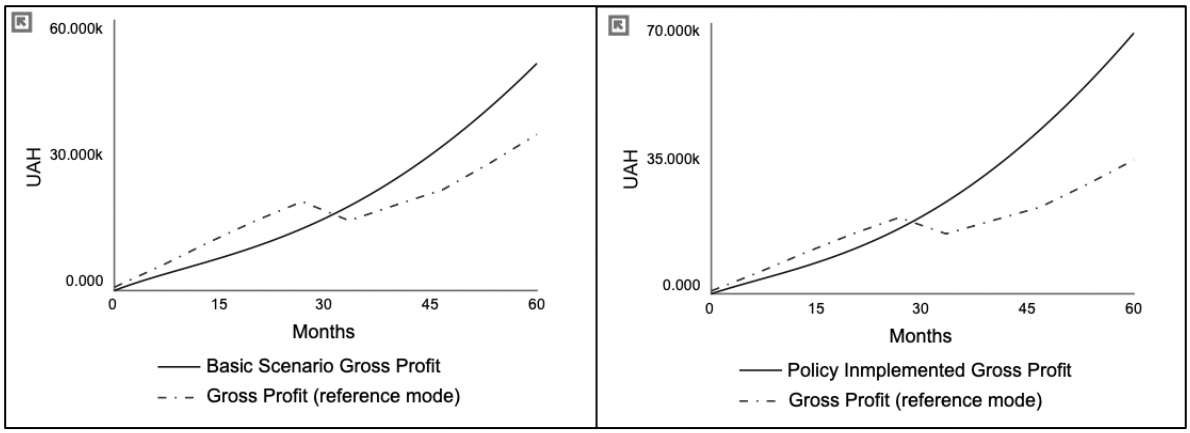


Figure 3.3 – Simulation results of Policy implemented run compared to Basic scenario

Source: by the author in Stella Architect.

There are some similarities in the behavior, however, the initial growth of profit is happening faster than in the Basic scenario of the simulation. It happens because increase in investments affects the number of clients and reduces Net costs faster than usual. Despite the fact that costs increase, it is assumed that increase of Online clients will cover them by increased profit.

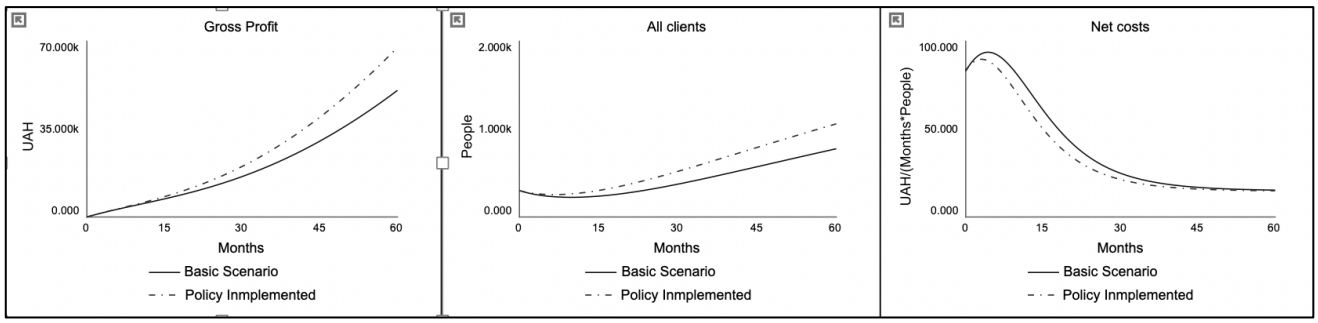


Figure 3.4 – Simulation results of Policy implemented run compared to Basic scenario

Source: by the author in Stella Architect.

On the graph above represented key variables of the system dynamics model affected by increase in Investments in website. A well-designed website can increase a company's sales by providing an easy and convenient way for customers to make purchases. This increased sales volume can lead to higher Gross profit – this trend is represented by the model and its simulation in Policy implemented run. By investing in its website, a company can reduce some of its costs associated with traditional marketing and sales methods, such as printing and distribution. Additionally, a website can help automate some business processes, reducing the need for manual labor and further reducing costs. A website can attract new customers to a business and make it easier for existing customers to continue doing business with the company. This increased customer base can lead to more sales and ultimately more profits [10].

However, it's important to note that the impact of a website on these parameters will depend on several factors, including the company's industry, target market, and competition. Additionally, a website must be well-designed, optimized for search engines, and easy to use in order to achieve the desired results.

A system dynamics model can help a company analyze the potential impact of website investments on these parameters, as well as identify other factors that may impact the success of a website investment strategy. By using this model, a company can make informed decisions about its website investments and optimize its approach to maximize profits.

3.3 Challenges and outlook for implementing policies to Insurance Sector of Ukraine

The object of the research has been shown to have significant issues through the methods and findings of the study. By conducting a statistical analysis, the calculations indicate certain observations regarding the state of insurtech development in Ukraine during the process of implementing new products.

The war in Ukraine makes its own corrections to the people's lives and to the financial market as well. The main assumption in this case concerns the Salesforce sector, as far as the model is limited and we do not include the market change (such as market price, migration of population, loss of electricity in offices and social activity of the company). Consequences of the russian invasion in Ukraine mostly changed the type of employment of hundreds of thousands of people. To consider this case in our model, we understand that most of the staff who work with Offline clients should work at the office, while on the other hand, staff for Online clients work from home.

On February 27, 2022, the National Bank, as a regulator of the insurance services market, recommended to insurers to simplify the procedure for settlement of cases with insurance characteristics by making maximum use of electronic documents and copies of necessary documents in case of impossibility or difficulty in obtaining their originals, as well as using other means remote settlement of insurance cases [3].

Assuming this reccomendation to implement this case to the model, we change the Desired rate of Salesforce both for Offline clients and for Online clients. In this case we assume that staff who worked at the office with Offline clients may start work from home and work with Online clients. This way we can increase the Satisfaction of service for Online clients, and increase the rate of growth for them as well. Sure that it will affect the Satisfaction of service of Offline clients inversely, but this way we can save a part of Profit for the company, because if not, we will lose both Offline and Online clients. This is the way companies work in Ukraine now, and moreover, some of them develop and implement different kinds of Web Platforms to provide Insurance.

On Figure 3.4 we can observe that this kind of scenario increases the Gross Profit if compared with the Basic Scenario. That means that our assumptions were almost correct, so as the number of Online clients increases faster. This kind of behavior produces the dominating loop in this scenario R3 (Time savers), because increasing the Desired rate of Salesforce for Online clients we increase the number of Online clients and so on. Important to mention another loop that compliments R3 is R1 (Old school), that reduces

the number of Offline clients and also leads to increase in Accumulative Profit by the way of reducing Net Costs.

