

## IMPLEMENTATION OF MODERN TECHNOLOGIES (PROPTech) BY DEVELOPERS ON THE LOCAL HOUSING MARKET

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**Introduction/background:** The implementation of modern technologies in the real estate market is a phenomenon that has been observed for several years in global markets. The emergence of solutions favouring the digitalisation of the relatively change-resistant real estate sector is a response to the changing needs and preferences of customers in this market. Taking up the topic within the framework of PropTech in the local real estate market aims to contribute to the discussion in this area and to identify opportunities for the uptake of new technologies in Polish conditions. The area of real estate development activity in the residential market with regard to the use of modern technologies in the business was selected for analysis.

**Aim of the paper:** The main aim of the paper is to analyse to what extent developers are aware of and interested in modern technologies. The 3 following goals were adopted: G1: assessment of the developers' state of knowledge in the field of modern technologies (PropTech); G2: identifying areas that, in the opinion of developers, have the greatest potential for implementing modern technologies; G3: perspectives for the use of modern technologies in the studied areas.

**Materials and methods:** In order to achieve the intended goals, a survey questionnaire was carried out among developers on the real estate market in Poznań.

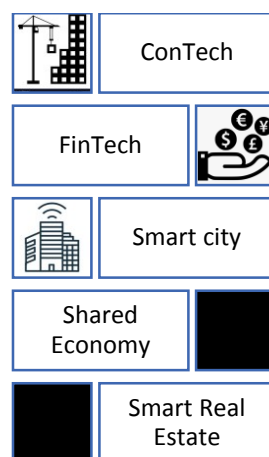
**Results and conclusions:** As the survey shows, the development of PropTech for developers is still at a rather early stage. Despite the fact that, in their opinion, customers already have expectations in terms of modern technologies and pay attention to environmentally friendly solutions, they use the available solutions only to a small extent, as if forgetting (or not knowing) that the possibilities for implementing modern technologies are much greater and cover many more areas.

**Keywords:** real estate market, PropTech, modern technologies, housing market, developer.

## 1. Introduction

Industry 4.0, which is the digital transformation of most areas of the economy, is also entering the real estate sector that is relatively resistant to innovation (Siniak, Kauko, Shavrov, Marina, 2020). The changes observed in this area may have the hallmarks of a revolution, the effect of which will be to increase the efficiency, agility and flexibility of real estate managers, intermediaries in their turnover, but above all, entities that create the supply of new products in the form of buildings and premises. The phenomenon of mass implementation of modern technologies in the form of virtual reality (VR), artificial intelligence (AI), building information modeling (BIM), advanced data analysis tools, Internet of Things (IoT), blockchain, real estate crowdfunding, in combination with such trends such as smart city, smart home or Sharing Economy create a new environment known as PropTech.

The concept of PropTech is a combination of the two words “property” - real estate and “technology”, and therefore includes innovative technology products and new business models for the real estate market. It is worth emphasizing that both in the field of science and practice, this term is relatively new on the one hand, and extremely fashionable on the other. The literature on the subject lacks a universal definition of the term PropTech, which makes it difficult to define the investments and market segments that are involved in this new trend. The concept of PropTech as the sum of technologies that affect the real estate market was introduced by Baum (2017), while defining its three basic sectors: smart real estate, shared economy and FinTech. Smart Real Estate is all technology-based platforms that facilitate the operation and management of real estate, but can also directly facilitate or control construction services (Baum, 2017). The concept of “Platform Real Estate”, which includes the social engineering dynamics driving the digitization of real estate technology, was also developed by Shaw (2018). Another sector of PropTech is the Shared Economy, which includes technology-based platforms that facilitate the use of real estate assets, including land or multi-purpose buildings. In this respect, the main purpose of the platforms is to provide information to users and space managers. The final sector is FinTech, which consists of technology-based platforms that facilitate real estate trading through various financing services. In addition to the sectors indicated by Baum (2017), PropTech also includes elements of smart cities and the construction industry (ConTech). PropTech sectors are presented on Figure 1.



**Figure 1.** PropTech sectors.

Source: own study based on (Baum, 2017).

