University of Sopron
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NEW CONCEPT OF SUSTAINABLE URBAN DEVELOPMENT: RESILIENT CITIES

Theses of doctoral (PhD) dissertation

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1. Objectives, research questions, hypotheses

It has become widely accepted that concepts of economic development, competitiveness and sustainability need to be reinterpreted. The concept of flexibility/resilience has come to the fore as a key factor of competitiveness. Resilience can offer a solution to the current and ever-growing challenges of global urbanization, including climate change, economic, demographic and social crises. The focus of the dissertation is to expand on the concept of flexible cities, to find methods for measuring urban flexibility, and to map the resilience of Hungarian medium towns.

The basic objective of the dissertation is to examine the resilience of towns, to study the theoretical background and adapt it to domestic practice, and to develop a model with a practical application that can improve the problem-solving ability and livability of urban areas.

Research questions, hypotheses:

1. How to interpret international and domestic research on urban flexibility and its measurement methods?

1.1. Flexibility as a factor of competitiveness and the concept of flexible cities are increasingly emphasized in international literature and development policies, and numerous measurement methods for urban resilience are available.

1.2. Elaboration of the concept of flexible cities in domestic literature and domestic adaptation of measurement methods known from international literature are in an early stage.

2. How can resilience be integrated into urban development strategy?

Resilience can be integrated into a city's strategy by incorporating, continuously monitoring and evaluating activities that increase the city's flexibility.

3. Is it possible to develop an index to measure the resilience of domestic medium towns? What other methods can be used to analyze the flexibility of domestic medium towns?

3.1. A domestic City Resilience Index can be developed.

3.2. Statistical methods can be used to perform data analyses on urban resilience.

3.3. Empirical research can be used to examine the resilience of domestic medium towns.

4. How flexible are domestic medium towns? How much do domestic medium towns differ in terms of flexibility?

4.1. Towns of low, medium and high flexibility can all be found among domestic medium towns.

4.2. The flexibility of domestic medium towns varies widely.

5. How is the CRI of domestic medium town distributed across regions? Can domestic medium towns be classified into clusters based on their resilience?

5.1. The CRI of domestic medium towns varies significantly by region.

5.2. Domestic medium towns can be classified into different groups based on their flexibility characteristics.

5.3. Middle cities geographically closer to each other show more similarities.

5.4. The flexibility of the four domestic medium cities selected during the empirical research is similar.

6. What do local residents and interviewees consider factors that affect the flexibility of their town? What is their opinion of their town? Based on empirical research, how does the flexibility of towns compare?

6. Based on the result of surveys and in-depth interviews, the ranking of flexibility of the four examined towns matches the ranking calculated based on CRI.

7. What are the key factors and priorities of Kaposvár? What indicators can be assigned to these?

In addition to the indicators used for the City Resilience Index, additional indicators can be defined for Kaposvár, which constitute a city-specific index.

2. Research content and methodology

2.1. Research delimitation in time and space

In line with the research objectives and work of the "Examination of the Sustainability of Social Innovation in Urban Spaces" research team, studies focused on domestic medium towns in general, then specifically on four domestic medium towns selected during the university research. Thus, the examined towns are Békéscsaba, Eger, Kaposvár and Sopron. The author considers settlements between 20,000 and 100,000 inhabitants to be medium towns (Kovács, 2002). Research data is valid for 2018; therefore, the analyses are static.

2.2. Methodology

The aim of the dissertation is to examine and measure the resilience of domestic medium towns. To this end, the author developed a City Resilience Index (CRI), which makes the resilience of towns measurable, and characterized domestic medium towns in terms of resilience using various statistical methods. Indices (CRI, dimension and subdimension indices) calculated based on data from secondary sources were developed using Microsoft® Excel 2013 spreadsheet software and IBM® SPSS® Statistics 25.0, Statistical Package for the Social Sciences software package.

Index creation: development of the City Resilience Index (CRI)

Based on international literature, the author performed the analysis of towns on the basis of three dimensions: economic, social and environmental.

