The impact of proptech on real estate industry growth

IOP Conf. Series: Materials Science and Engineering **869** (2020) 062041 doi:10.1088/1757-899X/869/6/062041

The impact of proptech on real estate industry growth

Nikolai Siniak[1], Tom Kauko [2], Sergey Shavrov[3] and Ninoslav Marina[4]

[1]University of Information Science and Technology "St. Paul the Apostle", Faculty of communication network and security, Partizanska bb, Ohrid, 6000, R. Macedonia, e-mail: nikolai.siniak@uist.edu.mk
[2]Independent scholar, Budapest, Hungary, e-mail: tom.kauko@yahoo.co.uk
[3]Belarussian State Technological University, production organisation and real estate economics department, 220006, Minsk, 13a, Sverdlova str, Republic of Belarus, e-mail: shavrov@ipps.by
[4]University of Information Science and Technology "St. Paul the Apostle", Faculty of communication network and security, Partizanska bb, Ohrid, 6000, R. Macedonia, e-mail: contact@uist.edu.mk

Abstract. The real estate industry is currently undergoing a digital transformation that not only changes its nature in terms of the markets and work environments, but is also influencing its growth. What are the main trends and concerns related to this transformation? To what extent is the real estate industry already prepared for this? This paper reviews the situation in terms of the emergence of a phenomenon known as PropTech. PropTech is characterized by the massive implementation of emerging technology such as home matching tools, drones, virtual reality, building information modelling (BIM), data analytics tools, artificial intelligence (AI), Internet of Things (IoT) and blockchain, smart contracts, crowdfunding in the real estate sector, fintechs related to real estate, smart cities, regions, smart homes and shared economy. This survey of changes in the real estate industry due to PropTech covers four areas: (1) PropTech applications in the real estate industry; (2) implications of PropTech for real estate market transparency; (3) how PropTech could give a region or a company a competitive advantage; and (4) concerns on the wider implications of these changes on a labour market and education. In a plausible scenario, changing the real estate technologies could change system dynamics and improve real estate market transparency. Moreover, it can be asserted that, in a broader sense, PropTech is beneficial for territorial competition and territorial growth strategies. And lastly, under different institutional arrangements, PropTech can affect the changing structure of the real estate market, the demand for hi-tech, new skills as well as emerging policy challenges for the real estate industry.

1. Introduction

Real estate and construction are important sectors in the economy. They both employ large amounts of capital and significant proportions of the workforce. Furthermore, together with other fields such as health, transportation, trade, agriculture, and so forth, real estate and construction have been targets of digital transformation. In the era of smart sustainable development and growth [1], companies are interested in solutions that allow their processes, machines, employees, and even the products and services themselves, to be integrated into a single integrated network for data collection, data analysis,

the evaluation of company development, and performance improvement. Staying smart, sustainable and inclusive in today's global business environment requires continuous improvement in productivity, quality, agility, and service levels [2]. Apart from the obvious benefits for firms, benefits from this turn also accrue to territorial governance, notably city management.

PropTech is defined as massive implementation of emerging technology within the real estate sector. A non-exhaustive list of such technologies include home matching tools, drones, virtual reality, building information modelling (BIM), data analytics tools, artificial intelligence (AI), Internet of Things (IoT) and blockchain, smart contracts, crowdfunding in the real estate sector, financial technologies (fintechs) related to real estate, smart cities and regions, smart homes, and shared economy. All these relatively recent innovations have the potential to improve productivity and competitiveness, increase energy and resource efficiency and effectiveness and hence to protect the environment and provide opportunities for developed and developing countries to achieve economic growth and sustainable development in line with the 2030 Agenda for Sustainable Development [3]. Property is at the heart of a 'smart' territory and it is time for the real estate industry to take a leading role. Moreover, it is likely that also territorial competition and territorial growth would benefit from the implementation of PropTech solutions.

The concept of «PropTech 3.0: future real estate" was developed in 2017 at the Oxford University School of business, the United Kingdom [4]. Subsequently, PropTech became part of the digital transformation of the real estate industry, in terms of leading the market and promoting a radically new approach to the acquisition, operation and management of the real estate. PropTech is furthermore a collective term used for the determination of start-ups that offer technologically innovative products and new business models for the real estate markets. PropTech means any application in the real estate sector, be it 3D visualizing, home matching tools, crowdfunding, fintechs, shared economy, smart cities, smart homes, AI, smart contracts or BIM. PropTech is still and a new trend, the scale of which will grow up over the time. Therefore, currently PropTech is developing in several areas: the real estate market as its own (PropTech in the narrowest sense), smart cities and buildings, the sharing economy, the construction industry (i.e. ConTech) and finance (thus, fintechs).

