

MANAGING INNOVATION IN THE RESIDENTIAL REAL ESTATE MARKET IN POLAND IN THE CONTEXT OF DETERMINANTS AND RISK OF INTRODUCING INNOVATION

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Abstract: The study aims to identify the innovations used and the conditions for their implementation, considering the role of risk management in this process by housing developers in Poland. The survey was conducted using the CATI and focused on developers carrying out residential projects characterized by constructing multi-storey and multi-family buildings in Poland. The paper is based on the results of a survey, where the χ^2 test was used to validate the survey questionnaire. The analysis of the results of the present research confirmed the validity of the thesis and emphasized the role of the risk of innovative activities in the residential real estate market, which, as demonstrated, is still not very transparent in Poland, often not measured, and not managed by developers. The paper also points to renewable energy sources as one of the innovations that are very important from the point of view of the situation of high prices of energy resources caused by Russian aggression in Ukraine. It has also been shown that developers do not undertake to identify the risks of implementation of innovations and point to problems in managing such projects. Therefore, it was concluded that risk management is necessary for implementing innovative housing projects. The present research allowed the author to propose using one of the methods of multi-criteria decision support in the real estate market (the DEMATEL method) as a tool for identifying cause-and-effect relationships between the various risks associated with the implementation of innovations.

Keywords: innovation, innovation risk, innovation management, residential real estate, developer

DOI: 10.17512/pjms.2022.26.1.17

Article history:

Received April 28, 2022; Revised July 18, 2022; Accepted July 29, 2022

Introduction

According to the OECD methodology (2008), which is also used in surveys by the Polish Central Statistical Office, innovative activities are understood to mean the involvement of enterprises in different types of scientific, technical, organizational, financial and commercial activities which lead, or are aimed to lead, to news of the product, process, marketing and organizational innovations (European Commission, 2019). However, in practice, these operations are characterized by a substantial variation of the scale of commitment, continuity, and degree of modernization of activities as well as final outcomes (implementation of the innovation, ongoing

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implementation, abandoning before implementation), which causes that the perception of enterprises as innovative entities can be substantially varied.

Innovation should be understood as the creation of fundamental changes involving the transformation of a new idea or technological invention into a marketable product or process. On the other hand, innovation should be treated as a continuity of technical and organizational changes, including modifications of existing products or processes to completely new business activities, organization of the workplace or relations with the external environment.

Innovation is identified in the literature as a key success driver that determines the competitive advantage of enterprises in the market, which, however, involves a substantial risk perceived as one of its major barriers. The positive impact of innovativeness on enterprise competitiveness improvement in financial results, and positive corporate image have been demonstrated in numerous scientific studies (European Commission, 2016; Hult et al., 2004; Jin et al., 2004; Srinok and Zandi, 2021).

At the same time, one of the characteristic features of innovative activities, which represents one of its major barriers in enterprises, is uncertainty about the final outcomes and the necessity to incur considerable expenditures. In addition to the risk of innovative activities, i.e. the risk of starting such activities, the studies in the literature also present the risk of neglecting this activity (Butryn, 2006; Świtalski, 2005). Failure to start the activities towards innovativeness over a longer period of time might lead to a loss that significantly exceeds the costs of innovative activities as a result of nonusing the potential for the adaptation of the organization to the conditions it will have to operate in the future, which may in turn even lead to its bankruptcy. Therefore, it can be concluded that a high level of risk characterizes innovation processes. Furthermore, the degree of risk, in this case, is higher due to the fact that innovation is something unique, and new to the market, resulting in a lack of market data on which to rely.

The motivation for addressing the problem was (until the period of the COVID19 pandemic and Russian aggression in Ukraine) the highly accelerated economic development associated with, among other things, innovative activities, and consequently the problem of the assessment of innovative activities, where the issue of innovation risk and its management becomes crucial. Over the past thirty years, the centrally planned economy in Poland has been replaced by market economy mechanisms. This short period of operation of the economy based on market principles causes Poland to lag behind other highly developed countries in terms of innovation. This creates the need to intensify the implementation of innovation in order to increase the competitiveness of the Polish economy.

It is also necessary to emphasize climate change, which, with the current global situation in the fields of economics, economy, and law, may soon lead to the elimination of life on our planet. In this situation, only innovation implemented throughout the economy provides a strong impetus against the degradation of life on our planet. In the case of the economy, this relates to long-term energy and climate

strategy, particularly reducing greenhouse gas emissions or moving away from fossil fuels as energy sources due to the widespread adoption of RES.

The aim of the study is to identify the innovations used and the conditions for their implementation, taking into account the role of risk management in this process by housing developers in Poland.

The main contribution of the present study concerns innovations in the residential real estate market, their management, and research on innovation risk and its theoretical basis for the application of the DEMATEL method as a tool for the identification of innovation risk networks in the real estate market (Wu and Chang, 2015; Gołąbeska, 2018; Dytczak et al., 2012). It is a multi-criteria decision support method to evaluate the relationship, in this case, between the characteristics of the real estate market. Its purpose is to test the strength of the reaction between different property characteristics. This method has been adapted to the real estate market. It is a multi-criteria decision support method to evaluate the relationship, in this case, between the characteristics of the real estate market. Its purpose is to test the strength of the reaction between different property characteristics. This method has been adapted to the real estate market consists of several computational steps, resulting in the assessment of the interdependencies between the analyzed innovation risk factors. These include:

- development of a direct impact matrix that reflects the direct impact of the analyzed factors, and indirect impacts,
- normalization of the direct impact matrix,
- development of a total impact matrix,
- determination of position index and relationship index. Their values allow for the evaluation and interpretation of the obtained causal chain between innovation risk factors.

