

# Supply Chain in Insurance of High-Tech Companies: Formation Characteristics

Valeriy Prasolov<sup>#1</sup>, Seymour Hajiyev<sup>\*2</sup>, Zarema Sharifyanova<sup>‡3</sup>, Yuliia Diachkova<sup>§4</sup>

<sup>#</sup>*Department of Risk Analysis and Economic Security, Financial University under the Government of the Russian Federation, Moscow, Russian Federation*

<sup>\*</sup>*Department of Finance and economics, Azerbaijan University, Baku, Azerbaijan*

<sup>‡</sup>*Department of Finance and Credit, Financial University under the Government of the Russian Federation Ufa Branch, Ufa, Russian Federation*

<sup>§</sup>*Department of Finance, banking and entrepreneurship, Donbass State Engineering Academy, Kramatorsk, Ukraine*

<sup>1</sup>valeriy.prasolov@yandex.ru

<sup>2</sup>hajievseymur@hotmail.com

<sup>‡</sup>ZFSHarifyanova@fa.ru

<sup>4</sup>uliad318@gmail.com

**Abstract**— This article was aimed at forming an idea of companies' portfolios applying high technologies in the process of modern supply chain insurance business digitalization. For this aim, the analysis of Russian and Azerbaijan insurance markets and the dynamics of their gradual implementation of online technologies was carried out. To compile an objective picture of the current market situation, two insurance firms, namely, AlfaStrakhovanie and Mango Insurance Company, were selected for the research. As part of the analysis, the study examined the supply chain insurance structure of the AlfaStrakhovanie Company. Within the present research, the features of its regulation and diversification were highlighted. Moreover, the study outlined the work specifics of new insurance companies and InsurTech startups in domestic realities. Despite higher possibilities of supply chain disruptions, enterprises in APAC exhibit lesser investment in the supply chain industry because of their lack of knowledge on the same and their reluctance to pay high premiums. The obtained results were based on the Markowitz portfolio optimization model and allowed creating the optimal supply chain structure of the insurance company's portfolio, taking into account the risks associated with the use of modern technologies.

**Keywords**— *Machine learning programs, InsurTech companies, balanced insurance portfolio, supply chain, Markowitz model, ICT.*

## 1. Introduction

From the perspective of both the buyers and the suppliers, this supply chain insurance industry procurement market intelligence report suggests ways to procure at the best market price. In recent

years, many countries are rapidly transitioning to a new type of economy based on modern technologies and knowledge of information communication technology (ICT). Transition into the new economy is characterized by changes in the nature of traditional production areas, shifting the information into the major production resource, with the economic system as the main development factor [1]. The rapid spread of digital technologies poses new challenges for insurance companies that should adequately respond to policyholders' changing needs. Digitalization has made information more accessible and personalized, and processes and mechanisms more simplified. In this regard, technologies applying artificial intelligence (AI) are actively applied in the insurance industry, including various chatbots, cloud databases, and other automation elements. Now, the use of modern developments and discoveries in business is not a unique competitive advantage, but rather a necessity.

Such activity contributed to the formation of a new direction in the field of financial technology – InsurTech. Nowadays, technological modernization of supply chain insurance is considered as an effective mechanism for strengthening market positions. Its popularity opens up new opportunities for traditional business and generates new competitive startup projects. The modern supply chain insurance sector is in the process of fundamental changes which only companies, able to accept and introduce innovations, will be able to withstand. The emergence of new products, online business models, and restructuring of internal mechanisms makes the supply chain insurance sector more mobile and flexible to consumer demands. Along with these processes, information risks that negatively affect the stability of the company also increase. Given the specifics of the supply chain

insurance business, a well-formed portfolio is supposed to be the key to achieving long-term financial sustainability. It plays a central role in the insurance process, serving as a balance of risks and their coverage [2]. Compulsory insurance, which has long been a safety cushion of the supply chain insurance market, brings an overall profit of no more than 5-10% of the total insurance companies' turnover. This amount of money is primarily spent on unprofitable insurance types, indicating the unbalanced portfolio of many organizations [3]. Digitalization has become quite popular among researchers during recent years [4]. Therefore, there are many studies on the relationship of high technologies and insurance both globally [5] and locally [6], [7]. Considerable attention is also paid to the insurance portfolio as the basis of insurance activity [2], [8]. However, the peculiarities of its formation under the company's active use of digital technologies require more thorough research. Therefore, the present study results will be of practical importance and become the basis for further developments.