The remainder of our review discusses first the major features of PropTech in itself (although, in this context, understood in a broader sense than merely boundaries of a given plot or building). After that we review the current development trends, and the main opportunities and challenges of PropTech through the prism of the real estate sector. In doing so, we focus here on three kinds of implications: (1) market transparency; (2) territorial competition and (3) workplace environment. Lastly we note a number of conclusions based on these issues.

2. PropTech in real estate and digital transformation.

Realistically, few businesses can escape the digital transformation taking place across the global economy, and the real estate sector is no exception. Real estate companies are already using PropTech to improve customer experiences, boost sales and increase operational efficiencies. Yet many real estate firms have been slow to keep up with adopting new tools and technologies to transform their companies. The following list identifies examples of what real estate companies can do to embrace digital transformation for long-term success [5]:

- Use of rich media visualization to improve customer experiences.
- Collect property data with IOT devices.
- Embrace BIM.
- Employ AI-powered data analytics for transformative insights.
- Streamline workflows with digital image classification and similar procedures.

World Economic Forum classified the PropTech sector into three major categories [6]:

- PropTech 1.0: Growth of online listing sites back in 2007.
- PropTech 2.0: Use of data analytics and virtual reality to offer better and more specialised services for customers.

- PropTech 3.0: Experimentation with emerging technology such as drones, virtual reality tools, IoT and blockchain which are observing in recent days.

Nowadays almost 50 countries have created national communities (PropTechRussia, Austrian PropTechInitiative, PropTechBelgium, SwissPropTech, PropTechDach, PropTechSpain, UKPropTechAssociation, PropTechAsia, ProTechBaltic, PropTechNL, NordicPropTechInitiative and so forth), and these have already been united in a single network. Furthermore, the PropTech community has a number of interesting features. It is organized exclusively by business and for business. The community generates B2B services without any government involvement. What is the unusual, they include companies from various fields: investors (i.e. institutional and private equity funds, banks and financial groups, venture capital funds, business angels), real estate market participants (i.e. rights holders property developers, builders, consulting and brokerage companies, valuers, management and insurance companies), and technological IT – companies (i.e. suppliers of IT -solutions, integrators, aggregators , developers of specialized cloud and mobile applications), and start-ups (i.e. developers of technology products and solutions in the field of real estate). The community systematically holds international symposiums, seminars, and competitions that influence the generation of new projects.

A certain methodology to identify unoccupied PropTech niches already exists, in order to initiate start-up projects in them. Throughout this purpose, national maps of fintechs and PropTech are developed. They are designed to get an idea of which ICT tools in the country's real estate market are well developed, which are bad, and which are not developed at all. The map is based on open sources, includes information about the PropTech community, about IT companies, their projects in the problem areas of PropTech, about PropTech-developments, about PropTech-projects of banks, about developers, about real estate managers, and about other real estate market participants. The market map of PropTech (Market Map) gives the most complete picture in which the parameters of the market have a visible development, about the potential and the level of competition.

Market map has an information about all market players consolidated and classified by a certain attribute: competitors, intermediaries and sellers. The map certainly includes an image in the form of the layout of the logos of its participants. The classification of participants depends on their position in the global and national markets and their role in marketing activities. The map shows how the company’s roles in market distribution and allows to evaluate the place of individual firms compared to competitors. The creation of such a map is considered today as the final stage of marketing research on the real estate market.