It is expected that this method should drive the strategy of managing innovative risks in the real estate market to minimize them. It should be stressed that the aim of this article is not to analyze the application of the DEMATEL method in managing the risk of implementing innovations in the real estate market, but only to indicate it as a possible application in this regard. Resolving the opportunities of its use and its effectiveness in this regard will inspire future research.

Innovations in the real estate market

As the last few decades have shown, the real estate market is considered one of the most conservative. The real estate market has always been rich and stable in macroeconomic terms. The stability and strength of the real estate market has always been based on the need for property and the resulting security. However, these are deeply rooted features that testify to responsibility for the family and the environment. And even only these features testify to his conservatism. The banks with a high risk of losing asset liquidity must be the most innovative. Therefore, innovations are therefore an integral part of a modern and smoothly functioning and growing real estate market. However, innovations are not uniform, and therefore, it is important to point out their generic structure. According to OECD (2008), there

are four types of innovations: product innovations, process innovations, organizational innovations, and marketing innovations.

According to studies Brzeziński (2001) and Prystrom (2012) for the real estate sector, depending on the activity conducted by the business entities in the real estate market, the innovation groups can be characterized as:

-technological innovations, which include modern solutions used in the construction sector,

-process and organizational innovations connected with implementation of technological innovations and legal changes adjusted to the contemporary customers in the real estate market,

-marketing innovations as those concerning the strategy of sales and distribution of products and services in the real estate market,

-financial innovations that allow entities in the real estate market to start investments through the application of modern financial instruments.

All the above-mentioned types of innovations play a very important role. In the case of marketing innovations, for example, AR and VR play an increasingly important role in sales, allowing to improve sales results (Junsawang et al., 2022). The real estate market is also currently using these techniques in presenting apartments during the sale process. However, in the current reality of huge changes in the geopolitical situation in the world initiated by the Russian invasion of Ukraine, innovations from the technical and technological group such as renewable energy sources (RES), are gaining particular importance.

The need to implement RES innovations was recognized much earlier. On 30 November 2016, the European Commission in Brussels (European Commission, 2016) proposed the "Clean Energy for All Europeans" package, stressing that the transition to clean energy will be a major energy growth sector (smart money) in the future, where the tools to achieve this goal are directed at increasing competition and ensuring efficiency in a macroeconomic sense (Regulations (EU) 2019/941; 2019/942; 2019/943; 2016/944). In 2015, the Commission presented a proposal to reform the EU Emissions Trading System (EU ETS), and, in the summer of 2016, it made proposals to accelerate the transition to a European low emission economy. Rising prices of carbon credits (Energia.rp.pl, 2022) (April 2017 - €5/ton; April 2020 - 22 €/ton, February 2022 - almost €100/ton) with falling costs of installing renewable energy sources (RES) have made green power generation a serious alternative to traditional, fossil fuel-based power generation. The leading countries such as Norway, Iceland, and New Zealand, use it on a large scale and cover most of their energy demand using this method at 70-80% (Energia.rp.pl, 2022).

The analysis of data presented in papers (Kwinta, 2020; THINKCO, 2020; GLOBEnergia, 2022; Wiśniewski, 2022) and in the report Photovoltaic Market in Poland 2021 (Fotowoltaika-dorobek, 2022; Instytut Energetyki Odnawialnej, 2021) describes the development of the PV industry and the domestic energy industry as a whole compared to the photovoltaic market in the European Union and the functioning of the KRS in 2019 (Polskie Sieci Energetyczne, 2019). To date, energy

transition in Poland has provided ca. 17 GW of installed capacity in renewable energy sources (RES). The directive is a follow-up of the previous 2009 directive, which set a 20% RES target for the entire EU for 2020 and a minimum of 15% for Poland (15.9% according to the National Action Plan (NAP)). The minimum RES energy share target for the entire EU in 2030 was 32%. Poland has adopted its 2030 target of 23% of energy from RES in gross final energy consumption. The largest contribution to the adopted 2030 target should be made by RES in the electric power industry (mainly wind and PV, 32%) followed by 28% in heating (with an obligation to increase by 1.1 pp year-on-year), and 14% in transportation (Sipa and Gorzeń-Mitka, 2021).

Energy production structures in Poland in 2021 are shown in Figure 1. As presented, Poland will achieve about 15% of its electricity from renewable sources in 2021. The photovoltaic sector continued to grow strongly in 2020 and 2021, with both larger commercial farms and residential micro-installations experiencing a market boom due to the subsidies for already relatively cheap PV panels. Furthermore, 2021 was also a boom year for the heat pump market due to very high coal and natural gas prices and high risks regarding their availability.