## 2. Literature review

Insurance is one of the first areas which began to take advantage of AI. Though, the most ambitious changes are yet to come. AI is a digital imitation of human thinking that most often used to analyze data and overcome complex challenges [9]. Researchers from the German insurance company Allianz Global Corporate & Specialty (AGCS) [10] note that such technologies can significantly improve insurance industry value chains. Computerization of insurance processes (for example, portfolio diversification or risk profiling) provides the best quality of customer service, optimizes policy issuing and financial regulation. In Azerbaijan, the conclusion of contracts online and performing calculations for compulsory insurance types positively affects the frequency of fraud cases that involve insurance companies and intermediaries. The electronic contracting also reduces the companies' expenses, thereby giving the opportunity to offer products at a lower price. All this contributes to the overall business competitiveness and insurance market development [11]. The analytical functions of intelligent agents are actively used in risk assessment and data analysis. The introduction of special software in the Azerbaijan car insurance market allows applying a more unified approach for assessing road accidents' damage and significantly reduces customer complaints in this area [11].

On the other hand, the use of AI in the insurance

sector has resulted in many threats associated with this type of activity. First of all, these are cyber-attacks and technical failures that can lead to significant data losses. As a result, one can observe the following paradox: unsafe technologies are the most effective tool for working with insurance risks, even though they promote better risks understanding. The leading players in the insurance business understand this fact and are actively investing in the development of InsurTech projects. For example, the IT budget of the previously mentioned Allianz insurance company in 2018 amounted to \$ 4.3 billion [12]. A similar interest in technological innovations among insurers was noted back in 2017 when investment support of AI increased by eight times [13].

Blockchain technology is considered to be a good "partner" for AI. What is unique about it is that the already entered data cannot be changed or deleted. The user can only add new ones. This fact equally provides both considerable opportunities and a threat to this field. Insurance companies primarily implement blockchain technology in the form of smart contracts – self-executing contracts whose terms are directly written into lines of code. They are regarded as a way to simplify business relationships between customers and investors [14].

The effectiveness of such tools directly depends on proper management. For example, many large insurers refuse to use them due to difficulties with implementation into a traditional insurance model. One of the ways out of this situation may be the change in the manner of conducting business processes. For the quality application of information technology in insurance, a specialized gathering center for collecting and processing data in the sales management department and insurer's risk control center is required. The latter involves such functions as reinsurance and underwriting, which are necessary to create a balanced insurance portfolio [15].

Reinsurance is especially useful in dealing with substantial single risks. It allows counteracting possible losses in unexpected events [16] and enables the insurer to conclude more contracts, expanding and improving the portfolio. The underwriting functions are somewhat broader and consist of risk selection, ranking of essential supply chain insurance conditions, and insurance coverage options [17].

At the same time, analytics, including forecasting, has always been a part of the traditional insurance business model. Throughout the industry's entire existence, insurers have improved risk assessment mechanisms, increasing the company's reliability and building trusting relationships with customers. With the help of predictive analytics, companies are able to identify predictors (parameters that affect the predicted event), e.g., age and driving experience in determining car insurance coverage [18]. High technology application is

a new round of insurance analytical development. According to McKinsey & Company, in addition to accuracy and speed, they give companies a chance to become part of entire digital ecosystems, providing their analytics as a service to other industry players [19].

## 2.2 Problem Statement

This article's objective was to find the best ways to minimize the risks of unbalanced insurance portfolios of those companies that associate their activities with new developments and technologies. To achieve the goal set, the following tasks, presented in the form of structured research stages, were performed (Fig. 1.).

