
STEEPVL and Structural Analysis as a Tools Supporting Identification of the Driving Forces of City Development

Submitted 20/03/20, 1st revision 14/04/20, 2nd revision 24/05/20, accepted 07/06/20

Danuta Szpilko¹, Ewa Glińska², Joanna Szydło³

Abstract:

Purpose: The aim of the article is to verify the possibility of using the Social, Technological, Economic, Ecological, Political, Values and Legal analysis (STEEPVL) and structural analysis in the process of determining the driving forces of city (town) development.

Design/Methodology/Approach: The research process incorporated two major methods: STEEPVL and structural analysis as well as five auxiliary ones: desk research, expert panel, citizen panel, brainstorming, survey research. The research process was carried out in the town of Zambrów in Poland with the involvement of a wide range of local stakeholders.

Findings: The results obtained in the research process for the town of Zambrów confirm the validity of applying the STEEPVL analysis and structural analysis in the process of determining the driving forces of city development. As a result of the conducted research process two key factors were identified efficiency of town authorities, and entrepreneurship of town inhabitants, which may constitute the driving forces of the development of the town of Zambrów.

Practical Implications: The areas studied in the article may become a useful source of knowledge for researchers and city authorities looking for new tools in the context of building urban development strategies.

Originality/Value: The research focuses on the application of a new approach to the identification of the driving forces of urban development with the use of STEEPVL and structural analyses – methods belonging to the catalogue of foresight methods. A wide range of town development stakeholders is involved in the research process, thanks to which the obtained results constitute a socialised, jointly developed basis for building a vision of its development.

Keywords: STEEPVL analysis, structural analysis, city strategy, development.

JEL codes: R11, R58, O18.

Paper type: Research article.

Acknowledgment: This research is supported by Bialystok University of Technology and financed from a subsidy provided by the Minister of Science and Higher Education (works: No. WI/WIZ-INZ/1/2019, No. WI/WIZ-INZ/1/2020, No. WI/WIZ-INZ/2/2020).

¹Assistant Prof., Ph.D., Bialystok University of Technology, Faculty of Engineering Management, Poland, e-mail: d.szpilko@pb.edu.pl

²Associate Prof., Ph.D., Bialystok University of Technology, Faculty of Engineering Management, Poland, e-mail: e.glinska@pb.edu.pl

³Assistant Prof., Ph.D., Bialystok University of Technology, Faculty of Engineering Management, Poland, e-mail: j.szydlo@pb.edu.pl

1. Introduction

In the modern world cities are centres of government providing a basis on which the future world order will be built (Khanna, 2011). Their creation began with the development of the first civilisation and continues to this day. They are a place of living and an environment of various activities. A city is a social and economic system. It is composed of many elements and links between them, thanks to which it can function and develop (Stawasz and Sikora-Fernandez, 2015). On the one hand, it is a means that solves many problems of social development, on the other – the source and place of their occurrence (Szymańska, 2007).

At present, 55% of the world's population lives in urban areas, covering only 3% of land area. According to forecasts published by the United Nations, in 2050 this percentage will increase to 68% (United Nations, 2019). The world's urban population grew from 751 million in 1950 to 4.2 billion in 2018. As urbanisation progresses and the global population increases on the whole, with a gradual migration from rural to urban areas, the global urban population will increase by 2.5 billion (2018-2050). Around 90% of this growth will occur in Asia and Africa (United Nations, 2019).

In Poland there are 944 cities (GUS, 2020). Poland has a well-developed, polycentric urban network. Cities play a key role in the socio-economic development of the country. Approximately 60% of the Polish population lives in cities, where roughly 80% of GDP is concentrated. The strategic objective of the 'National Urban Policy 2023' is to strengthen the ability of cities and urban areas to develop and create workplaces as well as improve the quality of life of their inhabitants (MPiT, 2018).

In the last 20 years, the concept of a smart city has become important in urban development planning because technological progress is rapidly occurring and because the challenges faced by local authorities regarding the resolution of climate, energy and urbanisation problems are growing (Ahvenniemi *et al.*, 2017). However, in the case of Polish cities, the implementation of this idea in local development planning is limited in practice and refers only to selected issues, including energy, intelligent transport, and e-government (Sikora-Fernandez, 2018).