PropTech being the sum of all technological innovations can also be described as a movement driving the change of mentality in the real estate industry (Dearsley, 2018). Hasenmaile, Rieder (2017) mentioned the possibility of optimizing products, processes or the entire business concept in the real estate sector as a result of the implementation of modern technological achievements, i.e. PropTech. On the other hand, it is difficult to determine which technologies and entities are involved in the digitization of the real estate sector and what their innovative potential is, especially considering that some markets (e.g. US, UK) that seem to be more active than others in keeping up with the pace of change (Tagliaro, Bellintani, Ciaramella, 2020).

The dynamic development of the construction industry in Poland offers great opportunities to use innovation. In 2020, according to Central Statistical Office (GUS) data, 7% more apartments were completed than in 2019. It is the construction industry that is one of the most frequently indicated areas of PropTech use. However, it also includes solutions for office space management, IoT technologies, solutions for trade or rental of real estate, and even financing for home purchases or crowdfunding of construction projects.

The main goal of PropTech is to improve the efficiency of the real estate market, which is perceived as relatively technologically backward and very resistant to any changes. PropTech, similarly to smart city solutions, effectively changes the space in which we operate on a daily basis. The issue worth noting are the two speeds of this revolution in Poland. On the one hand, large entities from the real estate industry, and on the other hand, many small companies that are not prepared - both in terms of resources and the possibility of introducing innovations or technological experiments, thus lagging behind.

The use of modern technologies and their importance in the real estate development process is an important current of research today. Maududy, Gamal (2019) emphasize the need to introduce innovative technological solutions by developers from the residential real estate sector, interpreting real estate technology as an innovations within construction, sales, management that changes the real estate development process.

Developers on developed real estate markets operate in various segments, including commercial, office, warehouse or residential (Trojanowski, 2004). Definitions of a developer often narrow the area of his activity, e.g. only to the housing market. This interpretation is used by Kirejczyk and Łaszek (1997), who define the developer through the prism of his main task, which is to define the market segment in which there is a housing demand, and then to organize a project consisting in the construction of apartments. The developer is also identified with the investor. Bryx and Matkowski (2001) define the developer as the investor who builds facilities that are then intended for sale and rent. The perception of a developer only as an investor is an approach that limits the nature of his activity, which consists in coordinating the entire development process, starting from the initiative of the planned project, through its implementation and handing over the final product for operation or for further development (Trojanowski, 2004). Similarly, Belniak and Wierzchowski (2001) define the developer as the coordinator of the entire investment process, which leads to the creation of a new form of land development. Kozłowski (2003) also emphasizes that mobilization and coordination of resources in order to develop the area are characteristic of development activity. The literature on the subject very often emphasizes the effect of the developer's activity, which is an increase in the value of the property. Dobrowolski and Sędek (1996) recognize as a developer an entity that intends to make the best use of real estate, providing it, through investment, with the greatest value.

The essence of development activity can be considered in terms of: semantic, economic and process. In semantic terms, a developer is defined as an entity whose activity is related to the development of land real estate. In economic terms, a developer is an entrepreneur who conducts, at his own risk, the activity of investing in real estate, earning income on this account. A real estate development company focuses on investing in real estate, which increases its value. The developer acts as a coordinator and organizer of the implemented project. From the procedural perspective, developer activity should be understood as a sequence of successive activities that make up the process of implementing a development investment project, considered in a broader or narrower aspect (Gostkowska-Drzewiecka, 2007).

The development process is often considered in many dimensions, as it results in a physical, material, social and economic transformation of space (Henzel, 2004; Peca, 2009) defines a real estate development project as a process that requires a highly creative approach, during which tangible components such as land and buildings are effectively combined with financial and marketing resources to create a space where you can live, work and play. This allows for the identification of basic features, common to each type of development investment project:

- real estate development,
- high degree of creativity,
- effective combination and use of space components, such as land and buildings,
- combining financial and marketing resources.