Categories of IT -platform PropTech, proposed by Oxford University, are divided into 12 types [7]:

1. Property Management.
2. Construction Management.
3. Facility Management.
4. Portfolio Management
5. Home Services
6. Commercial Real Estate Search.
7 Long-Term Rentals / Sale Search.
8 Short-Term Rental / Vacation Search
9 Life, Home, Property & Casualty
10. Real Estate Agent Tools
11. Indoor Mapping
12. The IoT Home

Some other community members classify PropTech's IT-platforms into the following categories [8]:

1. Listing and search
2. Marketplace

3. Broker-free List and Search
4. Investment/Crowdfunding/CrowdLending
5. Data, Valuation and Analytics
6. Mortgage Tech
7. Property/Building Management
8. Leasing Management Software
9. Real& Virtual Viewing (3D/VR/AR/Photo)
10. Tech-enabled Brokerage
11. Agent Matching
12. O-2-O Services
13. Smart Building & IoT
14. Smart City
15. ConTech/BIM
16. Sales and marketing
17. PropTech Associations
18. PropTech Startup Accelerator
19. Others

Start-up projects and PropTech Startup Accelerators are the most important in this PropTech concept. Their numbers have been increased significantly every year. Examles of start-up projects and their structures can be found based on the information we collected in the contet of a competition known as *PropTechRiga2019* [9]. As shown in Table 1, the largest number (five) out of 15 start-ups belong to the class of Portfolio Management, which accounted for 33% of all applications.

Table 1. Structure of start-up projects at the *PropTechRiga2019* competition

Name of a start-up project	The company, the country	Class of a platform
1. Construction processes synchronization platform based on BIM	BIMSynch (Latvia)	Construction Management
2. A platform for property managing and operating	ODN (Russia)	Facility Management
3. A corporate platform for day-to-day construction management	OROCON (Latvia)	Construction Management
4. Office Management Platform	Pingin (Lithuania)	Property Management, Short-Term Rental / Vacation Search,
5. Business Process Platform for Return Reinvestment	Profitus (Lithuania)	Portfolio Management
6. Smart Contract Real Estate Transaction Automation Platform	SmartLaws (Latvia), Agent House (United Kingdom),	Real Estate Agent Tools
7. SaaS Platform for Sales Synchronization and Tendering services for a variety of companies and suppliers	FIXtender (Latvia),	Portfolio Management
8. Analytical GIS platform with many B2B services	Einpix (Lithuania)	Home Services
9. Cloud portfolio platform for home developers	REALPAD Software (Czech Republic)	Portfolio Management
10. Blockchain platform for cross-border housing transactions	Velvet (Estonia)	Long-Term Rentals / Sale Search
11. Real Estate Portfolio Platform supported by Realtors and Crowdfunding	Reinvest24 (Estonia)	Portfolio Management

12. Digital Commercial Real Estate Operator	R8tech (Estonia)	IoT Home
13. Software complex to support the financing of ongoing projects	Securebadger (Estonia)	Portfolio Management
14. Cloud SaaS Urban Development Platform	Immovativ GmbH (Germany).	Property Management
15. The cloud-based long-term business management platform	Bidrento (Estonia)	Long-Term Rentals / Sale Search
16. SaaS Asset Management Platform with Increased Energy Efficiency	SmartVent (Estonia),	IoT Home

Apart from the entries listed for this competition, we also note that, in Belarus, two interesting start-up projects can be distinguished. These were carried out on the roadmap of the Companies Union of Realtor Activities Reengineering, namely:

(1) a project to integrate the Real Estate Agent Tools class platform with the E-government infrastructure,
(2) a cooperation between Russia and Belarus on projecting the property management class for transferring joint homeownership management to a single IT platform.

Analysis of PropTech solutions, including those submitted for the *PropTechRiga2019* competition shows that the business models of all the submitted start-up projects are global. Therefore, they are designed for users of the whole world, or Europe, or several regions, but not for a single country. As the allocation of venture capital funding by an increasing band of global investors is deployed to uncovering and developing the digital innovation of the future, traditional operators will come under increasing pressure to adapt or perish. One of the features of this 'survival game' undoubtedly pertains to the way market information is made accessible and maintained for any user or investor category dealing with real estate.

3. PropTech and real estate market transparency

Real estate market transparency entails the incorporation of the objectives of smart sustainable development and growth into industry and government operational practices and plays a crucial role in a city's success. It enables governments and public bodies to function effectively, providing long-run benefits to local communities and the environment. It also helps in creating a more competitive and flexible environment for investments and businesses, as well as contributing to improvements in quality of life for citizens. Without high levels of transparency, real estate markets cannot work efficiently. Four key issues, with significant implications for transparency, stand out here:

- The emergence of the PropTech sector, as new technologies are adopted by the industry.
- The rise of 'flexible office space', as major disruptors change real estate market dynamics.
- The spotlight on beneficial ownership and anti-money laundering, as public debates around corruption, tax evasion and ownership continue to make headlines.
- The maturing of the 'alternatives' sector, as it goes mainstream and investors demand higher transparency.