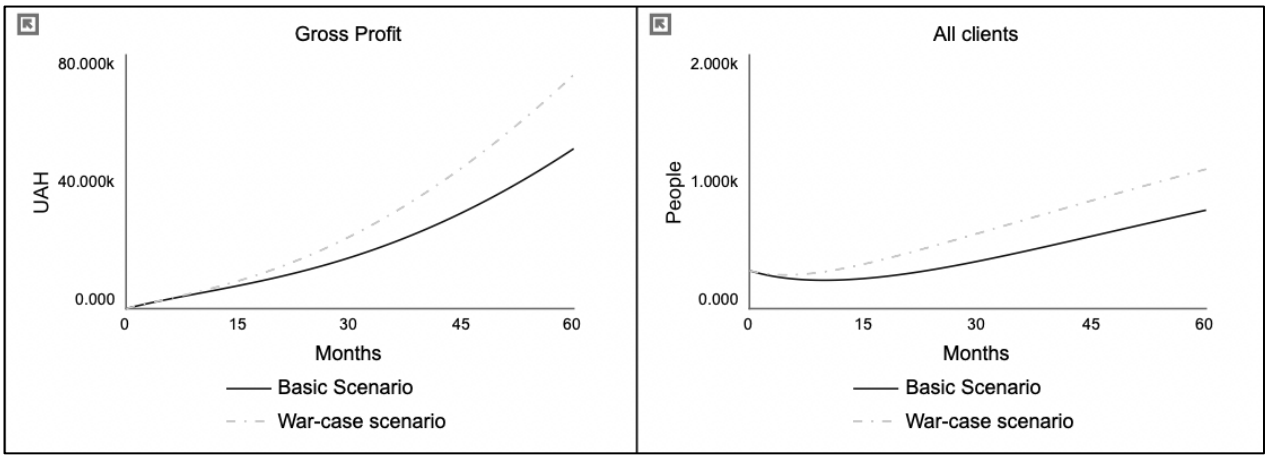


Figure 3.5 – Simulation results of War-case scenario compared to Basic scenario
Source: by the author in Stella Architect.

Considering two scenarios for the proposed model we can conclude that it seems to work properly and reproduces the reference mode accurately. The War-case scenario confirms this point, because of logical producing behavior with changed parameters.

Otherwise, there are a lot of challenges insurance companies face with because of war. Due to displacement, temporary territorial capture, and physical destruction of real estate, the number of customer service centers operated by insurers has decreased. Additionally, the settlement of insurance claims in regions affected by conflicts, as well as vehicle inspections and the proper processing of original documents for insurance payment submissions, pose significant challenges. Calling the police to the place of an accident is also problematic [18].

Furthermore, businesses have reported a substantial decline in insurance payments, and limitations on their operations have been documented due to challenges in organizing communication and staff work, as well as difficult access to offices and original documents. These obstacles make it challenging to process insurance payments, particularly in cases involving the death of insured individuals in occupied territories [67].

During wartime, the financial capacity of insurers is directly influenced by the quality and structure of their assets and capital stock prior to the outbreak of hostilities.

There are several factors that affect the development of insurtech in Ukraine:

- Infrastructure. The first and most important factor of development is advanced technology. That is, people have gadgets, such as smartphones, Internet coverage and access to it. According to current situation in Ukraine caused by russian attacks, there are a lot of issues with stable internet connection. Moreover, most of occupied territories have no access to internet and connection at all.
- Regulatory environment. A favorable legal and regulatory environment is equally critical for the advancement of the FinTech ecosystem. Factors such as the legal framework, transparency of business creation regulations, and investor and business rights protection play vital roles. In markets where regulatory and legislative environments are still evolving, FinTech firms can adopt a "learn by testing" approach. This means they can develop FinTech technologies while ensuring compliance with regulations, as long as there are no objections from regulators [37].
- Access to capital and investment. In Ukraine, access to capital and investment is limited compared to more developed markets. This can create challenges for Insurtech startups seeking to secure funding for their projects. The lack of available capital can lead to slower development of new technologies, longer time to market, and a decreased ability to compete with larger and more established players in the industry. This can be achieved through the creation of government-supported funding programs, venture capital funds, and angel investor networks.
- Limited adoption of digital technologies. Insurtech startups may encounter difficulties in disrupting traditional business models and gaining market share in Ukraine due to the early stage of digital technology adoption in the insurance industry.
- Fragmented market. Achieving scale and attracting a significant number of customers can be challenging for insurtech companies operating in Ukraine due

to the fragmented nature of the insurance market, which consists of many small players and has limited market concentration [9].

The list of challenges facing the development of insurtech in Ukraine is not exhaustive and further research may uncover additional critical issues that require new solutions. Possible recommendations to address these challenges include identifying specific problems, designing policies based on successful models, and drawing on international experience. These recommendations can be categorized as shown in Table 3.1 below.

Table 3.1 – Policies recommended

Policy	Explanation
Government support	Governement should provide financial and other support to insurtech startups. This could include grants, tax incentives, and access to mentorship and incubator programs.
Infrastructure development	The development of infrastructure such as high-speed internet and digital payment systems can help support the growth of insurtech companies in Ukraine.
Collaboration	Traditional insurers can work with insurtech startups to develop new products and services. This can help traditional companies stay competitive while also supporting the growth of startups.
Education and awareness	The government can support education and awareness campaigns to increase understanding of insurtech among businesses and consumers. This can help drive adoption and demand.

Source: by the author based on research results.

In Ukraine, the progress of technology in various fields is sluggish, but the insurance sector is an exception as it has already started its digital transformation journey. On the bright side, there are some improvements in the startup ecosystem with the emergence of accelerator programs that facilitate the necessary infrastructure [24]. However, much work is required to foster a conducive environment for business growth, including regulatory and legislative changes that support innovation, straightforward and transparent procedures for startups, and favorable tax policies. Overall, Ukraine has a long way to go to encourage and nurture the growth of new projects.

Conclusions to Chapter 3

Through a sensitivity analysis that was conducted on all factors of the model, the study identified the most effective points of intervention in a simulated system for a future policy, considering both behavioral and numerical sensitivity. The analysis indicated that investing in website infrastructure has the potential to enhance internal operations by simplifying workflows and minimizing manual processes.

Hence, the constructed model is not flawless or comprehensive as some factors are based on substantial assumptions or fall beyond the scope of the model. The model takes into account various parameters such as the satisfaction of clients, the desired rate of Salesforce, and the satisfaction of price. The results show that the satisfaction of online clients is more important than that of offline clients, and that the model is sensitive to changes in certain parameters such as the desired rate of Salesforce.

However, there are limitations to the model that must be considered when using it for expansion or further investigation. To the current limitations we can lead the ongoing political and economic situation in Ukraine, Insufficient data is available in the field of insurtech development, the demographic aspect of the model, and some excluded costs of the company.

The approach suggested to policies built by function "switches" for policy implementation. These converters would allow the user to switch policies on and off as needed, enabling access to both the baseline simulation and the simulation after policy implementation. The purpose of this approach is to simulate the effects of selected policy decisions over the long term. In addition, according to problems on the Ukrainian insurance market were mentioned some recommendations to develop the implementation of insurtech. The government can play a role in raising awareness of insurtech among businesses and consumers. Moreover, collaboration between traditional insurance companies and insurtech startups can foster the development of new products and services, enabling traditional companies to remain competitive while also promoting startup growth.