As the European Commission (2011) points out, urban governance should focus on understanding possible paths for its development and choosing those that are sustainable, durable, consistent with a forward-looking and shared vision of the city. Cities must also have adequate tools and instruments for strategic planning and collective vision building. The challenge faced by decision makers is therefore to look for new, often unconventional tools that enable effective management of the city's sustainable development and provide an opportunity to avoid the risks resulting from the increasing complexity and uncertainty of the environment. Tools that involve multiple stakeholders in working together to create common benefits are now essential in developing new solutions for smart cities (Paskaleva *et al.*, 2015; Pereira *et al.*,

2017; Winkowska *et al.*, 2019). The need to consider social participation in city management is also reflected by the National Urban Policy 2023 (MIR, 2015).

Therefore, the strategic urban policy plays a particular role in city management since it is aimed at creating and strengthening the development of a given centre in the long and medium term. The conceptual core of the strategic urban policy is the strategy of its development, which normally includes such elements as priorities, strategic options, directions of action, key development projects (Klasik and Kuźnik, 2019).

A skilfully prepared strategy of a coherent and long-term character, responding to the signals coming from the surroundings, will enable the city to undertake actions aimed at necessary transformations conditioning the development of the area. Ultimately, it will also constitute a tool allowing for counteracting accidental and chaotic decisions. The answer to the existing need to build a vision of city development may be foresight and a wide range of methods aimed at building a related vision of the future. This is reflected in the opinion of Klasik and Wrana (2019), who emphasise that the use of foresight as an innovative tool in strategic city management is currently one of the main determinants of the city's competitiveness.

At the same time, the adaptation of foresight to city management allows to minimise a number of barriers hindering the implementation of strategic city policy, such as formal and legal limitations, concerning decision-making powers, limitations concerning the desired knowledge of various phenomena and processes important from the economic, social, environmental, technological point of view, resource limitations, including financial ones, of city authorities and main stakeholders making on the dynamics of city development, as well as disintegration of the political sphere in the city (Klasik and Kuźnik, 2019).

Based on the analysis of descriptions of foresight projects available in literature, as well as own research experience in the implementation of foresight projects, the authors identified the STEEPVL analysis and structural analysis as useful methods in determining the driving forces of city development.

The aim of this article is to verify the possibility of using STEEPVL and structural analysis (included in the catalogue of foresight methods) in the process of determining the driving forces of city (town) development. The verification was carried out as part of the research process in the town of Zambrów (with about 20 thousand inhabitants located in north-eastern Poland) with the integration of knowledge and experience of a wide range of the local stakeholders.

The article consists of five parts. Section 2 presents issues concerning foresight – its essence and the characteristics of methods used in the research process. Section 3 presents research methodology with the use of STEEPVL and structural analysis methods. Section 4 presents the results of the research conducted in the context of the development of the town of Zambrów in Poland. As a result of the conducted research,

the authors identified the driving forces of the town's development. Part 5 presents conclusions resulting from the research and directions of future work. Two main research methods were used in the research process: STEEPVL analysis and structural analysis as well as five auxiliary methods: desk research, expert panel, citizen panel, brainstorming, survey research.

2. Theoretical Background

2.1 Foresight – Concept and Methods

Foresight is a systematic, participatory process focused on gathering knowledge about the future, building a medium-term and long-term vision, oriented on today's decisions and mobilising joint activities (Keenan and Miles, 2001; Gavigan *et al.*, 2001). Miles (2002) defines foresight as an equivalent of a stream of systematic efforts to look to the future and make the most effective choices. However, foresight assumes that there is no single future. Depending on the action or inaction in the present, many variants of the future are possible, but only one of them will exist (Miles, 2002). Foresight is about shaping the future through concerted actions of networks of interested groups (Anderson, 1997; Loveridge and Saritas, 2009). Five main elements of foresight are identified: anticipation and future design, participation, social networks, strategic vision and current decisions and action (Gavigan *et al.*, 2001).