Dimensions were divided into additional subdimensions, and indicators were assigned to subdimensions, which made quantified measurements possible. Definition of indicators was significantly determined by available data. The database used was the National Regional Development and Country Planning Information System. Within the database, the source of most indicators was the regional statistical database system of the Hungarian Central Statistical Office. The source of data on employees was the Hungarian State Treasury. The source of key data on personal income tax and corporate tax return was the database of the National Tax and Customs Administration. Hungarian Public Road Nonprofit Pte Ltd Co was the source of data on accidents. The author scaled indicators in order to aggregate them into an index. After scaling, the inverse of indicators with a negative impact was taken, ensuring that all indicators have a uniformly positive impact. Therefore, higher CRI values are better; the closer the CRI value is to 1, the more resilient the city. The arithmetic mean of indicators belonging to subindices were taken to avoid excessive weight of individual dimensions (indices) and subdimensions (subindices) in the multi-indicator index. Indices are considered with equal weight as well, as determining the effect of individual components on resilience is not possible. In case of shocks or city-specific applications, it is worth weighting the dimensions.

The author used 38 metrics to determine the indicators. The CRI thus consists of 3 indices, 10 subindices and 23 indicators. After calculating the CRI, the ranking of domestic medium towns in terms of resilience can be established. With the expansion of available data, the CRI can be further adjusted. During a detailed urban situational analysis, a city's key factors can be identified, based on which the CRI can be further developed with a city-specific sub-index. In the case of Kaposvár, the town-specific sub-index of the CRI (i.e.

the key indicators of the town) was determined based on analysis of secondary data, results of empirical research and strategic documents of the town.

Box plot

The author assigned medium cities to regions and examined the differences between regions with a box plot. The box plot displays the distribution of numerical data. Interquartile range is represented by a box, from which the median and quartiles can be read. The end of whiskers represents the minimum and maximum value. Essentially, it is a visual data aggregation method. The location of the box relative to the whole range and the position of the median provide information about the distribution.

Scatter plot

After the box plot, the author created a scatter plot for every combination of 2 indices for each region, then checked whether regional groups can be properly distinguished based on the position of regions according to indices. A scatter plot is a method used to represent values for two numeric variables. It shows data clusters, outliers and gaps in the values.

Cluster analysis

During the analysis, the author combined hierarchical and non-hierarchical clustering methods: first, the ideal number of clusters was determined by hierarchical cluster analysis, then the final groups of medium towns were defined with k-means clustering. The method uses simple Euclidean distance to measure the distance between clusters. Standardization was unnecessary because all variables range from 0 to 1.

Empirical research

Lack of data was the main obstacle in measuring the resilience of medium towns, so supplementing secondary sources with primary research was essential to measure resilience. Some of the indicators influencing resilience

are not included in statistical databases (e.g. involvement of local residents in decision-making); therefore, this information was obtained by data collection surveys and in-depth interviews. During primary research, in parallel with obtaining missing information, aspects of secondary research were examined as well. Due to the time-consuming and costly nature of qualitative methods, four domestic medium towns were examined with this method: the resilience of Békéscsaba, Eger, Kaposvár and Sopron was analyzed, joining the research „Társadalmi innovációk fenntarthatóságának vizsgálata városi terekben" (Examination of the Sustainability of Social Innovation in Urban Spaces; part of the project EFOP-3.6.2-16-2017-00007) led by Viktória Szirmai.

Surveys

300 persons per city, a total of 1,200 people, were surveyed with the help of a survey company, ensuring representativeness by gender, age, regional location and education. In the towns included in the sample, surveyed people were chosen with the "random-walk" sampling technique. During the empirical research, the research team used closed-ended and Likert scale questions, along with a few open-ended ones, where responders had the opportunity to express their opinion freely. The team sought to understand what kind of problems residents see with the town, what they consider important or less important, and in this context, what they perceive from urban development activities, what parts of these activities are visible to them, who benefits from these activities, which are the privileged groups, and which area of town is preferred in terms of development. Awareness and acceptance of urban development concepts and models, and the acceptance of changing urban visions as a result of urban development interventions were studied. What do residents think of the values and livability of their town? To what extent are local residents involved in urban decision-making?