CONCLUSIONS

This study focuses on the implementation process of an insurtech product within a company and its impact on profitability and its aim to identify potential problems and develop policies to enhance the implementation process and increase profitability are defined. The research results and a global assessment are utilized to define and address these aspects comprehensively. Chapter 1 summarizes the definition of “digitalization” and “insurtech” that refers to the application of technology by companies to innovate and enhance the insurance industry. It aims to leverage technology to achieve objectives such as increasing transparency, improving access to insurance, and delivering superior service to clients. The current state and developing stage of insurtech in Ukraine is defined on its early stages. Many companies are just beginning to explore ways to implement insurtech into their services. However, there is already a group of products available in the Ukrainian insurance market that incorporate new trends and technologies. Instant customer satisfaction can lead to a rise in sales, allowing insurers to allocate more time and resources to enhancing overall efficiency in other areas. However, the impact of insurtech on cost reduction for companies is a complex issue. While automation of processes and the utilization of digital channels have reduced the need for physical infrastructure and overhead costs, implementing insurtech solutions itself can be expensive for companies. The cost of technology and its implementation can vary greatly depending on the scale and complexity of the project. Chapter 1 also highlights the factors that affect these costs and revenues. In addition, the foreign experience of implementing insurtech products is presented, which is used for further recommendations.

Chapter 2 assesses the impact of implementation of website to the company using statistical methods and includes several stages of system dynamics research with a simplified explanatory model of company’s operational activity with new sales channel. After employing diverse statistical indicators, the subsequent findings were unveiled: the analysis of financial activity in the insurtech sector globally indicates a positive trend. The market is witnessing growth, and an increasing number of companies are emerging

as significant players in the field of insurtech, establishing themselves as new business leaders. Nevertheless, there was a significant decline in insurtech funding during Q4 of 2022, with a 57% decrease from US$2.35 billion in Q3 to US$1.01 billion. Despite this decline, there has been a substantial increase in total insurtech funding across all categories in 2022. As indicated in the table, the funding amount has nearly doubled since 2019. However, certain sectors experienced a decrease of more than 50% in funding during 2022. For instance, P2P insurance funding saw a decline of over 81%, highlighting the current market conditions. Based on the calculations conducted, it can be concluded that, on average, personal insurance funding represents approximately 43% of the total funding. This indicates that almost half of all investments are directed towards personal insurance, which holds a leading position both globally and in Ukraine.

A system dynamics model was developed based on historical data to analyse the factors influencing changes in the client structure of the chosen insurance company. The study of this model revealed the factors that influence clients' preferences when selecting an insurance method. One important variable for the company is Net Costs, which is expected to decrease due to sales through the website or app. However, it should be noted that in the initial months, Total Costs may increase before the benefits of the digital sales channel are fully realized. Through sensitivity testing (Chapter 3), two best policies are recommended: increase in investments to the website of the company and change the structure of salesforce for Online and Offline clients that will lead to decrease in Net Costs and increase in gross Profit.

Policies such as governmental support programs, infrastructure development and insurtechs collaboration were also explained and included to the research. The developed model holds significant potential for further expansion and addressing various issues within the system, as well as the possibility of recalibration for specific purposes and areas. With the completion of this research, new assessments are provided for insurance companies and need to be continued and expanded.

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Appendix A

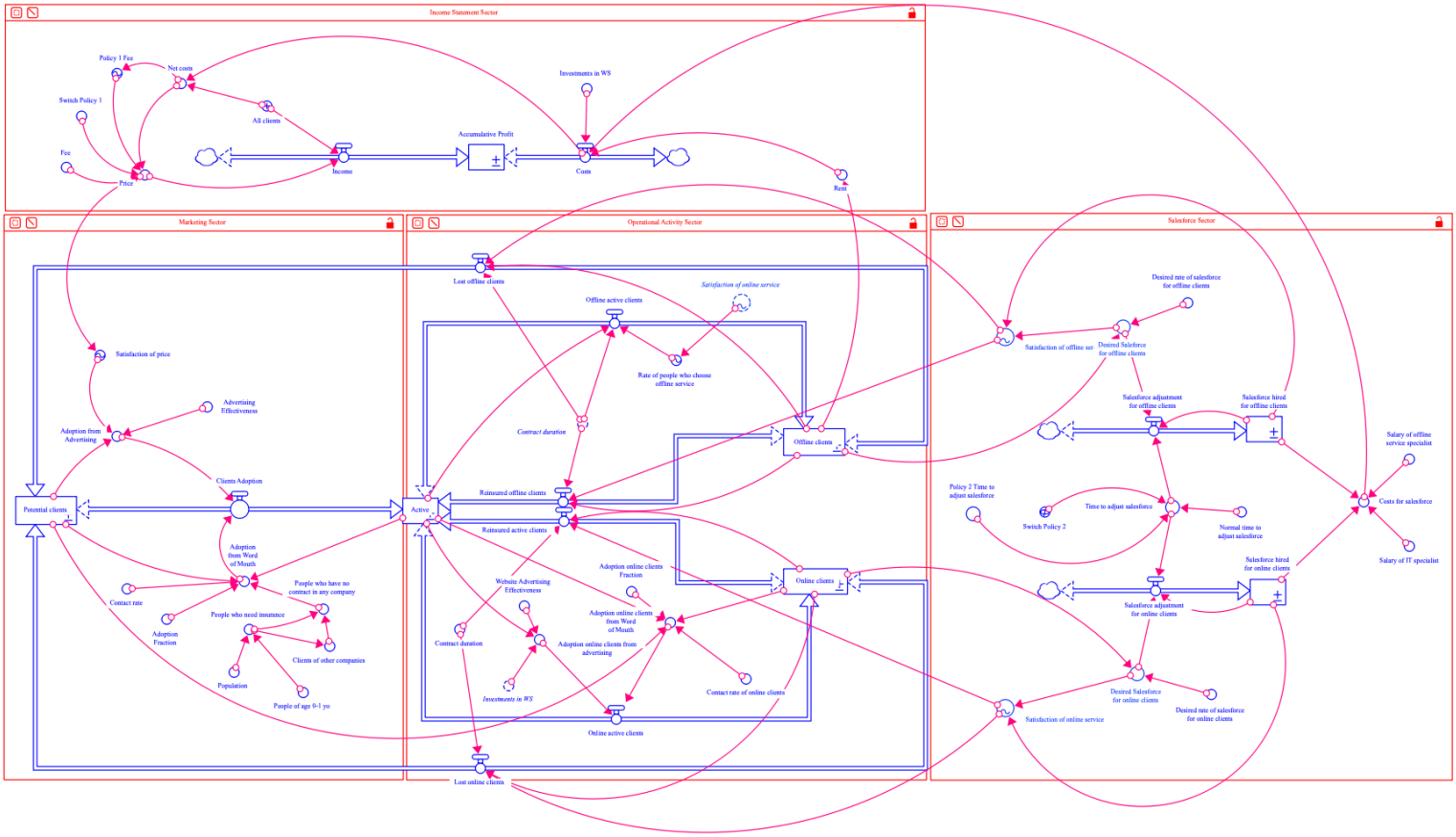


Figure A.1 – Explanatory system dynamics model of implemented insurtech product (website)

Source: by the author in Stella Architect.