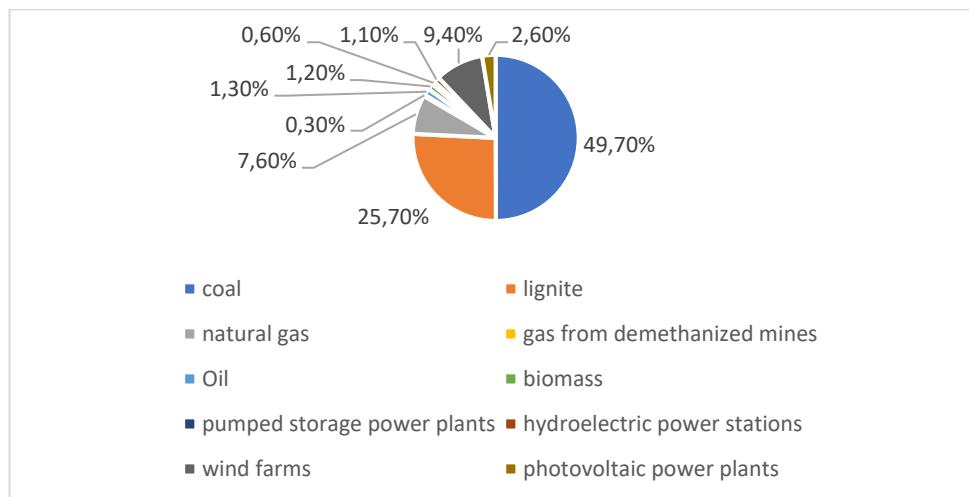


Figure 1: The structure of electricity production in Poland in 2021

Source: Author's elaboration based on (Wiśniewski, 2022; Fotowoltaika-dorobek, 2022)

As is well known, the change in the geopolitical situation in the world initiated by Russia's invasion of Ukraine on 24 February 2022, has made it necessary to intensify activities related to the implementation of innovative renewable energy sources (Polishchuk et al., 2021). Due to political reasons and due to the suspension of economic and economic cooperation with the EU, inter alia, due to the suspension of the import of energy resources, and due to restrictions imposed on the aggressor, it became necessary to introduce energy innovations very quickly throughout Europe in order to become independent from Russian energy sources deposits. Increasing

the generation of electricity from renewable sources is no longer just an environmental issue, but also an effort to ensure the energy safety of countries, especially those that are forced to import energy resources in whole or in part.

Every type of business, including real estate, is subject to the risk that must be considered. New uncertainties and innovation risks emerge when innovations are introduced into the real estate market (measurable uncertainties, according to Knight, 1964) emerge. They need to be recognized so they can be managed and their negative effects reduced. In general, the risk of innovative activities connected with implementing innovations is defined as a risk of threats and effects. Therefore, investment decision-making is based on the relationship (proportion) between risk and possible income (Damodaran, 2009; Rajiani et al., 2018).

Classification of the sources of risk in terms of the consequences for the innovative process risk turned out to be important. This inspired preparation of the classification of factors and sources of risk in the innovation process. Keizer et al., (2002) developed a list that categorized risk determinants in the innovative processes by dividing them into 12 groups: risk concerning product technology, production, supply sources, supply chain, competition, consumer acceptance, commercial agents, and social acceptance, project management and organization, in terms of intellectual property, price control, product positioning, and branding. The sources of risks were discussed for each group as a list of conditions that have to be met to reduce the risks of innovative processes. Detailed analysis of the classification of risk sources points clearly to the fact that the most important component of the analysis of innovation risk is not starting an innovative activity but awareness that giving up the activity in the longer perspective can lead to lost competitiveness in the enterprise.

A very interesting study by Zhang (2020) shows that risk is one of the drivers of innovation in China's real estate market. The study showed that risk positively impacts companies' innovation performance, including R&D investments, innovation levels, and other measures of innovation-related performance.

This should be understood in the context of the risk appetite, the taking of which makes it possible to achieve above-average returns. Furthermore, as mentioned above, the risk of not innovating can result in a decline in market share and thus also in profits, ultimately leading even to bankruptcy. Thus, taking into account the risk of not innovating, one can conclude that it is a driver for increasing innovation in businesses, including (Krajčík, 2021).

Given the above facts, it should be stated that the process of implementing innovations requires appropriate management (Civelek et al., 2020).

Killip and Owen (2020) argue that in order to study the process of investment implementation in the real estate market, most often the secondary one, it is necessary to analyze two markets: firstly, the market of repair, maintenance and improvement (RMI) of houses, where energy efficiency, and thus the implementation of innovations, is not the most important, and secondly, the market of deep modernization, with the main goal being energy efficiency and thus precisely

the implementation of innovations. The first RMI market is dominated by small and medium-sized enterprises, especially microenterprises operating in local markets. These companies do not maximize profits or focus on building energy efficiency. Companies focusing on energy efficiency in the secondary market are usually large companies cooperating in regional and national markets. The same situation exists in the primary housing market.

Developers, including residential developers, are pursuing a variety of projects ranging from the construction of apartments on undeveloped land in new locations, the redevelopment and modernization of existing resources, and the conversion, modernization, and adaptation of buildings originally intended for other uses into residential space e.g. lofts. Brown (2018) distinguished several elements of a successful modernization management model. This researcher pointed to value as the overriding principle of innovation management, assuming that value must be based on comfort, well-being, health, and aesthetics. He also notes the very topical issue of energy savings guarantees and savings-related integrated supply chains that can provide a whole-home approach. The above elements highlighted by Brown relate to an integrated, low-cost financing model for such ventures and a single point of contact with the customer. The researcher also pays special attention to the coordination of all the elements he specified.