In-depth interviews

During the empirical research, 15 in-depth interviews were conducted in each city. Interviewees were selected using the snowball sampling method from the circle of actors determining urban development, municipal staff (chief architect, urban development staff, project developer, etc.), politicians, local intellectuals, experts, regional developers, environmentalists, representatives of relevant market organizations and NGOs, real estate developers, real estate investors and important economic actors. The structured interviews were standardized conservations, or essentially, oral surveys, and served to make answers comparable. Interviews were conducted in person, and written records were prepared later based on audio recording. The following questions were addressed during the interviews: How do you assess the directions of urban development? Who benefits from urban development? What are the main problems you see with the town and can you see efforts being made to solve them in the short and long term? What international urban development collaborations did the town participate in? What were the main urban development projects in the town in recent years? How do you assess the effectiveness and impact of urban development efforts of recent years? What would you consider important for the future? Are there local civil initiatives aimed to solve urban and social problems? What is the main challenge for the town in the short and long term, and how could these be addressed?

3. Results

The research was based on a comprehensive study of international and domestic literature and a secondary analysis complemented by primary research. Based on the research questions, the author summarized the main

results and conclusions of the doctoral dissertation, which constitute the theses of the research work as well:

Thesis1: Research of flexible cities, measurement methods

1.1. Flexibility as a factor of competitiveness, the concept of flexible cities and measurement methods of urban resilience are increasingly emphasized in international literature and development policies. The concept of flexibility underwent significant development. Meerow, Newell, Stults (2016) present 25 definitions of urban flexibility.

1.2. Different approaches to urban flexibility also appear in domestic literature. Efforts are being made to elaborate the concept of flexible cities in domestic literature, however, domestic adaptation of measurement methods is in an early stage.

Thesis 2: Development of a flexibility strategy

Flexibility as a factor of competitiveness can be integrated into urban development policy and strategy. During the development of a flexibility strategy, it is important to apply measures to reinforce city flexibility and to continuously monitor and evaluate the implementation. Indicators should be chosen with the city's vision and problems taken into account. Indicators should be assigned to these goals and problems. Indicators provide information on the current situation, the achievement of goals, and the effectiveness and efficiency of various processes, based on which urban resilience can also be determined. The flexibility strategy should be focused on expanding capacities that allow the city to react to constant changes.

Thesis 3: Analysis methods of domestic medium towns

3.1. In order to measure the resilience of domestic medium towns, based on international literature, the author developed a new index, the City Resilience Index (CRI), which enabled to quantify and rank the resilience of domestic medium towns.

3.2. Based on the CRI and sub-indices of CRI, domestic middle towns were further analyzed with statistical methods (box and scatter plot, cluster analysis).

3.3. During the development of the CRI, the selection of indicators was significantly determined by available data. There are no domestic sources on important flexibility indicators revealed in international literature. Therefore, the study of resilience was supplemented by empirical research. However, due to the costly and time-consuming nature of primary research, this method could only be applied to 4 domestic medium towns (Békéscsaba, Eger, Kaposvár, Sopron). Empirical research consisted of surveys and in-depth interviews.

Thesis 4: Flexibility of domestic medium towns based on City Resilience Index (CRI) calculation

4.1. CRI calculations clearly show that all domestic medium towns can generally be considered moderately flexible. Among the 53 settlements, the lowest CRI value is 0.3178 and the highest value is 0.5670. According to the City Resilience Index, Budaörs is the most flexible Hungarian medium town, and Ózd is the least flexible one.

4.2. Based on the City Resilience Index, domestic middle towns do not exhibit great variability in terms of flexibility.

Thesis 5: Examination of the resilience of domestic medium towns by statistical methods

5.1. The hypothesis "the regional distribution of the CRI of domestic medium towns varies significantly" was not substantiated. All regions lie in the middle range (between 0.32 and 0.57), clearly showing that all medium cities of each region can be considered moderately flexible.

5.2. Domestic middle towns can be divided into three groups based on their flexibility characteristics. The first group consists of 18 towns with the lowest

economic, social and environmental indices. The 29 towns in the second group exhibit the highest social and environmental indices with a medium economic index. The 6 towns belonging to the third group possess relatively high social and environmental indices and the highest average economic index among the groups.