The first item is one of the most important. In this new age, digital technology has already become the defining transformational force. It has rapidly become an umbrella concept for the central new drivers of productivity growth, innovation and the diffusion of knowledge on a global scale. Those who embrace digital technologies as the central transformational force of this new age are likely to prosper. While digital transformation has disrupted almost every type of business, the real estate industry has been traditionally slow to move with the times. Why is it so? Reasons have to do with speculation, when better yields and profits can be extracted without innovating; another reason is conservative attitudes. We must remember that we are dealing with a particularly durable good. In general, we can refer to a rather constrained decision making setting of any real estate sector or subfield. [10]

In areas ranging from computer-aided design to development of new construction materials and technologies, to the use of augmented-reality marketing solutions, a long list of innovative new

technologies is starting to gain traction, with potentially profound consequences for the real estate and construction industry. It will help to increase the input of the real estate sector in GDP and provide sector's growth and transparency. PropTech is well placed to make the markets more transparent, in as much as we believe in the diffusion of the technology across market areas and segments. This is because the increasing accessibility of new technologies enables us to overcome the friction of space that would otherwise lead to spatial arbitrage conditions. In other words, information spread and removal of barriers of trade are realistic consequences of technological breakthrough – in general and with PropTech concepts in particular.

Whenever possible, these predictions need to be grounded in empirical realities. The Global Real Estate Transparency Index and methods are used for such transparency assessment. According to this source, real estate markets in most European countries can be considered transparent [11]. This means that transactions are fast and secured, government behaviour in tax and legal spheres is predictable and regulators fully disclose financial information. European part of the rating is headed by Britain, France, the Netherlands, Germany, Ireland, Sweden and Finland.

At the same time, Jones Lang LaSalle (JLL) experts found problems that affected Central and Eastern European markets [12]. The saddest situation in Europe is in Russia (38), Slovenia (46), Serbia (47), Bulgaria (49), Ukraine (69) and Belarus (88). In the newly released biannual Global Real Estate Transparency Index (GRETI) 2018 by JLL, Belarus is ranked 88th, an improvement from the 2016 edition of the Index where the country was ranked 100th from 108th countries. JLL has been tracking the transparency of the global real estate market for 20 years and today. Belarusian real estate market is considered as an opaque all these years – the only European country and the only from CIS countries in 2018. Kazakhstan and Mongolia accompanied Belarus in 2014 ranking as an 'opaque' market. However, in 2016 and 2018 Kazakhstan are considered as a Low Transparency market but not an opaque. Jamaica and Mongolia were withdrawn from JLL Global Real Estate Transparency Index update.

The world's largest emerging economies are concentrated on the cusp of 'Transparent' status. Accounting for almost 50% of global population, these 'Big 8' markets (Brazil, China, India, Indonesia, Mexico, Russia, Thailand and Turkey) present enormous real estate opportunities that are currently restricted by a lack of transparency. While many of these countries continue to make improvements, further regulatory reforms – and, crucially, stronger enforcement – will be needed to push these markets into the 'Transparent' tier.

Now let's describe what the Global Real Estate Transparency Index is and what kind of indicators contribute to the final results. The Global Real Estate Transparency Index is based on a combination of quantitative market data and survey results across 100 countries and 158 city markets. 186 individual measures are divided into 14 topic areas, which are then grouped and weighted into six broad sub-indices (i.e. blocks): (1) performance measurement 28.5%; (2) market fundamentals 16.5%; (3) and governance of listed vehicles 10%, (4) regulatory and legal frameworks 25%; (5) transaction process 15%; and (6) environmental sustainability 5%.

In the first sub-index (i.e. block), efficiency and effectiveness indicators are estimated. These are the price indices for real estate, the share of institutional investors in the market, independence and quality of the evaluation activities of foreign companies and so forth. The second block includes market fundamentals: the presence and duration of time scales, reflecting different quantitative data such as rent, yield, and occupancy (load), in different types of properties and similar data. The third block comprises a review of financial regulators – how often the market reports are published, how detailed they are, whether the English versions are available. The fourth block deals with the laws of is published all information about real estate registration and taxes. The fifth block is devoted to the transaction process: whether the complete presale information is available, how transparent are the auctions and how honest are realtors. The sixth block pertains to environmental sustainability assessment. Transparency index is calculated every two years.