According to this definition, only an appropriate combination of financial and marketing resources, in particular regarding market analyzes, is the key factor determining the profitability of development investments. The aspect of resource use can also be found in the definition cited by Dąbrowski and Kirejczyk (2001), in which the basis for a development investment is an appropriate combination of location, idea and capital. In any case, the starting point for a development project should be an idea tailored to the preferences of potential buyers.

At the core of the development process is the ability to effectively and sustainably shape space. In a narrower sense, the development process closes in two phases: pre-construction and implementation. In a broader sense, the development process is a three-phase process. This is the case where the developer not only carries out the project but also operates it. (Gostkowska-Drzewiecka, 2007) The development process of Dziworska and Trojanowski (2007) is completed in three basic phases: pre-investment (preparatory), implementation, and operation (operational). Karnaszewski (2000), in turn, distinguishes four stages of the construction investment process: the pre-investment phase, the investment preparation phase, the implementation phase, and the investment completion and commissioning phase. However, each development process, regardless of the division, has similar stages, starting with the initiation and ending with the sale or use of the property. Real estate development as a result of a developer's activity is a process that combines components and knowledge in order to create a specific product that meets the expectations of individual customer groups.

The developer, as a party creating supply on the housing market, and having large financial resources at its disposal, is an entity that, apart from construction companies, should be the first to try to digitize some of its activities. Innovations in terms of the presentation of the offer, the process of servicing a potential customer, as well as modernizing the product itself should be one of the main strategic goals for the developer. Maududy and Gamal (2019) emphasize that failure to use available PropTech technologies may lead to a drop in sales, deterioration of the competitive position, and eventually exit from the market.

## **2. Aim of the paper**

The technological revolution is entering the real estate market and concerns various stages of developers' investment projects, starting from the design phase, through the execution, sale and operation of the property. The question, however, is to what extent developers are aware of and interested in modern technologies. In response to this question, a study was conducted for which the following goals were adopted:

G1: assessment of the developers' state of knowledge in the field of modern technologies (PropTech).

G2: identifying areas that, in the opinion of developers, have the greatest potential for implementing modern technologies.

G3: perspectives for the use of modern technologies in the studied areas.

In order to achieve the intended goals, a survey was carried out among developers on the real estate market in Poznań. The adopted spatial scope results from the specificity of this research area. And although there are no substantive grounds for major generalisations, taking into account the size of the market in Poznań, it can be assumed that in other large Polish cities the degree of use of modern technologies is similar.

### 3. Materials and methods

The research was carried out in March and August 2022, and the time scope of the research coincided with the time of collecting the information. The spatial scope of the research covered the residential real estate market in Poznań. The subjects of the research were both local and domestic developers implementing investments in Poznań and its vicinity, while the subject of the research were the areas of application of modern technologies by developers on the local real estate market. In order to conduct the study, a survey questionnaire was used, which was conducted online by sending a form to developers and in the form of a telephone survey conducted by interviewers. The sample selection was deliberate, non-random. 22 out of over 47 were examined developers operating on the Poznań market (data from platform with developers' offers Rynekpierwotny.pl). According to the data on the marketpierwotny.pl website, they are currently implementing 69 investments in Poznań and its vicinity. Basic information on the study is presented in Table 1.

**Table 1.**

*Basic information on the developer research on the areas of application of modern technologies*

Itemization	Description
Information gathering time	2 months in March-August 2022
The spatial scope of the study	the local residential real estate market in Poznań
Material scope of the study	research subject: local and national developers of the residential real estate market offering investments in Poznań. research subject: areas of application of modern technologies by developers on the local real estate market
Time range of the study	coincides with the time the information was collected
Research tool	survey questionnaire
Selection and size of the sample	sampling non-random, purposeful, sample size n = 22 entities

Source: own study.