5.3. Based on cluster analysis, most domestic medium towns of group 1 are located in the Great Plain, most medium towns of group 2 are located in Transdanubia, and medium towns of group 3, with the exception of Hódmezővásárhely and Kazincbarcika, are located in the central region. This makes it evident that for the majority of domestic medium towns, there is a relationship between geographical location and flexibility, i.e. medium towns geographically closer to each other share a higher degree of similarity in terms of flexibility. This finding can be the starting point to examine the correlation between geographical location and flexibility.

5.4. The hypothesis "the resilience of the four domestic medium towns selected for empirical research is similar" was only partially substantiated. Based on k-means clustering, Sopron can be assigned to group 1, and Békéscsaba, Eger and Kaposvár to group 2. Thus, it can be stated that Békéscsaba, Eger and Kaposvár share similar resilience characteristics, while Sopron is different.

Thesis 6: Examination of the resilience of four domestic medium towns based on empirical research

The hypothesis "based on the result of surveys and in-depth interviews, the ranking of resilience of the four examined towns matches the ranking based on CRI calculation" was not substantiated. Based on the result of secondary research, Kaposvár ranks 6th, Eger 9th, Békéscsaba 27th and Sopron 34th among domestic medium towns in terms of flexibility. The same ranking can be observed for the indices characterizing economic and social dimensions of

the four towns, but Sopron ranks first in terms of environmental flexibility. Based on the empirical research, the most flexible town is Eger, and Békéscsaba is the least flexible among the four towns. Based on surveys, Sopron is in second place and Kaposvár is in third place, while according to the in-depth interviews, the ranking is the other way around.

Based on the three examinations, it can be stated that Békéscsaba, Eger, Kaposvár and Sopron are moderately flexible towns. Comparing the four towns, empirical research shows that Békéscsaba is the least flexible along all dimensions. This in not supported by the sub-indices calculated on the basis of the CRI, as the economic and social felxibility of Békéscsaba ranks 3rd among the four towns. However, it should be noted that there is a minimal difference between the values.

Thesis 7: Proposal for a town-specific index for a domestic middle town

In addition to the indicators used in the City Resilience Index, additional indicators can be defined for Kaposvár, based on which a city-specific index can be developed. Based on the problems and strategic goals revealed during the detailed situational analysis, the author identified the key factors of the town and assigned indicators to them. Key factos of Kaposvár: urban tourism based on culture and events, motorway connection, emergence of new companies, competitive salaries, population decline, alcoholism, drug use, segregation, community participation in political decision-making and green town concept. Some of the data related to the vision and strategic goals of the town is unavailable in the central database; therefore, it’s the responsibility of the local government to collect and organize related indicators and information.

4. New and novel scientific results

A novel result of the dissertation is the elaboration and adaptation of the concept and measurement methods of urban resilience in domestic literature. A novel result is the examination of the integration of resilience into urban strategy, which can be a guide for urban decision-makers and urban development professionals in defining goals and measures. A new result is the development of an index to measure city resilience and the analysis of the resilience of domestic medium towns. Domestic medium towns are moderately resilient. Medium towns geographically closer to each other show more similarities in terms of flexibility. A new result of the empirical research is information regarding the economic, social and environmental flexibility of four domestic medium towns (Békéscsaba, Eger, Kaposvár, Sopron). Another new result of the dissertation is the town-specific index developed for Kaposvár. The results can be useful for urban planning and development policies. The research results fill the gaps for urban decision-makers, theoretical and mostly practical professionals dealing with urban development, and can provide a starting point for the incorporation of resilience as a new factor of competitiveness into urban planning and development processes.

5. Unlocking the limitations of the research and future possibilities

The doctoral dissertation was aimed to provide a conceptual and interpretive framework as well as a research method for a research area whose empirical research and elaboration in domestic literature is in an early stage. The main obstacle in the examination of domestic medium towns was the lack of available data. Statistical databases offer little information that would allow full measurement of the resilience of domestic medium towns. The proposed resilience index, framework and methodology developed during the

dissertation can be further developed depending on available data. When developing the index, weighting and its extent should also be considered. Weighting can be influenced by a shock affecting the city and the risks it is exposed to (e.g. the economic dimension is more dominant in the case of an economic crisis, the environmental dimension is more dominant in the case of a natural disaster). The research proves the raison d'être of measuring urban flexibility and resilience in our ever-changing world. It is important to further examine the research topic, to explore its deeper connections, and to analyze the resilience of other domestic towns selected based on other aspects. Furthermore, it would be worthwhile to re-analyze the resilience of towns by examining the effects of developments of the Modern Cities Program, as based on the empirical research, many respondents expect these investments to solve many urban problems and improve the town's resilience indicators. "The Modern Cities Program is the golden age in our town's life" (Interviewee 2).