Therefore, innovation is integral to a successful project management model. The use of environmentally friendly (healthy) building materials, renewable energy sources, providing as many door-to-door services as possible as part of a whole home approach to the housing space, or financial innovations are some examples of value creation in the process of managing investment in the residential real estate market. Bringing innovation to the housing market refers not only to the use of housing but also, importantly, to the efficient management of resources in the housing production industry. Industrialized housing construction (IHC) is a strategy for implementing emerging innovations in resource-efficient housing. The sub-stages in the IHC management and value creation process include innovative and industrial materials and operational energy efficiency. This shows that innovations, including RES, are value-creating factors in the real estate market (Rohn et al., 2014)

An analysis of the literature helped identify a research gap in the implementation of innovations by housing developers in the real estate market and an assessment of the associated risks in the context of management. It is necessary to emphasize that this gap is most relevant to real estate development activities in Poland.

The paper poses the following research hypotheses:

H1: The introduction of innovations by developers into the real estate market depends on the scope of their operations (the geographic scope of the enterprise).

H2: Problems in managing innovative projects and the geographical scope of developers' activities are independent

H3: The geographic scope of development activity and undertaking the identification of innovative risk are independent.

Research Material and Methods

In the present study, the adopted research strategy is based on mutual verification and complementary data collection at two levels, the level of research techniques as a result of the use of various methods of data collection, such as CATI (computer-assisted telephone interviewing), and the analysis of the documents and data found. On the other hand, at the level of information sources, information was collected from different groups of respondents in order to collect various information on a given topic that may present a different point of view. The selection of the sample reflected such features of the population of entrepreneurs - developers as different seniority on the market, different employment levels and a different geographic scope. Most of the surveyed entities have Polish capital. A questionnaire was used to collect the data, and the answers to the questionnaire were collected using the CATI method, which consisted in obtaining answers from respondents by phone, while using an on-line questionnaire.

Research on innovation among developers of the primary housing market was conducted from 24 to 28 August 2020. The survey was conducted in the form of a survey on a sample of 130 entities: developers of the primary housing market implementing multi-family housing investments. The survey sample was drawn from 324 general population entities operating in the market at the time of the survey. The scope of the study was limited to housing developers who implemented projects to build multifamily and multi-story apartment buildings.

The survey includes a list of developers with their basic characteristics and the phone number used for contact and data collection. The list provides additional validation of the research conducted. It seems that in the survey conducted in the paper there is no problem of low (unverifiable) quality of the data. The differences between the declared and obtained data appear to be insignificant, and therefore the chi-square test (Szyjewski and Szyjewski, 2017; Berenson, Levine, 19998; Levin, 1987) was used as the selected and applied research method to validate the obtained survey data. On the basis of the survey data, 3 hypotheses were formulated, where the distribution of answers concerning the assumed hypothesis as YES or NO was obtained. For each of the hypotheses, the observed numbers, expected values and empirical values of the test statistic were determined, the sums and for each hypothesis being the empirical chi square statistic. With the assumed significance level $p = 0.05$ and the number of degrees of freedom, the χ^2 theoretical tables were read and compared with χ^2 calculated. Based on the reciprocal relationship between χ^2 theoretical and χ^2 calculated it was decided whether the relationship between the variables defined in the hypothesis is significant.

Research Results

The survey conducted in the paper enabled conclusions to be drawn on the motivations for introducing innovations in the housing market, types of innovations, benefits, and barriers, support, and management of innovations.

The survey was conducted on a sample of 130 developers building multi-family and multi-story residential buildings. The entities surveyed included small, medium-sized, and large enterprises. The research sample was not selected in terms of the specific size of the enterprises, which may seem to be a mistake, but was made more specific in terms of the type of projects under construction, i.e. construction of multi-family and multi-story residential buildings. This assumption has been made because it can be noted that both large and small companies are involved in capital-similar investment projects with the exception that the latter use subcontractors and not just their own resources, thus taking advantage of the privileges given to small and medium-sized enterprises.

Another element differentiating the surveyed entities was the scope of their activities, and here a division was made between developers operating in the local market, regional market, national market, and the five largest Polish cities.

Substantive questions in the form of 4 blocks concerned: motives for the implementation of innovations to the housing market, their nature, the reasons for cooperation and support for innovation activities, the effects of innovations and their performance characteristics, and the management of the innovation portfolio.

Regarding the introduction of innovations into the real estate market, 31.5% of developers responded positively. They stated that customers choose traditional construction due to a lack of demand (33.3%), a preference for proven solutions (33.3%), being attached to traditional construction (37.5%), and company specifics. As presented in Figure 2, developers declared that the effectiveness of innovation has translated very well and well into the expected end result of the financial resources involved.

