

# *Technological innovations in the insurance industry*

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*Abstract.* The main idea of this article is an overview and analysis of the technological innovations in the insurance industry. First of all, the authors have characterised the driving factors of innovative development in the insurance industry. Secondly, the innovation in the financial sector was described as an invention and as an adoption. The main part of the paper was based on an overview of the use of technological innovations (such as software, analytics, sensors, algorithmic) for the effective insurance value chain. At the end, the authors have made a SWOT-analysis of the technological innovations.

*Keywords:* technological innovations, insurance industry, risks.

*JEL Codes:* G22, O31.

## **1. Introduction**

Today, the insurance industry is considered among the most innovative industries in the world [Hocking et al. 2014]. This process is primarily driven by factors, such as the development of technologies that are being implemented at different stages of the provision of insurance services. The insurance company's growth of dependence on innovation in other industries requires elasticity in the strategic planning of its development. Innovations are becoming the main tool of competition in the market, which give an opportunity to add value to insurance products.

Among the factors that determine changes in the insurance market are: increased risks, development of technology, asymmetry of information, a change in generations and their social norms (the Millennials or Y generations) – the future clients of insurance companies and other. Development of technologies (e.g. Big Data analytics, Internet of Things, Artificial Intelligence, autonomously controlled technical means (automobiles, drones), connected sensors). The basis of insurance

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is the collection and processing of a large array of statistical indicators (Big Data) to construct models, which can stimulate the behaviour of events in terms of the probability theory. For centuries, insurers have been the main collectors of such data. However, today, companies such as Google, Apple, Amazon, Facebook are capable of performing similar functions. Mobile devices (mobile apps) simplify and speed up the process of customer interaction with an insurance company. Secondly, mobile devices provide an opportunity to monitor and record changes in factors affecting the risk of the insured, such as the manner of driving a car or the level of blood pressure of the insured person.

The asymmetry of information between a client and an insurer is the driving force behind innovation in the insurance market. Innovation is the answer to the imperfection of existing interconnections in the insurance market, which prevents market participants (insurers, reinsurers) from reducing their risks and maximising their productivity. The lack of complete (sometimes reliable) information about the subject of insurance increases the company's underwriting risks, in particular, in assessing the risks of specific objects or health. For example, for a relatively small price, a person can test his own DNA and get complete information about his own genetic diseases. Given this information, a person has the motivation to buy insurance with appropriate coverage. From the point of view of the insurer, this can be interpreted as the use of insider information. But from the other side, in practice, by having such information, insurers can make a negative selection among the consumers. So, it is a very thin dividing line between what is a fair, legal usage of information and what is unfair. In some countries, a genetic test as an obligatory condition for the client, has been outlawed according to the antidiscrimination policy (Germany, USA, etc.).

As there are many works in contemporary scientific literature that consider innovations and their role for entrepreneurship in general terms, the aim of this paper is a theoretical research of the role of technological innovations in the insurance industry.

## **2. Determinants of innovations and their functions for entrepreneurship: basic principles**

It is believed that the first scientific definition of innovations and their significance for entrepreneurship was given by J. Schumpeter. He characterised innovations as changes of the combinations of the factors of production that cannot be affected by infinitesimal steps or variations in the margin. They consist primarily in changes in the methods of production and transportation, or in the production of a new article, or in the opening of new markets or of new sources of material [Sweezy 1943, pp. 93-94]. Drucker [1985] gave a similar definition: the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth.

It can be said that innovation is a change that has an economic and technological character. According to the most widespread definition proposed by the OECD, innovations include the introduction, combination and use of new knowledge and technology for products, services, production and administrative processes [OECD 1992]. It should be noted that every company has an individual criterion of defining “new”, so it does not matter whether the innovation has already been introduced in other companies. That is, innovations are characterised by four main features: usefulness, new methods, new results and uncertainty.