The methodology and research presented in the doctoral dissertation can contribute to the development of new procedures for further research and to the practical application of urban resilience in the field of urban planning and development.

6. List of publications related to the dissertation

Peer-reviewed journal articles

Bertalan, L. – Hegedüs, J. (2016): A városi szétterülés problémaérzékelése és kezelése a hazai városokban – egy kérdőíves felmérés alaperedményei. E-CONOM 5 (2) pp. 94–106.

Hegedüs, J. (2016.): Könyvszemle: Fábián A., Bertalan L. (szerk.): Otthon a Kárpát-medencében. Területfejlesztési Szabadegyetem 2011–2015. Tér és Társadalom 30 (3) pp. 155-158.

Bertalan, L. - Inzsöl, R. - Hegedüs, J. - Jankó, F. (2019): Quo vadis Farmer Sales? The Experience of a Survey in Hungary. NASE GOSPODARSTVO/ OUR ECONOMY 65(1) pp. 30-39. , 10 p. (2019)

Hegedüs J. - Németh S. (2020): A rezíliencia, mint versenyképességi tényező. Comitatus Önkormányzati Szemle (befogadó nyilatkozat, megjelenés: 2020. őszi szám)

Conference proceedings

Hegedüs, J. (2017): Városfejlesztési innováció? „Zöld város" koncepció a gyakorlatban. In: Resperger, R. (szerk.) Geopolitikai stratégiák Közép-Európában : Nemzetközi tudományos konferencia, Sopron, 2017. november 9. : Programfüzet és előadáskivonatok: Geopolitical strategies in Central Europe: International scientific conference, Sopron, 9 November 2017: Schedule and book of abstracts, Sopron, Magyarország : Soproni Egyetem Kiadó, (2017) pp. 65-65.

Inzsöl, R. - Hegedüs, J. (2018): Rövid ellátási lánccal kapcsolatos támogatási lehetőségek a hazai LEADER programban (2014-2020). Tavaszi Szél 2018 / Spring Wind 2018 Tanulmánykötet 2018, Budapest, 11 p.

Hegedüs, J.- Jankó, F. – Inzsöl, R. (2019): Social Innovations and Sustainability of Modern Urban Development Models in Kaposvár. In: Resperger, R. – Czeglédy, T. (szerk.): Modern Gazdaság, Okos Fejlődés (Modern Economy, Smart Development) Nemzetközi Tudományos Konferencia. Sopron, 2019. november 7. – Konferenciakötet, Sopron, Magyarország, Soproni Egyetem Kiadó, pp. 130-142. ISBN 978-963-334-347-0

Books, book chapters

Bertalan, L. - Hegedüs, J. (2016): Mit eszik a városi ember? – Helyben termelt élelmiszerek és a városi ellátó övezetek dilemmája. In: Resperger, R. (szerk.) Európa: gazdaság és kultúra (Europe: economy and culture) Nemzetközi Tudományos Konferencia. Sopron, 2016. november 10. - Programfüzet és előadáskivonatok, Sopron, Magyarország, Nyugat-magyarországi Egyetem Kiadó, pp. 73-73.

Hegedüs, J. (2017): Városfejlesztési innováció? „Zöld város" koncepció a gyakorlatban. In: Resperger, R. (szerk.) Geopolitikai stratégiák Közép-Európában (Geopolitical strategies in Central Europe) Nemzetközi tudományos konferencia. Sopron, 2017. november 9. - Programfüzet és előadáskivonatok, Sopron, Magyarország, Soproni Egyetem Kiadó, pp. 65-65.

Németh, S. – Gárdonyi, I. – Hegedüs, J.(2019): Répcelak településföldrajza In: Csapó, T. – Biczó, F. - Boros , A. – Garas, K. – Szabó, J. (szerk.): Répcelak város monográfiája, Répcelak: Répcelak Város Önkormányzata, pp 134-180 (2019), ISBN: 9786150057934