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Theory Methodology Practice

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CONTENTS

The impact of Industry 4.0 on the processes of social innovation

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SUMMARY

Our previous research into this topic has proved that technical developments significantly affect processes and effectiveness of social innovation. The current process of this development is called Industry 4.0. The first part of the study deals with industrial evolutions and the process of Industry 4.0 is interpreted. The second part of the study presents national and international examples and good practices in order to examine the relationship between digitalisation and social innovation. The results of Industry 4.0 reveal that there is an increasing number of solutions for social innovation that are based on digitalisation and automation. The current digital revolution is radically changing societies and opening up new opportunities for social innovation. Industry 4.0 results in social innovation solutions that use artificial intelligence to improve and optimise processes.

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INTRODUCTION

Digitalisation is the greatest achievement of Industry 4.0. Since it is a global process, having a better understanding of international experiences and best practices contributes to more accurate and more detailed impact and relationship analysis. As digitalisation grows in space, the role it can play in social innovation processes becomes increasingly important. In the 21st century, the concepts of digitalisation, competitiveness and innovation are closely interrelated, influencing and stimulating processes. We can reasonably assume a causalrelationship between digitalisation and the effectiveness of social innovation. These relationships show the role that digitalisation must play in successful social innovation and the directions of social and economic development needed for success.

Industry 4.0 is increasingly intertwined with information technology and automation and is resulting in fundamental change in production methods. The emergence of a new technical environment will create new social challenges that will trigger the renewal of social innovation processes. Learning international experiences and best practices from other countries can help model social innovation more effectively. This study looked for best practices that investigate social innovation from the perspective of digital transformation and development. These international examples can be utilised in domestic practices. This study presents the factors in digitally-aided social innovation processes that increase efficiency compared to conventional social innovation. The analysis of digital social innovations in international practice helps us make comparisons and determine efficiency and success factors. Digital social innovations highlight the potential of digital technologies to identify social needs and to solve social problems effectively. This study extends the conventional social innovation model with aspects of digitalisation. They contribute to a better understanding of modern social innovation processes by applying a new operational mechanism.

INDUSTRY 4.0 AND DIGITALISATION

Describing Industry 4.0

One of the important tasks of industrial production is to improve the quality of life in society. In doing this, industrial production attempts to meet social expectations, which results in continuous development and industrial evolutions in the event of major technological changes. All industrial revolutions defined so far aimed to meet consumer demand for a higher quality with the new technologies available. Industrial revolutions are processes that change the tools

available to people in order to make their daily lives easier and open the way to more complete control over human's physical environment.

Considering the current global economic and social changes, the claim that we are living in the days of the Fourth Industrial Revolution is difficult to question. The term Fourth Industrial Revolution and Industry 4.0 is used in different ways in professional terminology (Nagy 2019). There are some people who mean the same process while others differentiate between the two terms in various aspects aspects. This study adopts the second standpoint and differentiates between the two terms. However, it is important to maintain the idea that Industry 4.0 is a result of the Fourth Industrial Revolution.

Industry 4.0 is a concept that attempts to respond to emerging technical and economic challenges by basically digitising industrial – and expending default – economic and social processes. The German government was the first to use the term Industry 4.0 in 2011, when it announced its industrial development program for 2020 (Zhou et al. 2015). Industry 4.0 is not just about upgrading technology but also about business.

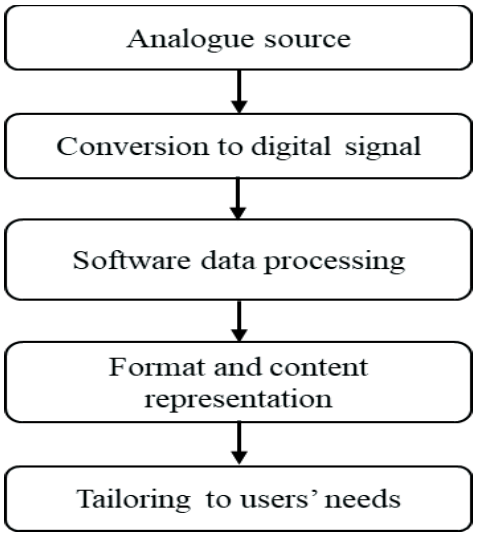
Industrial robots and automation processes appear in the second half of the twenties century, but the Internet appeared later, which created the possibility of networking. It is considered that Industry 4.0 is based on digitalisation and data. The computer is just a tool that carries out the digitisation process. The Internet and technological advances are creating a constantly connected network of people, machines and companies. By continuously sharing data from value creation processes, a fully customised product can be produced.

The concept and processes of digitisation und digitalisation

We need to distinguish between the concepts of digitization and digitalization. Digitisation is the conversion of changing the analogue to the digital. Digitalisation is how this new digital world will impact people and work.

A digitization process can be formulated very simply, since it is a process of converting analogue signals to digital signals. Figure 1 shows this process. After the conversion process, the data are tailored to users' needs. The digitisation process is performed in three steps: Conversion, software processing and form and content exploration. The achievements of digital technologies are seen as natural in our day-to-day life. GPS maps are used for orientation and navigation. Digital media is used for various purposes. Tickets and products are bought online. Digital photos are looked at on mobile phones. These and thousands of other activities could not be carried out without digitalisation.

ince the toolkit for digitisation opportunities is constantly evolving, the interpretation of digitisation is also constantly evolving. Digitisation today means something completely different than several years ago. Nowadays it has a more complex interpretation. In many cases, processes previously understood as digitisation are already considered as a basic skill. Thus, digitisation is considered an appropriate term only for more complex operations. Figure 2 presents elements of a complex interpretation of digitisation, which can already be called digitalisation. Even if a detailed analysis is not performed and only the elements are considered, the complexity of digitalisation can be observed. Digitalisation is present in every area of life. It means online presence, data and information exchange between device and person (Kollár & Poór, 2016).



Source: author's work

Figure 1. Conventional digitisation process

The socio-economic importance of digitalisation is enormous. It is one of the pillars of Industry 4.0, the Fourth Industrial Revolution and affects all areas of life. It helps and accelerates our daily lives, relationships and work. Also, it promotes and stimulates learning and entertainment and contributes to the quality of life. In addition, it fosters autonomy and innovation and transforms them in order to achieve growth (Siemens, 2018).

In 2016 and 2018 Siemens surveyed the digitalisation of the corporate sector. A digitalisation index was created, which is an aggregated index in the following categories:

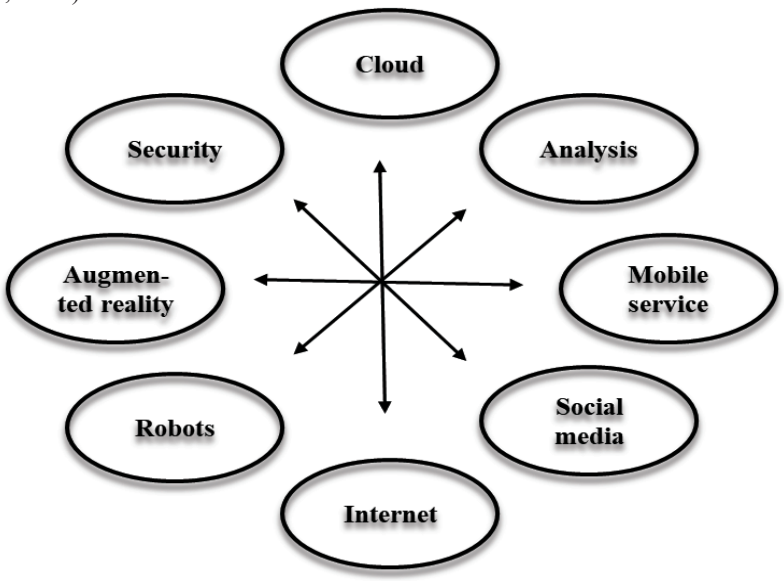
- Importance of digitalisation within the company,
- current level of digitalisation,
- the preparedness of the company for innovation,
- digitalisation plans and opportunities.

ompanies graded factors on a scale within a 1-5 range. The digitalisation index of companies was 3.5 in both 2016 and 2018, which did not seem to indicate any shift. In 2018 small companies were also surveyed. Their index was lower (3.2) than the average, which indicated that if small companies had been included in the survey in 2016, the aggregated index value would have been lower. It can be assumed that the digitalisation level actually increased during the two years. In 2018

the index of medium-sized companies amounted to 3.5 and the large company index increased to 3.7. (Siemens, 2018).

Companies considered the conditions for digitalisation as having improved in 2018. Fewer factors hindering the implementation of digitalisation were revealed. As for a corporate approach, small companies considered smaller IT investments as a digital improvement, whereas large companies regarded more complex and large-scale investments as a digital improvement. (Siemens, 2018).

Although the Siemens survey sampled different companies, its methodology can be adopted to investigate digitalisation of social innovation. The four categories (importance, level of digitalisation, preparedness for innovation and digital plans for the future) are essential conditions for providing effective and efficient digital solutions for innovative resolutions of societal constraints.



Source: Kollár & Poór (2016)

Figure 2. Complex interpretation of digitalisation

CHARACTERISATION OF SOCIAL INNOVATION

The definition and process of social innovation

Over the past decade, the academic literature on social innovation has significantly increased. The issue of innovation as a means to solve current complex societal challenges has received considerable attention from both governance and politics. The first debates on social innovation are closely linked with Moulaert et al., who attempted to provide a summary of the available literature on social innovation (van der Have & Rubalcaba, 2016). However, it is important to note that social innovation is not a completely novel concept. As Drucker noted, the notion of social innovation goes back almost two hundred years. Likewise, Godin claimed that social innovation began to be used as an independent concept only in the 21st century (Edwards-Schachter & Wallace, 2017). Contemporary sociologists consider social innovation to be a way of creating and implementing social change (van der Have & Rubalcaba, 2016).

Three interacting dimensions of social innovations are identified (Moulaert et. al, 2005):

1. unsatisfied social needs
2. changes in social relations
3. improvement of socio-political capabilities and access routes to resources.

The above dimensions are reflected in the following definition: social innovation can be seen as a new approach, attitude, paradigm, product, procedural process and practice that provide solutions to societal problems and needs while new values, attitudes, societal relationships or, perhaps, new structures start emerging (Nemes & Varga, 2015, p. 434).

The sociological approach needs to be distinguished from the economic approach since the former focuses on societal practices and the latter is an outcome-oriented approach focusing predominantly on societal impacts in line with practices of international organisations. An economic approach is presented in the definition provided by Pol and Ville. They noted that social innovation is different from business innovations, which are generally motivated by profit maximisation and neglect social impacts (Pol & Ville, 2009). In the Hungarian literature, Kocziszky et al. offer another definition. According to them, social innovation provides new or novel responses to problems of a community with the aim of increasing community prosperity (Kocziszky et al., 2017, p. 16).

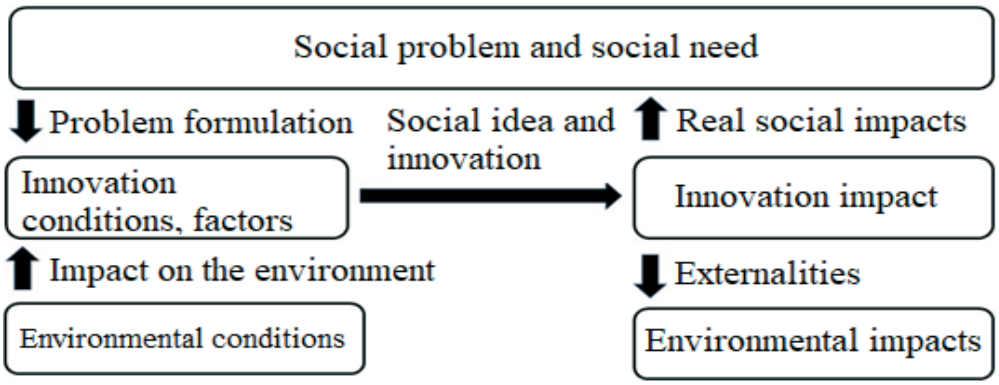
The European Committee uses the definition of social innovation provided by Caulier-Grice et al. according to which "social innovations [are] new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations" (Caulier-Grice et al., 2012, p. 18).

Considering the definitions mentioned above, this research defines social innovation as a non-profit activity aimed at a novel and innovative solution to a social problem. Social innovation is considered to be a non-profit activity because primarily actors of the non-profit sector are involved in its implementation, novelties are in line with social goals, and therefore, non-business interests prevail in the processes. During social innovation, innovations are implemented that are primarily aimed at changing social norms, values, and relationships.

The process of social innovation has received considerable attention in the academic literature (Mulgan et al. 2007; Nicholls et al. 2015; Schmitz 2016; van der Have & Rubalcaba 2016). Figure 1 presents a selected model in detail. In this social innovation model, a societal constraint or/and a need generates social innovation. However, it is impossible to start social innovation without clearly identifying the social problems to be addressed. The innovation process starts only when prerequisites for innovation (innovators, appropriate social drive and organisational conditions) are met. The next step involves implementing social innovation, which results in measurable social inputs, outputs and impacts and is embodied in real, concrete societal impacts. Environmental (community, political, institutional and supporters') conditions have a considerable impact on prerequisites and capabilities of innovation. However, the reverse is also true, since social innovation also influences the environment externally (positively or negatively).

Indicators of social innovation

In the social innovation model, input and process indicators on the innovation factor side and the output, result and impact indicators on the innovation impact side can be linked to processes, which allows us to perform quantitative impact analyses by defining and quantifying indicators.



Source: author's based on Schmitz (2016)

Figure 3. Process of social innovation

Levels of social innovation

The primary aim of technical innovation is profit maximisation without considering societal impacts. According to Pol and Ville, an innovation is termed a social innovation if the implied new idea has the potential to improve either the quality or the quantity of life (Pol-Ville 2009). Thus, social innovation is a non-profit activity that aims to provide innovative and novel solutions for community problems.

Similar to economic innovation, social innovation can happen at different levels (micro or organisational, meso or regional, and macro or national levels). From the micro-level perspective, social innovation is built bottom-up by civil organisations and non-profit businesses to address social demands and needs in a novel approach. The objective of bottom-up organisational processes – similar to those built from other levels – is to meet community needs and solve local problems. An effective implementation of social innovation requires an innovation-friendly micro-environment.

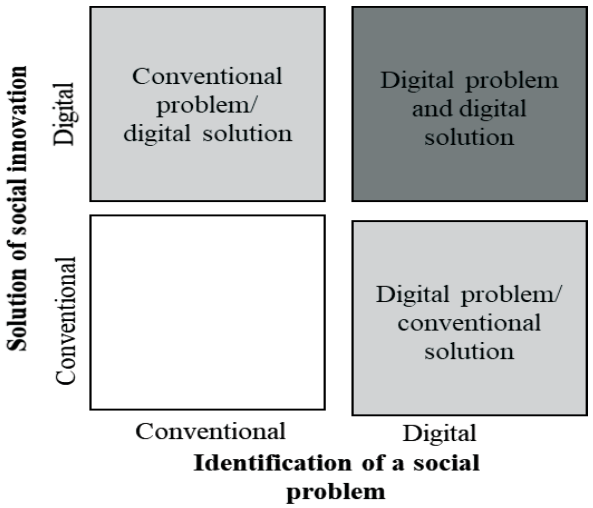
At the meso level, regional institutional systems and regional societal challenges are the focused. Social innovation plays a crucial role in managing economic and societal handicaps resulting from regional disparities and in creating catch-up opportunities. The evolution of processes over time and space also plays an essential role in social innovation. The role of novel ideas and solutions is of great importance in peripheral regions because the solutions of societal constraints in these regions require a completely novel approach. Since the innovation potential in peripheral regions is

low, innovation has a different character. Thus, fostering of innovation requires different tools than in developed regions and has different impacts on competitiveness. In macro-level social innovation, government measures trigger innovation.

DIGITALISATION AND SOCIAL INNOVATION

Social innovation means development and application of new ideas (products, services or models) that meet social needs, create social relationships and form new collaborations (European Commission, 2013, p. 6). If it is assumed that the primarily aim of problem solving is not profit generation, but rather improving social well-being, then "Social innovation is a non-profit activity that aims at providing novel and innovative solutions to social problems." (Karajz & Kis-Orloczki, 2019, p. 2)

Over the past few years digital transformation – in addition to profit-oriented activities – has significantly affected social and non-profit areas. Digitalisation – apart from providing a better information flow between social actors and networking – provides opportunities to develop new social products and services. Digitally aided social innovation or digital social innovation (DSI) is a new process that uses digital technology to address social challenges.



Source: Geser (2017)

Figure 4. Typology of social innovation from a digital aspect

Figure 4 presents Geser's typology (2017) based on two factors from digitalisation aspects. Digital technologies can be used to identify, understand and provide solutions to a problem. Thus, four types can be distinguished. The blank square represents conventional social innovation. If digital technologies are used in the process of problem identification and/or problem solution, we can speak about digital social innovation. It is obvious that in the broader sense, the identification of a social problem is also an element of the problem-solving process.

DIGITAL SOLUTIONS IN SOCIAL INNOVATION – INTERNATIONAL PRACTICES

It is observed that digitalisation provides innovative ways to identify social innovations and find solutions to them. However, the effective application of digital methods is impossible without social reforms, active engagement and participation of social actors. The scepticism of citizens about technological innovation often hinders the spread of new technologies. Thus, it is essential to persuade citizens of the favourable effects of innovative technologies. The huge amount of data (Big Data) that is available to people and organisations is a source of a major concern and fear. However, this Big Data enables accurate collection and relevant analysis of social needs in order to increase social well-being.

The international literature about digital social innovation offers plenty of examples of successful implementation of digital technologies and its positive effects. The aim of this paper is to present some effective practices as new opportunities for solving social problems by using digitalisation.

Decidim

Decidim is a free open-source software that enables stakeholders to participate actively in the governance and decision-making of cities and organisations. It is therefore also called the 'e-democracy platform', which helps to strengthen civic participation. The system was developed in Barcelona and is now used by dozens of cities (Helsinki, Loiret, Nancy, Merida, Tuusula, etc). It is suitable for strategic planning, participatory processes, convening meetings, assemblies, launching citizens' initiatives or submitting a participatory budget. It enables users to prepare, shape and accept local decisions over the Internet. Not only municipalities, but also civil organisations, public or private institutions or other communities can benefit from it because they can make their decisions in a transparent manner with the fullest possible knowledge of the related information and in the most democratic manner possible. (https://www.edemokracia.hu/?module=news&action=show&nid=246046#MIDDLE)

With the help of Decidim, a strategic plan was drawn up in Barcelona in 2016 in cooperation with the city citizens. Elements of the strategic plan were embodied in an operational action plan containing 7,000 citizens' roposals.

One of the major benefits of the platform is its traceability, with members being able to monitor the status of implementation of approved proposals at any time (https://decidim.org/).

Considering its structure, it consists of so-called attendance spaces, which are as follows:

- participatory processes that are capable of creating (de)activating processes;
- meetings where the composition, place and time of the decision-making bodies can be known and the participation is ensured;
- consultations that allow discussions to be launched and the results of votes to be reported;
- initiatives that can be used to generate initiatives.

In Hungary, the eDemocracy Workshop Association has introduced two social and administrative innovations to Hungary in the framework of its 'Strengthening Local Government Integrity' project, based on the practices of Barcelona and Helsinki. They are intended to (http://www.urbact.hu/node/451/):

- strengthen and extend the democratic functioning of municipalities,
- enable broad civic participation,
- socialize the preparation of local decision on the internet,
- conduct effective, transparent online consultations, thereby enhance the transparency of democratic functioning and the meaningful participation of citizens.

Sharing cities network

The sharing cities network was established in North America, but several European cities (Amsterdam, Athens, Vienna, Gothenburg, Lisbon, Naples, etc.) have joined the movement. In Vancouver, Canada's most active city, residents share their cars, tools, or even their gardens. Also, they offer their empty driveways and homes. This 'way of life' will not work without changing people's perceptions. (http://karbonkalkulator.hu/hir/megosztas-es-kozos-hasznalat-forradalma-zajlik)

Societies today are based on private property whereas a 'shared lifestyle' is based on the shared use of goods and assets. Consequently, the attitudes of society members need to be adjusted to these changes. This behaviour results in better and more intensive use of resources. Also, it can be an effective tool for global climate protection, which is the greatest challenge of our time. Sharing should not be only seen as a renunciation of private property, but as a new source of revenue by sharing unused resources. Social change is based on trust and a sense of responsibility, namely on trust in the others the things are shared with and a sense of responsibility for what is shared. If these behaviours are not properly integrated into the values of societies, various control tools (fines, exclusion from common use, etc.) are needed to operate the system.

Plum Labs

Plum Lab start-up has developed several tools and applications that are used to measure and share air pollution data for a specific area. The mobile application is called Flow, a personal air quality tracker which allows monitoring air pollution data measured by other users. Plume Labs collaborated in another project and launched the Pigeon Air Patrol. Pigeons were fitted with sensors that measured air quality in different boroughs across London. The data are shared on the Internet and the residents can track their exposure to air pollution. Five air categories are distinguished: fresh, average, poor, very poor, and dire. (https://plumelabs.com/en/)

One Farm

The One Farm project was started in the Netherlands targeting sustainable crop production. Its goal was to provide affordable and fresh food by launching new and innovative crop production technology. It is estimated that by 2050 the world population will have increased by over 2.8 billion people and close to 70% of the world's population will live in cities. A 50% increase in agro-industrial activity is needed to meet growing needs, whereas the useful area of arable land is diminishing rapidly across the globe due to environmental pollution. The main idea of the project is vertical farming, which has the potential for crop production since it can be operated not only by one person, but also by a local community (https://www.onefarm.io/).

Airlabs

Airlabs, a start-up company in London, developed a bench (Clean Air Bench) which creates clean air zones. Clean air is dispensed from under the armrests and other grilles in a semicircular structure where a filter system was installed. The system filters the air, traps pollutants and at the same time cleans the air around the bench (https://hu.euronews.com/2017/02/22/levegot-startupok-a-varoslakokert/).

FabCity

The FabCity initiative was launched in 2014 when the then mayor of Barcelona called upon the cities to produce everything they consume by 2054 and become self-sufficient. As many as 34 cities responded to the call in 2019. This initiative can be successful only if the network is operated, the knowledge and the technology is shared by the cities joining the project (https://fab.city/).

Digi.me

Digi.me was founded in 2009. It developed an application that ensures data protection in cases when personal data is used in applications and services since the control over data remains in the owner's hands. No one can see the imported data since they can be shared only with the owner's consent (https://digi.me/what-is-digime/).

CONCLUSIONS

Elements of new technology in Industry 4.0 – primarily digital technologies and Big Data – have opened up new perspectives in every field of life. The development of computers and network technologies has made it possible for people at different levels of society to interact. Also, since socio-economic processes and data are shared, an efficient and competitive system has been established where there is an opportunity to optimally meet the needs. Digital technology has appeared even in technological and social innovation. After investigating the process of social innovation it can be claimed that digital technologies can be relied on when the problem is identified, delimited and solved. Thus, if digital technologies are used for identification and/or a solution, this means digital social innovation.

Although there are still few good examples of digital social innovation in Hungary, there are many good practices in the international arena. Since independent problem solving skills and role-taking activities are poor in Hungary, the spread of digital technologies is slow in social innovation. The transformation of Hungarian society is likely to be slower than in more developed countries.

The international examples presented also demonstrate that the use of digital technology significantly changes social perceptions and values. However, a change in the value system is also a prerequisite for effective execution. New technology is used primarily to solve and address more democratic governance and sustainability issues in social innovation.

First reading the presented examples may seem to be e digital techniques that help solve social problems. However, the opportunity offered by digital technology is changing the mindset of those involved, their attitude to the problem, and is making them feel that they can actually and effectively do something to solve the problem. In the case of Decidim, digital technology has multiplied the number of people who make significant contributions and participate in strategy formulation and urban governance. (https://decidim.org/) The other examples presented were for solving other types of social problems. The “sharing city network” provides an alternative way to use resources efficiently by applying the sharing method. There are several solutions (Plume Labs, OneFarm, Airlabs, FabCity) that deal with the efficient use of environmental factors (air, farmland) and provide an answer to the problem of sustainability. There is also an application (Digi.me) that solves an important problem of today’s privacy. The presented examples come from different areas, thus, the solutions are also different. What is common in them is that stakeholders are actively involved in solving problems. This initiates self-impulsive processes during which people’s social sensitivity increases, thus providing an opportunity for the social system to develop in the right direction.

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Miskolc as a "Smart City" – Experiences of a Questionnaire Survey

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SUMMARY

In today's globalized world the socio-economic role of cities is decisive, therefore they have become one of the most important scenes where responses are given to the complex challenges facing our society. For a city to be successful and competitive, it is necessary to strengthen its flexible resistance, in other words, its resilience. For this purpose, efficient steps could be taken, benefiting from the results of digitization and Industry 4.0, by using smart applications and developments. Nowadays, smart city development and the application of smart/intelligent technologies are gaining an increasing focus in the development of a city. In our study we present the partial results of a primary quantitative research that we conducted in 2019 among the inhabitants of the City of Miskolc, in the age group of 20-64 years. With the help of a questionnaire survey, we were looking for the main focus points that should be given priority in urban smart developments according to the inhabitants' opinion.

Currently, Miskolc is at a medium level in terms of available smart cities technologies – in the inhabitants' view. According to the opinion of the inhabitants of Miskolc it would be of outstanding importance to introduce smart solutions in the health care, education, safety and fire protection, environmental protection and air pollution.