The process of innovation is characterised by a high degree of uncertainty. Knight [1964] emphasised that uncertainty is fundamentally different from risk. Not only because of the unknown probability of obtaining income from innovation, but even the form of this income (tangible or intangible). This information is especially acute for investors who learn about the effectiveness of an investment only after the completion and real-life implementation of an innovation. Secondly, the problem with the assessment of innovation is exacerbated by the influence of factors that may distort (twist) the results [Scherer, Harhoff 2000]. There are studies, which confirm that the distribution of return on an investment has the character of the Pareto distribution: the dispersion is equal to 0 or coincides in large samples. Very often, an assessment of the effectiveness of investments is made by experts on the basis of their own experience and judgment [Kerr, Nanda, Rhodes-Kropf 2014]. Thirdly, it is difficult for both the investor and the innovator (developer) to assess the potential of an innovative project. This is especially true for start-ups, where it is unknown what the ultimate developed product will actually be<sup>2</sup>. As practice shows, financial innovations can have an unpredictable negative impact on consumers. For example, the economic crisis of 2008-2009 in the United States and a number of European countries is associated with the emergence and use of new financial innovations in the market, that is, the role of this phenomenon in the development of the crisis still remains the subject of research [Laeven, Levine, Michalopoulos 2012; Sánchez 2010, p. 27].

The violation of established compromises by means of innovative changes allows the company to reach a strategic place in the market, offer customers a lower price for their products and achieve the highest performance, which the competitors cannot compete with [Raynor, Christensen 2003]. Innovations can be effective not only as tools for lowering costs or optimising company funds, but also for bringing non-monetary benefits to clients (e.g. to save time, provide more information, comfortable communication). Therefore, the use of value of an innovation for the company is subjective.

The existence of an innovation covers two stages: the process of invention (research, development) and diffusion (adoption), adaptation of a new product, service, or idea [Rogers 1995]. An invention in the financial sector, in most cases, is only an improvement of existing tools or interconnections, since nothing is entirely new,

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<sup>2</sup> More about the organization of Research & Development activities in an incomplete contracts framework was discussed by [Hart 2017; Jensen, Palangkaraya, Webster 2013; Aghion, Tirole 1994].

and the degree of novelty of the invention is very subjective. This raises difficulties when determining the criteria for the division of innovations into distraction and diffusion. The problem of clearly defining the criterion of innovation leads to the emergence of a large number of the so-called “*innovations*”, given the weak patenting mechanisms [Blach 2011, p. 22]. In addition, according to some authors, there is no pure diffusion, since each action for adaptation has a chance to create something new or requires some innovative action to adopt the new technology [Jovanovic, Rob 1989, pp. 570-572; Buera, Oberfield 2015; Benhabib, Perla, Tonetti 2017]. Similarly, every process of invention requires the adaptation of already existing (sometimes foreign) knowledge. Therefore, the division for radical and incremental innovations can be considered relative. Clearly, the selection of criteria for the classification of innovations is problematic: the names of innovations in the insurance sector are often uninformative; innovations are characterised by both common and distinctive features (this is informative, but limits the possibilities of taxonomy). In the Figure 1, the main criteria and general types of innovations have been shown, which were marked in literature, and the specific types of innovations will be presented in the following topic.

Figure 1. General classification of innovations in the insurance

Degree of novelty	<ul style="list-style-type: none"> <li>• Incremental</li> <li>• Radical</li> <li>• Evolutionary</li> </ul>
Forms	<ul style="list-style-type: none"> <li>• Products</li> <li>• Processes</li> <li>• Organizations</li> <li>• Business models</li> </ul>
Results	<ul style="list-style-type: none"> <li>• Technological</li> <li>• Financial</li> </ul>
Drivers	<ul style="list-style-type: none"> <li>• Customer</li> <li>• Technology</li> <li>• Design</li> </ul>
Size	<ul style="list-style-type: none"> <li>• Global</li> <li>• Local</li> </ul>

Source: Authors’ own elaboration based on [Nicoletti 2016; Hocking et al. 2014; International Association of Insurance Supervisors 2017].