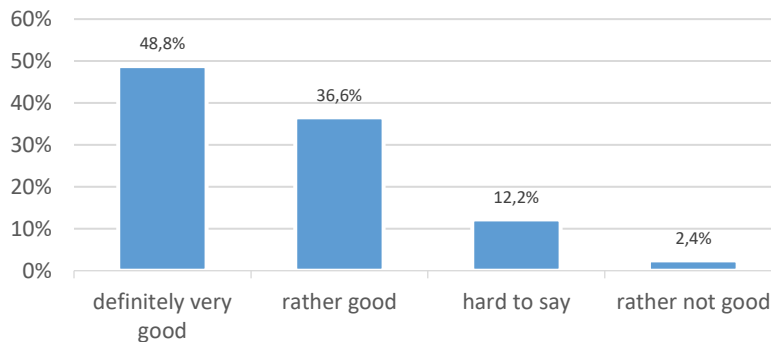


Figure 2: Effectiveness of innovation: resources committed to innovations
Source: Author's elaboration

According to the respondents' replies, the most popular innovations are those from the process and organizational group, primarily technical and technological (table 1). It should be emphasized that innovations from the technical and technological group allow, among other things to reduce building operating costs such as modern forms of building insulation, RES, or innovative architectural solutions.

As mentioned, the largest group is technical and technological innovations such as RES. Developers also responded about the environmental benefits of introducing innovations into the real estate market, such as energy efficiency, improving the environment, reducing harmful CO₂ emissions, effective water management, waste management, and the introduction of eco-friendly technologies. Introducing RES, reducing harmful CO₂ emissions, or efficient water management are the most frequently observed benefits by developers.

Regardless of the types of innovations introduced, in most cases, they are adaptations of existing solutions already introduced by others (78% of respondents). Only a small percentage of developers declared that they conducted research on their innovations (17.1%). The remaining 4.9% declared that they implemented innovations that were neither adaptations nor the result of their research.

Table 1. Types of innovations used

	Local	Within the voivodeship	Nation wide	The five largest Polish Cities
process and organizational innovations	29%	27%	27%	25%
technical and technological innovations	43%	37%	40%	25%
marketing innovations	23%	27%	20%	25%
financial innovation	6%	10%	13%	25%

Source: Author's elaboration

Higher housing prices, faster sales, high-quality housing, and, for the enterprise, higher job retention were cited as benefits of innovating in the real estate market. The problem of job retention stems particularly from the increase in the competitiveness of companies, where growth is fostered by activities specifically concerned with improving the quality and increasing the value of the housing units offered. For enterprises, this translates into improving the quality of housing and services offered, reducing environmental damage, and, most importantly, increasing competitiveness by improving quality and increasing the company's market share. Innovations are an important factor in management as they are introduced as an integral part of the enterprise's development strategy. Most respondents answered that they were innovating as part of their strategy, and the reasons for this are most often the desire to achieve a leading market position and high-quality real estate. Regarding innovation management, the respondents stated that it results from corporate strategy (31.7%) due to the leading position in the market among competitors, while 22% said it was a result of the need to adapt products to the level offered by competitors (Figure 3).

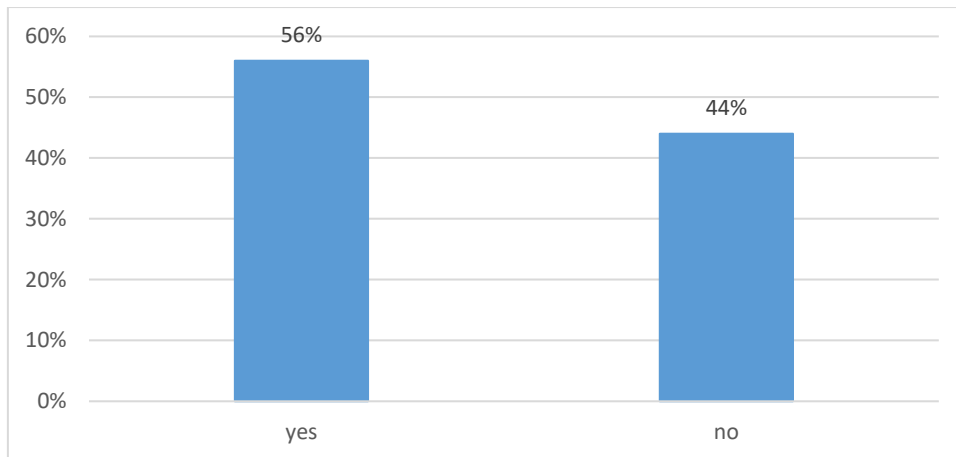


Figure 3: Innovating in projects create difficulties to management

Source: Author's elaboration

In the context of management, it should be noted that developers mostly found it difficult to manage housing projects when implementing innovations. Problems in managing a housing project with the innovations implemented in the project were also determined by the fact that developers admitted that they did not manage risks, not even by risk identification or identifying them intuitively. The respondents' answer about not implementing risk measurement in innovation activities seems to suggest the acceptable negligibility of these risks, where, however, the most important factors are risks in product and brand positioning, market viability of the product, consumer acceptance, competition, and risks in control and price.

The above-presented situation, i.e. the low proportion of innovations in developer housing projects, is due not to developers' reluctance to innovate but to the barriers they face. Among the most significant are overly complex legislation, lack of sufficient skills, failure to recognize new innovation needs, or lack of adequate financial resources. Developers also enumerated complex regulations, lack of financial resources, lack of identification of market needs, and particularly high risks of bringing innovations to market as barriers.

Regarding the effects of innovations on the real estate market, developers emphasized the increase in the quality of apartments, their high functionality and the reduction of building operating costs.

Based on the results of the survey, research hypotheses were adopted, and, to verify them, it was assumed that only companies classified as local in the survey operate in the local real estate market, while a wide range of activities is represented by other developers operating regionally, nationwide, and in Poland's largest cities.