Metric data about the respondents:

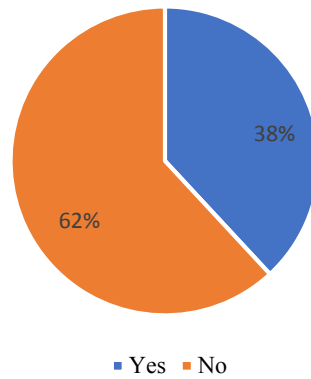
- 86% were companies that operate in a city with more than 500,000. inhabitants, 9% were companies with activities in the city between 250-500 thousand. residents, and 5% of respondents had their headquarters in cities below 250 thousand. Residents,
- over 90% of the surveyed developers have been operating for 10 years and more, and only 10% between 5 and 9 years; among the respondents there were no developers who had been operating on the market for less than 5 years,
- among the respondents, half of the developers operated on the local real estate market in Poznań, while the other half operated nationwide as well,
- over 70% of the surveyed developers specialize in the popular housing segment (based on the standard), while approximately 30% of the respondents operate in the premium apartment segment (higher standard),
- Almost half of the respondents (45%) consider that they are a large market player in terms of turnover, about 36% describe themselves as medium-sized companies, and only 18% indicated that they are a small company.

The developers covered by the study built a total of 8,370 flats in the presented investments, of which 1,793 are currently for sale. This means that the sales ratio is 79%. The starting point for the above data was the number of offers on the [marketpierwotny.pl](http://marketpierwotny.pl) website, while the analysis was based on the developers' websites, and therefore some data were updated. At the same time, it should be noted that among developers there are those who currently offer 1-2 available flats and those with over 400 available flats.

The survey questionnaire used closed questions. Only the metric question used open-ended questions regarding the entity's period of operation in the market and the number of employees. The developers that were selected for the survey were all entities that were making investments in the local market at the time of the survey.

#### **4. Results and discussion**

The first question in the conducted research was to determine the degree of familiarity by developers with the term "PropTech". This concept should be well known by them and used by them as participants of the investment process in which modern technologies are used, as well as entities taking care of the property after its use. The distribution of answers is presented in Figure 2.



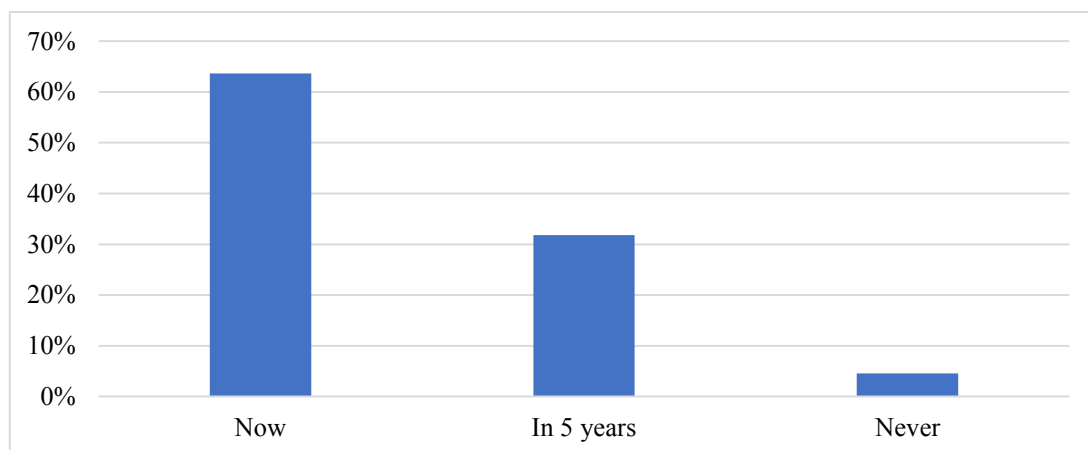
**Figure 2.** Knowledge of the concept of PropTech among developers.

Source: Own study based on the research.

As it turns out, slightly less than 2/3 of developers know or have heard of the term PropTech, while over 1/3 of developers have never come across this term. This means that despite the fact that modern technologies used in the real estate market are developing, many real estate market entities still do not know the basic concept in this regard. Perhaps this is due to the lack of interest in the trend as such, but only in individual innovative technological products.

The next questions concerned the areas that developers believe have the potential to apply modern technologies. In their responses, the respondents could indicate whether the potential for a given area already exists, whether there is an opportunity for a given area within 5 or 10 years, or whether the given area has no potential at all.

The first question concerned the area related to market research (Figure 3).