## 2. Existing research on innovations in the insurance market

In scientific literature, the problem of innovation occupies an important place and many works are devoted to it. For a long time, this concept had a technical nature and was mostly used to characterise the achievements of industry. However, with the development of the financial market throughout the world, innovations are

increasingly used to characterise new financial instruments, new B2B (business to business), B2P (business to people) or B2C (business to customer) interconnection, or organisational structures in companies.

The research of innovations in the insurance market mostly applies to digitalisation in motor insurance and to the introduction of various insurance products. First of all, it is caused by a large share of motor insurance in general sales. And the second is, in our opinion, due to the problem in choosing the method of analysing innovations. A quantitative assessment of innovation requires data collection of the tangible (or intangible) effect of its implementation and the cost of development. Typically, insurance companies do not disclose such information, especially in the case of negative results. In table one, it was proposed to collect works, the purpose of which was to study various aspects of innovation in the insurance market (in English only).

*Table 1. The researches of the innovations in the insurance industry*

<b>Authors</b>	<b>Title</b>	<b>Object</b>	<b>Innovations</b>	<b>Methodology</b>
Nicoletti [2016]	Digital Insurance. Business Innovation in the Post-Crisis Era	Products, Processes, Organisations, Business models	Technological	Overview, SWOT-analysis
Peterson, Rudelius, Wood [1972]	Spread of Marketing Innovations in the Service Industry	Life insurance industry	Premium differentials for women; Family policy; Guaranteed purchase option	Multiple-regression analysis
Desyllas, Sako [2013]	Profiting from business model innovation: Evidence from Pay-As-You-Drive auto insurance	Automobile insurance	Pay As You Drive - insurance	Overview
Pearson [1997]	Towards a historical model of services innovation: the case of the insurance industry, 1700-1914	Link between model of economic innovation and cycles of innovation in British insurance industry	Different types of insurance	Overview
Lado Maydeu-Olivares [2001]	Exploring the link between market orientation and innovation in the European and US insurance markets	Innovation degree, innovation performance	New insurance products	Questionnaire, correlation

Source: Authors' own elaboration.

Based on the conclusions of Catlin, Paliath, Segey, a thoughtful digitisation program can deliver up to 65% in cost reduction, a 90% reduction in turnaround time on key insurance processes, and improve conversion rates by more than 20% [2014]. The study of Desyllas and Sako [2013] confirms the benefits of introducing the PAYD

(Pay As You Drive) system in motor insurance, since the division of policyholders according to their risk criterion enables an efficient fair distribution of the rate and insurance reimbursement. Another positive outcome of the introduction of PAYD is the improvement in policyholders' discipline on the road while driving, thus reducing the number of insured events. This is how, for example, Karapiperis et al. [2015] justify how telematics in transport insurance can solve the problem of fair insurance rates and provide the client with an adequate, positive cost of insurance services.

When analysing innovation in the market of property insurance, Bednarczyk and Jańska [2015] consider a whole chain of property insurance services: from distribution to the elimination of insurance loss as well as a retrospective replenishment of insurance risks in insurance coverage (historical change). As was admitted by Nicoletti [2016, p. 43], disruptive innovations could bring benefits to the insurance company if using such innovations does not cause a big lose in a geographic area or product segments.

### 3. Methodology of research

The methods of studying innovations in the insurance market that are mentioned in the works listed in Table 1 depended on a specific purpose. Among the main methods on quantitative assessment of innovation are: SWOT-analysis, questionnaire, correlation-regression model, multiple-regression analysis, overview.

It is worth to pay attention to the model proposed by Peterson [1972, pp. 486-488] to evaluate innovation. According to Peterson, when choosing innovations for analysis, there are four criteria. Innovations should be clear and easy to identify (have boundaries); have a significant role in the activities of the company and be recognised by the state regulatory body; represent a significant leap in comparison to the previous proposals; should not have artificial limitations of diffusion.