The Global Real Estate Transparency Index scores markets on a scale of 1 to 5 (with 1.00 being the highest possible score). Depending on their overall performance, markets are assigned to one of

five transparency tiers. The criteria are qualitative or subjective and these are calculated on the basis of the experts' responses on a scale from 1 (highly transparent) to 5 (opaque).

In 2018 the demand for higher transparency was stronger than ever, as investors continued to increase their allocations to the sector, public debates around property ownership continued and the industry grapples with significant structural changes. Over the past two decades, the Global Real Estate Transparency Index has become established as the leading industry benchmark for assessing market transparency. Now in its tenth iteration, it continues to guide the sector towards higher standards. The survey also reveals that the landscape of transparency is shifting, with new issues emerging on the horizon as the real estate Sector undergoes unprecedented structural change.

Another Real Estate Environmental Sustainability (REES) Transparency Index is based on a survey completed by JLL Energy and Sustainability Services experts in every 100 countries. Canada has joined France, Australia, Japan and the UK in the 'Highly Transparent' group in 2018, while Belarus has still sheared the 'Opaque' group with Kazakhstan, Uruguay, Kuwait, Panama, Ukraine and others. Low REES Transparency has Slovenia, Turkey, Bulgaria, Serbia, Hungary, Saudi Arabia, Egypt, Iran, Lebanon and some other countries.

To sum up the discussion above, real estate transparency and environmental sustainability market transparency entails the incorporation of the objectives of smart sustainable development and growth, digital and investment performance, into the operational practices of government and industries. Now a new question can be raised about the territorial dimension of these practices. Could it be that the benefits of real estate market transparency can be seen at an intermediate level, so between the individual spaces of the real estate occupancy and a whole country? This is the topic of our next discussion.

4. PropTech oriented strategies of territorial competition for economic growth [13]

Territorial competition in the New Economy comprises a variety of strategies, both direct and indirect ones. The most common direct strategies are in essence traditional, digital, or cultural, derived from an interdisciplinary perspective (urban geography, economic geography and
urban economics, at least). The indirect strategies, in turn, focus on the territorial economic growth possibilities offered by particular industries, and herein lies the added value of PropTech. Namely, how land and buildings are situated in the reuse and restructuring process of cities involves digital transformation issues of both business and policy relevance. Even in ICT based economies, the headquarters and homes of workers require tasks of valuation and physical design. Following the principle of property market process by D'Arcy & Keogh (1998), the markets for land and buildings are both a precondition to economic growth and a consequence of growth [14]. In this field, research and development is aimed at a transformation towards green, socially and economically sustainable economies using innovations in construction and real estate sector.

So according to the overall argument by D'Arcy & Keogh, the property market can indeed influence a city's competitiveness by fulfilling preconditions for growth, and then signalling the actualized growth. This entails a feedback process between the two functions above: first, company headquarters need affordable high class office space, and the property market has the responsibility to cater for it; then, the functioning of the property market, in itself, indicates economic performance (see also van der Krabben & Lambooy, 1993; D'Arcy & Keogh, 1997) [15].

When deliberating the digitalization in n real estate context, the smart city approach can be seen as a real estate development principle where cutting edge technology is utilized to the maximum extent for the modernization of the urban realm. However, here a sharp divide exists between the proponents and critics of the smart city concept, as for example Valdez and colleagues (2018) note [16]. Here we approach the debate through an intermediate position.

According to Turok (2004), a broader economic and policy perspective to urban development and city-regional competitiveness is required than mere reliance on the contemporary perspective based on business clusters and networks [17]. On the other hand, traditional economic policies remain important as PropTech based competitiveness strategies are more difficult to aim at [18]. So strategies

vary as many different development models exist and trajectories emerge spontaneously in space, as Boschma (2004) has argued [19]. In this vein, cities are seen as differentiated products, and this differentiation defines their economic relevance. We also note the increasing use of images for city marketing, akin to corresponding product marketing strategies. This can be verified by comparing architectural and design solutions of big cities, as observed by Pompe and Temeljotov Salaj (2014) [20]. With the territorial benefits and opportunities generated by PropTech in mind, we move to the workplace and educational side of this concept next.

5. PropTech and workforce and education.

So PropTech is the profound transformation of business and organizational activities, processes, competencies and models. Those who thrive in the PropTech will need to develop and execute a vision for digital transformation take an ecosystem-first approach to delivering products and services, manage information effectively, optimize business processes for speed, efficiency, quality, and agility, create flexible and reliable human resource model.