**Figure 3.** Market research as an area with the potential of using modern technologies.

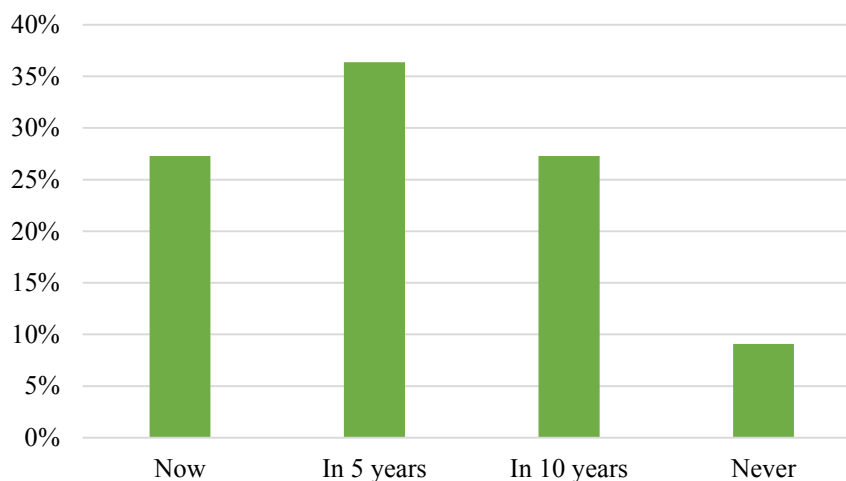
Source: Own study based on the research.

Over 60% of respondents believe that market research is an area that has great potential to use modern technologies today. About 30% of the respondents considered that the right moment to use the potential of this area was about 5 years from now. None of the developers indicated the period in 10 years, while only 1 respondent, representing 5% of the entire surveyed group, believes that market research will never be an area with the potential to use modern technologies. The modern technologies used in the field of market research include: using



artificial intelligence, VR glasses, data analysis (Big Data), creating virtual and augmented reality or 3D printing to visualize projects on the basis of which customers can evaluate the project.

Another area in which modern technologies can be used is the financing of housing investments (Figure 4).

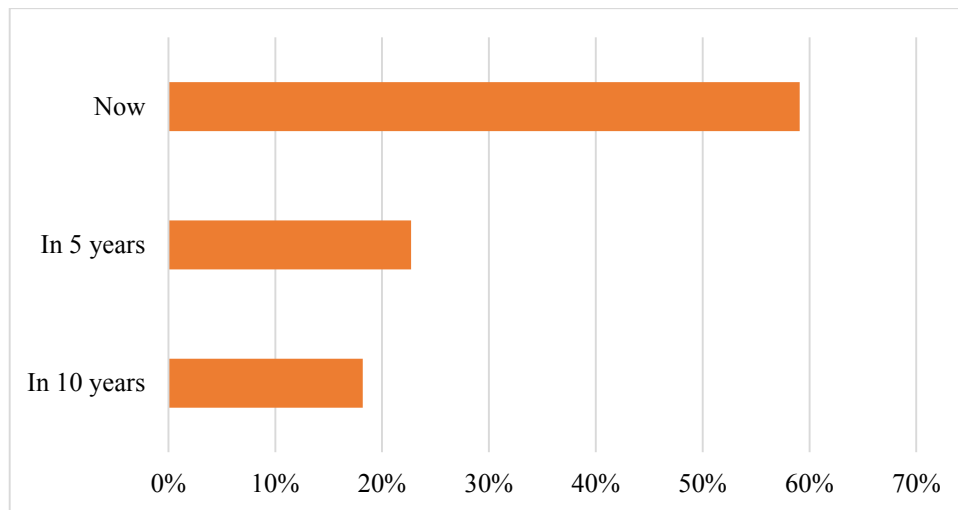


**Figure 4.** Financing of housing investments (e.g. crowdfunding) as an area with the potential of using modern technologies.

Source: Own study based on the research.