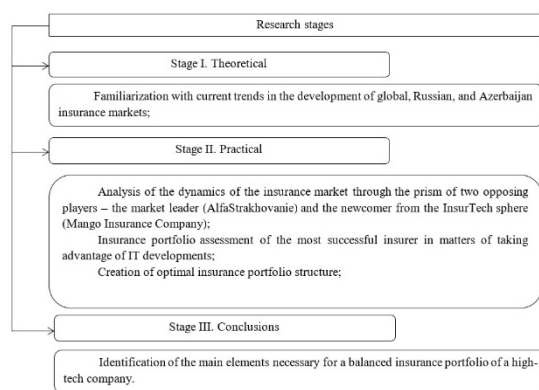


Figure 1. Research structure

## 3. Methods and materials

### Supply chain and risk management

Companies cannot avoid all the risks inherent to their "business model". They may nonetheless make recourse to the mapping of their supply chain in order to identify the threats they are under and reduce their exposure accordingly. Risk assessment is carried out at different levels of the supply chain:

- Within the company itself,
- Upstream: service or raw material suppliers,
- Downstream: distributors, transporters,...
- At the level of corporate environment: economic, geopolitical and climate risks

Supply chain Insurance portfolio analysis supposed the examination of the following criteria:

- Degree of risk of the offered services;
- Profitability level;
- Insurance portfolio structure.

Thus, the insurance portfolio can be categorized as conservative, diversified, and aggressive [2] (Table 1).

Table 1. Supply chain insurance portfolio diversification under the formation principles

Selection criteria	Type		
	Conservative	Diversified	Aggressive
Risk level	Low	Moderate	High (specific risks occupy from 40%)
Revenue	Low	Moderate	High
Structure	Traditional	Combined	Unique

Markowitz's portfolio optimization model [20] was taken as the basis for the development of the optimal insurance portfolio due to the similarity of examined indicators (profitability of securities is equivalent to the insurance profitability level). All necessary calculations were made using the MS Excel "Data Analysis" and "Solution Search" add-ins.

The first step was the determination of the profitability of specific types of insurance. The corresponding calculations were made according to formula (1).

$$P = \frac{\text{Insurance payments, thousand rubles}}{\text{Insurance premiums, thousand rubles}} \quad (1)$$

Then, specific indicators necessary for the model's application, such as the average value of profitability, variance, and standard deviation (standard risk for each type of insurance), were determined. The developed model can be formalized by formula (2).

$$\begin{cases} \sum_{i=1}^n w_i r_i \rightarrow \max \\ \sqrt{\sum_{a=1}^N \sum_{b=1}^N (w_a w_b \text{COV}_{ab})} \leq \sigma_{req} \\ 0 \leq w_i \leq 1; \\ \sum w_i = 1. \end{cases} \quad (2)$$

where  $w_i$  – the share of the  $i$ -type of insurance in the insurance portfolio;

$r_i$  – the profitability of the  $i$ -type of insurance;

$N$  – the overall number of the types of insurance;

$\text{cov}_{ab}$  – the coefficient of covariance between the pairs of specific types of insurance;

$\sigma_{req}$  – the maximum allowable risk of the insurance services portfolio.

The coefficient of payments for the insurance portfolio was calculated as follows:

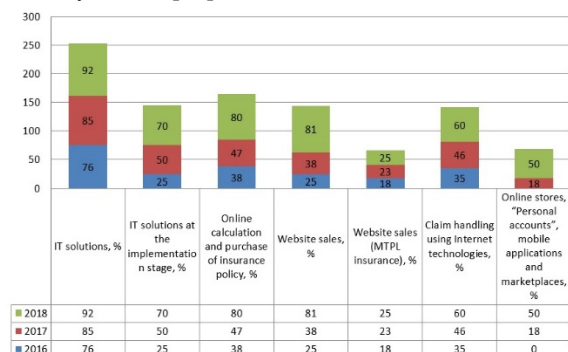
$$C_p = \frac{\text{Insurance premiums received during the year, thousand rubles}}{\text{Insurance payments, thousand rubles}} \quad (3)$$

Under normal conditions, this indicator should be in the range of 40-60%.