Key words: smart city concept; resilience; smart applications; urban development areas

Journal of Economic Literature (JEL) codes: R11

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INTRODUCTION, RESEARCH QUESTION

The role of cities in today's intensively globalizing world is unquestionable. According to the World Economic Forum Report 2014 the contribution of cities to global GDP reached 80 per cent, and further growth may be expected (Hajduk, 2016; Kola-Bezka et al. 2016; World Bank, 2018). In 1950 there were only 80 cities in the world with a population exceeding one million, and in 2011 their number went up to 480. Currently, more than three billion city dwellers live on the Earth, and their number may reach five billion in 2050. In addition to a decisive share of cities in global GDP and the world's population, 75 per cent of the world's energy consumption and 80 per cent of the global CO2 emission can also be associated with cities.

Cities are determining scenes of economic growth. There are more and more signs indicating that the challenges facing us (sustainable development, energy transmission, carbon neutrality, circular economy – just to mention the most important ones) can be managed efficiently at this level. Cities should also respond to the challenges of globalization, with special regard to various exogenous economic, social or environmental shocks. In this respect such a city can be competitive and successful in the long run that possesses factors strengthening its resilience. One typical case of increasing adaptive capacity could be to use the results of digitization and Industry 4.0 via smart applications and developments. Nowadays, an increasing emphasis is put on the use of smart urban development and the

application of smart/intelligent technologies on almost all the continents, with different focuses occasionally. The purpose of this study is to analyse the effectiveness of the smart strategy of a Hungarian county seat city from the inhabitants' perspective, using primary data collection.

We defined the following research questions during our investigations:

- Q1: To what extent is the term "smart city" known by the population? Are there any differences between the individual demographic groups regarding the knowledge of the term?
- Q2: What are the most important challenges that the city dwellers are confronted with in Miskolc?
- Q3: At what stage is Miskolc in the process of becoming a smart city? How is the city evaluated in terms of the currently available technologies? How do the inhabitants of Miskolc evaluate the implemented smart applications?
- Q4: In which areas are developments required in the process of becoming a smart city? How important/useful are the recently implemented or planned initiatives according to the inhabitants?
- Q5: To what extent do they consider the possible drawbacks of smart solutions dangerous? To what extent can smart solutions help fend off unfavourable impacts?

In order to reply to the above research questions we conducted a primary quantitative research among the inhabitants of the City of Miskolc, in the age group of 20-64 years. Of the nearly 100 000 base population 540 gave assessable replies to the questionnaire compiled by us, owing to which the results deriving from the sample can be projected on the full base population.

Hereinafter we are going to present the most important characteristics of a smart city, also covering the main correlations between resilience and adaptive capacity. Besides describing the basic concepts, we will also cover the advantages realisable by the various social groups (stake holder), and draw attention to the threats hidden in such developments. Summing up the results of the questionnaire survey (including the representative character of the survey), we will put forward suggestions with regard to the boundaries of the areas to be developed.

Literature review

It is not an easy task to define a smart city, as numerous approaches have been published over recent years. According to the definition of (Hall 2000) the smart city monitors and integrates all critical infrastructures, including roads, bridges, tunnels, railways, the metro, airports, ports, communication, water, energy and the main buildings. Thus it optimizes its resources in a better way, it plans its activities and controls safety criteria, while maximizing the services provided for the inhabitants. (Komninos 2011) speaks about regions where the ratio of knowledge and innovation is very high, which is partly ensured by the creative inhabitants of the city, and partly by the digital infrastructure and knowledge management. According to the definition of (Giffinger et al. 2007) it is about a digital platform, where the various actors create a complex ecosystem to enhance development, and where all the information is tracked by sensors, offering the best service at each time instant. The definition of (Szendi 2017) can be interpreted as the common intersection of the approaches with different orientations, according to which the smart city can be described as a complex concept. It is a city that uses innovative strategy and solutions to improve its inhabitants' life quality, while it efficiently uses the creativity and knowledge base of the inhabitants.

It is important to examine what advantages are offered by the developments related to smart cities for the individual stake holder groups.

1 1

Ten most important advantages of smart cities for the individual stake holder groups

Government	City dwellers	Business sector
Better public services		
Safety		
Economic competitiveness		
Increase of income/revenue		
Improvement of business productivity	Improvement of the ability to attract the inhabitants and tourists	Improvement of city workers' performance
Improvement of the ability to attract the inhabitants and tourists	Investment luring ability	Improvement of innovation ability
Inclusive growth	Improvement of innovation ability	Inclusive growth
Improvement of city workers' performance		Greater satisfaction with government services
Improving infrastructure	Improvement of business productivity	
Investment luring ability	Easier commuting and access to services	

Source: Authors' editing based on ESI ThoughtLab (2018)

The first table shows that there are several overlaps perceived in relation to the advantages offered by smart cities. At the same time specific advantages appear which can only be perceived at certain social groups.

The definitions of the smart city, apart from emphasizing the role of ICT, also highlight the significant contribution of developments to the promotion of economic growth, the support of sustainable development and the improvement of the living standards of the inhabitants. To attain these objectives, knowledge and innovation, as the tools of value creation, assume a significant role.

(Péter & Orosz 2018) investigated at what stage the Hungarian county seat cities are in the process of becoming smart cities. In the course of this, in the first phase the researchers gave an overview of the use of the 6 dimensions mentioned in the study of (Giffinger et al. 2007), then they illustrated the situation of the cities examined with good practices and developments related to geoinformatics. During their research they found that our county seat cities are starting to realise the opportunities included in the 'smart city', but only four cities (Debrecen, Győr, Miskolc and Szolnok) are at the level that qualifies them to be called smart cities. In the other country seat cities primarily transport development, infrastructure development and/or environmental development have a greater emphasis instead of the integrated approach. In their research they also pointed out that the role of geoinformatics is getting more and more significant in the lives of smart cities, as it is capable of displaying and analysing both spatial and non-spatial data at the same time, which are equally important for the development and control of the city.

The range of smart city applications is extremely extensive, examples can be collected from various areas (e.g. energy supply, water supply, transport, health, education, public administration, building, safety, waste management, etc.). However, the real challenge is to group these applications so that the individual groups mutually exclude each other, and they cover the occurring applications together.

Of the groupings so far published, one of the most significant is the work of Giffinger et al. (2007), according to which smart city applications can be classified in six groups: (1) smart economy, (2) smart people, (3) smart government, (4) smart mobility, (5) smart environment, and (6) smart living conditions. Sallai (2018) is also of the opinion that a smart city has six subsystems: (1) smart lifestyle, (2) smart transport, (3) smart city administration, (4) smart info-communication infrastructure, (5) smart city environment and 6) smart power. At the same time, the concept developed by Huawei (2017) differs from these to a small extent. Five sectors are defined in smart cities, which are dominated by the areas that may be associated with the environment: (1) smart energy, (2) smart transport, (3) smart water and waste, (4) smart community and safe city, (5) smart buildings. (Lados et al. 2011) in their analysis investigated the situation of smart cities based on seven subsystems: people subsystem, business subsystem, city services subsystem, transport subsystem, communication subsystem, water management subsystem, energy management subsystem. During the researches they examined 278 basic indicators, of which they narrowed down the applied data sets by main component analysis.

Smart city applications may extremely improve the city dwellers' quality of life, however they also carry risks as it will be more and more difficult to strike a balance between the city dwellers' rights to freedom and the use of technology. The other problem area is the safety of systems, which may be jeopardized by external attacks, and apart from that, human negligence (e.g. the use of insufficiently strong passwords) may also cause problems. According to Gartner Research and Analysis Centre (2020) as many as one third of the ongoing smart projects may stop until 2023, which may have several reasons. It names, as a potential source of danger, technological development not being able to keep pace with increasing demands. Loss of confidence related to data processing may also occur, and it may turn out about some projects that they are not as important as they were thought to be previously (or simply, they do not serve the objectives of smart cities well, and they do not produce the expected multiplicative effects sufficiently).

In parallel with the smart city concept urban resilience has been gaining increasing importance, which is defined by the World Bank (2014) "as the ability of a system, entity, community, or person to adapt to a variety of changing conditions and to withstand shocks while still maintaining its essential functions" (World Bank 2016). Cities should endeavour to avoid shocks and reduce risks, though it must be noted here that these shocks cannot be predicted in many cases. The aim is to keep urban functions in their original state or to make them restorable within a short period. Adaptive capacity appears to be key to resilience (Bristow & Healy, 2018). It shows how resistant a city is and how fast it is able to react to external changes (World Bank 2016). Adaptive capacity is "a characteristic of a given system, which ensures the long-term sustainable functioning of subsystems in spite of changing external conditions, and it also provides sufficient flexibility for partial or full transformation" (Buzási 2017). Adaptive capacity makes it possible for a city to ensure the well-being of the people living there and to contribute to long-term sustainability. It means that the terms mentioned (adaptive capacity and sustainability) go hand in hand, and neither can exist without the other. As it is also pointed out by (Bănică & Muntele 2017), resilience is not only a normative but also a strategic concept.

The basic approach of the range of ideas on resilience, adaptation and stability is that cities are usually in a state of equilibrium and even if it is tilted by some external shock, the main objective afterwards

is to return or to attain a new state of balance (i.e. to find stability). This practically corresponds to what Pirisi (2019) understands under adaptive resilience: "adaptive resilience refers to a capability by which the system changes as a result of external effects or it adapts to the changed external conditions" (Pirisi, 2019) At the same time, Bănică A. and Muntele I. (2017) represent an entirely different point of view. Notably, urban development cannot be considered as an unbroken and smooth process, the aim of which is to attain a state of balance, it is much more about progressing between imbalances. On this basis, stability is rather relative, and it must be accepted that a city is able to function not only in a certain state of balance, but the actual aim is to continuously fine tune individual subsystems. This is exactly the flexible adaption to changes as a result of which a state of balance can be attained that can also be considered stable (Buzási 2017).

It is very important to investigate the question of time. While in the short term the main aim may be protection, in the long run adaptation comes to the foreground. Urban resilience can also be interpreted as a key element of sustainable development (World Bank 2016). Resilience is, actually, a tool with which sustainability (with its content largely reduced in many cases) can be achieved (Buzási 2017) (Pirisi 2019). Resilient city as a concept does not only mean economic development (although in most cases it is measured by per capita gross value added, i.e. it is considered identical with economic growth), but it also covers the rehabilitation of brownfield areas or conscious urban planning and expansion. It includes the long-term improvement of the inhabitants' quality of life and well-being, the healthy and safe environment, equality and fairness (Bănică & Muntele 2017).

It is important to examine the interrelation existing between the smart city concept, urban resilience, well-being and sustainable development. In our understanding the smart city can serve as a tool to improve the resilience of cities, which leads (may lead) to sustainable development. A tangible result of that is the increase of the well-being of the urban population, the inhabitants living there.

Data and methods

In order to achieve our research objectives we conducted a large-sample questionnaire survey with the inhabitants of Miskolc. The basic population of the research was provided by the inhabitants of Miskolc aged between 20 and 64 years, whose number (N) – according to the then available most recent data – was 99 899.

2 2
Sample composition

Attribute	**Attribute versions**
Sex	Male: 49.1%; Female: 50.9%.
Age	20-29 years: 18.3%; 30-39 years: 22.8%; 40-49 years: 26.1%; 50-59 years: 20.4%; 60-64 years: 12.4%.
Highest education:	Primary school: 1.5%; Vocational school, vocational training school: 11.1%; School-leaving exam: 40.0%; Vocational technical secondary school: 10.9%; Higher educational degree: 36.3%.
Marital status	Married/cohabiting in a permanent relationship, without children: 23.5%; Married/cohabiting in a permanent relationship, with children: 38.7%; Single, without children: 29.4%; Single, with children: 8.1%.
Occupation	White-collar: 39.4%; Blue-collar: 22.4%; Entrepreneur: 5.6%; Student: 19.3%; GYES/GYED (On childcare allowance/fee): 3.1%; Retired: 7.2%; Unemployed: 3.0%
Net monthly income per person:	Less than HUF 50 thousand: 4.1%; HUF 50-100 th: 15.9%; HUF 100-150 th:31.3%; HUF 150-250 th: 32.8%; More than HUF 250 th: 16.1%
Size of household	1 person: 9.8%; 2 persons: 31.3%; 3 persons: 27.2%; 4 persons: 24.8%; 5 persons or more: 6.9%

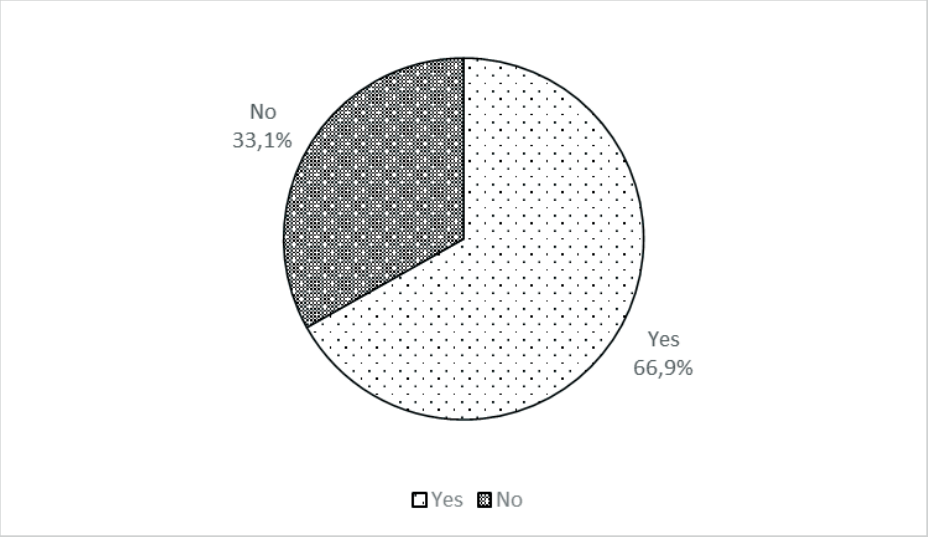
Source: Authors' editing

As it would have been too expensive to assign a sampling frame to the population, we applied the so-called quota sampling, which belongs to the non-probability sampling methods. The final sample size (n=540) was composed of two sources, on the one hand, the questionnaire items were asked in person from 400 people, and on the other hand, the questions were asked online from 140 people. Fieldwork took place in February 2019. In the course of data collection we made every effort all the way through that the sample reflected the composition of the population. Accordingly, as a last step prior to the analysis, we set the cell representativity of the sample by carrying out weighting by sex (male and female) and age (20-29 years, 30-39 years, 40-49 years, 50-59 years, 60-64 years). The weights used were between 0.90 and 1.31. The maximum error rate of the sample thus obtained was +/- 4.21 percentage point (with a confidence level of 95.0 per cent). It can be stated that the conclusions drawn from the sample can be expanded to the base

population, so our results reflect the general opinion of the inhabitants of Miskolc.

Main findings and their relation to the reviewed literature

(Q1) As an introduction, we were curious to know if the inhabitants of Miskolc had heard the term "smart city", therefore this was the first question that we asked. It is obvious that the responses included some "compulsion to comply", i.e. even those answered 'yes' who had not heard the term, but would not have wanted to look uninformed. Owing to this phenomenon, the responses are treated with reservation.



Source: Authors' editing

1 1. Have you heard the term "smart city" before?

Two thirds of the Miskolc inhabitants asked (66.9%) have heard the term "smart city", whereas one third of them (33.1%) have come across the term for the first time.

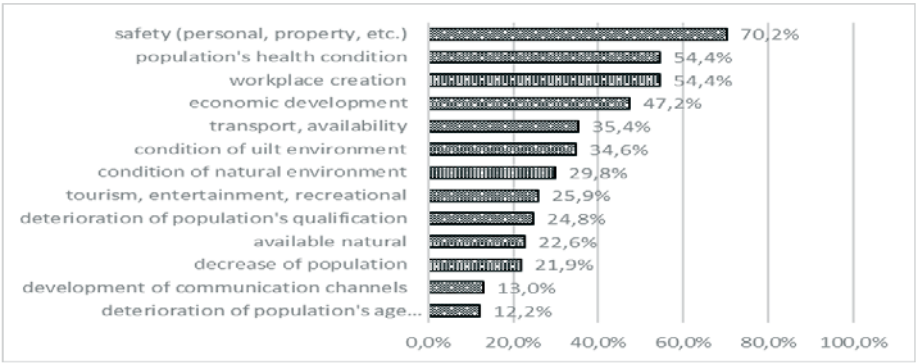
Although no significant relationship can be demonstrated (Chi-Square=3.239; P=0.082), but more men (70.6%) seem to know the term than women (63.3%). In our view this difference can also be explained by men's interest in technology.

As regards education, the knowledge of the term "smart city" is overrepresented in the group with a higher educational degree (73.0%) and underrepresented in the case of people having primary school (25.0%) or vocational school and vocational training school (51.7%) education. A significant relationship (Chi-Square=18.068; P=0.001) can be demonstrated between the two variables (education vs. knowledge of the term "smart city").

Being aware of the above figures, perhaps it is not surprising that white-collar workers (71.8%) know the term "smart city" at a significantly higher ratio than blue-collar workers (54.9%).

This sort of difference is also reflected in income relations, i.e. those with a lower income have a lower ratio of knowing the term than those with a higher income. This could be explained by the fact that those with a higher degree of education tend to work in white-collar jobs, and in such jobs salaries are higher. On the other hand, a better financial background also enables them to gain access to information more easily.

With regard to the other demographic variables examined in the questions, such as age, marital status, family size, no statistically significant relationship can be revealed.



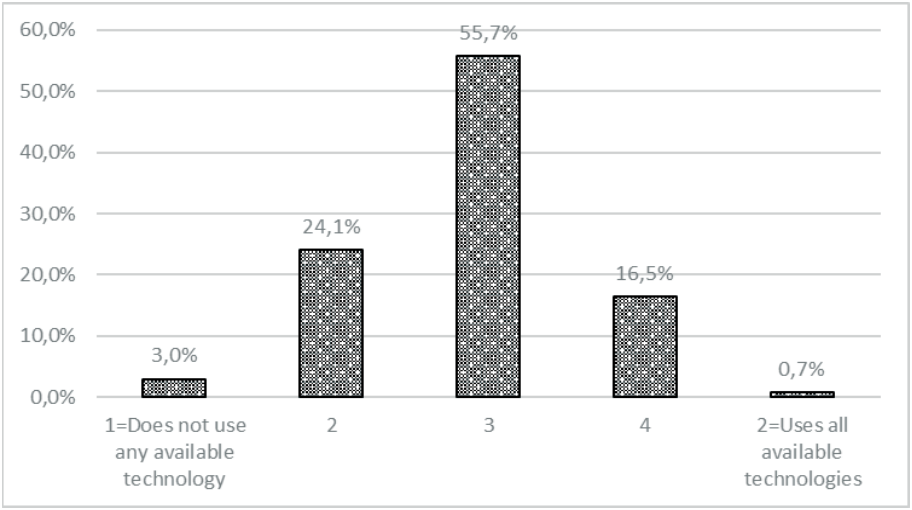
Source: Authors' editing

2 2. Which areas do you think pose the most important challenges in Miskolc?

(Q2) In our research we were also curious to know which areas are seen by Miskolc inhabitants as "challenges". Regarding this question, 13 areas were identified and examined in our target group.

The most important challenge viewed by Miskolc inhabitants is the creation of safety (personal and property), this was indicated by more than two thirds of the respondents (70.2%).

More than half of the respondents (54.4-54.4%) consider the preservation and improvement of the inhabitants' state of health and the creation of workplaces among the most important challenges. The problems of economic development are also regarded quite considerable (though the ratio does not reach 50%, based on the sample) according to the views of Miskolc inhabitants. The inhabitants of Miskolc put the least emphasis on the problems of the development of communication channels (mobile, internet, wifi) (13.0%) and the deterioration of the age composition of the population (12.2%).



Source: Authors' editing

3 3. Please evaluate Miskolc as a "smart city", based on the use of currently available technologies.

Going a little deeper, analysing further details, it can be found that transport and accessibility receive a greater emphasis by men (39.2%), and the preservation and improvement of the inhabitants' state of health by women (60.0%). In connection with the other factors no significant difference was identified in men's and women's priorities.

(Q3) In our research we also investigated how the inhabitants evaluate Miskolc as a "smart city", based on currently available technologies.

We received a mean of 2.88 at a 5-point scale, which can be regarded as a strong medium value. This is also borne out by the fact that the majority of respondents (55.7%) indicated value 3 in their responses. (This is at the same time the mode and median of distribution). A little less than one fourth of the respondents (24.2%) assessed the "smart city" feature of the county seat with a value 2, and one sixth of them (16.5%) with a value 4. Those who did not think that the city uses any smart solutions only account for 3.0% of the sample. There were hardly any (0.7%) who said that there existed almost all smart solutions in Miskolc.

In our research we also made a comparative analysis in respect of the individual demographic

groups, but no statistically significant differences were revealed.

At the county seat of Borsod County numerous developments have been implemented over the past decade, which are determining elements in the process of its becoming a smart city, and they could even be regarded as a milestone. In our research the inhabitants were also asked to judge the quality of such implemented applications.

Regarding the quality of the smart applications implemented in Miskolc, the best score (4.00) was given to the ordering of food on a website/with an application. Smart banking (3.90) and the use of parcel delivery lockers (3.82) were also evaluated at a similar high level. It must be mentioned that these smart solutions are not quite specific of Miskolc, they constitute a part of the business practice spread all over the country. The lowest rating (2.88) was allocated to the electric charging network available in Miskolc, which started a spectacular development in the year following the data collection. Newly established electric charging points can be discovered in the parking lots of several big stores, super and hypermarkets, the installation of which was primarily due to the business policy of the given retail chain, so it is not about a city decision and implementation.

3 3

Quality of the smart applications implemented in Miskolc

[scale from 1 (unsatisfactory) to 5 (excellent)]

	Mean	Standard deviation
Ordering food via an application, on a website	4.00	1.03
Smart banking	3.90	1.05
Use of parcel delivery lockers (e.g. Post-Office, Foxpost, etc.)	3.82	0.97
Parking with mobile application	3.74	1.10
Free wifi on the green arrow line	3.66	1.18
Timetable of Miskolc (MKV Zrt application)	3.62	1.17
Ordering of taxis with mobile app.	3.59	1.12
Digital public administration (electronic administration)	3.57	0.97
Timetable of Miskolc (not MKV Zrt application)	3.54	1.12
Intelligent passenger information system	3.53	1.10
Smart home system (google home, amazon alexa, mi home etc.)	3.42	1.25
Smart office building (e.g. NAV)	3.37	1.12
Reporting meter reading with an app	3.36	1.09
City card	3.35	1.15
Use of geothermal energy for heating (Avas)	3.34	1.17
Smart university applications (Neptun, student card)	3.28	1.25
Tourism application (e.g. guide@hand miskolc)	3.21	1.16
Intelligent space surveillance network	3.17	1.13
Digital community development – creating real and virtual spaces	3.12	1.10
Free wifi in public spaces	3.10	1.22
Giving priority to delayed trams	3.10	1.09
Electric charging network	2.88	1.24

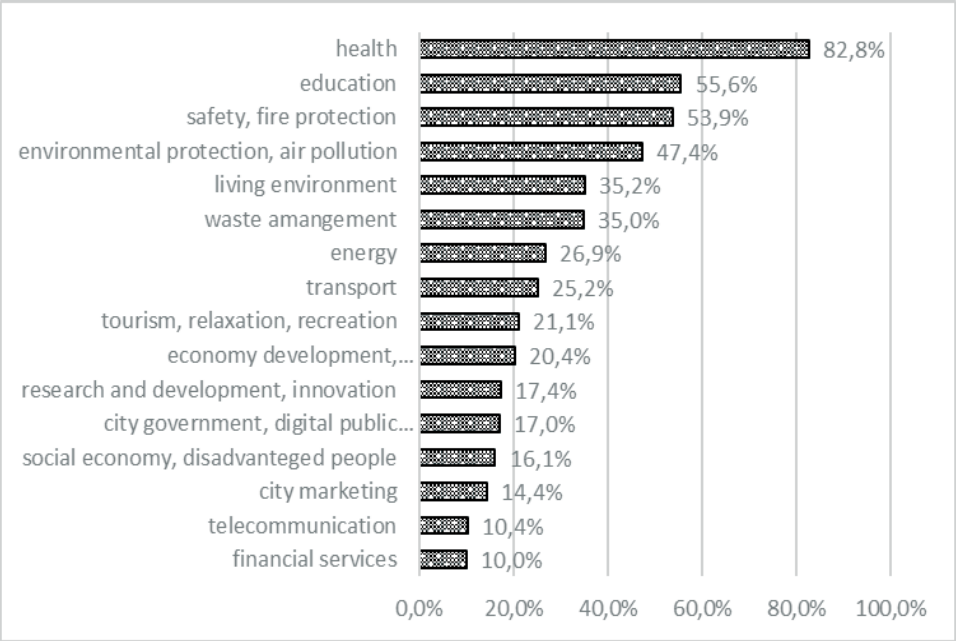
Source: Authors' editing

(Q4) Besides the evaluation of implemented applications it may be an even more important question to determine what areas are required to be developed in the process of becoming a smart city. We also asked about these gaps, the result of which is summed up in the table below.

The majority of respondents (82.8%) indicated health care as such an area. This is followed by education (55.6%), safety, fire protection (53.9%) and environmental protection, air pollution (47.4%) in the order of importance. In contrast, telecommunication (10.4%) and financial services (10.0%) are the areas where it is the least necessary/useful to introduce smart solutions according to the views of Miskolc inhabitants. We assume that in these areas there are well-established systems that appropriately serve the needs of inhabitants.

When looking for differences between sexes, we can discover that men rated the following areas at a significantly greater ratio: energy (31.3). The same concerning women's views: health (87.6%), environmental pollution, air pollution (52.4%)

In the city of Miskolc there have been a number of smart city projects proposed or being under planning or implementation recently. We wondered to what extent the inhabitants considered the implementation of these initiatives important/useful.



Source: Authors' editing

4 4. Where would you consider it necessary/useful to introduce some smart solution in Miskolc?