Appendix B

Model Documentation

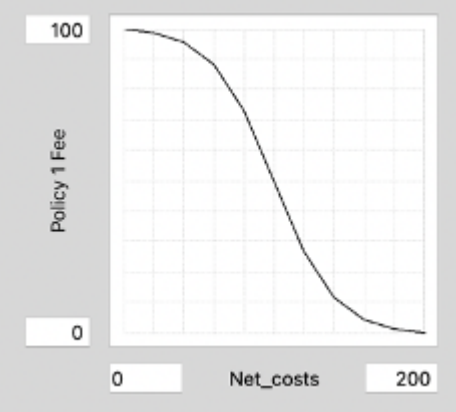
The model has 57 variables (array expansion in parens). In root model and 0 additional modules with 4 sectors. Stocks: 7 Flows: 11 Converters: 39 Constants: 19 Equations: 31 Graphicals: 5
Active(t) = Active(t - dt) + (Reinsured_offline_clients + Reinsured_active_clients + Clients_Adoption - Offline_active_clients - Online_active_clients) * dt INIT Active = Offline_clients+Online_clients UNITS: People DOCUMENT: This stock represents the number of All active clients of the company.
Income_Statement_Sector:
Accumulative_Profit(t) = Accumulative_Profit(t - dt) + (Income - Costs) * dt INIT Accumulative_Profit = 0 UNITS: Dollars DOCUMENT: The stock of Accumulative profit assumes that it is the main part of income to the stakeholders that equals to income - costs.
All_clients = Offline_clients + Online_clients {SUMMING CONVERTER} UNITS: People DOCUMENT: This converter is a sum of all clients we have in the company - both Online and Offline.
Costs = Investments_in_WS+Costs_for_salesforce+Rent UNITS: dollars/months DOCUMENT: The flow represents all costs of the company including the rent, salesforce, investments in Website. It is one of microeconomics statements that profit equals to income - costs. We take into account this assumption in the model.
Fee = 50 UNITS: (dollars/people)/month DOCUMENT: This converter represents the commissions fee per 1 client that is the part of income of the company. We assume this as constant in the Basic scenario.

Income = Price*All_clients
UNITS: dollars/month
DOCUMENT: The income of our company is sales per clients. In the model we assume that 1 contract per 1 client, so we calculate it as Price * All active clients of the company.

Investments_in_WS = 200
UNITS: dollars/months
DOCUMENT: Every month the company invests some money to the Website. These costs may be shared among the target marketing, extra payments to IT, some purchases products of fintech, etc.

Net_costs = Costs/All_clients
UNITS: dollars/(Months*People)
DOCUMENT: This converter represents the costs per 1 client by dividing the total costs per all active clients of the company.

Policy_1_Fee = GRAPH(Net_costs)
Points(11): (0.0, 100.0), (20.0, 98.74), (40.0, 95.66), (60.0, 88.35), (80.0, 73.24), (100.0, 50.0), ...
UNITS: (dollars/people)/month
DOCUMENT: This table function is a relation between the Net costs and Fee that is created as Policy 2. It means that if our Net costs decrease, as a fact of increasing Online clients, we increase the Fee and increase the Profit.



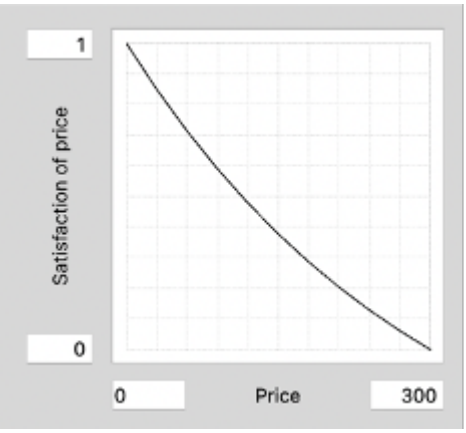
Price = (Net_costs+Fee)*(1-Switch_Policy_1)+Switch_Policy_1*Policy_1_Fee
UNITS: (dollars/people)/month
DOCUMENT: This converter represents the Price of a contract per 1 client.

Rent = IF Offline_clients >=300 THEN 1000 ELSE 700
UNITS: dollars/months
DOCUMENT: This Converter is an amount of money we pay for the rent. As far as we have offline clients, we need the office and the building to sign contracts. Sure we need to pay for it. As we decrease the number of Offline clients, we can decrease the rent as well because we do not need as much area.

Switch_Policy_1 = 0 UNITS: dmnl DOCUMENT: This converter represents a SWITCH of policy 1, that assumes the Fee should be the function of Net costs to increase the Profit.
Marketing_Sector:
Adoption_Fraction = 0.06 UNITS: dmnl/contact DOCUMENT: It is assumed, for simplification that while communicating only 6% of all people will choose our company.
Adoption_from_Advertising = Potential_clients*Advertising_Effectiveness*Satisfaction_of_price UNITS: People/month DOCUMENT: This converter represents possible number of Potential clients who may like our price and advertisement and may become the Active clients.
Adoption_from_Word_of_Mouth = Active*(Potential_clients/People_who_have_no_contract_in_any_company)*Adoption_Fraction*Contact_rate UNITS: People/months DOCUMENT: Main assumption of this variable is to gather all people from all advertisement channels to make them Active clients.
Advertising_Effectiveness = 0.01 UNITS: dmnl/Months DOCUMENT: For simplification we assume that this number the effectiveness of our posted advertisement to show the impact of it on the model.
Clients_Adoption = Adoption_from_Advertising+Adoption_from_Word_of_Mouth UNITS: People/month DOCUMENT: This flow represents people per month who come to our company and become Active clients.
Clients_of_other_companies = People_who_need_insurance*0.9997 UNITS: People DOCUMENT: Insurance market in Ukraine provides a huge variety of companies so as far as in this model only 1 certain company is considered we have to note this.

Contact_rate = 0.1 UNITS: contact/months DOCUMENT: Proposed contact rate assumes the number of contacts per month with potential clients about the insurance.
"People_of_age_0-1_yo" = 0.05 UNITS: dmnl DOCUMENT: Insurance companies in Ukraine do not insurance children under 1 year old, because it is too risky. In addition, the Law of Ukraine claims that people under 18 years old can not sign any contracts, so in the model we have to exclude this part of population.
People_who_have_no_contract_in_any_company = People_who_need_insurance-Clients_of_other_companies UNITS: People DOCUMENT: Among all population potentially our clients may be only people who need Insurance and do not have any contracts at other companies.
People_who_need_insurance = Population*(1-"People_of_age_0-1_yo") UNITS: People DOCUMENT: By this variable we exclude people who under 2 y.o. by throwing out the People of age 0 to 1 y.o.
Population = 41830000 UNITS: People DOCUMENT: The given number is Population of Ukraine published by State Statistical Service of Ukraine in 2022.
Potential_clients(t) = Potential_clients(t - dt) + (Lost_offline_clients + Lost_online_clients - Clients_Adoption) * dt INIT Potential_clients = People_who_have_no_contract_in_any_company - Active UNITS: People DOCUMENT: This is the stock of People who potentially may come to our company to insurance, we assume that initially it should exclude people who already have contract in our company.

Satisfaction_of_price = GRAPH(Price)
Points(11): (0.0, 1.000), (30.0, 0.8495), (60.0, 0.7132), (90.0, 0.590), (120.0, 0.4785), (150.0, 0.3775), ...
UNITS: dmnl
DOCUMENT: This table function represents the relation between the Price and the Satisfaction of clients of it. The idea is the lower the Price - the higher the Satisfaction. This is the law of Demand for any product that should definitely be taken into account in the model.



Operational_Activity_Sector:

Adoption_online_clients_Fraction = 0.1
UNITS: dmnl/contact
DOCUMENT: This fraction is simplification of adoption online service among clients.