## 4. Results

The Russian and Azerbaijan supply chain insurance markets are at the initial stage of digital development

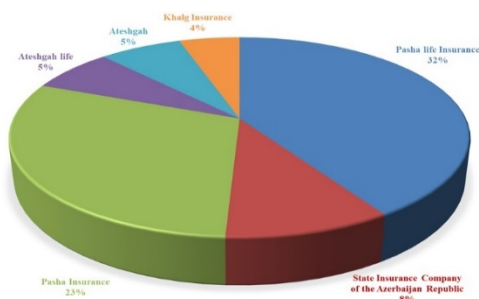
when there is a steady increase in the share of IT technologies and their derivatives [21] (Fig. 2). Nevertheless, the consumer response, in contrast to, for example, the banking sector, is still demonstrating weak dynamics [22].



**Figure 2.** The number of insurance companies working with IT and Internet resources (expressed as a percentage of positive answers among respondents of Expert RA surveys).

In the Russian insurance market, one can observe a tendency towards a reduction in the number of participants. In 2014, 404 insurers were officially registered in the market. However, by 2019, there remained only 122 universal companies and about 70 organizations that offer exceptionally medical and life insurance [23]. A similar decrease can also be observed in Azerbaijan – from 62 in 1991 to 22 in 2019 [24], [35]. This implies the presence of a considerable number of outstanding claims, which entailed lawsuits and a decrease in trust to the insurers among the population. In such circumstances, it is crucial to monitor the supply chain insurance portfolio balance, especially for those companies that apply risky technologies.

Azerbaijan’s supply chain insurance sector is mainly represented by six firms, which cover 77% of the market at supply chain insurance premiums (Fig. 3).



**Figure 3.** Leading supply chain insurance companies in Azerbaijan for October 2019.

Source: developed by the authors based on data adapted from the Central Bank of the Republic of Azerbaijan [25].

In the Azerbaijan market, the leading share of insurance products is held by compulsory insurance, the development, and implementation of which is carried out by the country’s legislative and executive authorities. The development of voluntary insurance is limited by the lack of competent insurance products’ promotion, combined with the habits of the population inherited from the Soviet Union – all rely on the state and not to take independent care of neutralizing risks [26].

Although growing, the country’s level of financial inclusion is low, particularly considering Azerbaijan’s relatively high per capita income. Less than one-third of the population has a bank account, and only one-quarter has a debit card. Mobile money is rarely used by the population due to limits on the amount of a transaction and other restrictions. The low penetration of credit cards, mobile money, and e-wallets are undoubtedly holding back the development of the country’s digital economy and, as a result, the digital growth of the insurance industry [27].

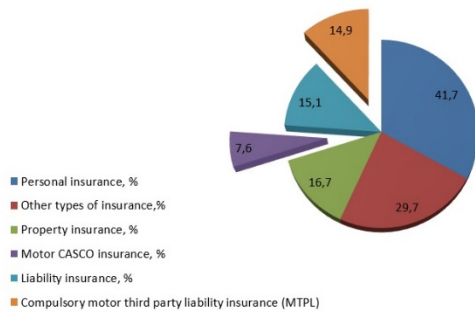
Two main types of insurers can be distinguished in the market – large companies with extensive experience in traditional insurance and new high-tech startups that offer modern approaches to the provision of standard services. Within the framework of the study, it was decided to dwell on a detailed analysis of one representative from each group (Table 2).

**Table 2.** Data on insurance companies participating in the study for 2019

Company name	Insurance premiums, thousand rubles	Insurance payments, thousand rubles	Payout ratio, %	Contracts		Insurance events	
				Concluded during the reporting period, number	In force at the end of the reporting period, number	Claimed	Settled
AlfaSt	108	58	5	48	16	5	5
	352	734	4	149	748	64	75
rakho vanie	589	84	%	37	29	972	098
		9		0	2		
Mang o	453	252	77%	38	29	11	11
				82	78		

Source: developed by the authors based on data adapted from the Central Bank of the Russian Federation [28].

An example of the successful interaction of traditional insurance with IT technology elements is the experience of the AlfaStrakhovanie insurance company. Being a part of the large-scale Alfa Group consortium, the company has been at the forefront of the market for several years and now provides a wide range of services. In 2019, it confirmed its financial strength by receiving a “ruAA+” rating with a stable outlook [29]. At the same time, diversification of the company’s supply chain insurance portfolio remains at a high level (Fig. 4).