Based on the responses given to this question it can be stated that the inhabitants can accept a large part of the ideas – such as electronic payment in public transport, which was rated as 4.00, luminous road surface signs and boards (3.97), intelligent traffic control (in public road junctions) (3.93) and intelligent (water and gas) measurement in real estates (3.93). On the other hand, there are initiatives regarding which respondents are indifferent: e-taxi system (3.16), e-school bus (3.13) and electric city sight-seeing bus (2.94).

(Q5) Like everything, smart solutions may also have some drawbacks and negative impacts. Our next question asked was to what extent Miskolc inhabitants perceived these dangers with regard to smart solutions.

4 4

In Miskolc the following smart city project ideas have been raised or have been under planning or implementation recently. Please rate to what extent do you consider their implementation important/useful? [scale from 1 (not necessary at all) 5 (absolutely necessary)]

	Mean	Standard deviation
Electronic payment in public transport	4.00	1.10
Luminous road surface signs, signboards	3.97	1.12
Intelligent traffic control (public road junctions)	3.93	1.13
Smart (water, gas, etc.) measurement in real estates	3.93	1.09
Community bicycle system	3.74	1.16
Business administration system integrated at city level	3.70	1.08
E-taxi system in Miskolc	3.16	1.23
E-school bus	3.13	1.37
Electric city sight-seeing bus	2.94	1.24

Source: Authors' editing

5 5

The use of smart solutions may also have some dark sides. To what extent do you consider the following areas to be of potential problems?
[scale from 1 (not at all) 5 (extremely)]

	Mean	Standard deviation
Personal data protection	3.81	1.15
Vulnerability of computer systems, virtual attacks	3.53	1.10
Increase of social differences	3.37	1.21
Reduction in the number of workplaces	3.31	1.29
Information flow is not full	3.29	1.11
Isolation of inhabitants	3.20	1.20
Reduction of the unique characteristics of the city	2.84	1.25

Source: Authors' editing

What worries the respondents most is the protection of personal data (3.81) and the vulnerability of computer systems, the virtual attacks (3.53). Of the potential problems the least important was the reduction of the unique characteristics of the city (2.84) according to the participants of the survey.

Cities are frequently exposed to shock-like effects. The use of smart applications may also be helpful in fending off unfavourable trends. The question is only how big such help can be in individual areas.

6 6

In ideal cases to what extent can smart solutions help fend off unfavourable impacts?
[scale from 1 (not at all) 5 (extremely)]

	Mean	Standard deviation
Fast technological shift	3.55	1.05
Overloading of transport infrastructure	3.38	1.09
Fast deterioration of public safety	3.28	1.15
Sudden increase in the number of tourists	3.17	1.18
Fundamental change in legal environment	3.15	1.03
Natural disaster (e.g. flood)	3.00	1.22
Climate change	2.98	1.21
National economic recession	2.90	1.10
Fundamental change in political environment	2.86	1.19
Global economic crisis	2.85	1.10
Population explosion	2.58	1.12
Depopulation	2.51	1.07
Mass immigration	2.50	1.22

Source: Authors' editing

Our respondents' view is that smart applications can offer solutions the most in the areas of fast technological shift (3.55), overload of transport infrastructure (3.38) and deterioration of public safety (3.28). The use of smart solutions can resolve demographic challenges the least, such as population explosion (2.58), depopulation (2.51) and mass immigration (2.50).

CONCLUSION

Finally, let us present the main findings of our research, which are based on the results of the large-sample questionnaire survey conducted among the inhabitants of Miskolc in a representative manner.

A large part of the inhabitants of Miskolc (66.9%) – by their own admission – have heard the term "smart city" in their lives, so this name is not completely unfamiliar for the city dwellers. Unfortunately, we do not have reliable and accurate statistical data on what they really understand by this term, but according to our experiences it does not have an entirely unified meaning in terms of its content even among experts. Based on the results, it should be considered that in order to increase the awareness of this notion, the local government will take steps, especially if it wants to add it to the set of items associated with Miskolc.

With regard to the most important challenges concerning the city, we were able to identify at least four areas that deserve particular attention, as reflected by inhabitants' opinions. These are safety, preservation and improvement of the inhabitants' state of health, creation of workplaces and economic development. In the process of becoming a smart city, it is sensible to put special focus on these areas, and highlight those smart applications that bring about positive changes in these areas.

Currently, Miskolc is at a medium level in terms of available smart cities technologies – in the inhabitants' view. This is the point from where there is still room to develop. It is a fact that the process has started – the inhabitants also perceive it, however there is still plenty to do, and in the course of the process: scheduled, conscious and systematic building may be the key to success. The mean of the judgement of the available smart applications is scattered between medium (3) and good (4) values. There is no development that is judged expressly positive, but there is no development that is considered expressly negative either. This is also characteristic of the stage that has a development potential. Further, it is not certain if the city dwellers were sufficiently satisfied with the development itself. It may occur that simply they are not aware of developments or they have too little information.

According to the opinion of the inhabitants of Miskolc it would be of outstanding importance to introduce smart solutions in four areas. These are health care, education, safety and fire protection, and environmental protection and air pollution. In respect of the project ideas raised in the city there are also four areas that are considered important/useful by the inhabitants: electronic payment in public transport; luminous road surface signs, signboards; intelligent traffic control; and smart measuring in the case of real estates.

We also provided space in our investigation for assessing the concerns related to smart city development, in this respect the greatest threats conceived, to the elimination of which serious attention should be paid, are the protection of personal data and the vulnerability of computer systems, the so-called virtual attacks. At the same time, fast technological shift, overload of transport infrastructure and deterioration of public safety are the areas where smart applications can provide solutions.

Finally we would like to highlight that it is important to define that key areas, where the city could be developed based on the inhabitants' opinion, and to adapt their ideas as bottom-up initiatives.

Based on our investigations, we can state that the majority of the municipal projects in Hungary are implemented from (EU) tenders the future of which is typically doubtful after the expiry of the obligations included in the contracts. Thanks to 'easy money', sustainability aspects rarely appear during the planning period, often smart applications don't fit the size of the municipalities, sometimes they focus on developments that already exist at the national or global level and/or there are free or cheap solutions focusing on the same tasks.

In conclusion, smart city projects should base on the real needs of the communities and the tools used should plan on the basis of cost-effectiveness and economic sustainability.

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Examining the Contribution of Smart Homes to the Smart Performance of Cities

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SUMMARY

One of the goals of smart cities is for their residents to live as comfortably as possible, at the highest possible standard of living, and for this, the existence of smart homes is essential. However, smart homes have so far not received much attention in smart city concepts, especially in Hungary. This study discusses definitions of smart cities and smart homes and asks how smart homes can contribute to increasing the performance of smart cities. I created a simplified model based on my search of the literature, which I supplemented with two new factors, which are emphasize the importance of people and education / communication.

Keywords: Smart Home, clever functions, Smart City, smart solutions, Internet of Things (IoT).
Journal of Economic Literature (JEL) codes: O30, R30
DOI: http://doi.org/10.18096/TMP.2021.01.03

INTRODUCTION

The first smart home controller computer or program was designed in the second half of the 1960s, it was far ahead of its time and was not commercialized. More than five decades had to wait more significant spreading of these systems, which thanks for the internet widespread availability and reliability. While in just a fragment of the traditional property real estate owners have been using the smart apps, in the case of newly built real estate, it is almost essential to have some clever features. The benefits are clear, in the long run, initial surplus investments are likely to return, the overhead costs of housing may be reduced, their comfort levels and their viability can be significantly improved. It is likely that in almost all residences in the future there will be some clever function.

More and more people around the world live in and move to cities. Urbanization is growing rapidly. If we compare cities with rural areas, the concept of urban existence is linked to higher standards of education, health and social services, as well as more active participation in cultural and political life. At the same time, urbanization also brings enormous challenges on the fields of socio-economic development and environmental protection. To cope with these challenges, the latest information and communication technology (ICT) and its available services are needed. A Smart City's ICT offers a concept with sustainable economic development and a high quality of life together with a wise management of natural resources. A smart city ICT infrastructure must be able to integrate the smart homes into a coherent smart city concept, because data from the smart homes will play a vital role in the development of innovative smart city services. For example, data from smart homes can help optimize a city's energy management, increase safety, or make health care more efficient, especially in the area of elderly care. Important elements in this concept are Big Data, Internet of Things (IoT), Clouds of Things (CoT), and Artificial Intelligence (AI).

In 2020 I started a new study focusing on the connections between smart homes and smart cities. My paper is now presenting the first steps of my research. In this paper, I would like to give a brief overview of what we mean by the terms smart city and smart home. The main question of the study is: How can smart homes contribute to increasing the performance of smart cities? This article will introduce a new concept, which I have found on my literature research, where smart homes can be the foundation of smart cities.

Brief Description of History of Smart homes

Technological advancements of the building construction sector in the 21st century have been beyond people's expectation. The emergence of electricity in residential spaces during the previous century was one of the first impetus for this change. This provided a new source of clean and convenient power for appliances. Besides, advancement of IT/ICT was another key player empowering such changes. IT/ICT enabled information exchange among people, appliances, systems and networks (Aldrich 2003). Here is a brief historical timeline to illustrate how these alterations led to the emergence of smart homes.

- The first remote controlled mechanism was built in 1898 (Nicola Tesla's toy boat).
- 1915-20: Many people were at home as a result of unemployment caused by World War I., therefore, the demand for the use of electrical appliances has increased. The electrical home appliances were introduced in this period. For example: food processors and sewing machines. clothes dryers, irons, toasters etc. Most of them were not 'smart' and connected to other appliances, but a few smart appliances were designed before WWII (Hardyment 1988).
- 1920-59: Since women had less time to spend for households during this period - as they had to replace their husbands in their workplaces for a few years - introduction of new home technologies elevated the living standards. For instance kitchens were completely transformed by the appearance of refrigerators, electric cookers, etc.
- 1960-70: The first modern smart home systems were designed in the '60s usually by hobbyists, they were not commercialized, and they were not too popular because of the lack of motivation to increase productivity in domestic work. Developers did not involve the potential users of the technology in the design process, and industry supposed that domestic technology is not enough attractive. In 1966 the ECHO IV Computer was able to compute shopping lists, control the home's temperature and turn appliances on and off (Harper 2003).
- 1980-90: Use of technological/electrical home appliances was widespread by this period. A wide variety of electronic devices became available ranging from cordless/mobile phones to entertaining devices such as PlayStations. Moreower the emergence of Internet allowed numerous new services for example: online banking, shopping and information acquisition. In 1984 by the American Association of House Builders introduced the term 'wired homes' (Aldrich 2003).
- 1990-2000: the emergence of World Wide Web (WWW) inaugurated a new chapter in the history of human achievements. The WWW was first developed by Tim Berners-Lee in 1989. It later became publicly accessible in 1991. In 1993, the first web browser (Mosaic) was introduced publicly. It enabled even amateur users to browse through the World Wide Web without requiring any special technical knowledge (Tuschl 2013). Subsequently, the basic features of modern life began emerging as the result of services delivered through the Internet namely, online shopping, banking, advertising, etc. (Day 2006). 18% of the US population had household Internet access by 1997. This percentage increased to 41.5% by 2000 (File & Ryan 2013).
- 2000-2020: Smart homes, or home automation, started to become popular in the early 2000s as the technology became more affordable and available in commerce. The exponential growth of the Internet continued during these years, enabling the emergence of novel developments in communication, trading, entertainment, education, etc. The term Internet of Things (IoT) was introduced in 1999. It indicated an emerging global Internet-based information architecture facilitating the exchange of goods and services (Wood 2015). Smart objects instrumented with sensing and interaction capabilities/identification technologies such as RFID were developed. IoT strengthens the establishment of smart cities. It enables the integration of smart objects and real world data, forming a digital world (Skarmeta & Moreno 2014). The main drivers of today's smart home systems are security and living greener. The most popular applications are remote mobile control, automated lights, automated thermostats, scheduling appliances, mobile/email/text notifications, and remote video surveillance.

Operationalizing electricity to accommodate shifting lifestyles and spending substantial time outside promoted development of new technological devices catering for the new circumstances. This evolutionary change throughout the times is known as the development basis of smart homes (Aldrich 2003). According to Dingli & Seychell (2015) the term 'smart home' was officially used for the first time in 1984 by the American Association of House Builders. They created a group named Smart House aiming to push forward the inclusion of several innovative technologies in the design of new houses.

Definitions of Smart Home

There is no agreed-upon definition of Smart Home; there are many different ones, they have often different names, some are partly overlapping or similar to Smart Home (remote-home, home automation system, automated home, home energy management system etc.). While the term smart home or smart house is starting to become familiar to the majority of people there is no 100% concrete definition of Smart Home. I have collected a few example of possible definitions:

- Harper defined smart home as "the home which is a well-designed structure with sufficient access to assets, communication, controls, data, and information technologies for enhancing the occupants' quality of life through comfort, convenience, reduced costs, and increased connectivity" (Harper 2003, p.3). This definition demonstrates the benefits that can be expected from a smart home.
- Stresse et al. defined the Smart Home as a private home with many devices of home automation, consumer electronics and so one, which are intelligent. The networking of these devices should generate new services and additional benefits for the residents' (Strese et al. 2010). This definition also focuses on the benefits of smart homes.
- According to Demiris and Hensel, a smart home is "a residence building equipped with technology that facilitates monitoring of residents or promotes independence and increases residents' quality of life" (Demiris & Hensel 2008). This definition highlighted the use of intelligent technologies in residential units to monitor the residents' behaviour for enhancing their quality of life.
- According to ITU (the International Telecommunication Union – United Nation's specialized agency for IT/ICT), smart homes are able to offer various services. These include but are not limited to the regular control of smart appliances (e.g. heaters, air conditioners, washers, etc.), the ability to remotely manage electrical devices, display of consumption data and associated costs, as well as communication between plug-in hybrid electric vehicles and their charging station and on-site micro-generators (e.g. rooftop solar panels) (ITU 2010).

  There are alternative definitions of smart home labelled 'E-home', 'Internet Home' or 'Intelligent living', widely connected with the 'Internet of Things', where every device is connected to the internet and they communicate with each other.
- "Advanced home control systems go by several names, including smart home, home automation and integrated home systems. By any name, these systems conveniently control home electronics and appliances including audio/video, home office, telecommunications, intercom, security, lighting, HVAC, and lawn sprinklers. Control systems can also provide information – residents can find out how much electricity they've used on specific appliances or systems, and utilities can read meters remotely. The systems can be accessed from remote locations by phone or computer, allowing residents to turn on the heat, for example, on their way home from work'" (Marsh 1998).
- 'Home Energy management system is used in the houses as computer-aided tool to monitor the energy and water consumption and control the running mode of home's appliances, fans, lighting and pumps and reset the room temperature in order to optimize the energy performance' (Stavropouloset al. 2014)

In conclusion, smart homes are residential units modernized through a communicating network of sensors, domestic devices and appliances enabling occupants to control the functions of houses through sophisticated monitoring/controlling systems. Implementation of smart homes results in enhanced quality of life, minimized building energy consumption, reduced cost of energy and improved security.

Advantages and Disadvantages of Smart Home Systems

In their research, Mussab et al. distinguished four groups based on the examined literature to determine the benefits of smart homes (Table 1). These four groups are the following: energy conservation; health care; reducing the cost of basic needs; entertainment and comfort (Table 1).

One of the primary purposes of creating smart homes is to conserve energy. The advanced technology provided with IoT devices can reduce energy wastage. These devices improve efficiency and performance while saving energy. For example, there are heating systems that can be controlled with smart devices, so you can control the temperature of your home anytime and anywhere to save energy.

In the case of health care IoT devices can be great help to the elderly and people with disabilities. In many countries, elderly parents do not live with children who can take care of them. In this case a smart home system can help to monitor parents' health status and direct contact is available with a health-care institution (Mano et al., 2016).

These two functions are closely linked to reducing the cost of basic needs, since energy savings and health monitoring significantly reduce spending. For example, because of health-care applications, we need to go to the doctor less often, which reduces our medical costs (Fisher & Hancke, 2014).

As for entertainment and comfort, an IoT based smart home provides comfort and an easily controlled system for the whole house with smart phones or other smart devices.

Table 1.
Advantages and disadvantages of smart home systems

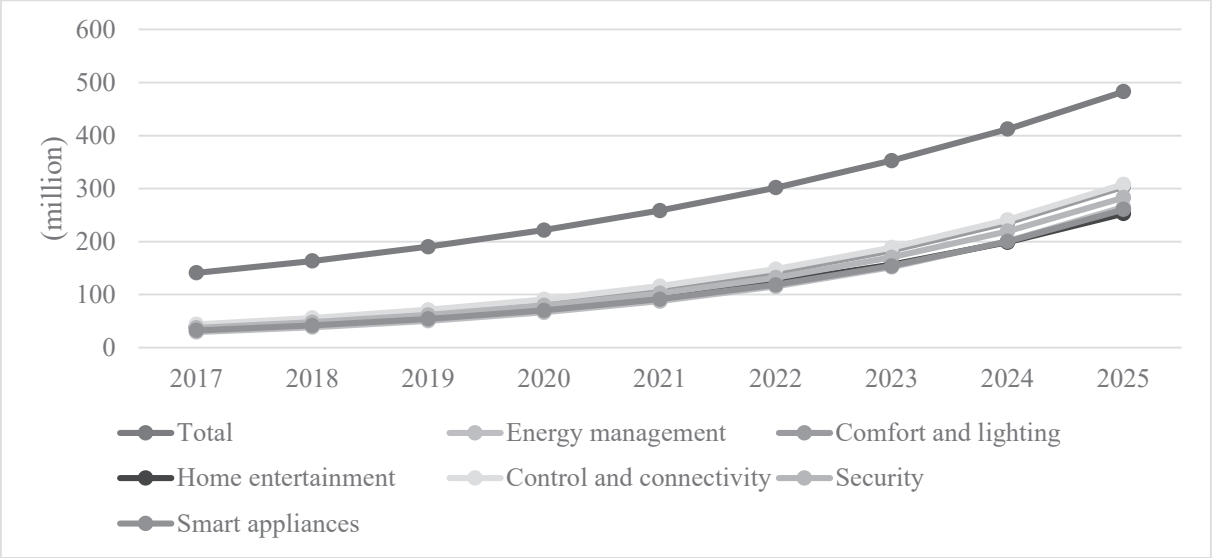
Advantages	Disadvantages (possible barriers)
Optimized energy consumption	Relatively expensive
Real estate value added effect	Lack of experience of using smart home systems
Increased sense of security	Risk of being hacked
Increased quality of life	Complexity
Savings (time, money, energy)	Any damage to the interconnections can disrupt the system
Possibility of convenient features	The technology takes time to learn and get used to. Some people believe it makes life too complicated.

Source: own edition based on Mussab et al. (2017)

Disadvantages of smart home systems include the relatively high price, lack of experience of using smart home systems, and the risk of hacking. There is a great deal of mistrust towards such systems among some people, as no one is happy to disclose their private data.

Directions and Development of Smart Home Systems

Applying the IoT in the context of a private household is what is commonly known as a smart home. The first figure clearly shows the steady increase in the number of smart homes. According to Statista surveys, by 2025, the number of smart homes is predicted to reach nearly 500 million. This represents nearly a quarter of homes worldwide (Statista.com).

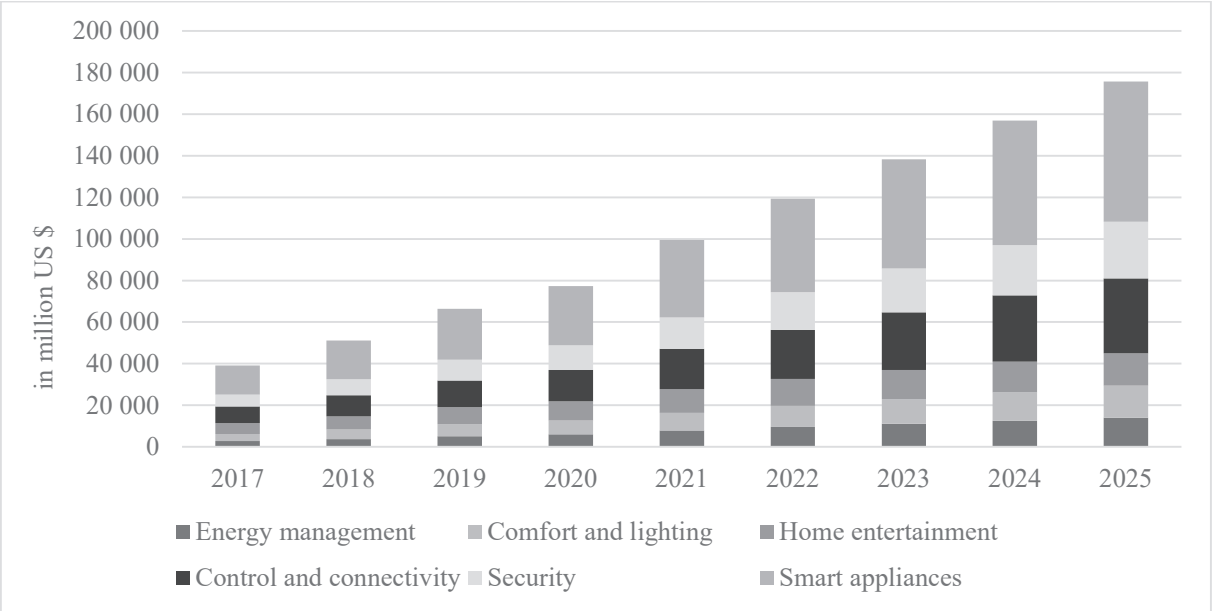


Source: Statista.com, own edition

Figure 1. Number of existing smart homes and homes equipped with a kind of smart solution, forecast until 2025 by Statista.com

Three different phases can be observed during smart home system evolution. In the first phase smart gadgets and their applications are able to collect data, report them, and display them in an organized manner. In Phase 2 the level of data usage is more advanced, and systems are characterized by modelling, notifications and predictive intelligent control. The most advanced smart home systems (Phase 3) are able to adapt and learn their environment (Parks Associates 2014).

Nowadays, there are many kinds of smart home systems and perhaps this is the biggest problem with these systems, as they are generally not compatible with each other. So one of the most important development directions is that these systems become compatible with each other, but this is not in the interest of the companies at the moment (Wood 2015). A useful development path can be the convenient multi-terminal control (built-in, mobile, web-based, PC) on all sorts of visual interfaces that synchronize with each other and provide real-time information and monitoring (Orosz & Péter 2017).



Source: Statista.com, own edition

Figure 2. Annual revenues of Smart Home categories, forecast until 2025 by Statista.com

Figure 2 shows annual revenues of smart home categories. By 2017-2025 an increase of about 135 billion USD is shown. The biggest revenue is clearly from the smart appliances category; nowadays it is about 28 billion USD. Significant revenue also comes from home control systems and from security. The other categories have also increased or are predicted to increase their earnings compared to 2017, so it looks like there has been a lot of progress in this area and it will probably continue in the future.

The Contribution of Smart Homes to the Performance of Smart Cities – Can Smart Homes be the Foundations of Smart Cities?

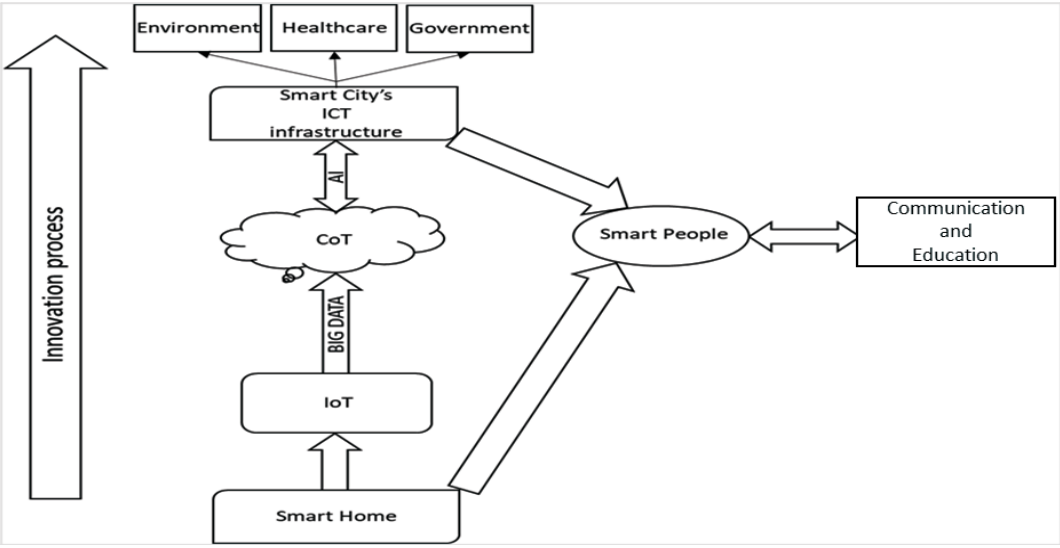
Since the development of the industrial revolution, specialists in the development of cities have been visioning the most advanced technologies in their ideas. The spread of smart technologies improves the quality of life, can contribute to reducing territorial differences within settlements, improving accessibility of urban services, reducing the burden on the environment, and contributing to improving the situation of disadvantaged groups.

The growth of smart city initiatives is unbroken. Cities are trying to solve systemic problems of complex problems, while increasingly complex processes need to be treated simultaneously. The term ‘Smart city’ is relatively new being used only in the 1980s and ‘90s in the literature. Although the expression ‘smart city’ is becoming more widely known – thanks to the rapid development of ICT – there is no commonly agreed definition or concept of its content (Nagy et al. 2016).

One of the best known smart city definitions is that of Giffinger et al. (2007): “a Smart City is a city well performing built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens”. They said that a smart city is a city that has to perform well in six dimensions: smart economics, smart people, smart governance, smart mobility, smart environment and smart living. In the dimension of smart living conditions, the role of smart homes in the life of a smart city was highlighted. Approached from another point of view, however, it can be not only an indicator of a smart home, but can even form the basis of a smart city (Figure 3).