Three types of impact on the labour market are obvious: (1) the labour market is shrinking, (2) the labour market is not changing, but is improving, (3) new niches are emerging in the labour market. As the tendency of ICT industry is to concentrate, all such development is not necessarily positive. Practical examples, such as Airbnb, WeWork and Amazon demonstrate how digital disruptors can materially affect the markets in which they operate, leaving incumbents scrambling to catch up. Potential problems with such global monopolists can also be observed. More than anecdotal evidence already exists on this. Examples include Amazon blocking potential publishers and Air Bnb barring potential guests with different political views than the left-of-centre or liberal norms.

The labour market reduction due to the disappearance of a number of traditional professions that are replaced by PropTech solutions. For example, the labour market of valuers is reduced by the platform «FinCase» (https://f-case.ru), a project developed in Russia, which can be attributed to the class of Portfolio Management. The platform offers the FinCase Scoring Value Analysis System solution – a solution for the automatic valuation of real estate, which allows automata of the valuation and forecast of the value of both residential and non-residential real estate. In fact, the phenomenon of labour market contraction entails any decision based on AI technologies. Thus, BIMSynch (Latvia) delivered a start-up project in Riga with the digital construction platform “BiM Building Synchronization Platform”, construction management class. The project proposes an IT- platform for managing construction processes under the “guidance” of BIM and a mobile application that allows comparing the real state of the construction object with its model. The platform will provide users with savings in time and money by optimizing the cost of a construction, improving synchronization of joint actions of subcontractors, improving copyright supervision, and construction monitoring processes, quality real estate management while reducing the number of employees.

PropTech is also driving growth in the labour market but in completely new segments. For example, the development of digital real estate marketing leads to the growth of the labour market for specialists in the creation of digital twins of virtual and augmented reality (3D-VR), operators of multi-level earth remote sensing systems, specialists in indoor mapping, facilitators in using IoT.

Companies in leading sectors have workforces that are 13 times more digitally engaged than the rest of the economy. In lagging sectors, the digital engagement of the workforce can be erratic; some organizations have made progress in certain areas but have not yet addressed foundational tasks their workers perform.

PropTech has also influenced the appearance of new trends that never existed before. These have influenced both the workforce and workplace in the real estate market. We go through each of them below.

Trends in the emergence of unique solutions that never previously existed in the history of mankind. Let us examine some examples of results that testify to such tendency. BIM data information models have never driven construction processes, as it is in the case in the aforementioned

BIMSynch project. Instruments are known as BIM are the source of information for AI, which makes construction budgeting in a few minutes. The instruments were developed in which BIM manage the logistics of construction materials on spatial data on the location of the respective warehouses. All of these solutions have a place for the simple reason that BIM had never been before.

Another example is the project of the Velvet (Estonia) company. Name of the project: *The Blockchain is the platform of cross-border housing transactions*. The platform solves the problem of remote authentication of civil law subjects, the design and implementation of e-transactions, communication with payment systems, and so forth. Its regulations allow all interested parties in transactions to identify themselves and make decisions based on big data (in this case: the list of sanctions, information on criminal offences) to ensure the fact of cooperation with the proper person. The regulations provide the necessary level of transparency, when customers can see at what level of transaction they have: the payment was made, the payment was accepted; the transaction was done, and so forth. Regulations of the platform provide an immutable record, when the terms of the transaction cannot be changed under any circumstances, while maintaining a high level of security and confidence to all types of transactions. Regulations of the platform have everything for the execution of transactions that provide interaction platforms for worldwide interbank financial SWIFT messaging for payments with escrow accounts (platforms).

Velvet implements transaction of purchase/sale with a high degree of security regardless of the geographic location of the property and civil rights. Possible areas of use of the platform: logistics, E-Commerce, real estate, stocks, and so forth. The top of the countries in the implementation of the project are Ukraine, Germany, Russia, Finland and Turkey. This project is unique for the simple reason that never before was not used smart contracts, blockchain and token in real estate transactions by this way.