Foresight constitutes a set of tools that facilitate the development of long-term development scenarios (usually 10-30 years) (Kuciński, 2006). It is an attempt to anticipate important factors and threats with the involvement of society which may be affected in the future (Loveridge and Street, 2005). It is a process that combines the expectations of various actors in order to formulate strategies for the future (Webster, 2002). It fosters dialogue between the participants of the process and sets the framework for communication and sharing opinions on possible future scenarios, at the same time creating the culture of society's thinking about the future (Martin, 1993; Barker and Smith, 1995; Jakuszczyk *et al.*, 2006). During the preparation and implementation of foresight projects, subject analyses and evaluations require the participation of a wide range of stakeholders representing the sphere of administration, business, science, non-governmental and social organisations, politics as well as inhabitants (Salmenkaita and Salo, 2004; Szpilko, 2020).

Foresight – in relation to cities – focuses on creating coherent city visions in order to plan and manage future long-term change (Dixon *et al.*, 2018b; Ding, 2005; Glińska, 2013; Ravetz and Miles, 2016). Urban foresight mainly focuses on creating a coherent vision of the city to plan and manage future long-term changes (LaColla, 1999; UNDP, 2014; GOS, 2016; Czajor *et al.*, 2015; Dixon *et al.*, 2018a; Kamińska *et al.*, 2016; Bendyk *et al.*, 2018; Król, 2018; Mahmud, 2011). Foresight has as well been applied in such research areas as demographic change (Gould, 2005), urban spatial planning (Guell and Redondo, 2012), ageing society (Gudowsky *et al.*, 2017), climate change (Eames *et al.*, 2014).

Foresight constitutes an example of a tool for building the competitiveness of a city that goes beyond the current paradigms, existing knowledge, beyond established traditions, experience, and patterns. It is the ability to use imagination and intuition in an unconventional way by different groups of stakeholders, politicians, communities, entrepreneurs, managers and professionals from different fields and disciplines. It is also a way of combining different sources and channels of strategic information with decision-making processes shaping the future of the city and opening the “windows of the future” while searching for new development paths (Klasik and Wrana, 2019). Foresight research is carried out with the use of various techniques and methods. The catalogue of methods and techniques used in foresight research is very wide (Popper *et al.*, 2007). They include both system and analytical, algorithmic, and heuristic, quantitative, and qualitative methods (Nazarko, 2013). Foresight entails methods both developed for the study of the future and borrowed from management and planning, which, although not directly related to the future, are used to create the methodological basis for foresight (UNIDO, 2005; Bell, 1997; Kononiuk and Magruk, 2008). These methods range from highly creative thinking to a structured use of expertise, with a wide range of methods in between them (Ziółkowski, 2009).

Magruk (2011) developed a classification of methods that can be used in foresight research, based on the analysis of subject literature and the analyses of foresight initiatives. It is presented in Table 1.

Table 1. *Classification of foresight research methods*

Classes	Methods
Consultative	Voting, Polling, Survey, Interviews, Expert Panels, Essays, Conferences, Workshops, Citizen Panels, Brainstorming
Creative	Wild Cards, Weak Signals, Mind Mapping, Lateral Thinking, Futures Wheel, Role Play, Business Wargaming, Synectics, Speculative Writing, Visualization, Metaphors, Assumption Reversal
Prescriptive	Relevance Trees, Morphological Analysis, Rich Pictures, Divergence Mapping, Coates and Jarratt, Future Mapping, Backcasting, SRI Matrix, Science Fiction Analysis, In-casting, Genius Forecasting, Futures Biographies, TRIZ, Future History, Alternative History
Multi-criterial	Key Technologies, Source Data Analysis, Migration Anal., Shift-Share Anal., DEA, Factor Anal., Correspondence Anal., Cluster Anal., Sensitivity Anal., AHP, Input-Output Anal., Prioritization, SMART, PRIME, MCDM
Radar	Scientometrics, Webometrics, Patent Analysis, Bibliometrics, Technological Substitution, S-Curve Anal., Technology Mapping, Analogies
Simulation	Probability Trees, Trend Extrapolation, Long Wave Anal., Indicators, Stochastic Forecast, Classification Trees, Modelling and Simulation, System Dynamics, Agent Modelling
Diagnostic	Object Simulation, Force Field Anal., Word Diamond, SWOT, STEEPVL, Institutional Anal., DEGEST, Trial & Error, Requirement Anal., Theory of Constraint, Issue Management, ANKOT
Analytical	SOFI, Stakeholder Anal., Cross-Impact Anal., Trend Impact Anal., Structural Anal., Megatrend Anal., Critical Influence Anal., Tech.