Big data and the way it is used can be the key to smart homes contributing to the development of a smart city.

"Big data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information." (TechAmerica Foundation 2012)



Source: own edition, based on Skouby et al., 2014

Figure 3. Smart Home as a foundation of a Smart City

Smart homes can play a big role in boosting the performance of a smart city as they produce a lot of data (Big Data) thanks to being connected to the internet (IoT). But this data is just usually used intelligently in just smart homes. The next step should be to turn smart homes into a larger, organic unit, into a smart city. Using Cloud of Technologies (CoT) to integrate the smart homes into a smart city concept creates new sustainable service opportunities, creates a basis for improving the quality of life for people, and forms new ways of implementing city governance. In this vision the CoT technology is a vital player because it handles the huge amount of information produced by the IoT devices. In simple terms a CoT is a pool of resources and calculation capabilities accessible through the Internet. For smart cities combining IoT and CoT is crucial, so that IoT data can be processed and stored (Skouby et al. 2014).

Complementing these two technologies (IoT and CoT) with artificial intelligence, the city management can collect and analyse data from citizens and robotic systems in real-time. A smart city can benefit greatly in many areas from these data, mainly in health care, energy consumption, administration and public safety. In my opinion, in this model one of the most important factors is the "smart" people, or community (who can be able to use smart city's tools, or systems correctly), because without them the whole system would not work. Education and communication are also important factors because a community needs to be able to use applications, systems, but for many smart city projects, a lack of information or communication is also a problem. I would like to present a few examples of why the smart homes are an important part of smart cities:

- **Healthcare:** The population of Earth is quite rapidly aging. According to the UN, the number of older people will make up 56 per cent of the whole population by 2030 and will exceed 2 billion people by 2050: every fifth inhabitant of the planet will be a person who is 60+ years old and life expectancy is steadily increasing in almost all regions. So smart home solutions will be very important in the future, for example in the field of elderly care or in the case of any health emergency. For example: AI detects unusual behaviour like an elderly person has fallen, AI monitors behaviour and informs caregivers in the area of telemedicine, etc. (Skouby et al. 2014).
- **Environment:** When homes are connected to a system with ICT-based infrastructure, artificial intelligence can be used to easily monitor, for example, residents' energy use patterns. Once the samples are available, then the system can schedule and optimize the energy use of each area, achieving local and global savings (money and energy).
- **Government**: Smart home systems are also able to detect unusual patterns of behaviour in our home and can immediately alert the police, or security

companies. This can also have a big impact on increasing public safety in a city.

These examples also show well that smart homes can be a key factor for a smart city in the future. Of course, the technologies that exist today still need to evolve, especially artificial intelligence. Furthermore, these systems must ensure the security of the data, as it can be dangerous if the data falls into the hands of a third party (hacker risk).

CONCLUSION

Due to the widespread of large number of IT applications and the use of the Internet, the functioning of settlements is becoming unthinkable without use of them. Due to technical progress, there may be positive changes in the life of the settlements due to the pressure, but there are quite different paths for settlements and cities which have conscious settlement development, thanks to the tools almost accessible to everyone. As a result, the smart home market is also developing dynamically worldwide. By 2025, a quarter of homes will already have some sort of smart-home solution and these systems may play an increasingly important role in the development of a smart city. After collecting data generated by the population of a smart city, there is a chance to increase the city's performance in a number of areas, such as in the fields of public safety, health care, and energy consumption. If technological progress continues at this level and the Internet of Things (IoT), Cloud of Things (CoT) and artificial intelligence (AI) can be linked with each other, smart homes can be the basis for smart cities. Of course, there are still many things to be solved in this area, such as guaranteeing data security, or creating simple smart home systems that even older people can easily learn to manage. The presented ICT-based infrastructure provides a new platform for services (Figure 3.). It mainly focuses on services in the areas of social programs and healthcare; environment, energy and water; and the area of government, administration and public safety.

The study presents a relatively new approach to the smart city concept, which is also a new topic in the international literature. The point of the approach is that smart homes can be the foundation of smart cities. I created a simplified model (Figure 3.) based on my literature research, which I supplemented with two important factors, which are emphasize the importance of people and education / communication.

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Linking smart city concepts to urban resilience

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SUMMARY

In this study, ten cities from the Visegrád countries are compared applying cross-sectional data (from the year 2015). After the standardization process of the involved 11 indicators, their adaptive capacity is measured by resilient index that we developed and a rank is created. This index is formed by three components (demographic, social-economic and spatial-environmental resilience components). Significant differences were revealed related to the adaptive capacity of the examined settlements. In spite of the fact that the capitals of the Visegrád countries are the most resilient cities from an economic perspective, their results are around or below the average regarding their demographic and spatial-environmental components. This indicates that the economic success of a city does not necessarily imply greater resilience: being an economically successful city is a necessary but not sufficient condition for being a resilient city.

Keywords: resilience; smart city; adaptation; Hungary; economic success
Journal of Economic Literature (JEL) codes: P25, R11, R58
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INTRODUCTION

Increasing globalization poses new challenges for cities. Today, cities make a significant contribution to global GDP, reaching over 80% in 2018 (Hajduk 2016, Kola-Bezka et al. 2016, World Bank 2018). The rate of urban populations is growing steadily. In 1950, there were only 80 cities in the world with a population of over one million, while by 2011, their number had increased to 480. World Bank (2016) data highlight that about 1.4 million people move into urban areas every day. As a result, more than three billion people live in cities today, which may grow to as high as five billion by 2050, and the total rate of the urban population may reach 70% (Muggah 2012). The importance of the cities is well reflected by four figures (2%, 50%, 75% and 80%) of the World Economic Forum: cities own 2% of the land while about 50% of the population live in cities, and cities are responsible for 75% of the world energy consumption and for the 80% of the carbon dioxide emission (WEF 2016).

Cities play an important role in the economic development of countries and regions. Cities provide economies of scale, agglomeration, they concentrate enterprises, capital and stock markets, they can attract a talented and skilled labour force to reach a higher level of knowledge and innovation and foster economic growth (Enyedi 1997; UN Habitat 2011).

The World Economic Forum (WEF 2014) emphasizes six megatrends that are related to the development of cities. These are increasing urbanization, rising inequalities, sustainability, technological change, industrial clusters and global value chains, and governance. In this environment, cities have complex challenges to adapt and reach competitiveness. Based on another analysis of the World Economic Forum (WEF 2016), a huge part of the technologies that are the major driving forces of global transformation show a significant connection to smart cities. The ten most important of them are Open Data, Smart Grid systems, location and position sensors, private e-ID, mobile health control, Internet of Things, forecasting with data analysis, mobile-device

based sensors, intelligent traffic and Big Data. The smart cities' main aim is to create new solutions mainly for city services by using these kinds of technologies.

Similar introductions and statistics on smart and resilient cities are available in numerous national and international publications, e.g. Lados (2011), Bizjan (2014), European Parliament (2014), Szczech (2014), Richter et al. (2015), and Hajduk (2016), wth Szendrei (2014) illustrating the challenges caused by globalization, climate change and accelerated urbanization

The global pandemic has boosted these challenges further and drawn attention to the city level, where nationwide measures are actually implemented. As the Secretary General of the United Nations concludes, local action is the key and cities will have a critical role not only in prevention of the virus spreading, but in the global economic recovery, too (Guterres 2020). This brings to the surface the problem of inequalities among territories and different social groups and puts a spotlight on accessibility vs. mobility. Digitalization can serve as an action tool accelerating environmental awareness and supporting long-term recovery strategies (OECD, 2020).

The current study is divided into four well-defined parts. In the section *Theoretical Background*, urban resilience is interpreted, defining the related key concepts and introducing the various resilience indicators (with special regard to the results of the FM Global Resilience Index). Section 3 (*Methodology and data*) describes the data and cities included in the analysis, the methodology of standardization and computing the resilience index. In the section *Results,* not only the resilience index is described in detail but also its components, and values are compared with the results of the smart index obtained in one of our previous studies (Nagy et al. 2018). In the last section (*Summary*), conclusions are drawn and experiences are summarized.

THEORETICAL BACKGROUND

Cities can be considered very complex and complicated systems: they are the power centres of development and the engines of economic growth. Urban population, industry and services (due to their high attractiveness of capital) are very concentrated. As a result of this increasing concentration, the vulnerability and dependence of cities keep increasing. The well-being of the urban population can be ensured by the safe operation of the infrastructure systems, the communications networks, the big operational systems and the supply chains (World Bank 2016). At the same time, however, large-scale interdependence among the systems makes them vulnerable. The UNISDR (2015) predicts that the cost of recovery after the damages in the built environment (caused by human mankind or a natural disaster) will come to USD 314 billion on average yearly by 2030 and will be as high as USD 415 billion yearly after 2030. Therefore, the focus should be on prevention rather than disaster recovery and reconstruction.

Thsstudy does not aim at synthesizing theories that focus on urban resilience and at developing new concepts. Numerous sources are available on the topic including Martin and Gardiner (2019), Pirisi (2019), Zhang and Li (2018), Wang et al. (2018), Buzási (2017), Meerow et al. (2016), and Bulkeley and Tuts (2013), who excellently summarize and clarify debates around the concepts. Hereinafter, the following definition of the World Bank (2016) is applied: "resilience is defined as the ability of a system, entity, community, or person to adapt to a variety of changing conditions and to withstand shocks while still maintaining its essential functions" (World Bank 2016: 12).

Cities should try to avoid shocks and reduce risks even if these shocks are often unpredictable. The aim is to keep the urban functions in their original state or to be restorable within a short time. Adaptability (or adaptive capacity) is the key to resilience (Bristow and Healy 2018). It shows how resilient a city is and how fast it can react to external changes (World Bank 2016). Therefore, adaptability is "a characteristic of a given system that ensures the long-term and sustainable operation of subsystems despite the changing external conditions, but also provides enough flexibility for partial or complete transformation" (Buzási 2017: 38). Adaptability enables cities to ensure their residents' well-being and contribute to long-term sustainability. The previously described concepts (adaptability and sustainability) go hand in hand; one cannot exist without the other. As Bănică and Muntele (2017) highlight, resilience is not only a normative concept but also a strategic concept.

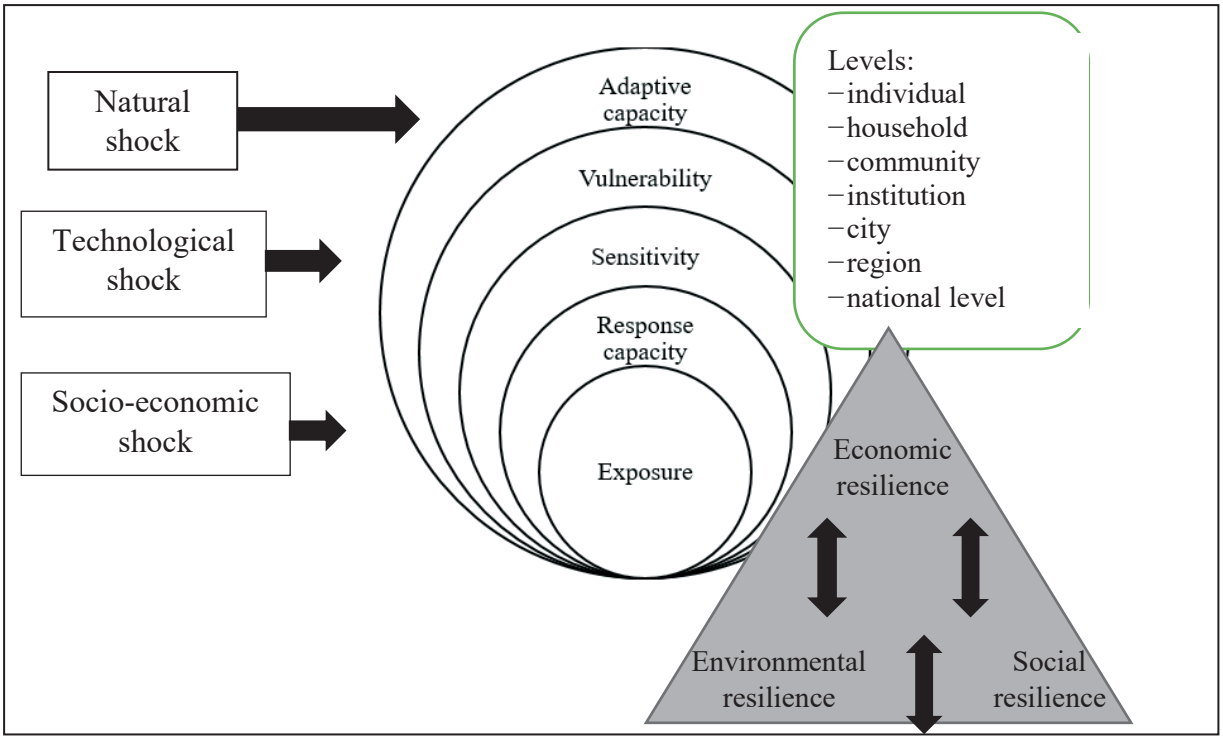
The basic approach of resilience, adaptation and stability is that cities are usually in some equilibrium state. Even if an external shock knocks them off balance, they aim at turning back to the equilibrium or reaching a new equilibrium state (i.e. finding stability). This corresponds to the definition of Pirisi (2019): "adaptive resilience refers to the ability which enables the system to change as a result of external effects, which implies that it adapts to changing external circumstances" (Pirisi 2019: 66). However, Bănică and Muntele (2017) have a completely different view, saying that urban development cannot be regarded as an uninterrupted and smooth process aimed at achieving equilibrium, but rather as progress among imbalances. This implies that stability is quite relative and it has to be accepted that a city is able to operate not only in a certain equilibrium state. The aim is to continuously "refine" each subsystem. It is as a result of flexible adaptation to changes that a steady state can be realized which can be considered stable (Buzási 2017).

It is important to examine the role of time. While in the short term, defence may be the main aim, the focus

in the long term is on adaption. Urban resilience can also be interpreted as a key element of sustainable development (World Bank 2016). Resilience is, in fact, the means by which sustainability can be achieved (Buzási 2017; Pirisi 2019). A resilient city, as a concept, refers not only to economic development (although in most cases it is measured with per capita gross added value and therefore it is identified with economic growth), brown-field rehabilitation or conscious urban planning and urban sprawl. It includes the long-term improvement or maintenance of the quality of life and well-being of the population, a healthy and safe environment, equality and fairness (Bănică and Muntele 2017).

The global pandemic (Covid-19) brought the topic to the surface, highlighting the practical side of the concept. Chong (2020) lists 5 early conclusions that can be drawn after the coronavirus: 1) multi-hazard problem – importance of holistic approach, 2) proactive measures should be emphasized, 3) importance of big data approach, 4) identifying critical points, 5) efficient framework should be created.

Figure 1 describes the different examination levels, the potential conceptualizations of urban resilience and the typology of external shocks.



Source: own compilation based on Wang et al. (2018) and World Bank (2016)

Figure 1. Conceptual interpretation of urban resilience

The World Bank (2016) distinguishes three types of external shocks: natural, technological and socio-economic risks. The first group includes the negative impacts of climate change (like flash floods, floods, mudslides, intense storms, frequent fires, drought, and higher average temperatures). Technological risks include, but are not limited to, sudden changes in the built environment (such as the collapse of bridges and buildings, chemical disasters, cyber attacks, explosions, fire, gas or oil leaks, other industrial disasters, poisoning, traffic accidents, failure in major supply systems). The third group includes corruption, changes in the business cycle, demographic changes, economic crisis, high unemployment, strikes, terrorism, political and social conflicts, supply crises and war.

In most of the cases, studies on resilience focus on a selected shock and concentrate on its analysis. Bulkeley and Tuts (2013) examine urban vulnerability, adaptation and resilience in the context of climate change. Kitsos and Bishop (2018) focus on the effects of the 2008-2009 crisis (economic resilience)
and Beyer et al. (2016) analyse the resilience of individuals, households, communities and institutions in Nairobi, which struggles with significant social problems. Khan and Labonté (2017) consider the technology sector as a key to economic resilience (they describe Toronto in their case study). Bristow and Healy (2018) focus on the role of the development of innovation capacity and the innovation ecosystem in urban resilience. They conclude that the European regions that previously had had higher innovation capacity and performance were more resilient to the 2008-2009 crisis.

Options of measuring resilience, indicators of resilience

There are several options to measure resilience: it can be carried out at lower levels such as at the individual or household levels, although it is much more general at the city, regional or national level. Most of the studies (e.g. Bănică and Muntele 2017; Kitsos and Bishop 2018,) aim at the quantitative measurement of resilience with analyses dominated by labour market research and approaches. The main reason for this is that a good indicator of economic complexity is the sectoral distribution of the employed, which refers to the exposure and dependence of the given city. In addition, it is widely agreed that an advanced, flexible and innovative SME sector contributes to the resilience of a region to economic crises, and can reduce (or even prevent) negative impacts (Kitsos and Bishop 2018).

When measuring resilience and adaptive capacity, different researchers use different numbers of indicators. For instance, while Drobniak (2017) starts from one single indicator, namely GDP, when examining the economic resilience of the EU Member States and the Central European regions, Wang et al. (2018) include 139 indicators in their analysis.

There are many very different resilience indicators available, including the City Resilience Index (2019), the Resilience Index Measurement and Analysis (RIMA) Model (FAO 2019), the Composite Resilience Index, the Savills Resilient Cities Index and the FM Global Resilience Index (FM Global 2019). The latter examines 130 countries in the world and ranks them based on 12 key factors that determine resilience. This is intended to provide investors and companies with information on the security of the business environment (FM Global 2019). It examines three components (economic, risk and supply chain components). The following indicators are related to the economic component: productivity, political risk, oil intensity and urbanization rate. The risk component takes into account natural disasters, the quality and type of the building stock (like fire protection rating or proportion of earthquake-proof buildings), and vulnerability to cyber attacks. The supply chain component includes the indicators of corruption and the fight against it, the quality of the infrastructure, and the assessment of corporate governance (accounting standards, rules about incompatibility, shareholder rights).

Table 1.
Position of the Visegrád Four countries based on FM Global Resilience Index (and its components) (2019)

	Hungary	Czech Republic	Poland	Slovakia
Resilience index	35	20	24	29
Economic component	25	15	19	9
Risk component	35	2	6	19
Supply chain component	43	29	33	49

Note: Light grey indicates belonging to the second quartile based on the given result, while dark grey indicates the first quartile.
Source: Own compilation based on FM Global (2019) data

Table 1 shows the position of the Visegrád Four countries in the resilience ranking including 130 countries. The Czech Republic has one of the best rating for each component and Hungary has the worst performance, similarly to Slovakia, especially in risk and supply chain components.

Hereinafter we aim at calculating the Resilience Index for ten major cities of the Visegrád Four countries for 2015. It is carried out based on the study of Bănică and Muntele (2017), in which the authors identify the three main components of resilience based on the well-known pillar structure of sustainability. Using this definition, we distinguish demographic, social-economic and spatial-environmental components.

METHODOLOGY AND DATA

Cities were selected based on two factors. One of them is the availability of qualitative data and indicators, given by the Urban Audit Perception Survey city list. The other is the EFOP-3.6.2. research project about the smart city characteristics of the Hungarian cities and about their relationship with urban resilience at the national and international level. Taking into account the available data, the cities included in the analysis are (Figure 2): Prague and Ostrava in the Czech Republic, two metropolitan areas according to ESPON (2007); Budapest (metropolis) and Miskolc (big city) in Hungary; Warsaw, Krakow and Gdansk (metropolitan areas) and Bialystok (big city) in Poland; Bratislava (metropolis) and Košice (big city) in Slovakia.

Source: own compilation

Figure 2. The cities included in the study

Our aim was to use indicators and to develop an index that meets the following requirements:

- selecting data, which are available for all the cities,
- the analysis can be repeated at other times,
- enables national and international comparability.

Table 2 describes the components used, the related indicators and their sources. In the course of data collection, we aimed at collecting data at the city or at least at the metropolitan region level. The number of hospital beds per 100,000 people and the employment rate are only available at NUTS 2 level. The list of indicators is compiled based on Bănică and Muntele (2017). However, some minor modifications were carried out regarding the data. The indicators were reconsidered based on relevance and availability of data.

Table 2.

The set of indicators for the demographic, social-economic and spatial-environmental resilience components

Demographic resilience component				
Indicator	*Year*	*Territorial level*	*Effect on resilience (+/-)*	*Source*
Population change between 2005 and 2015 (%)	2005-2015	city	+	Eurostat
Proportion of 0-14 year olds to total population (%)	2015	city	+	Eurostat
Proportion of elderly population (> 65 years)	2015	city	-	Eurostat
Population density (person/ km^2)	2015		-	Eurostat
Social-economic resilience component				
Indicator	*Year*	*Territorial level*	*Effect on Resilience (+/-)*	*Source*
Number of hospital beds per 100,000 people	2015	NUTS-2 (region)	+	Eurostat
GDP per capita at current prices (EUR)	2015	metropolitan region	+	Eurostat
Number of students in higher education in the total population (person/1000 persons)	2015	city	+	Eurostat
Employment rate (%)	2015	NUTS-2 (region)	+	Statistics Poland, Hungarian Central Statistical Office, Czech Statistical Office, Statistical Office of the Slovak Republic
Spatial-environmental resilience component				
Indicator	*Year*	*Territorial level*	*Effect on Resilience (+/-)*	*Source*
Number of days when the ozone concentration exceeds 120 µg/m^3	2013	city	-	Eurostat
Built-up area per capita, (m^2/person)	2010	metropolitan region	-	European Commission (2019): Urban and territorial dashboard
Green infrastructure per capita, (m^2/person)	2010	metropolitan region	+	European Commission (2019): Urban and territorial dashboard

Source: own compilation based on Bănică and Muntele (2017)

The direction (as the effect on resilience) of the selected indicator is a key issue and it is admitted that some contradictions can be found here. However, the main purpose of this paper is to build a resilience index to measure the resilience performance of the involved settlements. The results are put into wider context, emphasizing the connections between smart city theory and resilience. There are indicators (e.g. proportion of 0-14 year olds to total population, %) whose direction may be positive and negative, too (depending on the perspective). If the environmental dimension is considered, infants and toddlers are more vulnerable to heat waves and to other negative effects of the global climate change (more details in Dian et al. 2019). However, a young society is a key component of long-term development, because they are more open to digitalization and smart tools, so this is assessed as positive in the calculations.

Another debatable area is the indicators of population density and built-up area per capita. They are strongly correlated. Other studies (e.g. Sebestyénné Szép et al. 2020) and the latest events around the global pandemic highlight that urban areas with high population density are more vulnerable than rural areas (i.e. number of cases, death rate, etc.). The urban population is more vulnerable and exposed to the changes in the supply chains. Management of urban utility services is critical; any issue has a greater impact on local population. Both indicators are considered as having a negative effect on resilience.

Standardization of the values was necessary in order to ensure the comparability of the indicators with different units of measurement and scaling. A method to do so is z-transformation, which converts all indicator values to standardized values with an average of 0 and a standard deviation of 1. Its advantage is that it takes into account the heterogeneity of the units within the group and provides metric information. In addition, this transformation significantly increases the indicator's sensitivity to changes that occur. The method is widely used when data have different scaling/units of measurement and the aim is the comparability or the aggregation of individual components. This method is not new in the study of smart cities and urban resilience; Cohen (2014), Hajduk (2016) and FM Global (2019) also used it in their research. The method is based on a linear transformation of the data and can be performed using the formula below.

$$X = \frac{X_i - \bar{X}}{standard\ deviation} \qquad (1)$$

where X_i *is* the value of the indicator in the i^{th} city and X *is* the average of the indicator among the examined municipalities.

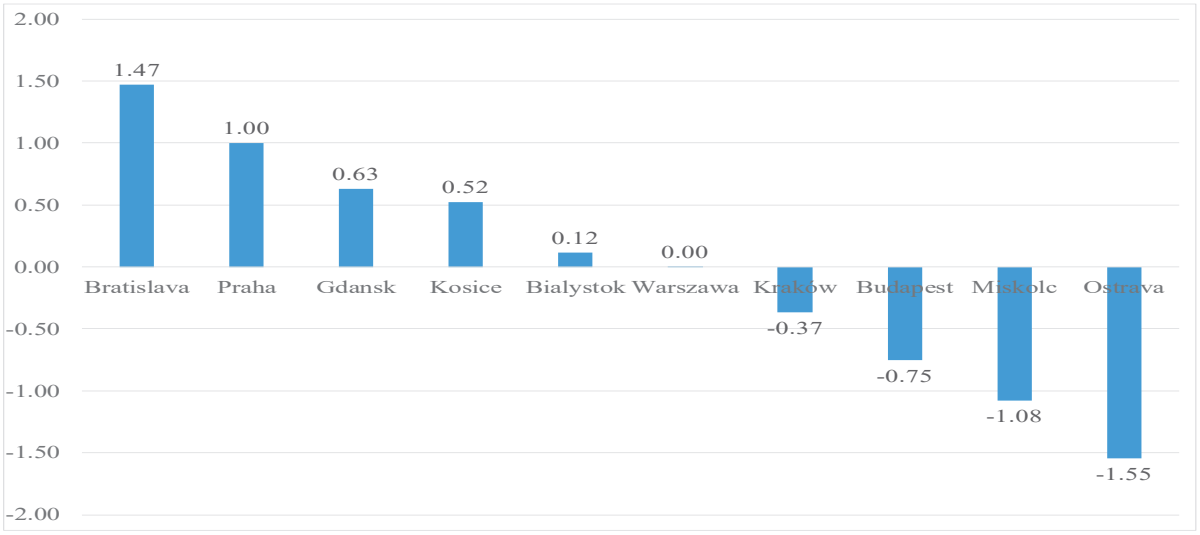
The main advantages of this method are:

- it allows aggregation of different sets of data (like kg, %, m^2) while retaining the original relationships,
- it does not cause data loss or distortion (Giffinger & Pichler-Milanovic 2007, Cohen 2014).