Most of the surveyed developers believe that the use of modern technologies in financing housing investments (especially through crowdfunding) will have the greatest potential in the next 5 years (36% of respondents), and even 10 years (27% of respondents). On the other hand, slightly over 27% of respondents believe that it is already an area with the potential to use modern technologies. Only 9% of the developers surveyed believe that modern technologies will never have such potential in this area. Crowdfunding using online platforms allows small investors to finance large projects without taking a loan. It is a relatively safe capital investment, however, to a large extent, the problem in terms of interest may result from the small number of investment platforms on the Polish real estate market, on the other hand, the lack of physical ownership of real estate, which in the case of this type of investment may be a certain barrier for a part of the society. Perhaps the developers decided that in the next few years the awareness of investors will increase, which will result in a greater potential for using the possibilities of modern technologies in this type of investing in the future.

Another area related to the implementation of modern technologies on the real estate market is the design and construction of residential real estate.

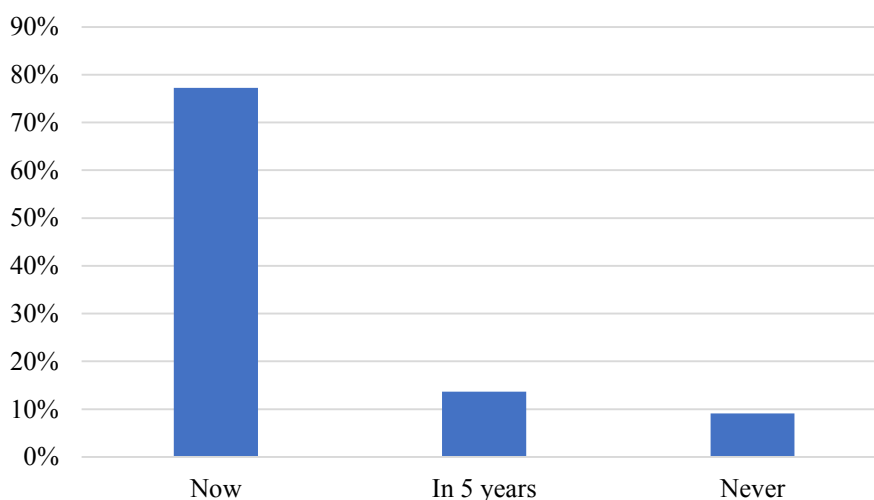


**Figure 5.** Designing and housing construction as an area with the potential of using modern technologies.

Source: Own study based on the research.

As shown in Figure 5, all respondents recognized that this is an area with great potential in terms of modern technologies. Almost 2/3 of the respondents already see the possibility of using them in the investment process, while slightly more than 1/5 see an opportunity in the next 5 years, and a little less than 1/5 in the next 10 years. None of the respondents indicated the answer that there will never be such prospects. In terms of design, the use of modern technologies largely concerns the creation of apartment visualizations, 3D models, projects in augmented reality or visualization of buildings. In the process of building residential real estate, direct video transmissions from the construction site are carried out, electronic document circulation is carried out, intelligent buildings are built or activities are carried out to optimize the construction process, among others, through digitization of work or a BIM model viewer.

The area that is considered to be the most potential in terms of using modern technologies is marketing, as shown in Figure 6.