**Figure 4.** The structure of the AlfaStrakhovanie insurance portfolio by type of insurance services.

The personal insurance category includes any voluntary and compulsory insurance offers – from life to pension insurance contracts [30]. Motor CASCO insurance is especially popular among property insurance (highlighted separately on the diagram). Nevertheless, the company also acts as insurers for cargo, agricultural sector, private and corporate property, as well as financial and business risks. A separate niche was taken by liability insurance and one of its types – compulsory motor third party liability insurance (MTPL).

AlfaStrakhovanie is trying in every possible way to modernize the process of providing insurance services, to make it more simple and understandable for consumers. One of the latest innovations is the development and launch of the application for remote collaboration. It allows the one to perform the regulation of insurance claims, purchase the company’s products, and receive service support [31]. The last option has become particularly relevant in light of recent events related to the introduction of quarantine measures due to the massive spread of COVID-19. As a result, despite the market instability, the company steadily holds its pre-crisis positions. Such special services, in addition to profit, also represent a kind of threat associated with insurance risks. The portfolio becomes aggressive and requires additional support to maintain financial stability. The best solution for this issue is reinsurance. Hence,

various reinsurance companies of Munich, Switzerland, Hanover, and Cologne as well as SCOR, Partner Re, and Lloyd’s of London corporation act as partners of AlfaStrakhovanie. Their cooperation with syndicates is carried out through international brokers Willis Limited, Marsh, and AON Benfield [31]. All of them have a rating of “ruAA” over the Russian national scale, denoting a high degree of cooperation reliability. The payout ratio in the AlfaStrakhovanie supply chain insurance company for 2019 was 54.21%, which provides evidence of its favorable financial situation.

Mango insurance firm, an analog of the American Lemonade company, became the first licensed InsurTech organization in Russia [32]. As of 2019, Mango’s payout ratio was 77%, which can be considered the norm, given that this was the first year of their work. Mango is still trying to gain a foothold in the market. Consequently, a positive reputation among existing and potential consumers is of most concern to them. Mango’s insurance portfolio is also under development. Now it consists of only two components – property insurance (67.5%) and liability insurance (32.5%). Though, in the future, it is supposed to be diversified with other insurance types.

With the purpose of designing the optimal form of a high-tech company’s insurance portfolio, the application of the well-known Markowitz model is proposed. Even though it was initially developed for the investment sector, the basicity of its approaches is applicable to insurance business conditions. The information on the AlfaStrakhovanie portfolio was taken as the basis of the model, including the most popular insurance services among consumers (Table 3).

**Table 3.** Optimal portfolio of insurance services for high-tech companies (based on AlfaStrakhovanie data)

№	Insurance type	Profitability (average)	Risk	Portfolio structure, %
1	Motor CASCO insurance	47.06	0.29	30
2	Accident insurance	83.68	0.046	5
3	Personal and corporate property insurance	85.39	0.054	30
4	MTPL insurance	60.52	0.65	5
5	Voluntary	27.96	0.15	30

	health insurance			
Total		100		
Total portfolio risk				5
Optimal return				75

Hence, with the chosen minimum risk level of 5%, the resulting profit is 75%. The priority place in the portfolio should be given to property, car, and voluntary medical insurance types. This kind of model is considered effective in shaping the strategy of an insurance company. Nevertheless, it should be revised annually to review the portfolio structural component in view of the fast changes in market trends.

## 5. Discussion

In the global insurance market, in addition to such key stakeholders as AXA Group (France) and Allianz (Germany), which use advanced technologies to strengthen their established positions, new startup projects offering the most modern insurance functions are actively appearing. For example, the work of the American insurance company Lemonade [33] is wholly based on a digital platform. It has no ordinary offices; thus, all communication and interaction with customers occur in an online mode through the website or mobile application. The company operates on the basis of AI, which allows it to work effectively with fewer agents, at lower costs, and processing applications in several minutes. For now, the company's insurance portfolio is rather monotonous and focuses mainly on traditional types of personal insurance. However, Lemonade plans to expand the range of services gradually. The global experience shows that the conclusion of insurance contracts and making payments online can reduce companies' expenses, increase their competitiveness, and positively affect the level of fraud in payments between insurance companies and intermediaries [11].