In some cases, some changes were required in the course of the interpretation of indicators (components) and of the development of a complex indicator due to the different scaling of the indicators. If the metrics were not scaled properly (such as when lower values are associated with better positions of the cities as the proportion of the elderly population or the number of days exposed to higher ozone concentrations), the inverse of the selected indicators are used for further calculations. The value of each subsystem was calculated as the sum of the standardized values of the selected indicators. Then the so-called smart index, as a final result, could be calculated as the arithmetic mean of the values of the pillars, similarly to the methodology applied in other studies (Giffinger & Pichler-Milanovic 2007; Nagy et al. 2016).

RESULTS

Comparing the values of the resilience index (Figure 3) created based on the three components (demographic, social-economic and spatial-environmental resilience components), different conclusions can be drawn than in the case of the smart index[i] (see Nagy et al. 2018). Out of the capitals, only Prague could keep its leading position, Warsaw fell to sixth and Budapest fell to eighth place. Although Bratislava extremely underperforms on the basis of the smart index (it is one of the least "smart" settlements among the examined cities of the Visegrád countries), it still seems to be the most resilient city based on the resilience index. The same applies to Košice: while it is at the end of the list based on the smart index (ranked at 10^{th} place), it is number four based on resilience. Ostrava performs differently: while it is the number four in the smart cities list, it is the least resilient (ranking 10 on the resilience index). In general, Polish cities are situated in the middle range according to the results of both indicators and the two Slovak cities are considered to be highly resistant. Miskolc performs poorly based on both indicators. Despite the smart city developments realized in recent years, it is ranked 8^{th} on the smart city index list and 9^{th} on the resilience index list.



Source: own compilation

Figure 3. Values of the resilience index in the examined Visegrád cities (2015)

In the following, we examine the performance of each city based on the components of the resilience index (Table 3).

In the case of Prague, Košice and Bialystok, the demographic pillar is the strongest one. In all three cities, the proportion of people aged 0-14 is over 14% (compared to the total population), population growth is significant, but population density is relatively low (compared to cities of similar category). This cannot be specifically explained by the high fertility rate, but rather by increasing urbanization and by the fact that these cities have become targets of internal migration. Bratislava lags behind these three cities in several respects and therefore is in fourth position. It is characterized by a higher population density and a decreasing population. At the same time, the rate of young people (aged 0-14) is high (14.3%), while the rate of those aged over 65 is lower than the regional average. Warsaw and Ostrava are ranked 5th and 6th with almost the same component values. The age composition of the population is nearly the same, but while Warsaw is a very densely populated and significantly attractive city, the population density in Ostrava is 53.9 persons/km^2 and characterized by outward migration. Miskolc and Gdansk are in the 7th and 8th position, respectively. The largest difference here, too, is in population growth and population density. At the end of the list there are two densely populated cities (Budapest and Krakow), where the rate of those aged over 65 is higher.

The capitals are that clearly the leaders in the social-economic component ranking, as they perform better than the average in the case of all four indicators (number of hospital beds per 100,000 people, GDP per capita, number of students in higher education and employment rate). On the one hand, Bratislava's exceptionally high employment rate may be due to the fact that its educational position is better that of other cities in the country (it is clearly the centre of higher education in Slovakia), and as a result, it has a large number of inhabitants with higher education attainment and with appropriate foreign language knowledge. Another factor is that large companies within the country prefer Bratislava as their main investment target. INC (2019) data reveal that in 2016, out of the 5,000 fastest growing privately owned companies in Europe, 215 were located in Slovakia, of which 77 were registered in Bratislava and 12 in Kosice.

According to a 2015 report of the European Commission, within European countries Prague, Cluj-Napoca, Munich and Bratislava are the cities where it is the easiest for new graduates to find a job (based on a population survey), while Budapest and Miskolc can be found in the second half of the list (European Commission 2015). While Krakow lags behind these cities in terms of GDP per capita, it is nevertheless considered a higher education-oriented regional centere, with a very high number of students (and their proportion of the total population). Obviously, the second half of the list includes rural towns. Miskolc performs well in terms of the number of hospital beds and is close to the values of the capitals (it even exceeds the value of Warsaw) (one of the largest hospitals in Hungary, the County Central Hospital of Borsod-Abaúj-Zemplén and University Teaching Hospital, can be found here). It is, however, at the end of the list based on other indicators: per capita GDP (only EUR 8000/person in the region), the rate of the students in higher education to the total population is only 60 (per 1000) and the employment rate is below 50% (which is partly explained by the city's industrial past and its decline).

As was expected, the Polish cities and Miskolc and Kosice are at the top of the list in the case of the spatial-environmental component, which is due to the lower ozone concentrations (i.e. better air quality) and to the fact that the per capita built-up area is below the

average. Košice has a slightly different position with its high built-up data (548.9 m^2/person), but with a significant green infrastructure. Budapest, Bratislava, Ostrava and Prague proved to be the least environmentally resistant.

Table 3.
Values of the components of the resilience index and the smart index in the examined cities of the Visegrád countries (2015)

	Bratis-lava	Pra-ha	Gdansk	Koši ce	Bialyst ok	War-szawa	Kraków	Buda-pest	Mis-kolc	Ostrava
Demographic resilience component	0.14 (4)	2.24 (2)	-1.09 (8)	3.81 (1)	1.85 (3)	-0.64 (6)	-2.18 (9)	-2.49 (10)	-1.02 (7)	-0.62 (5)
Social-economic resilience component	5.66 (1)	2.58 (2)	-0.43 (6)	-1.71 (7)	-2.87 (10)	0.27 (5)	0.59 (4)	1.17 (3)	-2.82 (9)	-2.44 (8)
Spatial-environmental resilience component	-1.38 (8)	-1.82 (10)	3.41 (1)	-0.53 (6)	1.37 (2)	0.37 (5)	0.49 (4)	-0.94 (7)	0.61 (3)	-1.57 (9)
Resilience index	*1.47 (1)*	*1.00 (2)*	*0.63 (3)*	*0.52 (4)*	*0.12 (5)*	*0.00 (6)*	*-0.37 (7)*	*-0.75 (8)*	*-1.08 (9)*	*-1.55 (10)*
Human component	5.18 (1)	3.39 (2)	-0.05 (5)	-0.60 (6)	-3.11 (9)	2.44 (3)	1.02 (4)	-1.04 (7)	-4.31 (10)	-2.91 (8)
Economic component	3.80 (3)	4.86 (1)	-0.46 (7)	-6.11 (10)	-4.04 (8)	3.81 (2)	-0.18 (6)	2.21 (4)	-4.48 (9)	0.60 (5)
Environment component	-4.55 (10)	1.15 (4)	1.30 (3)	-0.95 (7)	4.81 (1)	-0.40 (5)	-1.95 (8)	-0.56 (6)	3.82 (2)	-2.69 (9)
Governance component	-1.24 (7)	-2.26 (8)	-0.74 (5)	1.90 (3)	1.69 (4)	-2.71 (10)	-2.47 (9)	4.00 (1)	2.84 (2)	-1.02 (6)
Mobility component	-2.89 (9)	4.40 (1)	0.45 (5)	-3.64 (10)	-1.46 (8)	2.10 (2)	1.67 (3)	-0.11 (6)	-1.37 (7)	0.86 (4)
Quality of life component	-6.29 (10)	2.66 (2)	-0.75 (6)	-1.19 (7)	1.52 (4)	-2.23 (9)	1.53 (3)	0.68 (5)	-1.42 (8)	5.51 (1)
Smart index	*-1.00 (9)*	*2.37 (1)*	*-0.04 (5)*	*-1.77 (10)*	*-0.10 (7)*	*0.50 (3)*	*-0.06 (6)*	*0.86 (2)*	*-0.82 (8)*	*0.06 (4)*

Note: the position in the ranking can be found in brackets.
Source: own compilation and own calculation based on Nagy et al. (2018)

CONCLUSION

It can be concluded that the economic success of a city does not necessarily imply greater resilience. Our results are summarized below:

- Being an economically successful city is a necessary but not sufficient condition for becoming a smart and resilient city.
- There are significant differences in the adaptation capacity of the examined cities.
- In economic terms, the four capitals of the Visegrád countries can be considered to be the most resilient, but in the case of the social and environmental resilience components, their results are rather around or below the average.
- There is no close and direct relationship between the values of the resilience index and the smart index.
- Flexible resilience can be enhanced by the proper application of the smart cityconcept. At the same time, however, other urban development strategies may also be appropriate to improve resilience.

The global pandemic has put the issue of urban resilience into a new context. However, it raises more questions than answers. Our method and complex resilience and smart indexes suffer from certain limitations and shortcomings, which we have to consider by calculating it for other cities or different time horizons. The biggest limit is the data constraints, as these kinds of indicators cannot be reproduced in any possible time perfectly; some are available only for shorter terms or in some years. Regarding the data constraints, another issue is that these indicators are not available for every city in the same form, so the indicators' international comparability is imperfect. At the same time these examinations are crucially important, as local actions and resilient cities can contribute much to achieving sustainable development and sustainable development goals. In the long run Big Data can help to manage these issues. The new smart tools and solutions in the examined cities result in a lot of data. These data should be available and accessible for scientific research, which can open new dimensions.

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Impact of social innovation on population change in Borsod-Abaúj-Zemplén County

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SUMMARY

Technological and economic innovations cannot respond to all social challenges. Natural and material resources are becoming ever scarcer, so it is necessary to use investment assets, maximizing social and economic efficiency. It is a major task to address the backwardness originating from regional disparities and to create opportunities for catching up in peripheral regions. The study, based on the process-oriented model defined in our previous studies and the determination of the social innovation potential, tries to determine the relationship between social innovation potential, the spatial position of developmental image, and regional differences and population change in Borsod-Abaúj-Zemplén County.

Keywords: social innovation, spatial inequalities, spatial autocorrelation, population change
Journal of Economic Literature (JEL) codes: O35, R11, R14
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INTRODUCTION

In line with social changes, the European Union is paying more attention to the context of social innovation than before. There is a need for a paradigm shift (Veresné Somosi et al., 2019); besides the R&D activities in technical and natural sciences, which require more and more investment, there is a need for new, innovative solutions to address the social and economic problems of a given community (settlement or region).Social innovation highlights community development as an objective over regional development, and meeting needs over the exclusiveness of profitability and marketability (Katonáné Kovács et al., 2017).

Today, society faces many challenges. Insecurity, crises, unforeseeable technological changes and globalization make the future unpredictable (Ionescu, 2015). The conceptualisation of social innovation is an important task that also contributes to addressing societal challenges. The process of social innovation makes societies more sustainable and cohesive through inclusive solutions, collaborations and proactive bottom-up initiatives (Grimm et al., 2013). However, this does not only mean bottom-up efforts but also a process based on civic engagement, since social innovation, which can be found in new approaches to cooperation and structural transformation of society, is often created from the top by macro-level measures (Nemes & Varga, 2015). The concept of social innovation focuses on meeting the needs of the community, which is the process through which the quality of life is improved and well-being is realized (Hazel & Onaga, 2003; Mulgan et al., 2007; Pol & Ville, 2009; Kocziszky et al., 2017). Well-being, in addition to income status determining welfare, and the needs of subsistence, is associated with a sense of security, self-esteem and fulfilled relationship needs (Kocziszky et al., 2017). When examining social innovation initiatives, emphasis is put on the social benefits of innovative ideas that can be interpreted locally at community level and the role of community involvement in raising living standards. Social innovation means new (or new-approach) solutions that at the same time meet the needs of society and enhance the capacity of society to act (Czakó, 2000). Social

innovation is a process of change that responds to social challenges through a creative, reconsidered combination of available resources and solutions (Manzini, 2014). Social innovation initiatives are new combinations of social practices (Hochgerner, 2011) that, through new or novel coupling, result not only in a paradigm shift in innovation but also in a new category of innovation. New social practices and solutions aim at social change based on comprehensive, pre-planned, goal-oriented activities (Cajaiba-Santana, 2014).

Our study focuses on the social innovation potential of the settlements in Borsod-Abaúj-Zemplén County. After calculating the complex indicator measuring the social innovation potential, we examined how the most important territorial processes in the county are related to the processes defined by the indicator. In our study, we considered it important to analyse the extent to which social innovation potential can modify basic spatial structure conditions. As Nemes Nagy (2005) points out, territorial processes are basically unchanged in the short run. Modification of the basic structure can be achieved mainly in the medium term (10–15 years) as well as in the longer term.

EXAMINATION OF SOCIAL INNOVATION POTENTIAL IN BORSOD-ABAÚJ-ZEMPLÉN COUNTY

Borsod-Abaúj-Zemplén county is located in the northern part of Hungary. It is the second largest county in the country in terms of both area (7247.17 km²) and population (684,793 people). In Borsod-Abaúj-Zemplén county, the number of settlements is 358, and can be characterized by a high density of settlements and a high proportion of small villages.

Out of the 16 districts of Borsod-Abaúj-Zemplén county, 8 districts are among the most disadvantaged districts in the country.

There is a correlation between the economic capacity of the given region and its capability for innovation (Kocziszky et al., 2017). However, innovation (the search for new and innovative solutions) needs to be interpreted more broadly than before. Social innovation can be interpreted as a concept that results in meeting the needs of society, along with new or novel cooperation and structures. Social innovation efforts lead to the renewal of society while encouraging members of society to act.

Social innovation efforts can be proposed solutions for meeting social needs and handling the challenges of peripheral regions. Social needs and challenges facing the community can be grouped in three ways:

Table 1.
Social needs and challenges facing the community

Social		**Economic**		**Political**	
Needs	**Challenge**	**Needs**	**Challenge**	**Needs**	**Challenge**
involving citizens, social services, mobility, community	emigration, ageing, disadvantaged groups, inequality between levels of education	security, stability, employment, sustainability, trust	housing conditions, unemployment, financial resources, expertise	awareness, mobilizing power, political participation	government transparency, independence of decisions, commitment

Source: Veresné Somosi et al., 2019

Relationship between social innovation and spatial pattern

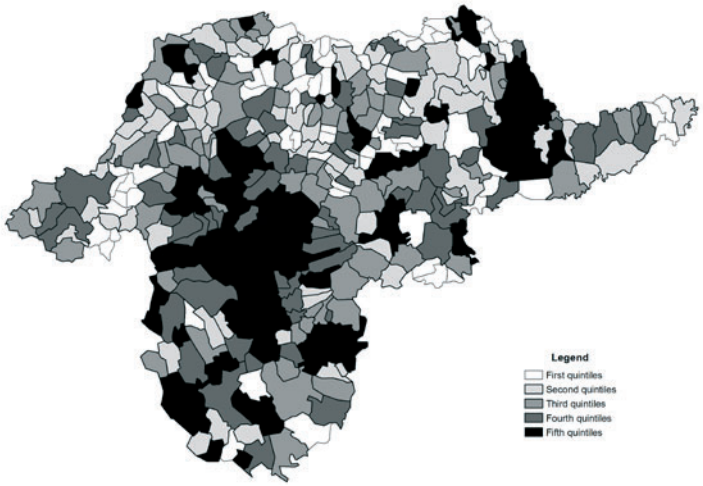
Based on Benedek et al. (2015), we developed an indicator system for measuring social innovation potential[1]. The indicator system consists of three parts: input, output and impact indicators. We calculated a complex indicator measuring social innovation from the average of the three indicator sets and using cartographic methods for the regional comparative analysis (in the first part of the study – Varga et al. 2020 – we dealt with the in-depth analysis of regional inequalities in the social innovation indicators, using cartographic methods for the regional comparative analysis).

We examined the extent to which the settlement classification determined by the complex indicator reflects developmental conditions and is responsible for the development differences. To this end, the settlements were ranked in quintiles according to the order set by the complex indicator and the per capita income of the quintiles and the county was calculated.

Table 2.
Per capita income according to the classification developed by the complex indicator of social innovation, 2017

Innovation quintiles	Per capita annual income, thousand HUF
First	751
Second	789
Third	855
Fourth	930
Fifth	1249
County average	*1083*

Source: own calculation



Source: own compilation

Figure 1. Quintiles according to the classification developed by the complex indicator of social innovation

To measure regional inequalities, we used the Hoover index, which measures the maximum vertical distance between the Lorenz curve and the diagonal (Major & Nemes Nagy, 1999).

$$H = \frac{1}{2} \cdot \sum_{i=1}^{n} |x_i - f_i| \quad (1)$$

where $\sum f_i = \sum x_i = 100$

In this case, x_i is the income and f_i is the proportion of the population by district. It was subdivided according to a previously developed procedure (Kincses, 2015) to find out the extent to which the grouping of settlements (quintiles) determined by the complex indicator of social innovation is responsible for the territorial disparities within the county.

$$H = \frac{1}{2} \cdot \sum_{i=1}^{n} |x_i - f_i| = \frac{1}{2}\{\sum_{j=\text{First quintile}} |x_j - f_j| + \sum_{k=\text{Second quintile}} |x_k - f_k| + \sum_{l=\text{Third quintile}} |x_l - f_l| + \sum_{m=\text{Fourth quintile}} |x_m - f_m| + \sum_{n=\text{Fifth quintile}} |x_n - f_n|\} \quad (2)$$

Table 3.
Hoover index according to the classification developed by the complex indicator of social innovation, 2017

Innovation quintiles	Hoover index, %
First	9.2
Second	9.3
Third	6.1
Fourth	5.6
Fifth	4.0
County total	*34.2*

Source: own calculation

It can be stated that the level of development, simplified by the per capita income, increases as the complex indicator measuring social innovation potential increases. In the case of territorial differences, the opposite is true. The lower the complex indicator within the county is, the greater the extent of the territorial differences attributed to the given group of settlements.

Impact of social innovation on population change (1999–2018)

The purpose of our study was to examine the characteristics of the impact of social innovation on spatial processes based on the demography data of the settlements of Borsod-Abaúj-Zemplén County. Our analysis focuses on how the distribution of the complex social innovation indicator relates to the change in population of the county's settlements. A shift share analysis was used for this. Several territorial statistics books highlight this method (e.g. Sikos T., 1984; Nemes Nagy, 2005; see a similar application in Nemes Nagy et al., 2001) detailing Hungarian applications (Tóth, 2002). This methodology is a somewhat different methodological approach to the basic method (Houston 1967, Stevens & Moore 1980), but with the same basic questions.

The applied method, which is essentially a double standardization, needs data in at least two structural – territorial and sector – dimensions. Sector indications actually may cover optional disjunctive distributions: economic sectors, age groups, settlement size groups. The territorial dimension also may have subgroups: e.g. settlements, regions, countries, specific spatial aggregates (in this case always the analysed counties). Concerning certain phenomena, chronological growth components may be analysed in the same way as specific data, e.g. per company revenue, or by differentiated structural patterns. This research applies the first type. In this case, the calculation is presented in relation to the first case. Two matrices are starting points to calculate:

$$K = \begin{pmatrix} k_{11} & k_{12} & \dots & k_{1j} & k_{1m} \\ k_{21} & k_{22} & \dots & k_{2j} & k_{2m} \\ \dots & \dots & \dots & \dots & \dots \\ k_{i1} & k_{i2} & \dots & k_{ij} & k_{im} \\ k_{n1} & k_{n2} & \dots & k_{nj} & k_{nm} \end{pmatrix}$$

$$V = \begin{pmatrix} v_{11} & v_{12} & \dots & v_{1j} & v_{1m} \\ v_{21} & v_{22} & \dots & v_{2j} & v_{2m} \\ \dots & \dots & \dots & \dots & \dots \\ v_{i1} & v_{i2} & \dots & v_{ij} & v_{im} \\ v_{n1} & v_{n2} & \dots & v_{nj} & v_{nm} \end{pmatrix}$$

The following values may be calculated (by adding up matrix lines as well as columns) from the basic data:

$$k_{i0} = \sum_{j=1}^{m} k_{ij} \text{ as well as } v_{i0} = \sum_{j=1}^{m} v_{ij} \tag{3}$$

Concerning the first (1999) and the final year (2018) of analysis population of the settlements at the different population size category.

$$k_{0j} = \sum_{j=1}^{m} k_{ij} \text{ as well as } v_{0j} = \sum_{j=1}^{m} v_{ij} \tag{4}$$

Concerning the first and the final year of analysis population for the different categories of complex social innovation indicator.

$$k_{oo} = \sum_{i} \sum_{j} k_{ij} \text{ as well as } v_{oo} = \sum_{i} \sum_{j} v_{ij} \tag{5}$$

Concerning the first and the final year of analysis population of Borsod-Abaúj-Zemplén County.

The first effective step of this procedure is to calculate the M(m_{ij}) matrices of population growth indices, which means to divide V matrix elements by the proper K matrix elements.

$$M = \begin{pmatrix} m_{11} & m_{12} & \dots & m_{1j} & m_{1m} \\ m_{21} & m_{22} & \dots & m_{2j} & m_{2m} \\ \dots & \dots & \dots & \dots & \dots \\ m_{i1} & m_{i2} & \dots & m_{ij} & m_{im} \\ m_{n1} & m_{n2} & \dots & m_{nj} & m_{nm} \end{pmatrix}$$

Similarly the total (Borsod-Abaúj-Zemplén County) growth index (m_{oo} – matrix/matrix) as well as the sectors (which are in this case population size categories) (m_{io} – quotient of matrix lines) and territorial (which are in this case the categories of the complex social innovation potential indicator) (m_{io} – quotient of territorial columns) growth indices may be also calculated:

$$m_{00} = v_{00} / k_{00}$$

$$m_{i0} = v_{i0} / k_{i0}$$

$$m_{0j} = v_{0j} / k_{0j}$$

By using these relations for all area units, given-period specific – above or below county average population growth generated – population surpluses and shortages (S_i) may be broken down into two components, in our case into the regional (S_r) and sectoral structure (S_a) impacts:

$$(S_i) = (S_r) + (S_a) \quad (6)$$

where

$S_i = v_{oj} - (m_{00} * k_{oj})$ i.e. the population column amount in the last analysed year – (county average growth* the population column amount in the first analysed year,

$S_r = \sum_j \left(v_{ij} - m_{i0} * k_{ij}\right)$ i.e. population data in a given population size category of the county in the last analysed year – (sectoral average growth in given population size category * population data in a given category of social innovation potential indicator in the first analysed year).

$S_a = S_i - S_r$ i.e. the difference of the two impacts.

This method is suitable for separating regional and sectoral (i.e. other, non-territorial based) factors of economic development.

Between 1999 and 2018, the population of the county decreased by about 15%. For all changes in Table 3, the settlement size categories received + 100% where the population decline was below the county average (or possibly even population increase occurred). Those groups where the opposite happened were given -100%. The territorial dimension in this study refers to the categories of the complex social innovation potential indicator. (This was obtained by ranking the settlements in ascending order according to this indicator and dividing the data series into five equal categories). Sectoral impact refers to the dimension according to the size of the population by size category. Our question is, therefore, to what extent the size is responsible for the change in the population of the settlements and to what extent it is due to reasons derived from social innovation potential.

We can see a greater decline than the county average in the category below 500 inhabitants and the two categories over 5,000 inhabitants. In three out of five settlement size categories, the population size of the settlements is more responsible for the population change (bigger in absolute terms), and the territorial dimension, i.e., the social innovation potential situation is more important only in two cases. In the case of the latter, in both settlements with less than 500 inhabitants and between 5,000 and 20,000 inhabitants, population change is fundamentally negatively affected by the social innovation potential situation.

Table 4.
Population surplus/shortage and its components, (%)

Population size categories	Total (%)	Territorial (%)	Sectoral (%)
-499	-100	-69	-31
500–1,999	100	38	62
2,000–5,000	100	-45	145
5,000–19,999	-100	-4939	4839
20,000-	-100	179	-279

Source: own calculation

Taking a closer look at the results of the analysis (Table 4), we can see that the demographic trends that are more favourable than that of the county are in the two population size categories between 500 and 5,000 inhabitants. With the negative trends in the two extreme population size categories, it is surprising that the share of those over 20,000 inhabitants in the unfavourable process is slightly higher.

Favourable territorial factors, i.e. a favourable social innovation situation, is identified for settlements with more than 20,000 inhabitants, while unfavourable territorial factors are predominantly for cities between 5,000 and 20,000 inhabitants.

The positive impact of sectoral effects, i.e. population size, is most pronounced in the category of 2,000 to 5,000 inhabitants, while a negative impact is found for cities above 20,000 inhabitants.

Table 5.
Country shares in revenue surpluses/shortages and related components, (%)

Population size categories	Population surplus	Population shortage	Favourable territorial assets	Unfavourable territorial assets	Positive sectoral impacts	Negative sectoral impacts
-499	–	43.9	–	26.2	–	8.2
500–1,999	44.9	–	14.9	–	16.7	–
2,000–5,000	55.1	–	–	21.7	48.0	–
5,000–19,999	–	1.2	–	52.2	35.3	–
20,000-	–	54.9	85.1	–	–	91.8
Total	*100*	*100*	*100*	*100*	*100*	*100*

Source: own calculation

SUMMARY

A number of fundamental problems of the economy and society – such as the decrease in population, unemployment, migration, or lagging regions – require long-term solutions that need new forms of cooperation between social actors, the direct voluntary participation of citizens in decision-making processes, and the pursuit of social innovation efforts (Veresné Somosi et al., 2019).

Our research questions in this area are the relationship of income distribution and territorial development disparities to social innovation potential and the relationship between population change and social innovation potential. These issues, in addition to the previous studies (Nagy-Tóth, 2019, Varga et al., 2020), are presented in this paper.

Firstly, we pointed out that income distribution and regional development disparities are closely related to the extent of social innovation potential in Borosd-Abaúj-Zemplén County. Secondly, our study examined the relationship between population change and social innovation potential in the county. We found that the size of the settlements is slightly more important in the population change of the county than the social innovation potential situation of the given settlement. The state of social innovation potential can only change or strengthen the fundamentally visible spatial structures.