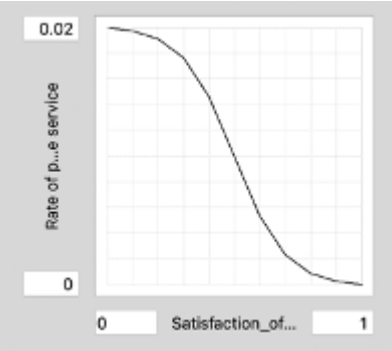
Adoption_online_clients_from_advertising = Website_Advertising_Effectiveness*Investments_in_WS*Active
UNITS: People/month
DOCUMENT: This converter represents the rate of people who choose online service because of website advertisement.

Adoption_online_clients_from_Word_of_Mouth = Online_clients*(Active/Potential_clients)*Adoption_online_clients_Fraction*Contact_rate_of_online_clients
UNITS: People/months
DOCUMENT: This converter represents the rate of people who chose online service through word of mouth.

Contact_rate_of_online_clients = 0.1
UNITS: contact/months
DOCUMENT: This converter represents the approximate number of contacts per month between users of online insurance.

Contract_duration = 12 UNITS: Months DOCUMENT: The usual time of insurance contract duration in Ukraine is 12 months so we include it to the model.
Lost_offline_clients = (Offline_clients*(1-Satisfaction_of_offline_service))/Contract_duration UNITS: People/month DOCUMENT: The flow represent the number of Offline clients who did not like the service and want to leave the company after the contract is over.
Lost_online_clients = (Online_clients*(1-Satisfaction_of_online_service))/Contract_duration UNITS: People/month DOCUMENT: This flow represents the number of people who did not like the service of Online insurance and decided to leave after the contract ended.
Offline_active_clients = (Active*Rate_of_people_who_choose_offline_service)/Contract_duration UNITS: People/month DOCUMENT: This flow represents the number of clients who choose offline service per month.
Offline_clients(t) = Offline_clients(t - dt) + (Offline_active_clients - Lost_offline_clients - Reinsured_offline_clients) * dt INIT Offline_clients = 300 UNITS: People DOCUMENT: This stock represents the number of Offline Active clients of the company.
Online_active_clients = Adoption_online_clients_from_advertising+Adoption_online_clients_from_Word_of_Mouth UNITS: People/month DOCUMENT: This flow represents the number of people who chose the Online service per month through different channels.
Online_clients(t) = Online_clients(t - dt) + (Online_active_clients - Lost_online_clients - Reinsured_active_clients) * dt INIT Online_clients = 0 UNITS: People DOCUMENT: This stock represents the number of Active Online clients of the company.

Rate_of_people_who_choose_offline_service = GRAPH(Satisfaction_of_online_service)
Points(11): (0.000, 0.02), (0.100, 0.01975), (0.200, 0.01913), (0.300, 0.01767), (0.400, 0.01465), (0.500, 0.01), ...
UNITS: dmnl
DOCUMENT: This table function is a relation between the Satisfaction of Online service and people who will choose Offline service. The idea is the more people will like the Online service - the less clients will choose Offline service.



Reinsured_active_clients =
(Online_clients*Satisfaction_of_online_service)/Contract_duration
UNITS: People/month
DOCUMENT: This flow represents the number of people who choose to be reinsured after the Online service first contract.

Reinsured_offline_clients =
(Offline_clients*Satisfaction_of_offline_service)/Contract_duration
UNITS: People/month
DOCUMENT: This flow represents the number of people who chose to be reinsuranced after the first contract as offline service.

Website_Advertising_Effectiveness = 0.0001
UNITS: dmnl/dollars
DOCUMENT: This converter represents the effectiveness of investments in Website. In other words, what is the rate of people who come to Online service per 1 invested dollar.

Salesforce_Sector:

Costs_for_salesforce = Salesforce_hired_for_online_clients*Salary_of_IT_specialist+Salesforce_hired_for_offline_clients*Salary_of_offline_service_specialist UNITS: dollars/month DOCUMENT: The converter sums the costs both for online and offline clients spent for salesforce.
Desired_rate_of_salesforce_for_offline_clients = 1/10 UNITS: Staff/People DOCUMENT: It is an average rate of agents the company need to hire per 1 client.
Desired_rate_of_salesforce_for_online_clients = 1/100 UNITS: Staff/People DOCUMENT: This converter is an average rate of IT specialists that we need to provide the service for Online clients.
Desired_Saleforce_for_offline_clients = Offline_clients*Desired_rate_of_salesforce_for_offline_clients UNITS: Staff DOCUMENT: This converter represents the exact number of staff we need to hire to provide the service for our Offline clients.
Desired_Salesforce_for_online_clients = Online_clients*Desired_rate_of_salesforce_for_online_clients UNITS: Staff DOCUMENT: The converter represents the exact number of staff we need to provide the service for Online clients including the desired rate of them.
Normal_time_to_adjust_salesforce = 6 UNITS: Months DOCUMENT: This is the average time to hire/fire the staff to keep the desired rate both for online and offline clients in order to provide the service. We assume this as 6 month to simplify the calculations but it changes while testing different scenarios.
Policy_2_Time_to_adjust_salesforce = 3 UNITS: Months DOCUMENT: This converter represents the time to adjust salesforce while implicating the policy 2 where it should be reduced to 3 months.
Salary_of_IT_specialist = 1500 UNITS: dollars/staff/month DOCUMENT: This is an average salary of IT specialist in Ukraine.

Salary_of_offline_service_specialist = 800
UNITS: dollars/staff/month
DOCUMENT: This is an average salary for the agent who works with offline clients per month.

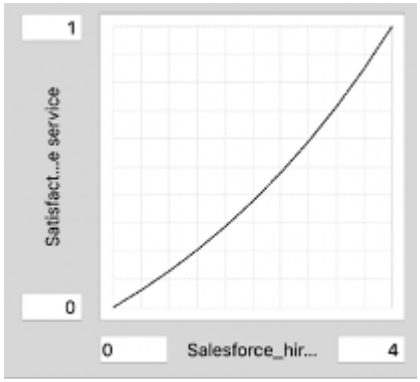
Salesforce_adjustment_for_offline_clients = (Desired_Saleforce_for_offline_clients-Salesforce_hired_for_offline_clients)/Time_to_adjust_salesforce
UNITS: Staff/Months
DOCUMENT: The flow represents the number of staff that we hire/fire in case of change the offline clients to keep the desired rate of salesforce for them.

Salesforce_adjustment_for_online_clients = (Desired_Salesforce_for_online_clients-Salesforce_hired_for_online_clients)/Time_to_adjust_salesforce
UNITS: Staff/Months
DOCUMENT: The flow represents the number of hired/fired IT specialists per month.

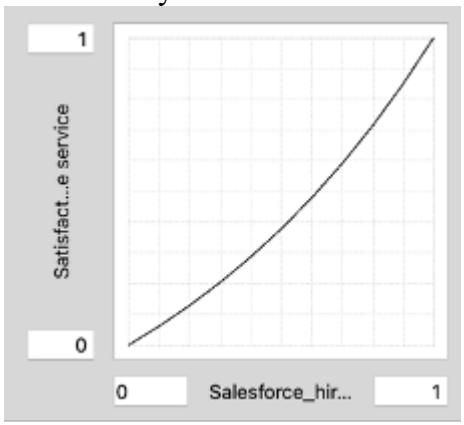
Salesforce_hired_for_offline_clients(t) = Salesforce_hired_for_offline_clients(t - dt) + (Salesforce_adjustment_for_offline_clients) * dt
INIT Salesforce_hired_for_offline_clients = Offline_clients*Desired_rate_of_salesforce_for_offline_clients
UNITS: Staff
DOCUMENT: The stock accumulates the salesforce for offline clients that is desired to provide the service.