In the Russian insurance market, in addition to already analyzed startup, there is one more project of the Absolute group – Mafin [34]. These days, it specializes only in the sale of CASCO and MTPL supply chain insurance policies. The company performed a full-fledged transfer of all insurance process to the online mode. Besides, Mafin's insurance platform has built a liberal pricing policy. Taking advantage of machine learning algorithms

and neural networks in the analysis of big data reduced the policy prices by 10-20% for 70% of buyers. It should be especially noted that the strategic goal of Mafin is not an extensive market coverage but testing new technologies for further implementation in the insurance portfolio of Absolute Group. It is too early to talk about Mafin's portfolios' structure since the company is in the process of gaining its strength and formation of the final list of services.

It is essential to pay attention to research related to managing the supply chain insurance portfolio. American economist Edward Fries presented his own indicator for determining the portfolio risks – risk measure relative marginal change (RM2) [35]. Hence, the concept of a risk measure is the amount of assets needed as protection against the risk's uncertainty. Forming separate models for dependent and independent risks, he offers three options for possible strategic interactions with the client: obtaining insurance franchises, coinsurance, and payment of the maximum annual amount of money (the choice of deductible, coinsurance, or upper limit). When forming an insurance portfolio, it is crucial to remember the danger of an excess of so-called market "safety cushions" in the form of compulsory supply chain insurance. Occupying a large part of the portfolio, they bring minimal profit, leading to an unbalanced insurance portfolio of the company [3].

Such statistical techniques, as the method of covariance analysis, can be used not only to determine the structure of the insurance portfolio but also to study the impact of information technology on the development of direct insurance [36]. As an example, the authors have examined the ANCOVA model, which allowed taking into account both quantitative and qualitative variables, as well as homogeneous and heterogeneous statistical data. Based on the information retrieved from the largest insurers, researchers have identified and analyzed the relationship between the introduction of electronic policy systems and the amount of insurance premiums. Their research materials are of practical importance for insurers because it gives the concept of a correlation between business digitalization and profitability level [11].

For conducting a similar examination, correlation and regression analyzes can also be used. With their help, Zarina, Voronova, Petteere [37] have proved that digitalization has a positive impact on the speed of claims processing.

## 6. Conclusions

Summarizing the study on supply chain insurance markets, it can be concluded that a universal insurance portfolio structure does not exist in Russia and Azerbaijan markets. The key to a balanced supply chain insurance portfolio is finding an optimal ratio between the expected profit for each type of supply chain insurance and the level of risk. Given the high risks of using high-tech equipment, associated with technical failures and lack of qualified personnel, supply chain insurance companies, working with such technologies, should form their portfolio carefully, avoiding excessive reliance on supply chain insurance “safety cushions.” Since supply chain insurance companies provide specific services, their portfolio can take an aggressive form, leading with time to a loss of financial stability. Based on the analysis of one of the most successful companies in the market, it can be stated that the involvement of reliable partners to provide portfolio reinsurance will contribute to solving this problem. In such a way, the companies can balance the risks associated with the technical and organizational features of working with machine learning programs and increase the overall portfolio profitability.

On another note, the examination of new supply chain insurance market players (InsurTech startups), explicates that they are only entering the industry and occupy a small niche position. In the current situation, their weak portfolio diversification does not have a negative impact on operating activities. Over the next few years, such firms should consider expanding the range of services since, despite the low cost in execution and response to modern consumers’ needs, a narrow specialization will undoubtedly lead to the loss of their stability. Therefore, the tested model can contribute to the formation of a balanced insurance portfolio for InsurTech companies.

It should be particularly noticed that Russian and Azerbaijan supply chain markets are fully open to any technological innovations. Even though today’s number of newly-created supply chain insurance firms cannot compete with existing leaders, the situation may change dramatically against the backdrop of the rapid growth of a similar direction in American and European insurance sector over the next five years. Traditional supply chain insurance companies should consider attracting IT technology to their business, if not to optimize internal processes, then to provide new services. With similar purposes,

they can implement investment support for various new startups or create projects based on their own or cooperative research base.

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