The trend of companies moving away from office space and moving from permanent offices to fragmented use of common space and workplaces right at home. This phenomenon was envisaged by the PropTech concept, which introduced the concept of ‘separation economy’ into practice. Coworking (Co-working, ‘teamwork’) is becoming a new approach to organizing the work of people with different occupations in a common space. Coworking space is often called a shared space, a collective office. Coworking characterizes the flexible organization of the workspace and the demand form communities.

Coworking space is referred to as the ‘third place’, separate from two ordinary social environments: home (‘first place’) and workplace (‘second place’). Examples of third places are often shown as environments such as cafes, clubs, public libraries, parks, shared offices, and so forth. According to Jones Lang LaSalle (2016), 25% of average working time is currently spent in the third places. Dennis Frenchman from the Massachusetts Institute of Technology proposed the term ‘fractionation of real estate’ to describe the fragmented use of inefficiently-used space of the same real estate. Fractionated real estate becomes a workspace sharing platform. Projects of the Short-Term Rental / Vacation Search class have already been implemented, allowing to become the owner of the office on the principles of coworking for several hours from the moment of a contact. The demand for joint workspace is caused by the growth of creative and technical industries, as well as a change in the nature of work. The number of collaborators that have been used coworking is growing steadily from year to year and, according to current estimates, reached 1 million participants in 2017.

Educational Trends. When we deliberate ongoing and inevitable changes in the education, three trends should be noted.

Firstly, the more active participation of universities in start-up projects. For example, the company R8tech (Estonia) entered the competition (table 1) with the project ‘Digital operator of commercial real estate’ (IoT Home class). The IT operator is based on a model of facilitation management with elements of AI; with the so-called Autopilot on the premises; with the mapping of interior spaces; with continuous communication with customers. The ‘Autopilot’ function of the

operator gives users confidence that all rooms are heated/cooled and ventilated properly. This saves 20% of energy consumption. The 'Diagnostics' function of the digital operator analyses the current characteristics of the engineering equipment of the building, and determines the details of its anomalies and malfunctions. The 'Accident Detection' function is provided by the technical services of a digital operator, which are provided continuously, oriented to owners and managers, in order to ensure long-term operation of engineering equipment, transparency of management, and a comfortable indoor climate. The company's partner in the project is Tallinn University of Technology, which implements modern innovative projects of intelligent agents based on AI for the technical operation of buildings.

Secondly, universities began to train future specialists in the PropTech segment with an expanded profile. They are equally prepared in four areas: information technology, legislation, economics and management.

Thirdly, universities strive to transfer their education towards practical and project-oriented training, thereby attracting students to start-up projects carried out in partnership with companies in the PropTech community.

This approach even allows you to teach what is not yet but will appear in the future. Undoubtedly, the main challenge of the future is constantly changed. To cope with this constant change, the educational unit must be more flexible.

6. Conclusion

PropTech can be seen as a new battleground in real estate. Global technology entrepreneurs and investors have already begun turning their attention to reinventing the real estate sector, through business model innovation and product innovation. Companies are using PropTech to raise the bar in operational efficiency, customer engagement, innovation, and workforce productivity. The general impact of PropTech on the labour market is a more complex issue than the impact on real estate and built environment alone. The results are expected to be mixed: one the one hand, widespread dislocation of workers, and possibly unjust treatment of dissident voices by global monopolists, but on the other, a proliferation of PropTech that offer new, potentially more flexible ways of working, education, matching skills, and acquiring skills. So at the same time two opposite trends emerge: one, harm caused by movement of unskilled labour force (possibly together with over-abundant skilled labour force), from low-income countries towards high-income countries, where their arrival, in the absence of strong unions, will lead to a race towards bottom in the local labour market; two, for those who are in the market for high level technology and management oriented roles, a convenient fit between demand and supply for such jobs (controlling of BIM process, moderation of AI and so forth).

While precise predictions for next generation or two are impossible, our approach necessary needs be forward looking. University graduates must have the skills to adapt to a rapidly changing labour market; they must have the skills to solve the still unknown problems of the future. The fact is that professional and technical skills can be acquired and updated at a later stage of their career, while theoretical problem- solving skills, self-development skills can be achieved only through the process of academic preparation at universities. To cope with this constant change, the educational base must be more flexible, universal and – where a scientifically rigorous Real Estate course is established in the curriculum – PropTech oriented. All this considered, we believe that our survey be helpful for companies, foreign investors and government in terms of making a proper choice of a real estate sector digital development and creating clear investor-friendly conditions in different countries.