Classes	Methods
	Barometer, Cost-Benefit Anal., Technology Scouting, Technology Watch, Sustainability Anal., Environmental Scanning, Content Analysis, FMEA, Risk Anal., Benchmarking
Overview	Web Research, Desk Research, Technology Assessment, Social Network Anal., Literature Review, Retrospective Analysis, Macrohistory, Back-View Mirror Analysis
Strategic	Technology Roadmapping, Technology Positioning, Delphi, Scenarios, Social Impact Assessment, RPM, Technological Scanning, Multiple Perspectives Assessment, Causal Layered Analysis, MANOA, Action Learning

Source: Magruk, 2011.

2.2 STEEPVL Analysis

The STEEPVL analysis stands for and serves to identify Social, Technological, Economic, Ecological, Political, Values and Legal factors that influence the development of a given research area (Ringland, 2007; Kononiuk, 2010; Ejdys *et al.*, 2017). It is classified as an expert method and constitutes a development of the PEST analysis (Political, Economic, Social, Technological), which takes into account four groups of factors. The first modification of the PEST analysis was the STEEP analysis dedicated on the analysis of Social, Technological, Economic, Environmental or Ecological, and Political factors (Loveridge, 2002). Due to the multidimensionality of the environment, Holroyd and Loveridge (2002) proposed another modification of the PEST (and also STEEP) analysis to STEEPV, enriching it with the Values factor analysis. Ringland (2007) presented the final form of the STEEPVL analysis, expanding the STEEPV analysis by the analysis of Legal factors. The increased number of PEST analysis dimensions to seven dimensions of STEEPVL allows for a more accurate identification of factors of development of the analysed area, which could be omitted in case of traditional PEST analysis (Ringland, 2007; Nazarko *et al.*, 2017).

The main purpose of applying the STEEPVL analysis is to identify potential driving forces in scenarios. The STEEPVL analysis can also serve as a checklist for all important dimensions of the research area (Kononiuk, 2010). It also allows for capturing unprecedented breaking trends (Mendonça *et al.*, 2004; Nazarko, 2013). The results obtained with the use of the STEEPVL analysis can provide input for other analyses, such as SWOT analysis (Nazarko and Kędzior, 2010).

2.3 Structural Analysis

Structural analysis allows for organising and analysing mutually interacting factors (variables). By detecting relations between seemingly unconnected variables, it makes it possible to determine relations between them and, on their basis, to identify key factors in the system under study (Arcade *et al.*, 1994; Nazarko *et al.*, 2011). A list of variables can be identified, for example, by performing the STEEPVL analysis. Next, the analysis involves pairs of factors A and B, for which the following are determined;

direct influence of factor A on factor B and strength of influence: weak -1, medium -2, strong -3. No influence is marked with 0 (Nazarko, 2013; Wójcicki and Ładyżyński, 2008; Szpilko, 2014). An exemplary matrix of mutual interaction of factors is presented in Figure 1.

Figure 1. Matrix for structural analysis

Specification	Factor 1	Factor 2	Factor 3	Factor N
Factor 1				
Factor 2				
Factor 3				
Factor N				

Source: Nazarko *et al.*, 2011.

The direct influence matrix fosters calculations aimed to identify direct and indirect relations between factors influencing a given research area. Calculations can be performed with the use of MIC-MAC (*Impact Matrix Cross - Reference Multiplication Applied to a Classification*) software. The application of MIC-MAC software allows for studying and comparing the hierarchy of individual variables with regard to their direct and indirect influences (Wójcicki and Ładyżyński, 2008). It is based on Bolle's algebraic principle of logic (Czaplicka-Kolarz, 2007). The MIC-MAC programme determines the strength of direct and indirect interactions between factors on the basis of a predefined direct influence matrix (Godet, 1994). It should be stressed that it allows for determining also indirectly influencing factors, which is important in case of variables that may easily escape the analyst's attention (Coates, 2000).