The table 2 presents the observed numbers, expected values and empirical values of the χ^2 statistic for each of the hypotheses (1-observed number, 2-expected values, 3-empirical value of the test statistic).

Table 2. Test statistics calculated from data concerning the hypotheses H1, H2 and H3

Market	H1			H2			H3		
	1	2	3	1	2	3	1	2	3
	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Narrow range local	15/46	19,24/41,76	0,93/0,43	37/24	35,2/25,8	0,09/0,13	20/41	29,56/31,44	3,09/2,91
Wide range nationwide	26/43	21,76/47,24	0,83/0,38	38/31	39,8/29,2	0,08/0,11	43/26	33,44/35,56	2,73/2,57
Total			2,57			0,41			11,30

$$\chi^2_{\text{empirical}} = 2.57 \quad \chi^2_{\text{empirical}} = 0.41 \quad \chi^2_{\text{empirical}} = 11.30$$

df=1; p=0,05

$\chi^2_{\text{critical}} = 3.8415$

Source: author`s elaboration

As it results from the data presented in Table 2:

H1- the empirical value of the test statistic = 2.57 is less than the critical value = 3.8415. Therefore, there is no basis for rejecting the null hypothesis.

The χ^2 technique was used to confirm the hypothesis that the introduction of innovations by developers into the real estate market depends on the scope of their activities (the geographical scope of the enterprise).

H2- the empirical value of the test statistic = 0.41 is less than the critical value = 3.8415. Therefore, there is no basis for rejecting the null hypothesis.

The χ^2 technique was used to confirm the hypothesis that problems in the management of innovation projects do not depend on the scale of the geographic scope of developers' operations.

H3- the empirical value of the test statistic 11.30, and the critical value is equal to = 3,8415. It follows that $\chi^2_{\text{cr}} < \chi^2_{\text{em}}$, that is, there is a significant relationship between the variables of innovation activities in the real estate market and risk measurement. The null hypothesis was rejected by accepting the alternative hypothesis.

Therefore, one should accept the alternative hypothesis H3:

The geographic scope of developers' operations affects the undertaking of the identification of innovation risks in housing projects.

Based on survey responses related to hypothesis H3, it is reasonable to believe that developers are possibly using intuitive risk measurement, while specialized risk measurement tools are not being introduced.

Despite the fact that the scope of activities does not affect the identification of risk, and consequently, developers operating on a large scale of risk identification, and most local developers do not, the identification of this risk, if performed, is in most cases intuitive and not based on specialized tools enabling precise measurement. This shows how much risk management tools are needed for introducing innovation to the residential real estate market. Hence the proposal of the DEMATEL method. On the other hand, confirmation of whether this method is appropriate will be the subject of future research.

The presented results of the examination of reliability, i.e. a significant relationship between variables confirm and give credibility to the obtained results of the surveys, especially regarding innovations in the real estate market.

Management of innovations in the residential real estate market taking into account the risks of implementation of innovations

Taking into account all aspects concerning innovations, it became necessary to develop new management principles to ensure the constructive development of management theory and practice. According to Drucker (2009), in today's world of globalization and integration of technology, science, practice, and politics, there is an urgent need to develop new fundamental principles of management that (unlike the historical paradigms used until the 1980s) would ensure the constructive development of management theory and practice.

The new paradigm for 21st-century management developed by Jamala (2005) is presented in Table 2 as its assumptions and the needs of the modern global economy. In addition, it was extended with the conclusions of the survey and related to the management of innovation in the residential real estate market.

Table 3. Guiding principles of the new management paradigm (21st century)

Assumptions of	Theses used for	Theses for management policy in
the new management paradigm	management policy according to the new paradigm	the context of the implementation of innovations in the housing market
Value creation	Added value is a fundamental social obligation of the enterprise	Value creation through the implementation of innovations in housing projects
Quality	Quality as a fundamental requirement that determines the competitiveness	Quality created by, among other things, the introduction of innovations as a source of achieving competitive advantage, and the decline in competitiveness as a consequence of failure to implement innovations
Responding	Responding to changes in the external environment and customer expectations	Responding to emerging innovations in the market and customer expectations in this regard and creating needs among customers through innovation
Agility	Flexibility in communication and operations	Flexibility in the implementation of innovations taking into account risk monitoring and countermeasure operations

Innovation	Nurturing new ideas, exploiting people's creativity and enthusiasm	Analysis of innovations implemented in global markets and creating innovations if possible
Integration	Integration of technology portfolio for the achievement of clear competitive advantage	Integration of the portfolio of new and implemented innovations into subsequent projects
Teaming	Creating and developing decentralized, multifunctional, and multidisciplinary teams in the enterprise	Creating and developing decentralized, multifunctional, and multidisciplinary teams in the enterprise in both the creation and management of innovations

Source: author's own elaboration based on Jamala (2005)

A thorough analysis of management according to the new Quality paradigm clearly shows that achieving and maintaining a high level of competitiveness requires continuous restructuring, including the improvement and introduction of new products or services, the development, search and implementation of new technologies, the improvement of business management systems, production processes, sales and marketing. Based on the results of the study, it was indicated that competitiveness will also be determined by innovation.

To demonstrate the comparison of the results of the research with the existing state of knowledge, the theses of management according to the new paradigm were modified in the context of innovations.