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[i] *The input indicators:*

1. *Number of non-governmental organizations (NGOs) per 10,000 inhabitants*
2. *Number of active companies per 1,000 inhabitants*
3. *Number of non-profit organizations per 1,000 inhabitants*
4. *Proportion of children in the population*
5. *Number of elderly per 100 children*

6. *Dependency ratio: children (aged zero to 14) and elderly (age 65 and above) as a percentage of the total population aged 15 to 64)*
7. *Activity rate (taxpayers/population * 100)*
8. *Average number of completed years of education, 2011*

The output indicators:

1. *Payout per capita (2007–2013)*
2. *Proportion of the public employees compared to the population aged 15–64*
3. *Number of participants in cultural events per thousand persons 1,000 inhabitants*
4. *Proportion of people living in segregation*
5. *Number of persons receiving social catering service per 1,000 inhabitants*
6. *Number of recipients of home care assistance per 1,000 inhabitants*
7. *Unemployment rate*
8. *Average patient turnover per GP and pediatrician*

The impact indicators:

1. *Annual average income per capita (thousand HUF)*
2. *Percentage of population with primary education over 7 years (including early school leavers)*
3. *Proportion of one-person households*
4. *Proportion of families with three or more children*
5. *Number of registered crimes per 1000 inhabitants*
6. *Number of beds in institutions providing long-term residential care per 1000 inhabitants*
7. *Proportion of taxpayers earning in the 0 HUF to1 million HUF income band*
8. *Proportion of regularly cleaned public areas.*

Microregional convergence through social innovation

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SUMMARY

The national and international literature pays increasing attention to the research of social innovation and its impacts. Among the areas to be examined, we deal with the issues of measurability within the framework of the study. The conceptualization of social innovation, the determination of the logic of the social innovation process and the definiton of its measurement levels, and modeling based on empirical research are relevant challenges. However, the different sources dealing with the topic examine these issues in a different approach. The purpose of the study is to investigate the social innovation endeavours of a district to be developed by a complex program. Nyírbátor District includes disadvantaged settlements that are facing numerous problems due to their peripheral position. The challenges of the area (migration, ageing, unemployment and scarce financial resources) mean doubly disadvantageous stigmatization for these settlements. On the one hand, they mean an external negative judgment, and on the other hand, an internal stigmatization processes of local inhabitants, which require the exact identification of local needs and the involvement of the inhabitants in decisions. One of the tools of such initiatives can be social innovation, and also the support of social innovation endeavours. Within the framework of the research, we examine social innovation as a process of creative cooperation, during which we pay special attention to the analysis of social initiatives supported by local governments. The social innovation endeavours presented in the framework of the study are multi-stakeholder initiatives based on the involvement of the local population.. Their good practice analysis makes it possible to map the process of social innovation. The purpose of this study is to present the points of focus that serve as potential activating factors for the endeavours in the case of Nyírbátor District. The examined cases play a significant role in managing the unfavourable processes of the area, and their adaptation as best practices can support the process of catching up. The study also defines the main sets of criteria which, in addition to providing a structured record of individual case studies, help to compare good practices.

Keywords: social innovation, disadvantaged area, periphery, stigmatization, good practice
Journal of Economic Literature (JEL) codes: O18, R23
DOI: http://doi.org/10.18096/TMP.2021.01.06

INTRODUCTION

Nowadays society is facing numerous challenges. Uncertainty, crises, unforeseeable technological changes and globalization make the future unpredictable (Ionescu, 2015). The conceptualization question of social innovation is a task that should be emphasized, and it also facilitates the management of social challenges. The process of social innovation makes societies more sustainable and cohesive through inclusive solutions, collaborations and proactive, grassroots initiatives (Grimm et al., 2013) It does not only mean bottom-up efforts and processes based on the inclusion of citizens, since social innovations that could also be identified in novel cooperations and the restructuring of society, are often created from the top, as a result of macro level measures (Nemes-Varga, 2015). The concept of social innovation focuses on satisfying the needs of the community, and through this process the development of the quality of life and the increase in welfare/well-being are also implemented Hazel-Onaga, 2003; Mulgan et al., 2007; Pol-Ville, 2009; Kocziszky et al. 2015).

Social innovation endeavours are emerging as a new tool for helping disadvantaged areas to catch up. Benedek et al. (2016) identify social innovation as a new means of solving economic and social problems.

Nagy and Piskóti (2016) emphasize the importance of innovative collaborations which could mean regional development, support for local communities and the integration of local products. Several basic problems of the economy and society, such as population decline, unemployment, migration or lagging areas, require long-term solutions relying on novel cooperation between the actors of society, the direct, voluntary participation of citizens in decision-making processes, and the implementation of social innovation endeavours. The concept of social innovation focuses on satisfying the needs of the community, and this process also brings about an improvement of the quality of life and an increase in welfare/well-being. Apart from the income levels determining welfare and the necessities of life, well-being is also related to the sense of security, self-esteem and a need for relationships (Kocziszky et al., 2015).

Social innovation solutions play a prominent role in the lives of decision-makers, politicians, researchers, civil society organisations, and individuals as well. In spite of the increasing attention it attracts, the concept is not yet uniformly established. In certain interpretations the concept of social innovation is strongly fragmented (Pol-Ville, 2009; Dawson and Daniel, 2010; Cajaiba-Santana, 2014, P. van der Have-Rubalcaba, 2016). Raasch et al. (2013) emphasize that the most significant challenge in conceptualization is how to make up for the lack of clearly defined boundaries in individual approaches and research goals.

LITERATURE REVIEW

In our literature review we give special attention to clarifying the relationship between social innovation and technical and economic innovation. The reason for this is that, in our view, technological and economic innovations are not able to give a comprehensive response to all the social challenges. Social challenges that require long-term solutions (e.g. unemployment, migration, disadvantaged areas) demand novel social cooperations. Social innovation is a necessary step to enhance development and competitiveness, in which the role of innovators is significant. The innovators are members of the local community, or in a broader sense, of society, and being aware of their needs they meet the demands determined by social challenges with new or novel solutions.

Zapf (1991) understands under innovation the solution of social problems that require the redistribution of resources in order to increase living standards. Smeds (1994) identifies technical innovations as preconditions for and originators of social change. The European Union (EC, 1995) emphasizes the social aspect of innovation, highlighting the creativity of society and its willingness to cooperate. According to Introna et al. (1999) no technological innovation can be created without the renewal of society. Innovation, according to the "extended" interpretation is a new or significantly improved product, procedure, marketing method or organizational method in business practice and organizations or in relations that encourage cooperation (EC, 2005). The definition primarily provides guidance for technical and economic innovations, however, the programme defining the research & development and innovation policy of the European Union (Horizon 2020) pays a special attention to the definition of social innovations. Hämäläinen and Heiskala (2007) identify social innovations as an answer given in response to rapid technological and economic changes. According to Tidd et al. (2005) the starting point for examining social innovation is the typology of technological innovations: product, process (procedure), positioning and paradigm. Murra et al (2010) studied novel social cooperations, and in their view, the new structures develop their novel social solutions in order to address social problems through technological development. Lundström and Zhou (2011) are of the opinion that economic and technological innovations are basically created in the course of company initiatives but these processes also have social implications. In spite of this, social innovations tend to be defined more at the level of (local) governments, non-profit organizations, foundations and individuals, thus their measurement structure also differs from the measurement methodology of technical innovations. Franz et al. (2012) explore technical and social innovations separately, and they stress how important the question is whether innovations producing new technological achievements are always desirable for society. In their view, the new is not necessarily a desired category, social innovation endeavours are in line with those practices that are widespread and widely accepted in society.

Since 2012 local initiatives and novel collaborations have become the focus of social innovation theories. Neumeier (2012) emphasizes the function of the various development programmes and other measures as catalysts in the catching up processes of lagging settlements. Moulaert et al. (2013) identify social initiatives as ones that lead to the renewal of social relations and government operation with their cooperative, participation-based solutions. Cajaiba-Santana (2014) attributes changes in attitude and behaviour to the social innovation endeavours, which facilitate the appearance of new institutions and structures. In his opinion social transformation produced as a result of social innovation also carries in itself the potential to solve the social problems. Bulut et al. (2013) highlight the significance of the individual level in social initiatives, and they consider the endeavours that are sustainable and respond to the individual's social development challenges as a new and genuine idea.

When investigating local initiatives, special attention should be paid to the cooperation between (local) government and the civil sphere and the business model based operation of such a cooperation

(Battilana-Casciaro, 2012, Grassl 2012, Unceta et al., 2016). According to Tardif-Harrison (2005) social innovation often starts as a local level process, during which the participants of the innovation process try to restructure their relationship system. Special emphasis has been put on bottom-up initiatives (Nemes-Varga, 2015, Kocziszky-Szendi, 2018, Veresné Somosi-Varga, 2018) because they act as key factors in the implementation of the social innovation endeavours of a given nation (Bulut et al., 2013).

Social innovations are inseparable companions of technical innovations, thus innovations can be interpreted as complementary processes (Drucker, 1985, Freeman, 1988, Bulut et al., 2013, Kocziszky et al., 2015, Varga, 2017). New innovative bases, such as the area of social innovations, help the implementation and effectiveness of technical innovations, and at the same time, by increasing each other's strength, they are able to react to the current challenges of society (Varga, 2017). The successful implementation of social innovation is relative to cultural acceptance, economic sustainability and technological applicability (Bulut et al., 2013). Social innovation and technical (economic) innovation are closely interrelated (Varga et al., 2020). Technical and social innovation together, complementing each other, are able to ensure the well-being of society.

Social challenges that require long-term solutions (e.g. unemployment, migration, disadvantaged areas) demand novel social cooperations. Social innovation is a necessary step to achieve development and enhance competitiveness, in which the role of innovators is significant. The innovators are members of the local community, or in a broader sense, of society, and being aware of their needs they meet the demands determined by social challenges with new or novel solutions. In the course of our investigations we pay special attention to the most disadvantaged areas and to the examination of their opportunities helping them to catch up. In the case of the lagging villages/towns of the district it is absolutely necessary to introduce novel cooperations, identify and accurately satisfy local needs, involve citizens in local decisions, and analyze the impact of social innovation endeavours on raising the living standards.

There is a correlation between the economic output and the innovation capability of a given area (Kocziszky-Veresné Somosi, 2016). Innovation (looking for new and novel solutions), however, should be interpreted in a broader sense than before. The European Union, in line with social changes, pays more attention to the correlations of social innovation than previously.

A change of paradigm is required. In addition to the technical and scientific R&D activities requiring increasingly high expenditure, there is a growing need for new and novel solutions suitable for managing the social and economic problems of small communities (settlement, region). Each type of innovation has a social implication, the different types of innovation are interrelated and they lead to the transformation of economic and social relations. Bulut et al. (2013) claim that social innovation exerts a direct influence on technical innovations because it is able to provoke a change in education, health care, employment, and social development in general. Accordingly, social innovation is a complement to and a trigger for technical innovation.

We started out from a statement in literature, according to which social innovation tries to meet the social needs that the market is not able to satisfy, thus it may as well be an alternative solution in the catching up of peripheries (Kocziszky et al. 2015, Szörényiné, 2015; Benedek et al. 2016, Kocziszky–Szendi, 2018). We assumed that in the case of peripheral areas catching up may be assisted by both generally used and special social innovation solutions. General social innovation solutions mean in this context, solutions used (also) somewhere else, operating efficiently as part of a complex program after the adaptation of the practice, while taking into account local needs and conditions. Contrary to that, special solutions are defined by the members of the relevant community as the result of innovative cooperations and structures that improve the social innovation capability of the relevant settlement as a single solution.

Known examples of special solutions, relating to the relevant local government:

1. Alsómocsolád: the enterprising village

Alsómocsolád is a settlement with a population of 376, situated in one of the multiply disadvantaged districts of Hungary, in the northern corner of the most southern county of Hungary. The local government considers the village a living organism, and it established wide-ranging partnership relations with the citizens of the local government, the civil society organisations, the employees of its institutions and business companies, the actors of economic life and the neighbouring local governments. Planning is always based on grassroots (bottom-up) initiatives. During work it combines "local knowledge" with the high-level professional knowledge of external experts (NFGM, 2010).

2. Hernádszentandrás: the self-sustaining village

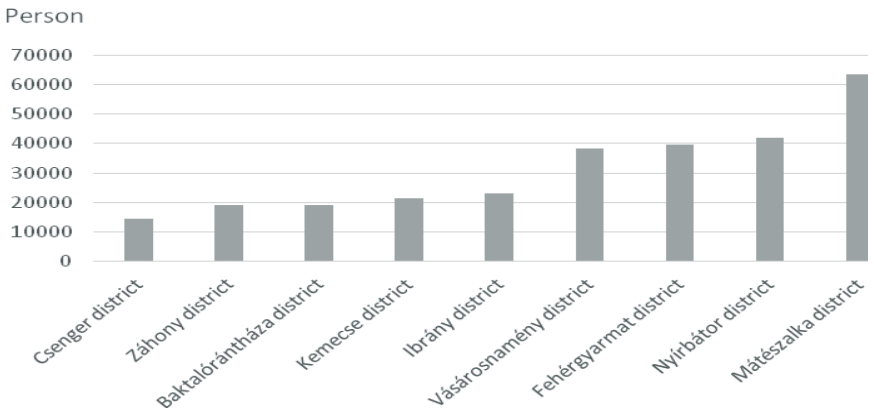
Hernádszentandrás, located in the Northern-Hungarian Region is a settlement with 425 inhabitants in one of the most disadvantaged districts. The mayor's high priority was the creation of workplaces in the village, as a result of which, currently vegetables are produced and sold under the brand name of BioSzentandrás, and people are engaged in organic farming, which increases the market value of the raw materials produced (Lipták-Horváth, 2018). At present, work opportunities are provided for 25-30 people.

3. Cégénydányád: Have a piglet! (for Hungarians it means "Good luck to you!")

Cégénydányád, with its 641 inhabitants, is situated in one of the most disadvantaged districts of the eastern part of Hungary. The program implemented with the support of the local government has offered pig-keeping possibilities for the program participants since 2015. With the program the local government responded to local needs (employment, development of tourism). The main aim of the initiative was to create workplaces. The local government cooperates with social enterprises, citizens and civil and economic organisations in a novel way.

STUDY: MATERIAL AND METHOD

The examined Nyírbátor District belongs to the least developed districts of Hungary. According to the complex development indicator designed to measure the development level of districts (KSH - Central Statistical Office), this district does not reach even 60% of the average number characteristic of Hungary. Government Decree No. 290/2014 (XI. 26.) and Government Decree No. 106/2015 (IV. 23.) amending it, separate the districts that are at the end of the development ranking list and have to be developed with a complex program and supported with a special system of instruments. The districts to be developed with the complex program are situated in the peripheral part of the country, and a significant number of them are border districts (23 districts). More than 60% of the population of the districts to be developed with the complex program live in Szabolcs-Szatmár-Bereg, Hajdú-Bihar and Borsod-Abaúj-Zemplén counties (KSH, 2016). Most of the districts to be developed are in Szabolcs-Szatmár-Bereg County located in the eastern part of Hungary, altogether 9 districts need catch up programs implemented based on comprehensive plans. Every other citizen of Szabolcs-Szatmár-Bereg County lives in a district that needs complex development. The population of the 13 districts of the county exceeds 552 000, of which altogether nearly 270 000 people live in the 9 districts to be developed with the complex program.



Source: authors' editing (based on KSH data)

1 1. Population of the districts in Szabolcs-Szatmár-Bereg County to be developed with the complex program (per person)

Nyírbátor District is situated in the northern-eastern part of Hungary, in the southern part of Szabolcs-Szatmár-Bereg County, which can be considered the periphery of Hungary. The examined Nyírbátor District has an area of 696 km^2, and it is composed of 20 settlements[i]. The population of the district is 42 998 (on 1 January 2019). In terms of population and number of settlements Nyírbátor District can be considered a medium-sized district among the districts of Szabolcs-Szatmár-Bereg County.

Nyírbátor District takes the 13th place in the ranking of districts to be developed with the complex program, and it includes three towns (Nyírbátor, Nyírlugos, Máriapócs) and 17 villages. Its complex indicator is 27.15, which does not reach even 60% of the 46.68 average.

The research on Nyírbátor District was conducted based on the analysis of available statistical data (TEIR, KSH) and interviews with experts. On the basis of the qualitative interviews made with the mayors and experts from the economic and civil sphere, it can be stated that the district includes disadvantaged settlements, which are confronted with significant challenges. Social innovation efforts play an outstanding role in the management of these challenges, and their successful implementation possibilities are examined by this study.

The research consists of two parts:

- statistical analysis,
- interviews with experts and analysis of the interviews.

By means of the interviews with experts (20 semi-structured interviews) we visited each administrative

area at least once in 2019, and basically we examined five groups of questions in Nyírbátor District according to the following topics:

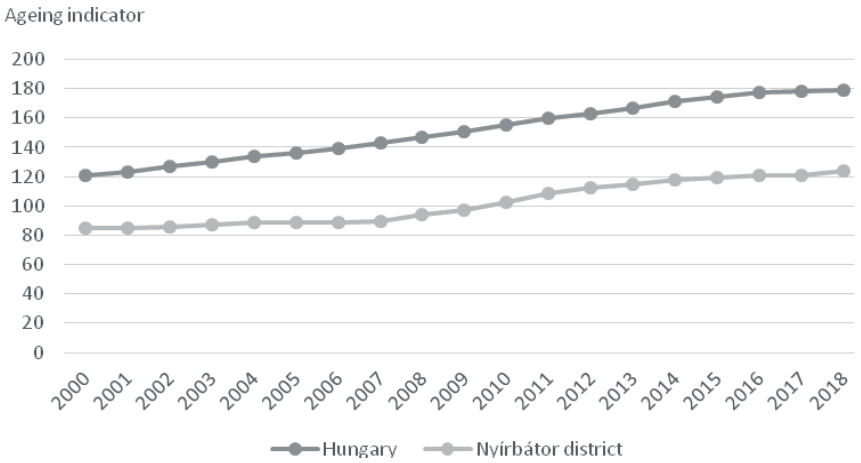
- general information on the settlement,
- implemented social innovations,
- planned social innovation efforts
- successes and obstacles,
- regional (area) cooperations (and their opportunities).

We made the 60-90-minute interviews with members and leaders of the groups who are experienced in community matters or have a determining opinion of them (mayor, notary, leaders of civil society organisations, church leader and heads of the enterprises operating at the village or town). We recorded the interviews by Dictaphone and took notes in a notebook. The research log contains nearly 30 hours of audio materials and 92 handwritten pages.

ECONOMIC AND SOCIAL CHARACTERISTICS OF NYÍRBÁTOR DISTRICT

The most disadvantaged districts are different from the other districts in terms of their demographic characteristics. In the districts to be developed with the complex program a higher ratio of children (0-14 years of age) and a lower ratio of the elderly (60-x years of age) tend to be typical, on the whole (KSH, 2016). In the case of districts to be developed with the complex program the ageing indicator (population aged 60-x years per 100 children aged 0-14 years) is significantly lower than the national average. An outstandingly high ratio of the children's age group is characteristic of the districts of Szabolcs-Szatmár-Bereg County. In these areas the ratio of the elderly is lower, and the districts have a young age structure. The ageing indicator of Nyírbátor District was 124 in 2018, which does not reach 70% of the national average (179).

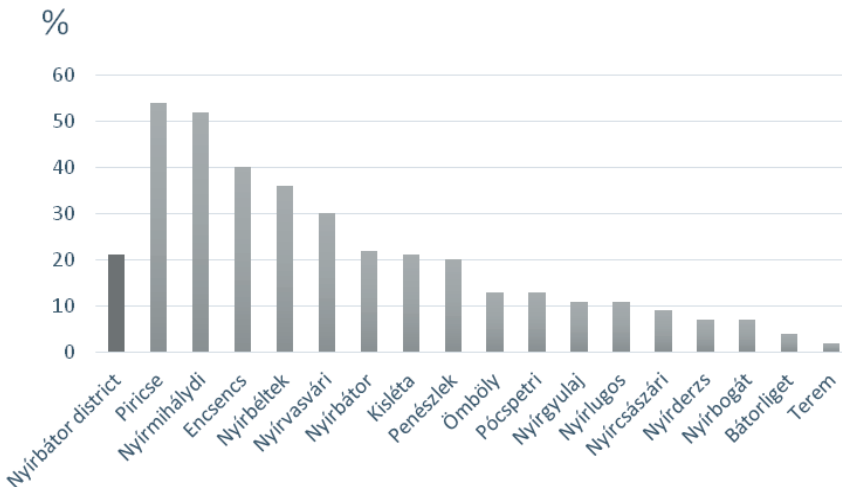
The demographic characteristics of young age-structured districts (such as Nyírbátor District) are influenced by ethnical features, i.e. the significant proportion of Roma nationals.



Source: authors' editing (based on KSH data)

2 2. Number of people aged 60-x years per 100 children aged 0-14 years from the permanent population

Significant factors relating to special ethnical features are unfavourable rate of deaths (low ratio of the elderly), high fertility rate, low level education and low rate of employment, which are also apparent in the case of Nyírbátor District. Regarding the number and ratio of the Roma population, it can be stated, based on the estimates of notaries, that one fifth of the inhabitants are of Roma origin at least in eight settlements of the district (Farkas, 2012).

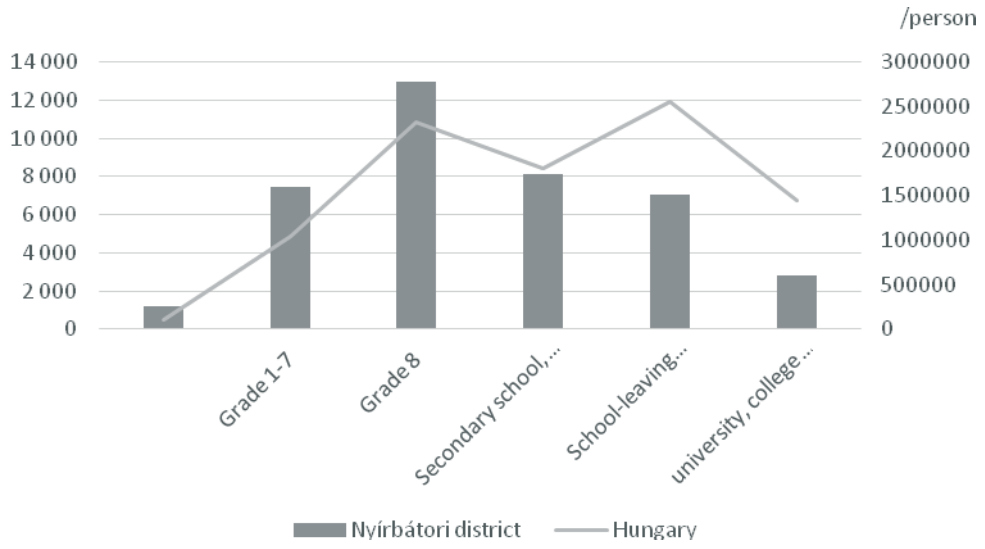


Note: There are no available data for Máriapócs, Nyírgelse and Nyírpilis
Source: authors' editing (based on Farkas, 2012)

3 3. Estimated proportion of the Roma population in the settlements (notary datasheets)

Apart from the significant proportion of the Roma population, a critical factor is the acceleration of the out-migration of the non-Roma population and the young skilled workforce (selective migration).

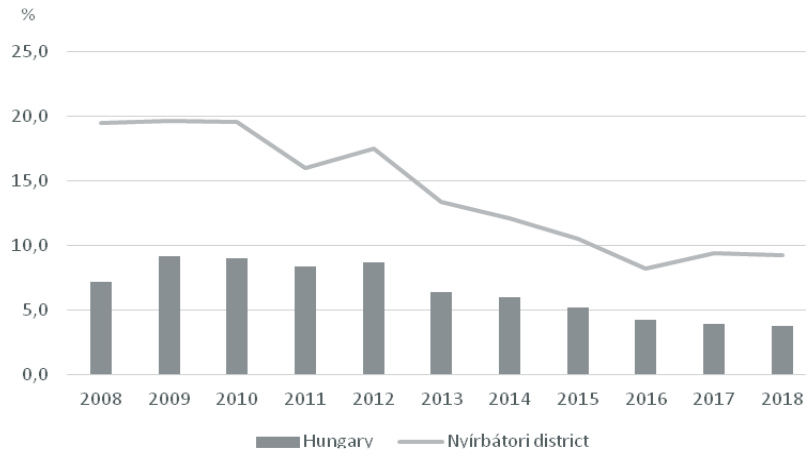
Based on the data of the census of 2011, 54% of the population aged 7 and older completed at most the 8th grade of the primary school in Nyírbátor District (national average: 37%). As opposed to that, the ratio of people with a higher educational degree is 7.1% in the district, which is lower than half of the national average (15.5%). The ratio of those with a secondary school-leaving exam certificate is also significantly lower in Nyírbátor District (17.7%) than the national average (27.5%).



Source: authors' editing (based on KSH data)

4 4. Population aged 7 and more by the highest completed education level

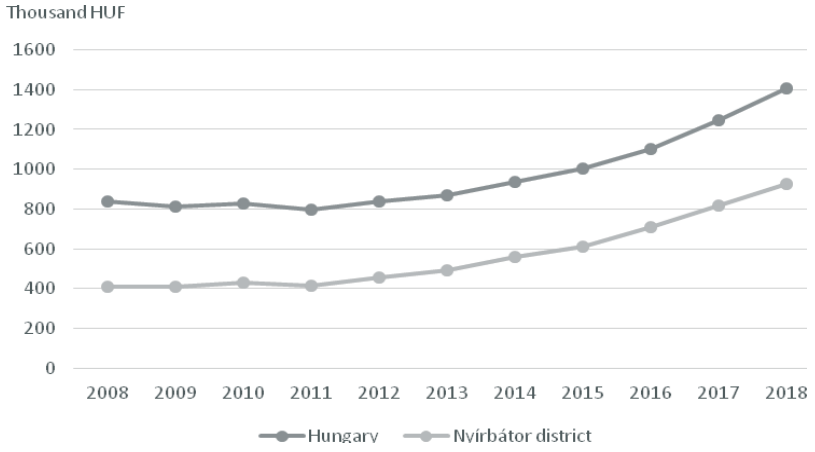
The rate of the unemployed was 3.7% nationally in 2018, whereas in Nyírbátor District it reached 9.3%. Between 2008 and 2016 the rate of unemployment decreased both at national level and in the district, but after 2016 the value started to rise again.