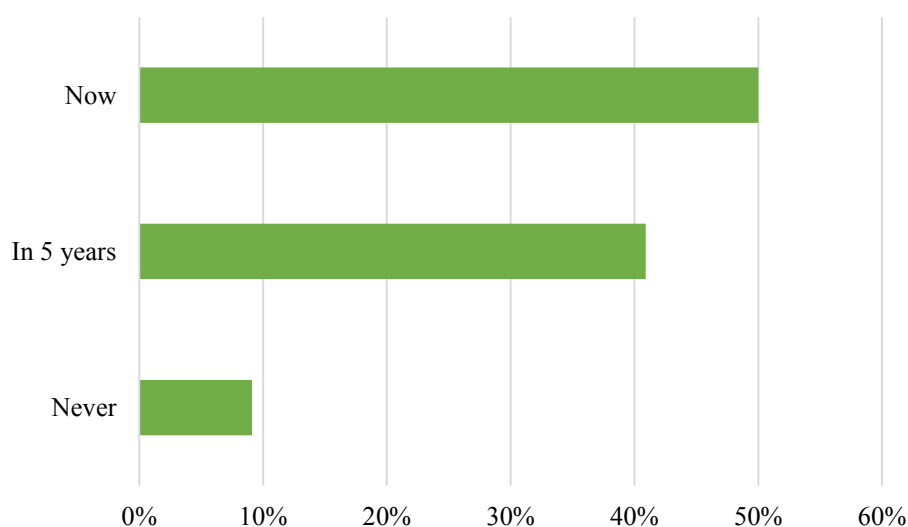


**Figure 6.** Marketing as an area with the potential of using modern technologies.

Source: Own study based on the research.

According to the survey, 77% of the surveyed developers believe that real estate marketing has the potential for modern technologies right now. Only 14% see the potential in the next 5 years, and only 9% of respondents believe that this potential will never exist. Real estate marketing is also related to other areas and so the visualizations of buildings or apartments used in the design or construction phase in terms of marketing are to promote individual investments. Other possibilities of using modern technologies include virtual walk, interactive location maps, 3D models or QR codes enabling quick transition to selected parts of the offer.

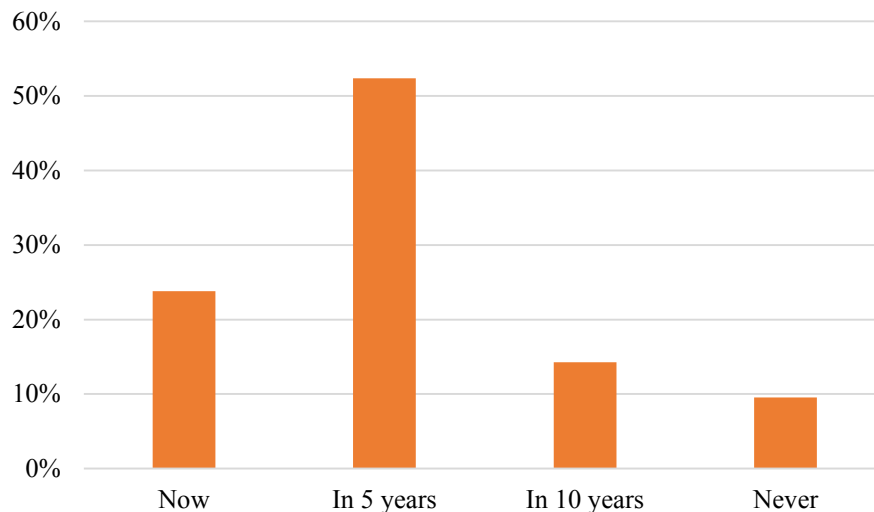
Another area with great potential, according to the respondents, is the sale or rental of real estate (Figure 7).



**Figure 7.** Real estate sale/rental as an area with the potential to use modern technologies.

Source: Own study based on the research.

Over 90% of the developers surveyed indicated the sale or rental of apartments as an area with potential in the use of modern technologies. Equally, half of the respondents agreed that now is the time to use them, while 41% of respondents said that there will be time in the next 5 years. Only 9% of the respondents answered that there will never be potential in this area, and none of the respondents indicated that it will happen in the next 10 years. Modern technologies in the process of selling or renting an apartment include the use of chatbots, virtual assistants for buying an apartment, apartment search engines and online meetings with sellers.