Peterson's research was based on an analysis of the correlation between the date of the introduction of an innovation and the size of the firm (positive correlation), its rating (positive correlation), annual sales volume (positive correlation), increase in sales (negative correlation). Peterson's proposed model of innovation was mathematically expressed:

$$M = \beta_0 + \beta_1 T + \beta_2 R + \beta_3 TR + E$$

where:  $M$  – innovation index,  $T$  - type of firm (0 for a mutual insurance company and 1 for joint-stock company),  $R$  – rating,  $TR$  – indicator which reflects the relationship between the type and size of the company,  $E$  – error;  $\beta_0, \beta_1, \beta_2, \beta_3$  – correlation indicators.

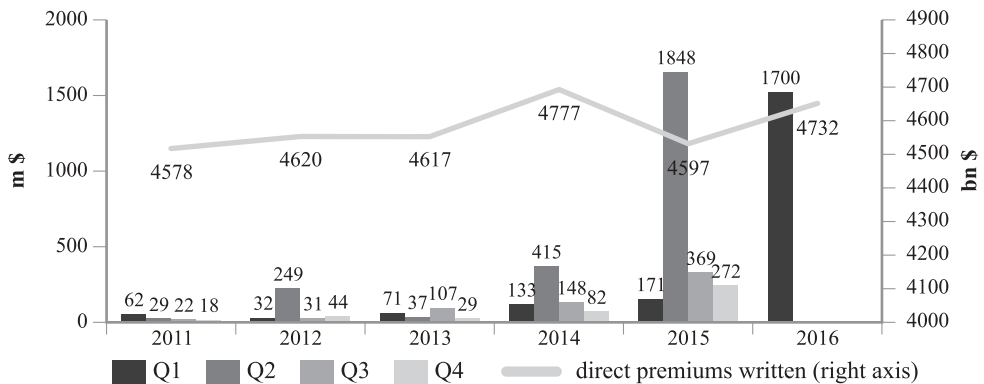
In the article, the SWOT-analysis was proposed to present different sides of innovations.

#### 4. Overview of the innovations in the insurance industry

History shows that technological innovations are increasingly adapting in society. To reach one million users, the following was necessary: 110 years for the phone; 49 years for television; 22 years for the cell phone; 14 years for the internet; 8 years for the smartphone; 8 years for Facebook [Hocking et al. 2014]. That is, the role of technology and its availability in people's lives is increasing and insurance companies must take them into account in the struggle for effective activity. Each year, the investment into technological innovation for the insurance market is growing globally. As Figure 2 shows, since 2011, the cost of innovation has increased from \$62m to more than \$2bn in 2015. Geographically, the growth of InsurTech investments was located in USA, Germany, India, United Kingdom, France, China and Canada [FinTech Developments 2017]. The main factors that led to this growth can be identified as innovation supply, demand and environmental drivers:

1. reduction in the demand for insurance products. The direct written premium has decreased in 2014 from \$4,777bn to \$4,397bn, and in 2015 was admitted the high increase of InsurTech investments (see Figure 2);
2. reduction of liquidities in the financial systems;
3. increased risk and uncertainty about the future;
4. consequences of changes in innovation policy.

Figure 2. World InsurTech investments and direct premium written; 2011-2016



Source: Authors' own elaboration based on [International Association of Insurance Supervisors 2017, p. 4; Hoking et al. 2014; Swiss Re Institute 2017].

The main types of innovations that were implemented in insurance activities include:

- Digital platforms – Internet, smartphones;
- Internet of Things – connected and smart devices that enable to collect data;
- Telematics / Telemetry – sensors that allow to receive, transmit and process data through telecommunications without affecting control on the remote objects;



- Big Data and Data Analytics – modelling data to support decision-making;
- Comparators and Robo-advisors – online services that provide automated, algorithm-based product comparison and advice;
- Machine Learning and Artificial Intelligence – modelling of predictions.