Source: Authors' editing (based on KSH data)

5 5. Rates of unemployment in Nyírbátor District

A comprehensive picture can be obtained about income discrepancies at district level based on the income constituting the personal income tax base (hereinafter earnings). In our investigation we analyzed the amount of earnings and their relation to the national average. In 2018 the average annual earnings per permanent inhabitant amounted to 926 thousand forints in Nyírbátor District, which did not even reach 2/3 of the national average.



Source: Authors' editing (based on KSH data)

6 6. Annual earnings per inhabitant (thousand HUF)

The significant lagging behind is due to the low ratio of the employed and the low level of incomes. In 2018 there were 509 tax-payers per one thousand inhabitants on the average, which is, in the case of Nyírbátor District, approximately 90% of the above value.

Nyírbátor District is also lagging in terms of its technical infrastructure. The distance of the capital city is rather considerable (255-350 km), which distance may mean even 5 hours travelling time by railway (typically with 1-3 transfers). On road it takes about 3 hours to cover this distance due to the closeness of the motorway, however, the number of car owners per one thousand people is lagging behind the national average by almost 20% (KSH).

The process of lagging has created a paradoxical situation in the area. On the one hand, there is strong social pressure placed on local inhabitants to involve them in social processes, and on the other hand, the area has scarce financial and human resources available.

The special characteristics of peripheral areas include ageing and migration. In addition to the problem of unemployment, these communities also lack financial resources, which makes it more difficult to involve the inhabitants in decisions. These unfavourable processes induce a double stigmatization process (Döringer, 2017):

- on the one hand, internal stigmatization from the inhabitants (e.g. leaving them out of public work or decision-making),
- on the other hand, external stigmatization from the inhabitants observing the area from outside (e.g. due to the negative news of the media).

POINTS OF FOCUS OF THE SOCIAL INNOVATION ENDEAVOURS SUPPORTING CATCHING UP

Based on the interviews with experts, it is found that in the case of the disadvantaged settlements of Nyírbátor District, social innovation appears in the form of a model and it determines the success of the catching up process in that form. The basic criterion of the social innovation process is that the endeavour should be a novel initiative. This does not necessarily mean a completely new solution, but a novel combination of schemes that had already worked well, which satisfy the existing social needs. Social innovation is not a linear but a spiral-shaped process with feedback loops. After the successful implementation of the endeavour, new needs will emerge that the socially innovative community is able to satisfy by following the process described above. Thus social innovation is a dynamic process resulting in social learning with the help of feedback loops and constant risk assessments (Varga, 2018).

The endeavours/efforts basically respond to local needs, they address the challenges impacting the inhabitants in the form of creative problem-solving and novel cooperation, and they bring about higher living standards and well-being.

Based on the above, the main points of focus of the current social innovation endeavours of the district are aligned with the critical areas identified during the investigation:

- education (providing high quality and tailored to needs),
- employment (labour market programs based on personal mentoring),
- health (improvement of the state of health and prevention),
- housing (improvement of housing conditions)

It is rather complex to identify the cause-and-effect relationships between the factors as their impacts exerted on each other and their sequence are not clear-cut, but it can be stated that if a disadvantaged citizen's housing conditions are inadequate, it can lead to health problems. Health problems can cause learning difficulties, which may lead to reduced productivity at work, which may result in the deterioration of housing conditions. The necessary steps are to improve housing conditions, encourage retail services to meet local needs, increase the proportion of community programs and spaces, and expand community and social services. In addition, the establishing of appropriate transport conditions should also be emphasized, but the improvement of physical infrastructure alone is not sufficient for increasing the social welfare of the inhabitants. Taking into account the disadvantaged situation of the district, it is indispensible to have social innovation endeavours to increase the living standards of society. Within the framework of social innovation, the local government has a prominent role. In cooperation with the enterprises and civil society organisations of the settlements, it helps the implementation of training and labour market programs, and facilitates accessibility to social services and public information through innovative initiatives and programs. We examined several innovative activities of the measures that are new in the life of the relevant settlement and are different from the traditional self-government model. The town management with its traditional local governance is slow and is lagging behind in comparison to the initiatives based on active participation, thus it is necessary to define a local government model. The new local government model is cooperative and consultative, involving the inhabitants of the settlement in decision making.

The study presents a case, already implemented and working successfully, in line with the above points of focus, which could be the main activating factors of the social innovation processes in the district. It can be stated that the individual points of focus are interrelated, and the initiatives created to address certain issues often tend to lead to further social innovation efforts.

In the centre of the district (Nyírbátor) a complex program was launched in 2015 to support disadvantaged groups and achieve catching up. The Nyírbátor program mainly supports the education and employment of Romas. The identification of short and long-term goals help the Romas to be integrated into work. The participants of the subprogram (local government, business sector representatives, civil society organisations) defined, as a first task, the long-term objectives, then the shorter-term activities that ensure achieving the objectives set.

In the case of disadvantaged inhabitants the area of education is a critical point, and in this respect the following target structure was defined:

1 1

Short-term and long-term objectives defined in the area of education in Nyírbátor

EDUCATION OBJECTIVES

SHORT-TERM OBJECTIVES	LONG-TERM OBJECTIVES
- improve communication - preserve Roma values and culture - involve parents in school programs - organise family visits and provision of help - mentoring (mentors of Roma origin) - organise programs helping to assume responsibility for themselves - set up a computer workshop - teach health education as a school subject - organise life coaching programs for parents	- provide training tailored to individuals' abilities - organise integrated education - motivate parents and children continuously and efficiently - reduce and stop dropping out of school - support cooperation between the institution and parents - eradicate prejudices

Source: authors' editing (based on Veresné Somosi-Varga, 2018)

Due to the innovative cooperation, the local government defined specific actions and tasks related to the activities for short and long term. The enterprises help the implementation process with various training programs, information, scholarship and mentoring programs, whereas the local government, apart from preparatory work and mentoring, supports catching up by employing mediators (mediators of Roma and non-Roma origin). The training of Roma mediators and their inclusion in the program makes it possible to improve relations between Roma parents and the kindergarten or school, between Roma parents and teachers, and between Roma and non-Roma parents. A sort of perspective-shaping takes place regarding the importance of learning and the increase of Roma children's chances for a successful life

When examining the objectives of education, the key objective can be identified as developing the inhabitants' skills, knowledge of information, and their awareness (The World Bank-EC, 2015). The efforts primarily focus on training, during which the disadvantaged inhabitants' cognitive and non-cognitive skills are improving. Life management programs strengthen motivation (self-evaluation, interpersonal relations) and develop social and job-seeking skills. These are complemented with the mentoring process, during which the mediators (basically of Roma origin) help the disadvantaged groups to get access to educational and labour market services by improving communication and managing conflicts through active participation. The initiatives are based on the inclusion of the Roma inhabitants by sharing kindergarten and school tasks. Parental support provided in pre-school and primary school years significantly influences the future opportunities of the child. The regular meetings between parents and the institution, provision of advice, parents' support groups and the shared activities also contribute to the development of the children's learning skills. The provision of advice and the information programs on healthy lifestyle and prevention and on how to avoid risky forms of behaviour increase the awareness of the disadvantaged groups.

Besides raising the level of education, and ensuring it, there is also emphasis placed on the implementation of labour market programs designed to encourage employment.

2 2

Short-term and long-term objectives defined in the area of employment in Nyírbátor

EMPLOYMENT OBJECTIVES

SHORT-TERM OBJECTIVES	LONG-TERM OBJECTIVES
- information on available training possibilities and occupations - present positive examples (with the involvement of Romas) - start vocational training according to the needs of employers - provide mentoring at the workplace - organise talent development - operate a scholarship system - keep continuous contact with the relevant people	- presence of Roma employees in all areas of the labour market - open-minded and welcoming employers - realize equal opportunities on the labour market - eliminate labour market discrimination - provide well-prepared, motivated, disciplined, purposefully trained workforce

Source: authors' editing (based on Veresné Somosi-Varga, 2018)

The objectives defined emphasize the creation of a comprehensive local employment program (The World Bank-EC, 2015). Provision of information and advice, mentoring and support are fundamentally important for the disadvantaged inhabitants not having appropriate information, network of contacts and job-seeking skills. As the Roma origin is often a disadvantage on the labour market it is necessary to have consultations and forums with the involvement of Romas and employers mediated by mediators. The various scholarship programs play a prominent role among the objectives. In addition to taking into account the disadvantaged position, the scholarship model built on performance evaluation supports the employment and dual training of students studying in secondary and higher education.

The novelty of the endeavours is that the elaboration of the programs was preceded by different professional forums, round-table discussions (businesses – local government – disadvantaged inhabitants), and open days. These are socially innovative solutions that are based on real social dialogue and partnership, and during which partnership goes beyond the usual forms and really active reflection, thinking together is produced. In this process cooperation among the village/town leader(s), the inhabitants, the enterprises and the civil society organisations have an outstanding role. During cooperation willingness and confidence are key issues (Vilmányi-Hetesi, 2017, Vilmányi, 2019). It is a condition for the implementation of social innovation if a given community is able to see the social phenomena in a novel way, transform their practices, and newly configure its relationship system.

In the case of the example in Nyírbátor it is worth pointing out specifically the innovator role of the town management, and primarily that of the mayor. The mayor, like Schumpeter's former "entrepreneur", takes part in the process of innovations as an innovator alongside a new cooperation and structures. In order to generate social innovation endeavours, it is also necessary, in the case of settlements, for the innovator(s) to have internal dedication and courage, take into account bottom-up initiatives, to use the cohesion force of the common past and traditions, to have expertise, to involve the stakeholders and follow good practices.

THE GOOD PRACTICE OF SOCIAL INNOVATION

The activities implemented as part of the complex program started in Nyírbátor in 2015 were closely interrelated, and their aim was to increase the level of education and employment. Focusing on the special ethnic features, the town's endeavour is to improve the quality of the relationship between Romas and non-Romas and to achieve a kind of perspective-shaping with the help of the program. Putting the town on a long-term growth path clearly depends on the comprehensive management of the problems of disadvantaged inhabitants and their social integration. For this purpose, when the town involves its inhabitants, it primarily uses the methods of community planning, forums for consultations and workshops. During the program it can be observed that the challenges of critical areas (education, employment, housing, health) are addressed in a complex way. One of the exemplary practices of the initiatives realized in the district seat of Nyírbátor District is the Good Start Program launched in 2015. The introduction of the program was preceded by and is continuously supported by the cooperation of local specialists, the exchange of experiences and knowledge expansion of the experts keeping contact with the children and their families. In the course of the implementation of the program working groups were set up, which provide the common platform needed for the dialogue. The workshops offer a scene where the viewpoints of the specialist areas involved can appear, conflicting opinions can be discussed, their knowledge can be presented, common lessons can be drawn, which helps individual and joint work in the interest of improving the situation of the children and their families. The aim is to pass on the good practices to each other, mutually learn from each other and transfer experiences. The leaders of specialist workshops draw up a schedule of topics based on the proposals of the members and they meet half-yearly. On such occasions, the workshops held at alternating venues provide a good opportunity for discussing unique, special problems, give professional assistance to each other and feel more relaxed about asking for help or information from each other.

Main elements of the program:

- improve access to quality education services and early childhood care service,
- notify and inform Roma parents about the significance of early childhood services and kindergarten education,
- 'Fairy Tale World' Program to improve Roma mothers' reading, writing and communication skills,
- facilitate Roma children's enrolment to the kindergarten with the help of Roma mentors,
- support adaptation to kindergarten with the help of kindergarten teachers and health visitors,
- facilitate transition between educational levels, further training organised by the college through lectures for college students and kindergarten teachers (conflict management, communication, keeping contact with parents).

3 3
Good Start Program in Nyírbátor

General Information	Name/Address	Good Start
	Contact person	Nyírbátor, local government
	Aim	To implement scientific evidence-based, result-oriented early childhood interventions in a disadvantaged community, mainly of Roma origin.
	Target group	Disadvantaged inhabitants of Nyírbátor (with special regard to inhabitants of Roma origin)
	Target region	Nyírbátor
	Required human resources	150 people (families, college students being trained to be health visitors)
	Financing	project competition sources, local government support
	Required infrastructure	real estates, internet, training sessions of conflict management and communication
Description of the practice	Brief presentation / needs identification	Improving the access to quality education services and early childhood care services for disadvantaged Roma children (age group of 0-6 years). Notifying and informing Roma parents within the framework of the program about the significance of early childhood services and kindergarten education by employing a mentor receiving dedicated training specifically for this purpose. In line with that, the final aim of the project is to lay down the foundation for success at school.
	Presentation of implementation	- Dissemination of the 'Fairy Tale' Program (age group of 0-9 years, appr. 105 mothers): Improving Roma mothers' reading, writing and communication skills through fairy tale telling, which the mother will be able to pass on to her children. The program prepares mothers for tasks related to kindergarten, for taking 3-year-old children to kindergarten, for teaching their children how to follow a healthy lifestyle. - Facilitate Roma children's enrolment to the kindergarten: supporting the enrolment of children aged between 3 and 6 to the kindergarten with the help of Roma mentors. The mentors' tasks will include conducting Roma community awareness-increasing campaigns, providing special family-support services (e.g.: individually tailored social mentoring), regular family visits in order to encourage children taking part in the program to go to kindergarten and to monitor the tasks of enrolling into the kindergarten. College students, in close cooperation with Roma advisors, will also participate in this activity. - Facilitating transition between educational levels, further training organised by the college through lectures for college students and kindergarten teachers (conflict management, communication, keeping contact with parents).
	Results, outputs, future ideas	involvement of a total of appr. 50 families, 33 events and lectures
	Identified problems and lessons	resistance, challenges of attitude shaping
Why can it be a good practice?	Area-based approach	In the case of the disadvantaged children of Nyírbátor, neither the family nor the school can create appropriate conditions for adaptation at the kindergarten.
	Bottom-up approach	The practice clearly focuses on local social challenges, involving local inhabitants into the implementation.
	Partnership approach	Cooperation of local government, civil society organisations and local inhabitants
	Innovation	Partnership steps out of usual forms and really active reflection, thinking together is produced.
	Integrated approach	The practice manages the social challenges of the settlement in a complex way (it also impacts employment, not only education)
	Publication / networking	appearance in electronic media, project presentation
	Sustainability	The project responds to real challenges, it reached a total of appr. 100 families.
	Adaptability	Local special features and priorities can be identified as emphatic factors. The framework conditions designed to improve local living conditions jointly result in catching up. Identification of the stakeholders of the process, the role of communication (information), the planning of financial resources, the attempts at changing attitudes, and the institutional background are of key importance.

Source: Authors' editing (based on Szabó-Nagy, 2014)

The use of the documentation principles, defined on the basis of the groups of criteria, supports the process of adaptation, which is critical in the successful implementation of social innovation endeavours.
After studying the accomplished endeavour in Nyírbátor District, it can be found that in addition to external help (project competition sources, professional advice) it is necessary to mobilise local inhabitants, set up a novel cooperation and think together in new structures. Basic requirements are creative problem solving, innovative management of challenges, exact mapping of community needs and reaction to these. The break-out points should be defined in the case of the individual settlements, also taking into account the set of conditions of the given settlement. By involving the local community as partners and emphasizing the innovator role of local management, social innovation good practices can be supported and implemented with success.

CONCLUSION

When examining social innovation initiatives, the social benefit realized in the innovation ideas that can be interpreted at local, community level and the role of the community's active participation to increase the living standards should also be stressed. The new social practices are aimed at a social change based on activities that encompass solutions, are pre-planned and target-oriented (Cajaiba-Santana, 2014).

Nyírbátor District is a peripheral area where out-migration, ageing and the decrease in the opportunities for entering the primary labour market are coupled with the lack of financial resources. The technical and economic innovations and the initiatives controlled from the top, so characteristic of more developed areas, can hardly be found here or are completely missing in the peripheral, disadvantaged areas.

In the case of disadvantaged, lagging settlements, the active participation in decision making and the mobilisation of civil society are key issues, one tool of which is to help social innovation endeavours/efforts. The success of social innovation initiatives significantly depends on regional or local collaborations, networks, the support of which is a basic task for the local governments of the relevant area. Decision-making based on the involvement of local inhabitants is a change of paradigm in the operation of local governments, which qualifies as social innovation in itself.

Within the framework of the research, we mainly examined the realization of micro-level social innovation processes. A limitation of the research in terms of generalization is that we conducted our research in the Nyírbátor district to be developed with the complex program, starting from the assumption that in the case of multiple disadvantaged areas, social innovation as a new tool and model offers solutions to social challenges and problems.

Based on the research, it can be stated that the commonly used social innovation solutions are suitable for developing the innovation capacity of the Nyírbátor district. There is no single good solution, any of the examined practices can be adapted to other settlements. All these findings predict that a so-called library of good practices can provide practical advice to decision-makers, participants in the social innovation process.

Further research is needed to support the generation of social innovation endeavours. In our previous research (Veresné et al., 2019) we came to the conclusion that due to the huge amount of data in the database supporting the generation of social innovation, it is expedient to use an IT solution, ie. it is necessary to introduce a support system. As a result of our methodological study, we support the application of fuzzy logic. The fuzzy system can handle multiple data types simultaneously and can be perfectly combined with decision trees. The database needs to be constantly updated with new good practices and statistics and can be documented along a defined set of criteria.

Our further research task is to define a value-driven training model that supports the generation and realization of social innovation, and to build a network of consultants.

Further investigation of the above research directions may result in the exploration of important connections, which may complement the investigations carried out in the framework of the present study.

Acknowledgement

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[i] Settlements of the district: Bátorliget (740 people, 33 km^2), Encsencs (1921 people, 32 km^2), Kisléta (1877 people, 22 km^2), Máriapócs (2130 people, 22 km^2), Nyírbátor (11 891 people, 67 km^2), Nyírbéltek (2910 people, 62 km^2), Nyírbogát (3037 people, 55 km^2), Nyírcsászári (1192 people, 13 km^2), Nyírderzs (656 people, 17 km^2), Nyírgelse (1092 people, 28 km^2), Nyírgyulaj (2074 people, 36 km^2), Nyírlugos (2633 people, 58 km^2), Nyírmihálydi (2279 people, 25 km^2), Nyírpilis (891 people, 16 km^2), Nyírvasvári (1969 people, 28 km^2), Ömböly (451 people, 30 km^2), Penészlek (1032 people, 37 km^2), Piricse (1870 people, 37 km^2), Pócspetri (1682 people, 26 km^2), Terem (671 people, 49 km^2).

Student perception and the efficacy of universities in shaping the entrepreneurial mindset

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SUMMARY

Modern universities may play a significant role in entrepreneurial ecosystems by boosting the entrepreneurial activity of the region. One way to achieve this is through entrepreneurship education. In this study we suggest that one reason why entrepreneurship education has a weak impact on entrepreneurial activity is that the effect of courses and extracurricular programmes depends on how students perceive the entrepreneurial activity. We use the 2018 GUESSS database, which includes 9,667 answers for Hungary, to develop a general linear model. The model suggests that students' entrepreneurial intentions, attitudes toward entrepreneurship, self-efficacy, social norms, as well as the university, and the field of study all have a small but statistically significant impact on how students perceive the entrepreneurial ecosystem within the university. Our conclusion is that more emphasis on shaping attitudes and arousing student interest can increase the efficiency of entrepreneurship education.
Keywords: entrepreneurship training, entrepreneurial ecosystem, entrepreneurial motivation, higher education
Journal of Economic Literature (JEL) codes: L26, I23
DOI: http://doi.org/10.18096/TMP.2021.01.07

INTRODUCTION

Although entrepreneurs have attracted considerable research interest for at least half a century, entrepreneurship moved into the core of business research in the 21st century. Koppl et al. (2015), when attempt to create a framework for a non-stable and non-causal economic system, coin the notion of entrepreneurial economics. In their approach "entrepreneurs solve the frame problem of social systems", where the frame problem can be defined as "the problem of modifying the system's implicit frame of analysis to adapt successfully to non-algorithmic change" (p. 22). In other words, entrepreneurs are the ones who make it possible for the economic system to adapt to unforeseeable changes, and so they have a fundamental impact on its performance and its ability to create and provide wealth to the members of the community.

Baumol et al. (2007) suggest that developing entrepreneurial skills is increasingly important for growth and prosperity; one of the current arguments is that the main reason for this lies in machine learning and the rise of artificial intelligence (Brynjolfsson & McAfee 2014; Acemoglu & Restrepo 2018). The rise in the demand for entrepreneurial skills is supported by empirical evidence as well (e.g. Prüfer & Prüfer 2020). One of the key takeaways of the empirical studies is that entrepreneurial skills are not only vital for classical entrepreneurs; they represent a meta-capability that is also required in large organisations (intrapreneurship), or in areas where social change should be promoted (social entrepreneurship) (Obschonka et al. 2017).

Entrepreneurial thinking and entrepreneurial skills are thus seen as 21st century skills. Another line of literature focused on entrepreneurial ecosystems (Moore 1993; Zacharakis et al. 2003, Mason & Brown 2013) suggests that universities have a role in training entrepreneurial skills. The research problem addressed in this paper is related to this: we examine how effective universities can be at training students with little interest in entrepreneurship, and entrepreneurial skills.

We use the 2018 GUESSS (Global University Entrepreneurial Spirit Students' Survey) database to test our research question. The novelty of our discussion lies in the incorporation of student perception in our analysis: we may get a more accurate picture on the effectiveness of university projects aimed at training entrepreneurial skills, when the attitude of students towards entrepreneurship is also considered.

LITERATURE REVIEW

We need to review three areas in order to formulate a testable hypothesis on entrepreneurship education: the literature of entrepreneurial ecosystems that connect universities with entrepreneurship; theories and empirical tests on what impact universities have on ecosystems; and finally, the literature of perception as an influence in training performance.

In his 1993 article Moore suggested that "a company be viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries" (Moore 1993, p. 76). When new innovations are born, companies not only compete, they also work cooperatively, and the business ecosystem is the framework through which this coevolution takes place. Business ecosystems are typically defined as a set of large number of hubs (entrepreneurial actors, organisations and processes, and different institutions) that are loosely interconnected in a complex way (Mason & Brown 2013; Ma 2019). Over the past decade (2012 is the first year when the number of academic papers related to the topic exceeds 10 in the Scopus database; see Figure 1 in Cavallo et al. 2019, p. 1293) a number of sophisticated business (or 'entrepreneurial', as they are more commonly called nowadays) ecosystem models have been developed, and universities typically are included in them. Isenberg (2011) created a complex model where six major domains interact; universities are part of it through the Human Capital domain. A later model published by the World Economic Forum (WEF 2014), created by a team that included Isenberg, Foster, and Shimizu, listed eight pillars of an entrepreneurial ecosystem; one of these pillars is formed by major universities as catalysts of the entrepreneurial process. The 6+6 model suggested by Koltai & Muspratt (2016) has six pillars and six key actors, that contribute to the development and training of entrepreneurial skills, one of which is academia.

Even though universities are considered natural actors in entrepreneurial ecosystems, their exact role and impact on the system is disputed. One obvious role is to provide talent for the entrepreneurial process (e.g. Isenberg 2011; Feld 2012). The World Economic Forum (2014) suggests that universities have an even deeper role in promoting the entrepreneurial culture within the ecosystem, and they also play a key role in idea-formation. This latter is questioned by Feld (2012) when criticising the intellectual property rights regulations that universities impose on their spin-off firms. Åsterbro & Bazzazian (2011) add that the number of spin-offs created by the median university among top US universities is quite low (less than two per year).

Koltai & Muspratt (2016) believe that universities play a key role in promoting entrepreneurial skills. Isenberg (2014), on the other hand, claims that entrepreneurship education might be helpful, but it is not critical for the success of the entrepreneurial ecosystem (arguing that the first master course in technological entrepreneurship in Israel started in 1987, 15 years after the first Israeli initial public offering at NASDAQ). Rice et al. (2014) provide very detailed case studies on six successful university-based entrepreneurial ecosystems. They find that strong faculty leadership and constant curriculum development are both key success factors.

Given the critical role of universities in (at least some) entrepreneurial ecosystems, a new line of studies have emerged related to the so-called entrepreneurial universities (Guerrero et al., 2006, 2015; Sánchez-Barrioluengo et al., 2019). Entrepreneurial universities contribute to social and economic development not only through their traditional teaching and research activities, but through a third pillar as well, connected to the boosting of entrepreneurial activities. In this paper we focus on one element of this entrepreneurial pillar: the promotion of entrepreneurial skills and values. This may be achieved through curriculum development and through other activities that influence student perceptions on entrepreneurship.