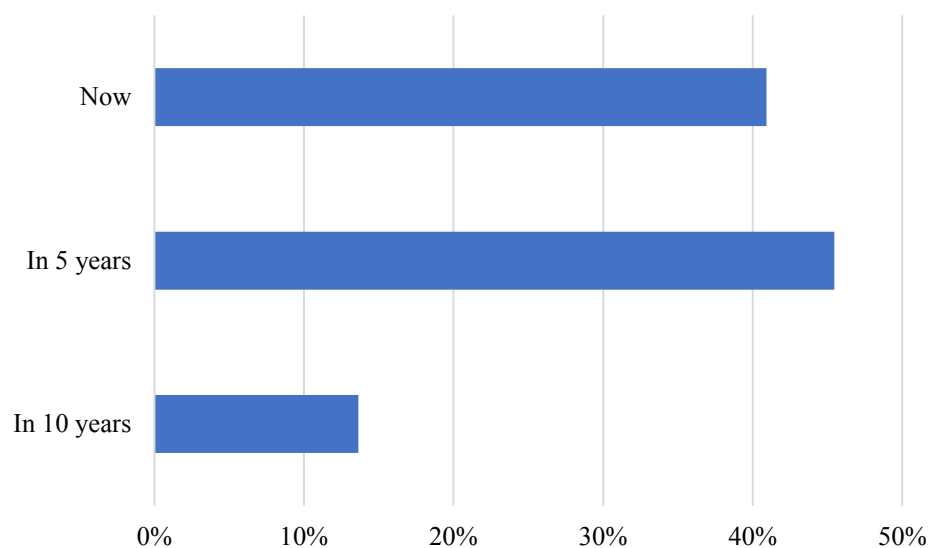
**Figure 8.** Residential real estate management as an area with the potential of using modern technologies.

Source: Own study based on the research.

In addition to the issues related to the process of building and then selling real estate, the real estate management process, during which the manager supports the facility using technologies designed and implemented in the building, is of significant importance from the point of view of the use of modern technologies.

Interestingly, more than half of the respondents agreed that modern technologies in the property management process will have the greatest potential in about 5 years. Just over 20% of the respondents assumed that the potential is there today, and 14% see it in 10 years. On the other hand, 10% of respondents decided that there will never be any potential for modern technologies in this area. Perhaps this is due to the degree of application of modern technologies in residential buildings - the low level of implementation of modern technologies means that property managers do not have systems that they could use, while older buildings lack adequate funds to undertake investments in this area (Figure 8).

The last area subject to the developers' opinion was the issue of Smart Buildings (Figure 9).



**Figure 9.** Smart buildings (so-called intelligent buildings) as an area with the potential of using modern technologies.

Source: Own study based on the research.

All surveyed developers concluded that the use of modern technologies in the creation of Smart Buildings is an area with potential. Most of the respondents (45%) believe that the greatest potential in this regard will be in about 5 years, 41% believe that the potential of this area should be exploited now, and 14% believe that despite the fact that they see the potential, it will be possible use only in about 10 years. Intelligent buildings cover many aspects related to real estate - these are systems related to controlling lighting, heating, air conditioning, electricity, roller shutters and household appliances, but also all devices that irrigate the garden, monitor objects and use solar energy.

## 5. Summary

According to the research, developers see potential in the use of modern technologies on the real estate market. It varies depending on the suggested area, but predominantly now, and in the next 5 years at the latest, they forecast that modern solutions will be introduced on the market. The areas perceived as the most promising are market research, design and construction, as well as real estate marketing. This is the result of using modern technologies in facilities that are just under construction and are at the concept or design stage. The use of modern technologies at this stage is mainly to help avoid possible design errors (e.g. through prior visualizations and 3D prints), speed up the construction process (e.g. through electronic document flow) and minimize costs (e.g. through the use of BIM models). On the other hand, the lowest potential of modern technologies was indicated in the context of financing housing investments through crowdfunding or real estate management. This is probably the result of

insufficient popularity of this type of investment in the case of real estate financing and the still relatively "old" housing stock in general, in which modern technologies have not been used so far, and the prospects for their use are low due to the necessity to incur additional costs. The conducted analysis may constitute an introduction to further research related to the determination of the use of modern technologies in particular areas in the future.

The results of the research can be used in the activities of developers and entities preparing technologies and tools that can be used on the real estate market in such areas as, for example, sales and customer service.

Unfortunately, there are significant research limitations including the local market situation - lack of ordinary housing, developers are selling everything they build in a very short time; the COVID-19 pandemic - difficulty in reaching respondents; the local market, which may be a limitation since it is an example. However, despite these limitations, the above study can provide a starting point for examining the level of implementation of modern technologies on the local primary housing market.

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