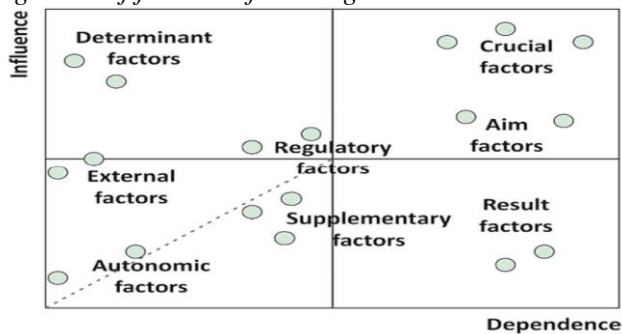
The structural analysis is carried out in three stages (Arcade *et al.*, 1994): (I) establishment of a list of variables influencing a given research area; (II) description of interrelations between variables; (III) identification of key variables. The structural analysis carried out by means of MIC-MAC software allows for distinguishing seven groups of factors from all those affecting a given research area (Keenan *et al.*, 2003; Mazurkiewicz and Poteralska, 2009; Ejdyś, 2013; Nazarko *et al.*, 2011; Wójcicki and Ładyżyński, 2008) as follows:

- crucial factors – characterised by strong influence and high degree of dependence on other factors; due to considerable instability they require special attention and research;
- aim factors – more dependent on other factors and changing under their influence as compared to other factors; they represent possible aims of the studied system;
- result factors – characterised by low impact and high dependence on other factors; definitely susceptible to changes in key factors;
- determinant factors (drives and brakes) – have a very strong influence on the system and at the same time are characterised by a low level of dependence on other factors; they are driving or braking; they are difficult to control;

- regulatory and supplementary factors – have a weak influence on the system and can help to achieve strategic objectives;
- external factors – have a weaker influence on the system than determinants, but a stronger than autonomic factors; factors in this group are not influenced by other factors;
- autonomic factors – have the smallest influence on changes in the system as a whole.

Figure 2 illustrates the arrangement of factors.

Figure 2. Arrangement of factors influencing a research area



Source: Nazarko et al., 2011.

The advantage of structural analysis is the ability to identify relations between variables whose mutual influences are not obvious and are difficult to identify. Its disadvantage, however, is sometimes an artificial narrowing of the number of variables under consideration in such a way as to enable experts to identify their interrelations in a given time (Nazarko, 2013).

3. Methodology

The research was conducted as part of the social project “Zambrów Foresight 2040”. The project was based on cooperation between Zambrów Town Hall (in Poland) and the Faculty of Management Engineering at Białystok University of Technology. Research work began on 1st December 2019. Its completion is planned for 30th July 2020. Project execution was entrusted to a group of four researchers from the Faculty of Management Engineering at Białystok University of Technology.

The research process involved a group of Zambrów town development stakeholders. Invitations were sent to 50 people selected deliberately on the basis of their experience, knowledge, and skills in the field of Zambrów town development. 35 people (both women and men) declared their participation in the survey. The research group was composed of representatives of local government administration, municipal organisational units (such as schools, kindergartens, cultural and sports institutions), business, non-governmental organisations and uniformed services. The principle of

tripartite triangulation was applied in selecting stakeholders. The involved stakeholders represented different professional environments, different genders, and ages (expert triangulation). During the research process various sources of information were used (data triangulation) and stakeholders represented different areas of knowledge and research (theoretical triangulation) (Nazarko and Koniuk, 2013).

Figure 3 illustrates a diagram of research process operationalisation. It presents 5 research tasks in connection with particular research methods. Two main research methods were considered in the process: STEEPVL and structural analysis and five auxiliary ones desk research, expert panel, citizen panel, brainstorming, survey research.

Within the framework of task 1, a group of experts (research executors) identified factors determining the development of the town, based on the results of desk research. The result of their work comprised individual sheets of identified factors from seven areas of the STEEPVL analysis: social (S), technological (T), economic (E), ecological (E), political (P), values (V) and legal (L). In the next step, during a meeting the expert panel compiled a list of STEEPVL analysis factors that was based on a brainstorming method and constituted a starting material for the next stage of work.