References

[1] European Commission, 2010. Europe 2020: A strategy for smart, sustainable and inclusive growth. COM (2010) 2020 final [online]. [cit.2018-10-01]. Available at: http://ec.europa.eu/budget/img/budget4results/SustainableDevelopmentInTheEU.pdf.

[2] Territorial Agenda 2020 - Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions [online]. [cit.2018-10-05]. Available at: http://www.nweurope.eu/media/1216/territorial_agenda_2020.pdf
[3] UNIDO, 2016. Proptech. Opportunities and Challenges of the New Industrial Revolution for Developing Countries and Economies in Transition. Panel discussion online]. [cit.2018-10-03]. Available at: https://www.unido.org/sites/default/files/2017-01/Unido_industry-4_NEW_0.pdf
[4] Baum, A. PropTech 3.0: the future of Real Estate // University of Oxford Research [online]. [cit.2019-10-05]. Available at: www.sbs.oxford.edu.
[5] Siniak, N., Shavrov, S., Marina, N., Krajco, K., 'Examining the feasibility of industry 4.0 for the real estate sector with a lens of value and job creation'. Proceeding of scientific papers from the international scientific conference The impact of industry 4.0 on job creation, Trenčianske Teplice Slovak Republic, 22 November 2018, Publishing House Alexander Dubček University in Trenčín, 2019, pp. 179-186. ISBN: 978-80-8075-837-0, https://fsev.tnuni.sk/konferencia2018/Zbornik-industry-4-0.pdf
[6] See https://www.weforum.org/agenda/2018/01/proptech-drones-data-ai-property-sector/
[7] See https://www.sbs.ox.ac.uk/sites/default/files/2018-07/PropTech3.0.pdf
[8] See https://www.proptechbiz.com/eng/research/proptech-categories/
[9] Т.Н. Недерева-Архипец, Шавров С.А., Цифровая трансформация бизнеса в сфере недвижимости Research [online]. [cit.2019-09-16]. Available at: www. http://land-reform.com/wp/category/publikacii/
[10] Kauko, T., 'Innovation in Urban Real Estate – the role of sustainability', *Property Management*, 37(2), 2019, pp. 197-214.
[11] Newell, G. 'The changing real estate market transparency in the European real estate markets', *Journal of Property Investment & Finance*, 34(4), 2016, pp. 407-420, https://doi.org/10.1108/JPIF-07-2015-0053
[12] Global Real Estate Transparency Index 2018. Transparency: Data, Disclosure and Disruption. Global Research. Jones Lang LaSalle, Inc, 2018. [cit.2018-12-14]. Available at: http://greti.jll.com/greti/Documents/greti-revamp/JLL-Transparency-Report-2018-FINAL-Reports.pdf
[13] This section is based on a prior article by one of the authors: Kauko, T., 'Territorial competition in the New Economy. Different strategies in different urban settings', *Urbanism. Architecture. Constructions*, 6(1), 2015, pp. 5-28
[14] D'Arcy, E. and Keogh, G. Territorial Competition and Property Market Process: An Exploratory Analysis. *Urban Studies* 35, 1998, pp. 1215-1230.
[15] Van der Krabben, E. and Lambooy, J.G., 'A theoretical framework for the functioning of the Dutch property market', *Urban Studies*, 30, 1993, pp. 1381-1397. D'Arcy, E. and Keogh, G. Towards a property market paradigm of urban change, *Environment and Planning A*, 29(4), 1997, pp. 685-706.
[16] Valdez, A.-M., Cook, M. and Potter, S., 'Roadmaps to utopia: Tales of the smart city', *Urban Studies*, 55(15), 2018, pp. 3385-3403.
[17] Turok, I., 'Cities, Regions and Competitiveness', *Regional Studies*, 38(9), 2004, pp. 1069-1083.
[18] We have derived this claim from a more general assertion made in the following paper: Malecki, E. J., 'Jockeying for Position: What It Means and Why It Matters to Regional Development Policy When Places Compete', *Regional Studies*, 38(9), 2004, pp. 1101-1120.
[19] Boschma, R., 'Competitiveness of regions from an Evolutionary Perspective', *Regional Studies*, 38(9), 2004, pp. 1001-1014.
[20] Pompe, A. and Temeljotov Salaj, A., 'Qualitative criteria of urbanism and brands: A comparative analysis', *Urbani izziv*, 25(1), 2014, pp. 74-92.