Analysis of the thesis in the context of developer housing projects has shown that project value is created precisely through innovation, as emphasized by both Rohn et al. (2014) and respondents in the survey, who stated that through the innovations introduced in their enterprises, they were able to increase prices of sold apartments, make sales more quickly, and achieve higher quality, with obtaining a higher price for an apartment being the most frequently cited result of innovations among developers.

Quality is also created through innovation, as emphasized by respondents. It is obvious that not only innovations create quality in the market. However, it should be noted that they improve it, thus increasing the competitiveness of the housing project. On the other hand, it seems more interesting that despite the thesis presented in the literature that failure to innovate leads to lower competitiveness, developers, while confirming this, declare that they mostly do not innovate. This is due to a number of factors, but it should be emphasized that in Poland there is still a gap between demand and supply of apartments, which makes the market not competitive enough to force the implementation of innovations.

Developers also admitted that a very important factor is the analysis of innovations implemented by direct market competitors and the need to adapt them to the extent possible, if, of course, they are accepted by the market. Therefore, failure to respond

to innovations being implemented and to customer needs in this regard can have negative consequences.

Flexibility in the management of development activities will refer both to the above-presented response to innovations introduced in a given market, but also to the ability to manage the project from the point of view of the occurrence of risks associated with the implementation of innovative projects. The use of appropriate measures of such risks and their management may seem necessary for an innovation that is intrinsically new and unique. However, most respondents admitted that they do not use measures to determine such risks and at best measure risks intuitively.

Innovation in the operations of enterprises, including housing developers, is widely considered a leading factor, through increased competitiveness to market success, both financially, socially, and environmentally. However, innovation itself is a challenge, and innovation creation is an even more difficult and complex process. The survey showed that developers in Poland mostly adapt previously implemented innovations rather than create them themselves. This is associated with a number of barriers to such a process, the most significant of which are the lack of financial resources, research facilities, and systemic support, including an unfriendly patent system.

The above facts, and in particular the lack of adequate research facilities, including adequate staff, is another reason for the failure to implement innovations. The lack of experience in this area and the lack of appropriate tools in the management of the innovation process means that teaming is rarely achieved among developers as a factor of appropriate management.

Integration in terms of the implementation of often interdependent innovations requires even better management tools and, above all, knowledge. Therefore, in order to create portfolios of complementary innovations, one must first gain experience in this area.

Decisions on innovation involve a high degree of technical, scientific, technological, and market risks. It should be emphasized that each can become the basis (source) for another type of risk, meaning that risk classifications are not disconnected elements. In the risk management process, available methods facilitate the coordination of activities related to eliminating given risks. At this stage, it is important to correctly identify the sources of risk so that their implications can be properly analyzed. This is a factor of great importance from the point of view of the speed of response to risks and, thus, the possibility of minimizing it.

However, since the detailed analysis of innovation risk is highly complex, it seems that in this case it would be appropriate to use one of the methods of multicriteria support for decisions, which are used for the multi-faceted evaluation of investment risk decision options with regard to innovation risk in the real estate market. It should be assumed that the complex nature of investment innovation risk in the real estate market requires an approach that will enable proper assessment of the situation and the development of a model of conduct based on risk minimization, and thus

contribute to increasing the profitability of innovative investments (Wu, 2015; Gołąbeska, 2018; Dytczak et al., 2012).

In the case studied here, the DEMATEL method should consist of several computational steps, resulting in the assessment of the interdependencies between the analyzed innovation risk factors.

The DEMATEL method has been used so far in the strategy of knowledge management in enterprises, identification of factors of competitiveness, or management of supply chain and human resources (Wu, 2015; Azazi et al., 2014). This is also true for the decision-making problems of finance and banking (Tsai et al., 2013; Lan, Zhong, 2016) the modern biofuel industry (Liang et al., 2017) and the social sphere (Kiakojuri et al., 2015).

Due to the possibilities and effects of using the DEMATEL method, research can be undertaken to answer the question of whether it can be considered as one of the research tools used in analysing innovation risk in the real estate market. Greatly important in the case of innovative risk is the ability to analyze risk factors that are difficult to measure in the real estate market, which can be achieved by using the discussed multi-criteria method. The answer to the above question may inspire further research.

Conclusion

The presentation of the data obtained in the direct research allows for assuming that the study aims were achieved and hypotheses were confirmed and supported in worldwide data for the period under study.

In the present study, as part of the validation of the hypotheses, it was shown that the introduction of innovations by developers into the real estate market depends on the scope of their operations. This is understood to mean that developers operating in a nationwide or regional market are more likely to innovate. This may depend on the fact that these enterprises, which operate in a larger area, have to compete with more developers and thus become more competitive.

Another hypothesis concerned the management of innovation projects and assumed that problems in the management of innovation projects do not depend on the geographic scope of the developers' operations. This means that introducing innovations is so complex and difficult due to their uniqueness that even enterprises with a large geographic scope (i.e., those that innovate more often) report having problems with the management of such projects.

The last hypothesis was that the geographic scope of developers' operations does not affect the undertaking of innovation risk identification in housing projects. This hypothesis was rejected and thus the alternative hypothesis was adopted, stating that the geographic scope of developers' operations affects the undertaking of innovation risk identification in housing projects. It should be noted that the scope of operations does not affect the undertaking of risk identification, and consequently, large-scale and local developers do not conduct innovation risk identification. Even when such

identification is conducted, it is mostly intuitive and not based on specialized tools for precise measurement.