The aim of activities undertaken in the framework of task 2 was to identify key factors in each of the identified groups of factors of the STEEPVL analysis. They were selected by a group of stakeholders within the work of the citizen panel with the use of a questionnaire form (PAPI – Paper and Pen Personal Interview). Each stakeholder selected three factors in each of the groups, which in their opinion were the most important from the point of view of town development.

In the course of task 3, a list of main factors of the STEEPVL analysis was evaluated in terms of their importance and predictability in the context of Zambrów town development. This approach served primarily to identify the most important factors that constitute potential driving forces of the town's development. The assessment incorporated a specific time perspective until 2040. The stakeholder group assessed the importance and predictability of the factors by means of the 7-level Likert scale with the use of a research form constituting the PAPI survey.

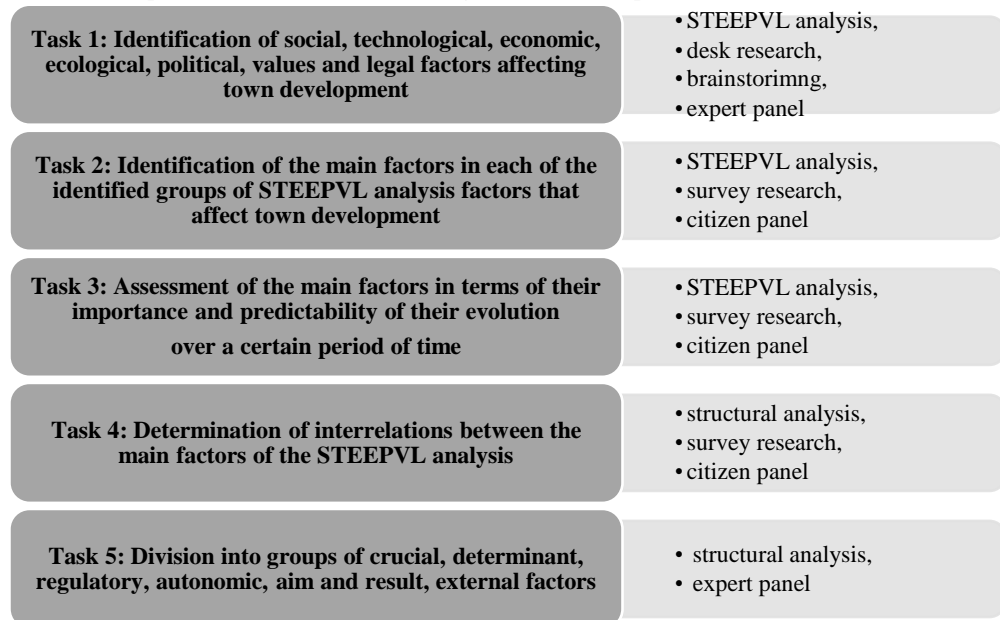
The aim of task 4 was to determine interrelations between major factors in the STEEPVL analysis. This evaluation was carried out by a group of stakeholders, also using a research form in the form of a survey – PAPI. Stakeholders in the course of their work determined whether and to what extent individual factors influence other factors.

As part of task 5, the expert group prepared a resultant matrix of mutual influence of STEEPVL factors, which was analysed with the use of MIC-MAC software (Arcade *et al.*, 1994). This analysis allowed for distinguishing separate groups of factors influencing town development into crucial, determinant, supplementary and

regulatory, autonomic, aim and result as well as external factors. The aim of the structural analysis was to identify key STEEPVL factors with regard to their strength of influence and dependence. The identified key factors with a high level of importance and uncertainty (low level of predictability) and the highest degree of influence on other factors and dependence on them may constitute the driving axes of the town's development.

A number of factors higher than 3 would have to trigger a workshop where stakeholders should express their opinions on the factors that drive the town's development axes. In the absence of a consensus, a vote should be considered to make a clear choice between two factors.

Figure 3. Operationalisation scheme of the research process



Source: Own elaboration.

4. Research Results

At the beginning of the research process, the expert group analysed literature, reports, strategic documents, and information from Internet sources concerning cities in the context of identifying factors that determine their development. Each expert was to identify factors influencing the examined area in each of the following groups: social (S), technological (T), economic (Econ), ecological (Ecol), political (P), values (V) and legal (L). As a result of the conducted work, experts identified a total of 173 factors, including social –32, technological –22, economic –31, ecological –21, political –25, values –23 and legal –19.