Salesforce_hired_for_online_clients(t) = Salesforce_hired_for_online_clients(t - dt) + (Salesforce_adjustment_for_online_clients) * dt
INIT Salesforce_hired_for_online_clients = Online_clients*Desired_rate_of_salesforce_for_online_clients
UNITS: Staff
DOCUMENT: The stock represents the number of IT specialist hired to provide the service for Online clients.

Satisfaction_of_offline_service = GRAPH(Salesforce_hired_for_offline_clients//Desired_Saleforce_for_offline_clients)
Points(11): (0.000, 0.000), (0.400, 0.06121), (0.800, 0.1289), (1.200, 0.2036), (1.600, 0.2862), (2.000, 0.3775), ...
UNITS: dmnl
DOCUMENT: This table function represents the relation between the Salesforce for Offline clients and their satisfaction. The more agents will serve the clients, the higher their satisfaction will be.



Satisfaction_of_online_service = GRAPH(Salesforce_hired_for_online_clients//Desired_Salesforce_for_online_clients)
Points(11): (0.000, 0.000), (0.100, 0.06121), (0.200, 0.1289), (0.300, 0.2036), (0.400, 0.2862), (0.500, 0.3775), ...
UNITS: dmnl
DOCUMENT: This table function is about the relation between the salesforce for Online clients and their satisfaction. The more salesforce for online clients we have - the more satisfied they will be and vice versa.

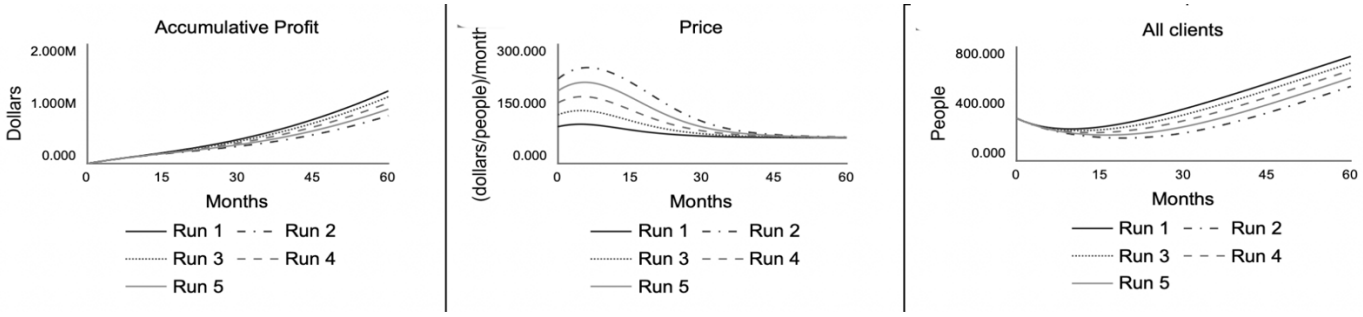


Switch_Policy_2 = 0
UNITS: dmnl
DOCUMENT: This converter is a SWITCH for Policy 2 that expects reducing the time to adjust salesforce to increase the profit.

Time_to_adjust_salesforce = Normal_time_to_adjust_salesforce*(1-Switch_Policy_2)+Switch_Policy_2*Policy_2_Time_to_adjust_salesforce
UNITS: Months
DOCUMENT: This converter includes both normal time to adjust salesforce and switch for the policy.

Appendix C

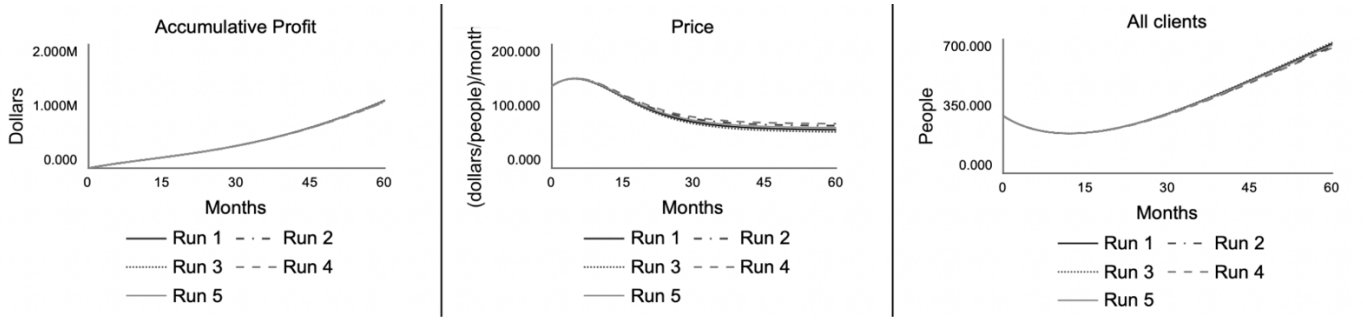
Sensitivity Analysis



Number of runs: 5
Parameter: Desired rate of Salesforce for Offline clients
Distribution: Uniform
Range: 0.05 - 0.2

Figure C.1 – Sensitivity analysis results for a Desired rate of Salesforce for Offline clients

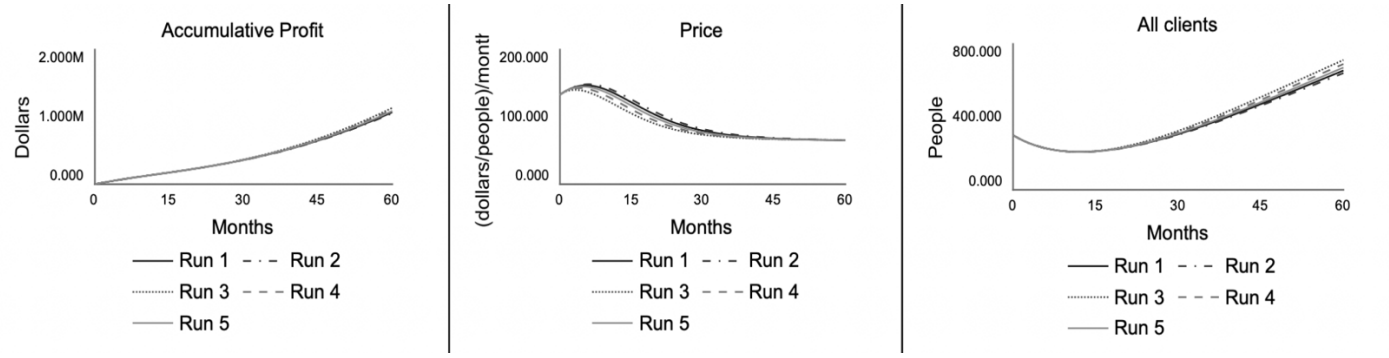
Source: by the author in Stella Architect



Number of runs: 5
Parameter: Desired rate of Salesforce for Online clients
Distribution: Uniform
Range: 0.005 - 0.015

Figure C.2 – Sensitivity analysis results for a Desired rate of Salesforce for Online clients