In addition to verifying the hypotheses set forth in the paper, the results of the study also lead to the following conclusions:

-Developers pointed out that despite the little interest in innovation on their part, introducing innovations has an effect on a significant increase in competitive advantage in the real estate market.

-Developers confirm that implementing innovations increases competitiveness by improving quality, which increases the company's market share.

-Developers further stressed that innovations from the technical and technological group make it possible to reduce building operating costs by introducing innovations in modern insulation, energy, or specific architectural solutions.

-In a survey conducted before the Russo-Ukrainian war, developers indicated that RES innovations were among the most important to meet environmental goals. In today's reality of the new geopolitical system in the world and thus the energy crisis, the introduction of RES is a priority due not only to the reduction of electricity costs but also for the sake of security of supply.

-It was emphasized that innovations, as an important factor in management, is an inseparable element of the enterprise's strategy because of the desire to achieve a leading market position and achieve high quality of real estate.

-Regarding the management of innovation risk in the real estate market, it was pointed out that despite awareness of its existence and awareness of the difficulty of implementing innovative development projects in the residential real estate market, developers do not use identification and measurement of this risk, and even if such identification takes place, it is intuitive in nature.

-Due to the possibilities and effects of using the DEMATE method, it is recommended that it be used in the real estate market as an innovative risk assessment tool by providing the opportunity to analyze risk factors that are difficult to measure in the real estate market.

-The most important barriers indicated by all enterprises participating in the survey were the lack of possibility of obtaining adequate support for the implementation of innovations from external entities, particularly public ones, financial deficiencies (lack of understanding and acceptance by the investor), and difficulties in the customer market (the customer accepts innovations but does not want to pay for them). This shows the need for tools to manage the risk of innovating in the residential real estate market. Therefore, the present study proposed the use of the DEMATEL method. Whether this method is appropriate will be the subject of future research.

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ZARZĄDZANIE INNOWACJAMI NA RYNKU NIERUCHOMOŚCI MIESZKANIOWYCH W POLSCE W KONTEKŚCIE DETERMINANT I RYZYKA ICH WPROWADZANIA.

Streszczenie: Celem badania jest identyfikacja stosowanych innowacji oraz uwarunkowań ich implementacji z uwzględnieniem roli zarządzania ryzykiem w tym procesie przez deweloperów mieszkaniowych w Polsce. Badanie zostało przeprowadzone metodą CATI i koncentrowało się na deweloperach realizujących projekty mieszkaniowe charakteryzujące się budową wielokondygnacyjnych budynków wielorodzinnych w Polsce. W pracy oparto się na wynikach badań ankietowych, gdzie uwiarygodnienie ankiety nastąpiło w wyniku przeprowadzenia testu χ^2 . Analiza wyników przedstawionych badań potwierdziła słuszność postawionej tezy oraz eksponuje znaczenie roli ryzyka działalności innowacyjnej na rynku nieruchomości mieszkaniowych które, jak wykazano, do dziś jest w Polsce mało przejrzyste,

często nie mierzone oraz nie zarządzane przez deweloperów. W pracy wskazano również na odnawialne źródła energii jako jedną z innowacji tak istotną z punktu widzenia obecnej sytuacji związanej z wysokimi cenami źródeł energii wywołanych agresją rosyjską na Ukrainie. Wykazano także, że deweloperzy nie podejmują się identyfikacji ryzyka wprowadzania innowacji, a jednocześnie wskazują na problemy w zarządzaniu takimi projektami. Wnioskowano zatem, iż zarządzanie ryzykiem jest koniecznością w realizacji innowacyjnych projektów mieszkaniowych. Prezentowane badania pozwoliły na zaproponowanie zastosowania jednej z metod wielokryterialnej wspomaganie decyzji na rynku nieruchomości – metody DEMATEL jako narzędzia do identyfikacji związków przyczynowo – skutkowych pomiędzy poszczególnymi rodzajami ryzyka związanego z wdrażaniem innowacji.

Słowa kluczowe: innowacje, ryzyko innowacji, zarządzanie innowacjami, nieruchomości mieszkaniowe, deweloper

管理波兰住宅房地产市场的创新 在决定因素和引入创新的风险的背景下

摘要：本研究的目的是确定所使用的创新及其实施条件，同时考虑到波兰住房开发商在这一过程中风险管理的作用。该调查是使用 CATI 进行的，重点关注在波兰开展以建造多层、多户住宅为特征的住宅项目的开发商。本文基于调查结果，其中使用 χ^2 检验来验证调查问卷。对本研究结果的分析证实了论文的有效性，并强调了创新活动风险在住宅房地产市场中的作用，正如所证明的那样，在波兰仍然不是很透明，通常没有衡量，并且不受开发商管理。该文件还指出，从俄罗斯侵略乌克兰造成的能源价格高企的情况来看，可再生能源是一项非常重要的创新。还表明，开发商不承诺识别实施创新的风险并指出管理此类项目的问题。因此得出结论，风险管理是实施创新住房项目的必要条件。目前的研究允许作者提出使用房地产市场多标准决策支持方法之一（DEMATEL 方法）作为识别与实施相关的各种风险之间因果关系的工具的创新

关键词：创新，创新风险，创新管理，住宅房地产，开发商