During the panel meeting, experts compiled a list of STEEPVL analysis factors. They discussed the identified factors, which led to the exclusion of recurring factors. These factors were also subject to verification and aggregation. As a result, a list of 121 STEEPVL factors was obtained, including: social – 21, technological – 13, economic – 24, ecological – 15, political – 16, values – 19 and legal – 13.

The next stage of the research process engaged a group of 35 stakeholders in the development of the town of Zambrów. Each stakeholder received a set of 121 STEEPVL factors that influence the town's development, constituting a research form. The task of the stakeholders was to select three, in their opinion most important, factors determining the development of the town of Zambrów in each of the seven groups of factors. As a result, the stakeholders selected 21 main factors, three most important ones for each area (with the highest number of indications). Table 2 presents a list of factors selected by the stakeholders.

Table 2. *Main factors of Zambrów town development*

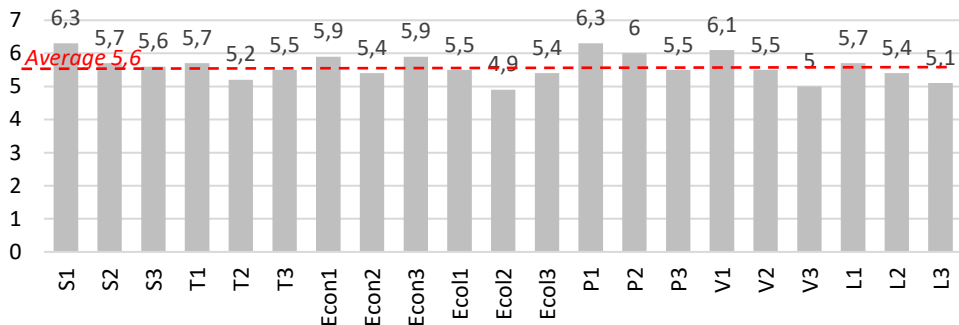
Acronym	Group of factors
SOCIAL FACTORS (S)	
S1	Urban labour resources
S2	Outflow of inhabitants from the town
S3	Population aging
TECHNOLOGICAL FACTORS (T)	
T1	Level of urban infrastructure development
T2	Level of infrastructure development for the needs of an ageing population
T3	Ability to create innovative products and services by entrepreneurs
ECONOMIC FACTORS (Econ)	
Econ1	Level of using external (including EU) financing by the town
Econ2	Cooperation between town authorities and business environment
Econ3	Level of urban economic development
ECOLOGICAL FACTORS (Ecol)	
Ecol1	Condition of natural environment (including air quality) in the town
Ecol2	Ecological awareness of inhabitants
Ecol3	Obtaining energy from unconventional sources
POLITICAL FACTORS (P)	
P1	Efficiency of town authorities
P2	Efficiency of town management system
P3	State policy on urban development
VALUES FACTORS (V)	
V1	Entrepreneurship of town inhabitants
V2	Openness of inhabitants to changes
V3	Healthy lifestyle
LEGAL FACTORS (L)	
L1	Clear and transparent legislation in Poland
L2	Stability of legal regulations in Poland
L3	Urban spatial development plans

Source: Own elaboration.

Next, the stakeholders received a form with 21 identified major factors determining the development of Zambrów town. Their task was to make a two-dimensional assessment the importance and the predictability of the impact of the factors on the development of the town of Zambrów in the perspective up to 2040. The evaluation was carried out with the use of a research questionnaire, in which the 7-level Likert evaluation scale was applied. Stakeholders assigned values between “1” and “7” to the factors, where “1” meant very low importance or predictability of the factor, and “7” very high importance or high predictability of the factor in the perspective until 2040. The level of predictability for further analysis was converted to an uncertainty level according to the relation 8 minus predictability level.