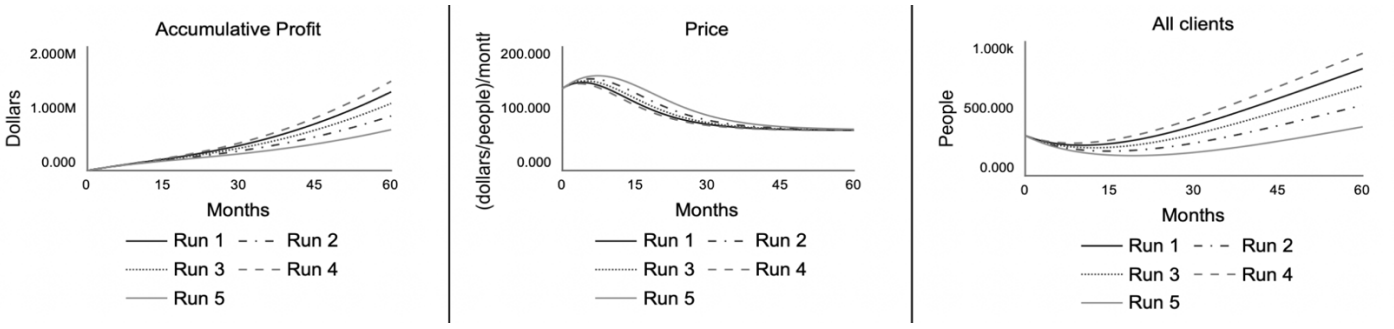
Source: by the author in Stella Architect



Number of runs: 5
Parameter: Normal time to adjust salesforce
Distribution: Uniform
Range: 3-9

Figure C.3 – Sensitivity analysis results for a Normal time to adjust salesforce

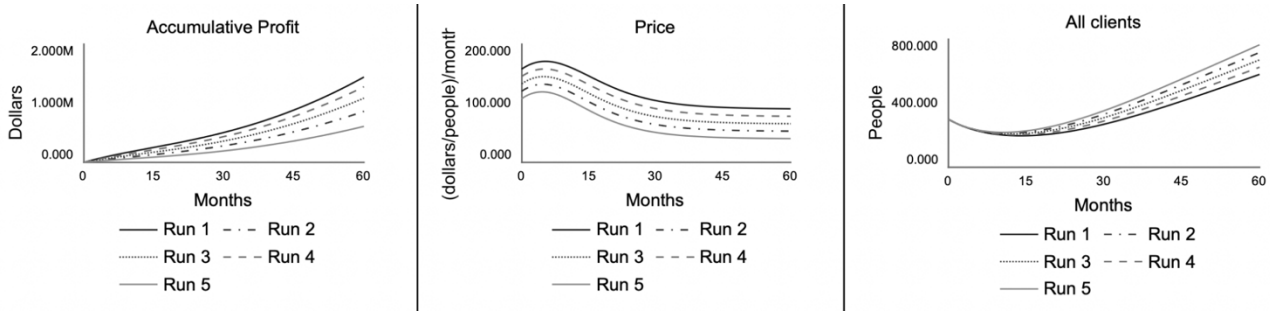
Source: by the author in Stella Architect



Number of runs: 5
Parameter: Investments in Web-Site
Distribution: Uniform
Range: 100-300

Figure C.4 – Sensitivity analysis results for Investments in Web-Site

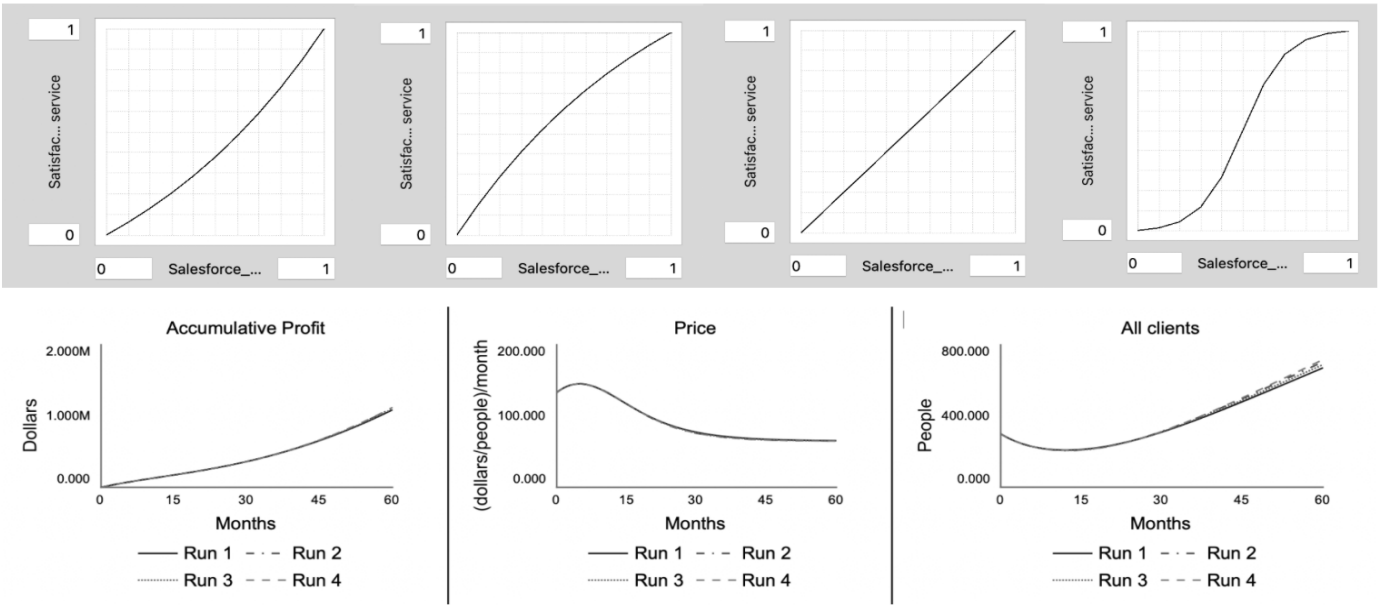
Source: by the author in Stella Architect



Number of runs: 5
Parameter: Fee
Distribution: Uniform
Range: 25-75

Figure C.5 – Sensitivity analysis results for Fee

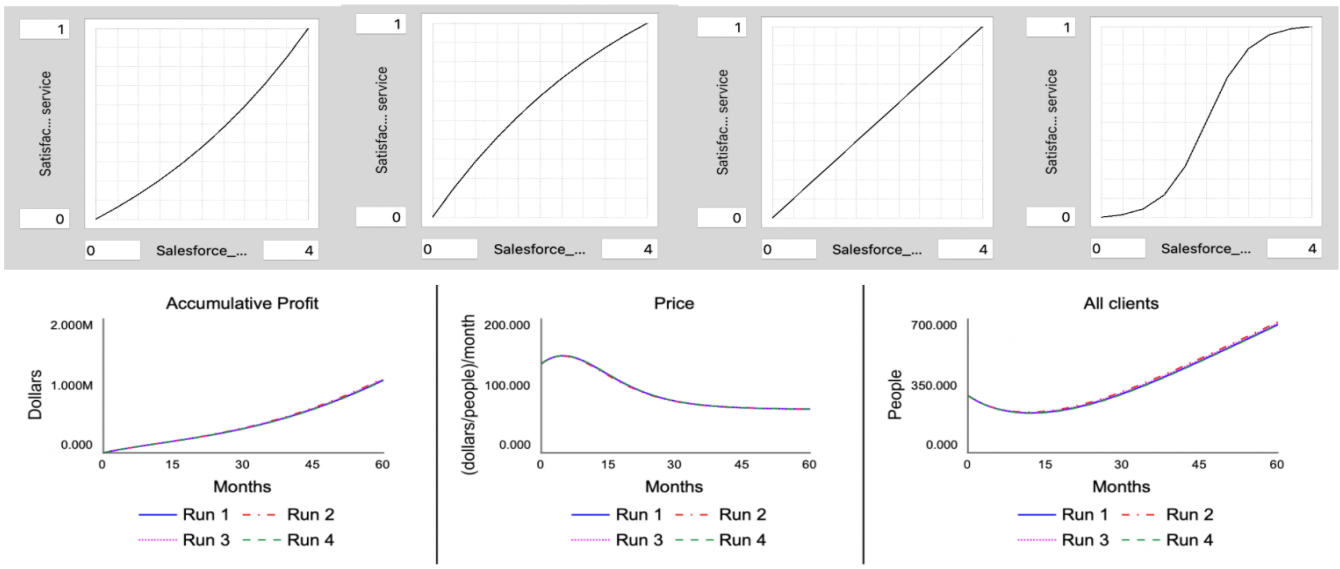
Source: by the author in Stella Architect