It is expected that, in Southern Europe, less than 1/3 of the revenue forecasted by 2018 insurance companies will be received from the sale of insurance services related to digitalisation. In the Nordic countries, this figure is expected to reach 62%, in Eastern Europe - 29%, in Western Europe - 51%, in the US - 42% [Broeders, Khanna 2015].

Almost every process in the insurance value chain is being revolutionised by technological innovations, but, first of all:

1. Client interaction and channels – personification of forms and channels for customer relationship. Insurance companies have the opportunity to expand their customer base by using new forms of marketing on the Internet. Connection also means real-time services for clients during the validity of the insurance policy. To realise this goal, insurers modernise their consumer-facing systems using Customer Relationship Management software. Chatbots provide real-time feedback and insurance consulting to deliver quality service and improve the business' bottom line. Based on using algorithms, an insurance product was generated that enables to insure an object based on photography (for example, *SnapSure* and *Cover*).
2. Flexible and low-cost, error-free and fast claim processing and core policy management. This software is created for improving claims and billing processes, geographical reach and original propositions of insurance. The start-ups *Trov* and *FinanceFox* offer full management of the insurance claim process. In addition, some technological innovations have been focused on the efficiency of insurers' back-office operations in order to reduce costs.
3. Integrate, manage and analyse data from various sources, including the Internet of Things and telematics. The increasing number of connected devices, combined with analytical software, have allowed insurers to capture more information on policyholder's behaviour and is improving their understanding of individuals. But it must be admitted that insurers and technology firms need to implement adequate technical and organisational steps to support the security of personal data in their collection, its sharing, processing, correction and to prevent any cyber incidents, breaches or unintended use.

Artificial Intelligence enables to forecast important changes in weather or health monitoring to make insurance more effective. In motor insurance, it allows insurers to supply products based on vehicle use or the behaviour of the driver (*Pay as You Drive*). In health insurance, the company can change the premium set based on vital signs (for example, *Clover Health*, *Embroker*). In property insurance, InsurTech devices help to control and monitor the situation with smoke or carbon monoxide meters.

A new form of insurance is On Demand insurance, which allows to cover risks that one faces at a certain moment: of pay-per-use or period based products. These



insurance products are applicable when using online services, such as Uber or Airbnb. They could enable the cross-selling of product insurance directly at the point of sale in e-commerce (for example, *Simplesurance GmbH*).

One of the new phenomena in the market is the “*digitally born*” insurance companies, which are created in the form of start-ups. According to experts, this gives the opportunity to reduce the insurance rate by 20%. In some cases, individual start-ups are focusing on improving specific aspects of the insurance processes, but in the case of peer-to-peer business models (a form of individuals self-organised pool of risks and capitals), they could squeeze out insurers. In addition, peer-to-peer insurance could also function on blockchain transactions. That is, all business processes that are typical for a traditional insurance company are completely transferred to the network.