Entrepreneurship education is a very fast-growing field within the higher education domain. In 1985 around 250 courses focused on entrepreneurship at colleges in the USA; by 2008 this number had grown to over 5,000 (Hayes et al., 2020). The impact of such courses is disputed. Isenberg (2014) does not see these courses as critical. Studies tend to confirm that university graduates have a higher intention of becoming entrepreneurs (e.g. İlhan Ertuna & Gurel 2011). Entrepreneurship education may enhance entrepreneurial intentions (Block et al. 2013; Barba-Sánchez & Atienza-Sahuquillo 2018), but it was also found that after completing an entrepreneurship course the entrepreneurial intention declines (von Graevenitz et al. 2010). The impact may be dependent on the content of the course (Bădulescu et al., 2020). In addition to the content, it is also important to pay attention to what methods and learning forms come to the fore: traditional frontal solutions that can be used in case of large numbers of students, or teaching taking place in small groups using interaction, cooperative techniques, simulation or case studies. Numerous studies argue for the effectiveness of the latter and emphasise that there is a need to move toward more unconventional, experienced-based teaching, and evaluation methods (Solomon et al. 1994; Kickul & Fayolle 2007; Harms, 2015; Costin et al. 2018). They complement and reinforce prior classroom learning through application, facilitate learning about the real world of the entrepreneur, and have a positive impact on entrepreneurial intentions (Mason & Arshed 2013) and on self-efficacy.

The efforts of universities are just one side of the coin. As the interpretation of the environment is based on prior knowledge about it, which consists partly of the individual's personal experience and partly of experience and knowledge taken from others (Farkas 2010), given the availability of the same conditions and information, there are significant differences in the perception of the usefulness of a program and in general there are differences in the recognition of opportunities

among students. From the point of view of entrepreneurship, the role of an entrepreneurial family background seems to be important; according to the literature, this has an incentive effect on entrepreneurial intention (Gubik & Farkas 2019), as well as perceived social norms, which mediate possible roles and values. A supportive environment increases the entrepreneurial intention (Liñán & Chen 2009, Autio & Wennberg 2010). In a study of German university students, Bergmann et al. (2018) found that the students' perception of the entrepreneurial climate around the university is shared among students, and so they suggest that the entrepreneurial climate perceptions differ between students with and without an affinity for entrepreneurship.

All these factors (knowledge, experience, values) largely determine how students relate to entrepreneurship and how they evaluate their own role and skills. This affects not only how motivated they are to participate and how well they perform, but also how much they perceive the availability of opportunities. Perception is the result of a brain process based on the sensation of current events, which also uses our knowledge and previous experiences (Csépe 2017). We are only able to perceive a fraction of the continuous stimuli we experience (this selection process is attention) (Juhász & Takács 2007). Attention only processes those moments that are important for current behaviour (Schutz 1962; Csépe 2017) and is influenced by internal factors such as attitudes, expectations, values and beliefs. The consequence of this is relevant to this article: the supply side (i.e., the provision of services by the university) is not sufficient to achieve the objectives set. Gubik (2013) states that the task is not merely to increase the number of courses or to increase the provision and availability of other services and resources, but to get students to recognise their potential.

In the following, we examine whether there are differences in student assessment of the entrepreneurial ecosystem among universities and what factors cause the differences in evaluation within the same university. The former is attributed to the different university efforts and the different characteristics of the universities, while the latter is attributed to the different attitudes and interests of the students.

DATA AND METHODS

GUESSS (Global University Entrepreneurial Spirit Students' Survey) investigates entrepreneurial intentions and activities of university students. The survey explores the students' career intentions, the families' and students' own businesses, and investigates their motivations and goals and their orientation and behaviour in their business activity. It also analyses the role of higher education and culture in the decision.

The first survey was conducted in 2003 with the participation of two countries. By 2018 55 countries had joined the project and 208,636 students sent their responses to the questionnaire. In the framework of this paper we investigate the sample of Hungary, where the 2018 database contains 9667 answers. Table 1 shows the distribution of the sample according to the main descriptive statistics of the respondents.

Table 1
Distribution of GUESSS 2018 Survey Participants, Hungary

Study level	%	Gender	%	Area of studies	%
Bachelor	69.6	Female	58.3	Arts/Humanities (e.g., cultural studies, history, linguistics, philosophy, religion)	8.4
Master	16.3	Male	41.7	Business/Management	10.6
PhD	2.4			Computer sciences/IT	9.3
Other (e.g., MBA)	11.7			Economics	11.7
				Engineering (incl. architecture)	22.3
				Human medicine/health sciences	8.3
				Law	6.2
				Mathematics	0.7
				Natural sciences	6.5
				Science of art (e.g., art, design, dramatics, music)	0.7
				Social sciences (e.g., psychology, politics, education)	8.3
				Other	7.1

Source: own elaboration, N=9667

About 22.3% of respondents studied engineering, 22.2% of students studied business and management and economics. Computer sciences/IT students represented 9.3% and Arts/Humanities students accounted for 8.4%. The sample of students in medicine, health sciences and social sciences amounted to 8.3%. The vast majority of respondents (70%) attended bachelor-level studies. The proportion of master-level students in the sample was much lower (16%). Regarding the respondents' gender, the sample contained a larger ratio of females (58.2%). As for age, 85.2% of respondents were born after 1990, that is, they were younger than 28 at the time of completing the questionnaire.

Variables

On the basis of the survey of 2018, the entrepreneurial ecosystem and its influencing factors were analysed. We used the following variables:

Entrepreneurial ecosystem (ECO)

-Please indicate the extent to which you agree with the following statements about the university environment: The atmosphere at my university inspires me to develop ideas for new businesses; There is a favourable climate for becoming an entrepreneur at my university; At my university, students are encouraged to engage in entrepreneurial activities. (1-7 Likert scale)

Entrepreneurial intention (INT)

-Please indicate your level of agreement with the following statements: I am ready to do anything to be an entrepreneur! My professional goal is to become an entrepreneur; I will make every effort to start and run my own business; I am determined to create a business in the future; I have a very seriously thought of starting a business; I have a strong intention to start a business someday. (1-7 Likert scale)

Attitudes (ATT)

-Please indicate your level of agreement with the following statements: Being an entrepreneur implies more advantages than disadvantages to me; A career as entrepreneur is attractive for me; If I had the opportunity and resources, I would become an entrepreneur; Being an entrepreneur would be very satisfying for me; Among various options, I would rather become an entrepreneur. (1-7 Likert scale)

Subjective norms (SUB)

-If you were to pursue a career as an entrepreneur, how would people in your environment react? Your close family/your friends/your fellow students. (1-7 Likert scale)

Self-efficacy (SEF)

-Please indicate your level of competence in performing the following tasks: Identifying new business opportunities; Creating new products and services; Managing innovation within a business; Being a leader and a communicator; Building up a professional network; Commercialising a new idea or development; Successfully managing a business. (1-7 Likert scale)

Education - University (UNI), Field of study (STU)

-Please select your university/university of applied science. What is your main field of study?

Family business background (FAM)

-Are your parents self-employed or majority owners of a business? No/Yes

Hypotheses

In our article, we treat the terms ‘university entrepreneurial ecosystem’ and ‘university entrepreneurial environment’ as synonymous concepts. In the course of the work, we focus on the perception of students. This means that not the real activity of the universities but rather their perception by the students and their main shaping factors are the focuses of the research. During operationalisation, the concept was understood as the students' perception of a university atmosphere that encourages and supports developing business ideas, starting businesses and engaging in entrepreneurial activities.

There may be several reasons why the entrepreneurial ecosystem of each university differs. Although the curriculum is largely standard in Hungarian universities by field, the exact content of the subjects and the efforts beyond the curriculum (competitions, workshops, business clubs and others) can vary greatly. There is also likely to be a difference in how much money each university spends on such tasks, but Bergman et al. (2018) found no correlation between the amounts spent on entrepreneurial activity and student perceptions of the entrepreneurial climate. At the same time, they found that the size of universities has a negative impact, while its reputation has a positive impact on the entrepreneurial climate. The latter may also be related to the geographical location and the characteristics of the students admitted (admission scores, interest).

The choice of the field of study on the one hand expresses the student's interest, and on the other hand determines the student’s curriculum. We know that formal training is a significant explanation for the development of entrepreneurial intentions (Gubik 2013; Szerb & Lukovszki 2013) but it is also decisive in how much and what kind of information reaches students. Participants in entrepreneurship programs are more likely to start their own business (Kolvereid & Moen 1997). The knowledge, experience and confidence – conveyed partly by education and partly by the narrower and wider environment of students – also influence how they perceive their own knowledge and how they see their role in shaping their own future. This, in turn, affects the recognition of opportunities and the efforts made to exploit them. To express this, we use the self-efficacy concept of Bandura (1982), which is defined as people's sense of personal efficacy to produce and to regulate events in their lives. Self-efficacy judgments, whether accurate or faulty, influence peoples’ choices and also determine how much effort people will expend and how long they will persist in the face of obstacles or adverse experiences (Bandura 1982). From the viewpoint of this paper entrepreneurial self-efficacy is relevant, which is the “strength of a person’s belief that he or she is capable of successfully performing the various roles and tasks of entrepreneurship” (Chen et al. 1998, p. 295).

Our hypotheses are:

H1a: Student perception of the university's entrepreneurial environment varies from university to university.

H1b: The field of study of the students influences the perception of the entrepreneurial environment of the university.

H1c: Self-efficacy influences the perception of the entrepreneurial environment of the university.

In general, research deals with the impact of education on entrepreneurship (Kolvereid & Moen 1997; Chen et al. 1998; Gubik 2013; Szerb & Lukovszki 2013). However, this relationship cannot be construed as a one-way relationship. After all, motivation also strongly influences how much we notice and value the activities that target us. Even in the case of compulsory programs (such as a compulsory university course), we may experience large differences in student performance and activity according to how motivated they are to enter the program. Students who have a positive attitude towards starting a business and who have a high intention to do business are more attentive to the opportunities offered by universities. Thus, they are likely to have a better perception of the entrepreneurial climate and also appreciate the efforts of the university.

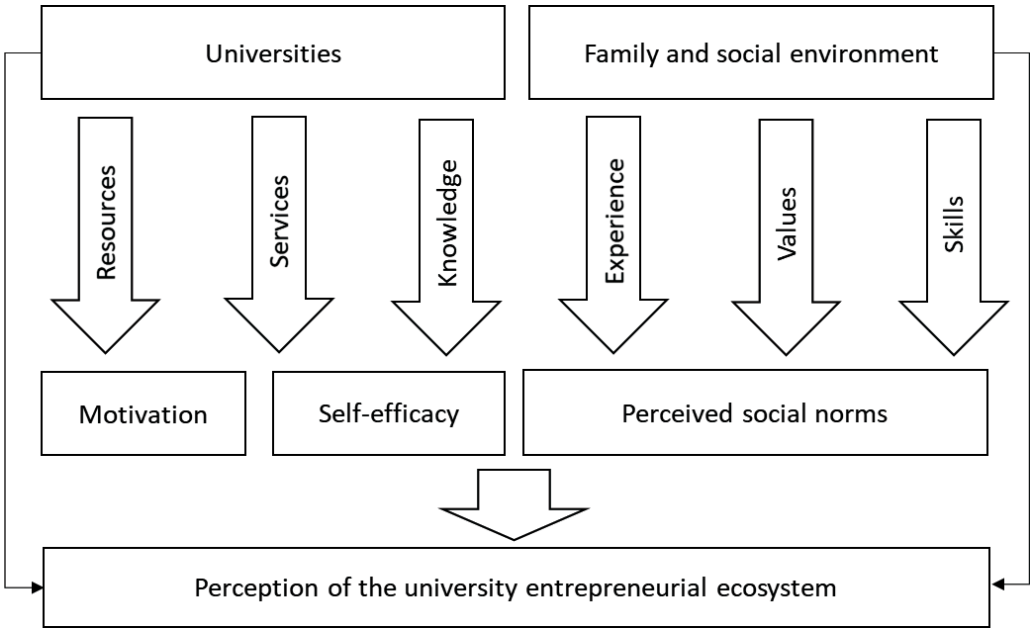
H2: The entrepreneurial motivations of the students positively influence the perception of the entrepreneurial environment of the university.

Numerous studies confirm the positive impact of entrepreneurial family background on entrepreneurial intention. Laspita and his colleagues (Laspita et al. 2012) also highlighted that the strength of the effect varies across cultures. Autio and Wennberg (2010) suggest that individuals' community norms and attitudes can have more influence on young people's entrepreneurial behaviour than their own personal attitudes and perceived self-efficacy. Role models emerge as influential factors in individual decision making (Bosma et al. 2012), and thus family entrepreneurial patterns may be dominant in future career plans of students.

H3a: The entrepreneurial family background of students positively influences student perceptions of the university entrepreneurial environment.

H3b: The supportive social background of students positively influences student perceptions of the university entrepreneurial environment.

These factors are closely related, but exploring the relationships between them is not the purpose of this article.



Source: own elaboration

Figure 1. Perception model of the higher education entrepreneurial ecosystem

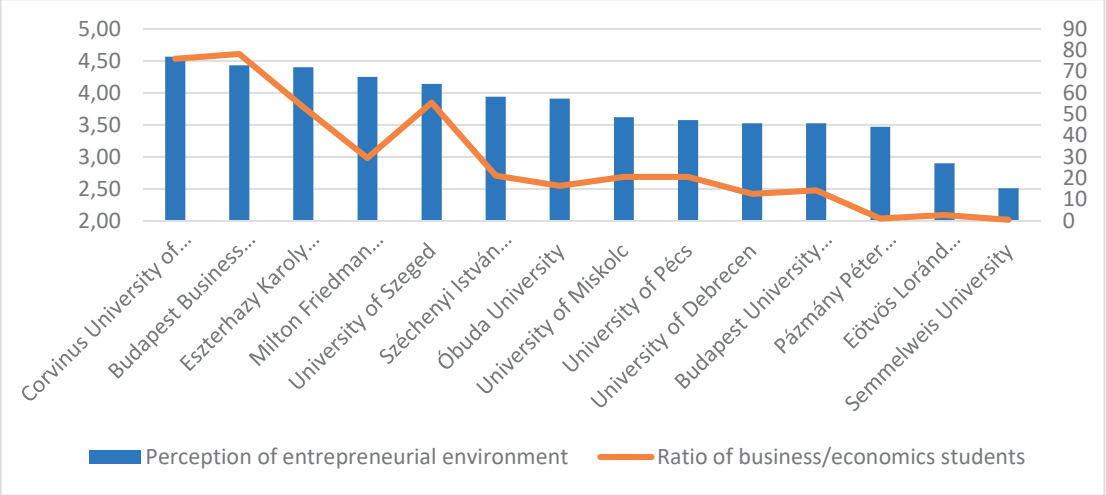
RESULTS AND DISCUSSION

In the first step, we examined how studies (university, field of study) influence the perception of the university entrepreneurial ecosystem in Hungarian universities. For this, we calculated the average of the responses obtained during the evaluation of the university entrepreneurial environment. This average represents student opinions. First we analysed the differences by university. Only universities with at least 100 respondents (a total of 14 universities) were included in the analysis. We found that there is a weak but significant difference in the perception of the entrepreneurial environment among the students according to the university they attend (Eta Squared = 0.098, p = 0.000).

Based on the assumption that interest is dominant in perception, we assumed that for students in economics/business areas in general value the entrepreneurial environment of universities is higher. The choice of a given profession itself already expresses the interest of the students (and/or the family). It also seems an important argument that economic/business

curricula contain a lot of knowledge related to business or entrepreneurial activities. We took this into account when evaluating the ranking per university, by calculating and illustrating the ratio of economics/business students.

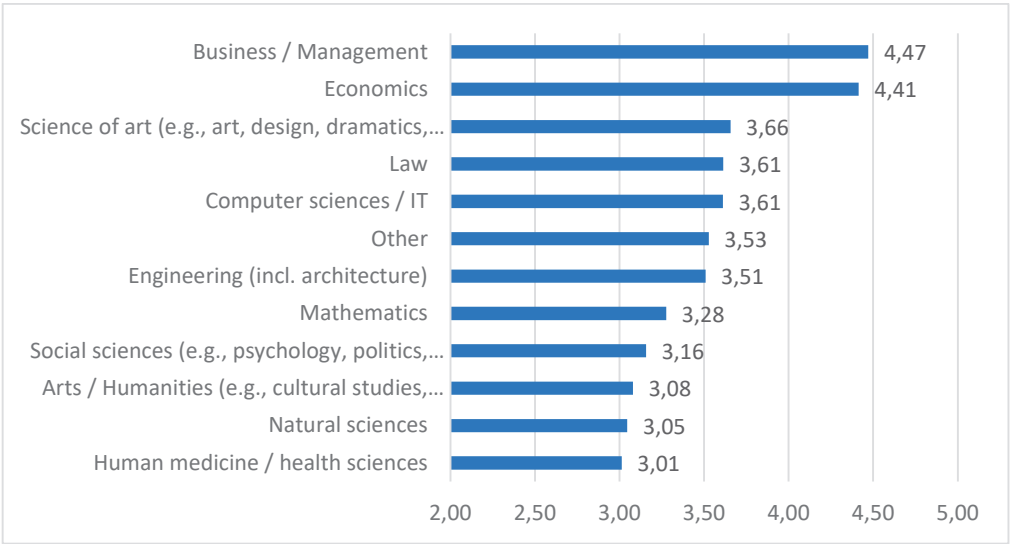
Figure 2 shows the university ranking with the differences in the training focus. The left-hand axis shows the perception of the university's entrepreneurial environment (bar chart) and the right-hand axis (line chart) shows the percentage of students in economics/business education among the respondents of the given university. It is clear from the figure that a higher economic/business student ratio is associated with a higher assessment of the environment.



Source: own elaboration, only institutions with above 100 responses. N=9265

Figure 2. Perception of entrepreneurial ecosystem according to institution

In the following, we examined the extent to which the field of study affects perception. Figure 3 shows that students in economics/business rate their entrepreneurial environment the highest, followed by social sciences and natural science. The correlation is significant (Eta Squared = 0.102, p = 0.000).



Source: own elaboration, N=9575

Figure 3. Perception of entrepreneurial ecosystem according to field of study

After analysing the impact of the field of study on the assessment of the entrepreneurial environment, we repeated the analysis by universities as well. We found that, even when examined on a university-by-university basis, the differences in the assessment of the entrepreneurial environment by field of study remain, but the strength of the relationship lags behind that of the combined calculation.

Another important reason for the differences in the assessment of the university entrepreneurial environment is the entrepreneurial intention of students. Our starting point was that those students with

entrepreneurial ideas will pay more attention to the efforts that universities make, such as various programmes, courses or trainings, so they will give a higher value to the entrepreneurial ecosystem.

Table 2 shows that there is a positive and significant correlation between perceptions of the entrepreneurial ecosystem and entrepreneurial intention. The greater the students' entrepreneurial intention, the higher students value the university's entrepreneurial environment (r=0.269, p=0.000). Attitudes toward entrepreneurship also have a positive effect on the evaluation (r=0.236, p=0.000). The more favourable a person's attitude toward entrepreneurship is, the more favourable the evaluation of the university environment is.

Self-efficacy also shows a positive and significant relationship with the entrepreneurial ecosystem (r=0.371, p=0.000), which can be interpreted as follows: the more an individual feels that he/she has acquired the appropriate skills and knowledge to start an enterprise, the more likely that he/she will give a high rank to the questions.

The last factor is the social norm, which reflects the opinion of the student's environment on the student's entrepreneurial ideas. According to the results (r=0.193, p=0.000) we can conclude that a supportive social environment is also helpful from the viewpoint of the evaluation. Thus, the more positively the individuals' environment reacts to the entrepreneurial plans, the more likely students are to evaluate the university entrepreneurial ecosystem with a high score.

Table 2
Correlation coefficients

	ECO	INT	ATT	SEF	SUB
ECO	1	0.269** 0.000	0.236** 0.000	0.371** 0.000	0.193** 0.000
INT	0.269** 0.000	1	0.845** 0.000	0.553** 0.000	0.358** 0.000
ATT	0.236** 0.000	0.845** 0.000	1	0.540** 0.000	0.421** 0.000
SEF	0.371** 0.000	0.553** 0.000	0.540** .000	1	0.299** 0.000
SUB	0.193** 0.000	0.358** 0.000	0.421** 0.000	0.299** 0.000	1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).
Source: own elaboration

The differences assumed according to the entrepreneurial family background could not be justified. Although the averages of the answers to the ecosystem questions differ slightly (3.57 in the absence of family business background and 3.66 when it exists) the difference was not found to be significant.

General linear model to evaluate the combined effect

Previously, we checked the pairwise relationships between the variables included in the study. However, we have also seen that the variables used to explain the differences in ecosystem assessment are themselves correlated. In the next step, therefore, we wanted to find out whether the effect of these variables remained significant even if the effects of the other variables were kept under control.

The general linear model (GLM) integrates multivariate linear regression and standard deviation analysis methods (Ketskeméty & Izsó 2005). The dependent variable in our case is the evaluation of the ecosystem, which is derived from the average of the responses measured on the Likert scale from 1 to 7, i.e. it enters the model as a continuous variable. This dependent variable is expressed as a linear function of continuous and discrete independent variables. Here the variables previously described were included in the model, such as university (UNI), field of study (STU), entrepreneurial intention (INT), attitudes (ATT), social norm (SUB) and family entrepreneurial background (FAM). The Type I method takes into account all parameters that cannot be expressed with the other parameters at the same time.

Table 3
Tests of Between-Subjects Effects

Source	Type I Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4082.329[a]	184	22.187	12.325	0.000
Intercept	84975.334	1	84975.334	47203.841	0.000
SEF	2207.312	1	2207.312	1226.163	0.000
SUB	85.432	1	85.432	47.458	0.000

INT	61.059	1	61.059	33.919	0.000
UNI	959.410	23	41.713	23.172	0.000
STU	346.455	11	31.496	17.496	0.000
UNI*STU	422.661	147	2.875	1.597	0.000
Error	12153.004	6751	1.800		
Total	101210.667	6936			
Corrected Total	16235.333	6935			

R Squared = 0.251 (Adjusted R Squared = 0.231)
Source: own elaboration

The fit of the model can be expressed by the value of adjusted R Squared. A value of 0.231 suggests that the variables included in the analysis explain 23.1 per cent of the variability of the data.

In the model, the effect of the intercept and the variables of entrepreneurial intention (INT), self-efficacy (SEF), subjective norm (SUB), university (UNI) and field of study (STU) are significant. Students' assessment of the entrepreneurial ecosystem of universities depends on both the university that students attend, on the major they have, and on a combination of these two variables. The difference according to the universities is significant when the training area is under control. Although in the framework of this article we did not examine the reason for the different evaluation of universities, it can be assumed that it is to be found in the different efforts of universities, geographical reasons, and the specifics of the student body. The field of study can have the greatest impact through the curriculum, as the economic and entrepreneurial subjects that students may encounter are very different from field to field. The more an individual feels that she possesses the skills and knowledge needed to start a business, the higher she rates the entrepreneurial ecosystem of the university. This is self-efficacy, which complements the two objective variables related to studies with the subjective assessment of knowledge by students. Based on the results, Hypotheses H1a, b and c can be accepted.

The significant effect of entrepreneurial intention on the ecosystem assessment suggests that students who plan to start a business in the future will value the entrepreneurial efforts of universities more highly. The attitude variable could not substantially increase the explanatory power of the model, presumably due to its close correlation with entrepreneurial intention. The results led to the acceptance of Hypothesis H2. It is also decisive whether students come from an entrepreneur-friendly environment (feedback from their narrower and wider environment is positive toward entrepreneurship), this is the subjective norm. A student with such an environment is likely to value the entrepreneurial knowledge and experience gained at the university even more.

The family entrepreneurial background did not prove to be significant in the model, so it is not included in the final version presented here. However, its combined effect with the university and the field of education variables is significant (although their partial effect is very weak). This may suggest that the impact of family entrepreneurship background may be reflected in the choice of university and field of education. This assumption requires further investigation. We were able to confirm Hypothesis H3b using the calculations, but we could not support Hypothesis H3a.

CONCLUSION

The main focus area of entrepreneurship education studies is the impact of entrepreneurship courses/training on the entrepreneurial intentions of students. Most studies find a positive relationship between the two, which suggests that universities can boost entrepreneurship through standard courses and extracurricular academic programmes. But the results are not unanimous. Some studies find no significant relationship between the two phenomena, and there are even some that suggest a negative relationship. Our findings point to a positive relationship: the field of study is positively associated with the students' evaluation of the entrepreneurial ecosystem, while there is also a positive correlation between the entrepreneurial ecosystem evaluation and the entrepreneurial intentions. Students enrolled in business/economics study programmes in Hungary are more likely to have entrepreneurship courses, and so their evaluation on the entrepreneurial ecosystem is higher; a higher evaluation of the ecosystem is also positively correlated with higher entrepreneurial intentions.

The perspective of our study, however, is different from that usually taken in the literature. We focus on student perception, namely how students evaluate the entrepreneurial ecosystem around the university, and we suggest that the perception is influenced by a number of factors, including the entrepreneurial intentions of students. In this sense our perspective is similar to the one taken by Bergmann et al. (2018). In our opinion it is not enough for universities to focus only on what programmes and services they come up with in order to develop the students' entrepreneurial skills. Our analyses has shown that a number of individual student factors, such as their prior knowledge of entrepreneurship, their family background, how their

environment relates to entrepreneurship, and their area of interest largely determine whether they perceive opportunities at all. Students who perceive opportunities are presumably more likely to take advantage of them by participating in non-compulsory programmes, as well as being more engaged in required entrepreneurship courses.

The general linear model we set up (using a database of almost 10,000 Hungarian university student answers obtained in 2018) found that the 1) entrepreneurial intentions of students, 2) their self-efficacy (the rate of confidence that the student possesses the skills that are needed to start a business), 3) the social norms perceived by the students, 4) the university they attend, and 5) the field of study all have a small but statistically significant impact on how students perceive the entrepreneurial ecosystem around the university. These five factors explain 23.1% of the variability of the data.

It seems that along with their efforts to improve entrepreneurial skills, universities should pay much more attention to shaping attitudes and arousing students' interest in entrepreneurship. Many higher education institutions are making serious efforts to develop their entrepreneurial character by launching various programmes, providing services and, more generally, by creating an entrepreneurial environment. Very often the impact of these programs is below expectations. The goal is not only to further increase the number of courses or provision of services, but to awaken student demand for them.

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