Number of runs: 5
Parameter: Satisfaction of Online Service
Distribution: Uniform

Figure C.6 – Sensitivity analysis results for Satisfaction of Online Service

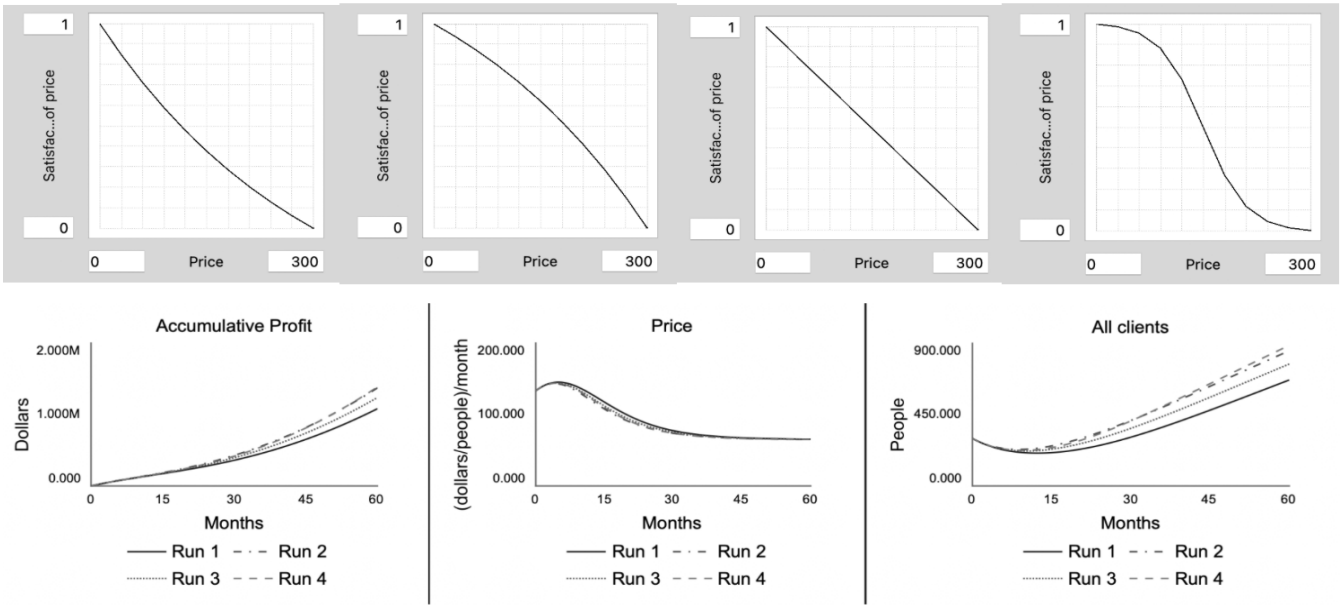
Source: by the author in Stella Architect



Number of runs: 5
Parameter: Satisfaction of Offline Service
Distribution: Uniform

Figure C.7 – Sensitivity analysis results for Satisfaction of Offline Service

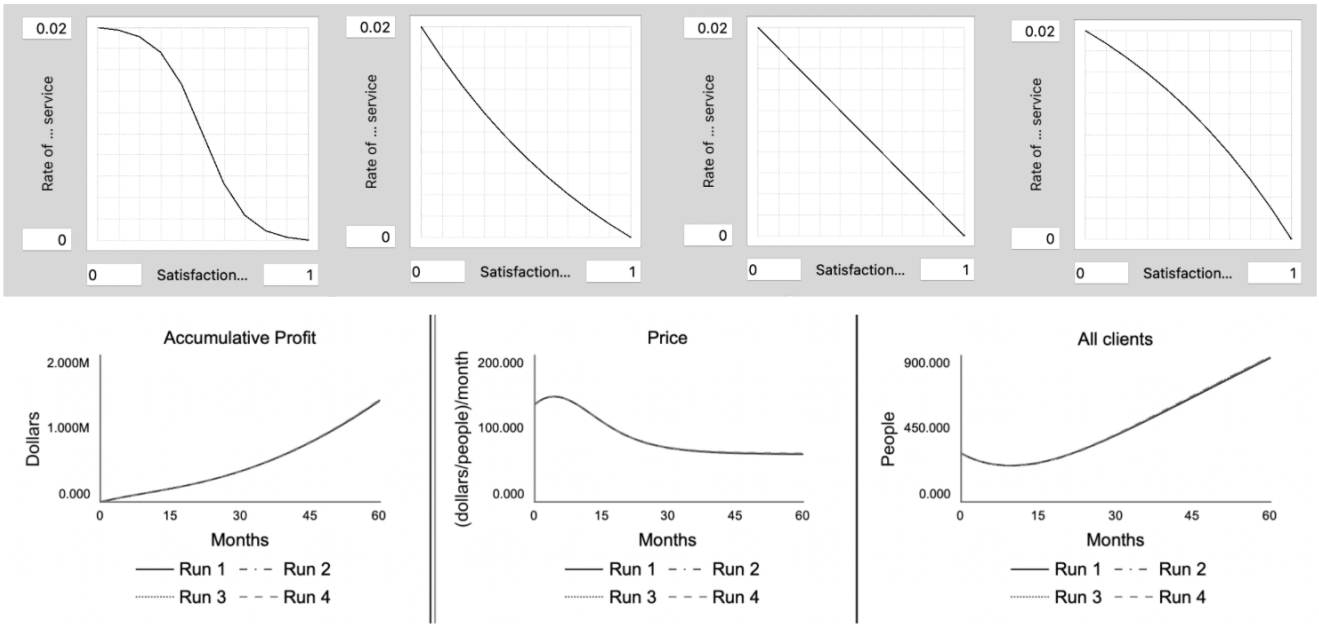
Source: by the author in Stella Architect



Number of runs: 5
Parameter: Satisfaction of Price
Distribution: Uniform

Figure C.8 – Sensitivity analysis results for Satisfaction of Price

Source: by the author in Stella Architect



Number of runs: 5
Parameter: Rate of people who choose Offline service
Distribution: Uniform

Figure C.8 – Sensitivity analysis results for Rate of people who choose Offline service

Source: by the author in Stella Architect