Table 2. SWOT-analysis for digital insurance

<b>strengths</b>	<ul style="list-style-type: none"> <li>- creative brand;</li> <li>- real-time risk management (in terms of places and time);</li> <li>- high level of privacy for clients;</li> <li>- effective risk underwriting;</li> <li>- fast pay offs (P2P, P2C);</li> <li>- reduced operational costs;</li> <li>- decrease in insurance frauds;</li> <li>- improved internal communication.</li> </ul>	<b>weaknesses</b>	<ul style="list-style-type: none"> <li>- the quality of service depends of the quality of devices and connections;</li> <li>- necessary technical support (call centres, live chats);</li> <li>- exclusions of potential no-devised clients;</li> <li>- low possibility of human decisions;</li> <li>- lack of clear state regulation;</li> <li>- strong integration with other branches;</li> <li>- smaller risk pools in the same types of insurance;</li> <li>- uncontrolled operating systems, handsets and network operators.</li> </ul>
<b>opportunities</b>	<ul style="list-style-type: none"> <li>- creation of new products and fulfilment of customers’ needs;</li> <li>- possibility to include young people;</li> <li>- increase of selling possibilities (omnichannel);</li> <li>- management of claims process more effectively;</li> <li>- higher degree of customer trust;</li> <li>- improving company service;</li> <li>- granular risk categorisation;</li> <li>- cost-effective processes.</li> </ul>	<b>threats</b>	<ul style="list-style-type: none"> <li>- loss of data;</li> <li>- cyber-attacks;</li> <li>- dishonest market competition;</li> <li>- offers of insurance by other industries or in other ways (e.g. crowdfunding);</li> <li>- possibility of high losses in case of failed disruptive models;</li> <li>- disruption of the conventional risk pooling.</li> </ul>

Source: Authors’ own elaboration.

To analyse digital innovations in insurance, we use the SWOT-analysis. This method will allow us to evaluate the qualities, strengths, weaknesses, opportunities and threats of innovativeness in the insurance activity. During the twentieth century, the main problem in the insurance market was the lack of or limited information and statistical data. Mainly, this was relevant for actuaries, underwriters, and liquidators

of losses, since their activity was based on accurate calculations and had an important impact on the effectiveness of the insurance business. With the introduction of computer technologies and the ability to quickly process a large array of data, the quality of work on the specified areas has increased. Modern digitalisation tools make it possible to track changes of the indicators of the insured object in real life and automatically adjust insurance rates as well as take steps to prevent or reduce insurance loss. The obtained data arrays provide the possibility of a qualitative simulation of threats (risk simulation).

The asymmetry of information has caused one more problem – a weak boundary between the “*fair*” distribution of rates among clients from different risk groups and solidary distribution of cumulative insurance risk among clients. This question is increasingly becoming a cornerstone in assessing the factors of demand for insurance. Customers decide on the expediency of insurance coverage based on two indicators: the value of the insurance rate and the possibility of obtaining insurance reimbursement. Even back in 1967, Bickley wrote about the pricing problem in the insurance market [Bickley 1967, p. 180].

## 5. Conclusions

Based on the research presented in the article, the following conclusions can be drawn:

1. Insurance is one of the most innovative industries in the world, but it will increase its dependence on other industries. As shown in the article, this will have both positive and negative effects: the possibilities of providing insurance services are expanding, but at the same time, the risks associated with the security of personal data in its collection, sharing, processing, correction and prevention of any cyber incidents, breaches or unintended use.
2. The main factors that determine the emergence and adaptation of new technologies in the insurance sector include the asymmetry of information, the increase in competition, the change of generations and their social norms, the growth of technical and computer capabilities, the economic crisis and the decline of insurance premiums.
3. The main instruments in digitalisation in the insurance industry are: Digital platforms; Internet of Things; Telematics and Telemetry; Big Data and Data Analytics; Comparators and Robo advisers, algorithm-based product comparison and advice; Machine Learning and Artificial Intelligence.
4. The main processes in the insurance value chain that were being revolutionised by technological innovations are: customer relationship (e.g. client interaction and channels), product development, distribution, pricing (underwriting), claim managements and the activity of the back office.
5. SWOT-analysis has showed us that InsurTech has a great potential and could provide benefits to the insurance industry (for instance, effective risk underwriting, decrease of insurance frauds, higher effectiveness of the claim

process), but also can bring threats (dependence on the quality of technicians, lack of a clear state regulation, risks of cyber-attacks). That is why the risks of radical innovations have to be estimated on each level of this process and have to be regulated by the authority of states for the protection of consumer rights.

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## Abbreviation

B2B – Business to business; B2C – Business to customer; B2P – Business to people; InsurTech – Insurance Technology; OECD – Organization for Economic Cooperation and Development; PAYD – Pay As You Drive.