Average scoring of importance of particular factors in the perspective of 2040 ranged from 4.9 to 6.3 on a seven-level importance scale. Nine factors with values higher than the arithmetic mean in the studied group (5.6) included: S1 – urban labour resources (6.3), P1 – efficiency of town authorities (6.3), V1 – entrepreneurship of town inhabitants (6.1), P2 – efficiency of town management system (6.0), Econ1 – level of using external (including EU) financing by the town (5.9), Econ3 – level of urban economic development (5.9), S2 – outflow of inhabitants from the town (5.7), T1 – level of urban infrastructure development (5.7), L1 – clear and transparent legislation in Poland (5.7). The assessment of the importance of the remaining factors was equal to or lower than the arithmetic mean of importance assessments (5.6) in the whole group of factors. Factors that received the lowest scoring were: Ecol2 - ecological awareness of inhabitants (4.9) and V3 – healthy lifestyle (5.0) (Figure 4).

Figure 4. Assessment of the importance of STEEPVL factors determining the development of the town of Zambrów in the perspective until 2040



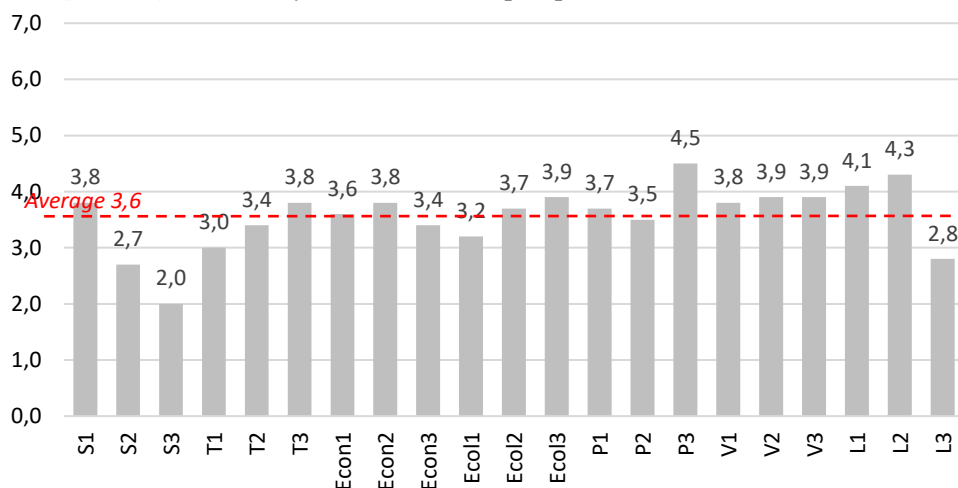
Source: Own elaboration.

The stakeholders considered the groups of social (5.9), political (5.9) and economic (5.7) factors to be the most important in the perspective until 2040. The lowest average value in terms of importance was obtained by the group of ecological factors (5.3). Among all 21 factors, the highest average score was given to factors S1 – urban labour resources (6.3) and P1 – efficiency of town authorities (6.3), and the lowest Ecol2 – environmental awareness of inhabitants (4.9).

When analysing the list of all the factors in terms of the uncertainty of their development in the perspective up to 2040, it can be observed that twelve of them have a higher uncertainty rating than the average for all factors (3.6). According to the stakeholders, the most uncertain factors influencing the development of the town of Zambrów are P3 – state policy on urban development (4.5), L2 – stability of legal regulations in Poland (4.3), L1 – clear and transparent legislation in Poland (4.1), Ecol3 – obtaining energy from unconventional sources (3.9), V2 – openness of inhabitants to changes (3.9), V3 – healthy lifestyle (3.9), S1 – urban labour resources (3.8), T3 – ability to create innovative products and services by entrepreneurs (3.8), Econ2 – cooperation of town authorities with business environment (3.8), V1 – entrepreneurship of city inhabitants (3.8), Ecol2 – environmental awareness of inhabitants (3.7), P1 – efficiency of town authorities (3.7).

Factors considered by the stakeholders to be highly predictable in the perspective up to 2040 (with the lowest uncertainty level) are: S3 – population ageing, (2.0), S2 – outflow of inhabitants from the town (2.7), L3 – urban spatial development plans (2.8), T1 – level of urban infrastructure development (3.0) (Figure 5).

Figure 5. Evaluation of the uncertainty of STEEPVL factors determining the development of the town of Zambrów in the perspective until 2040



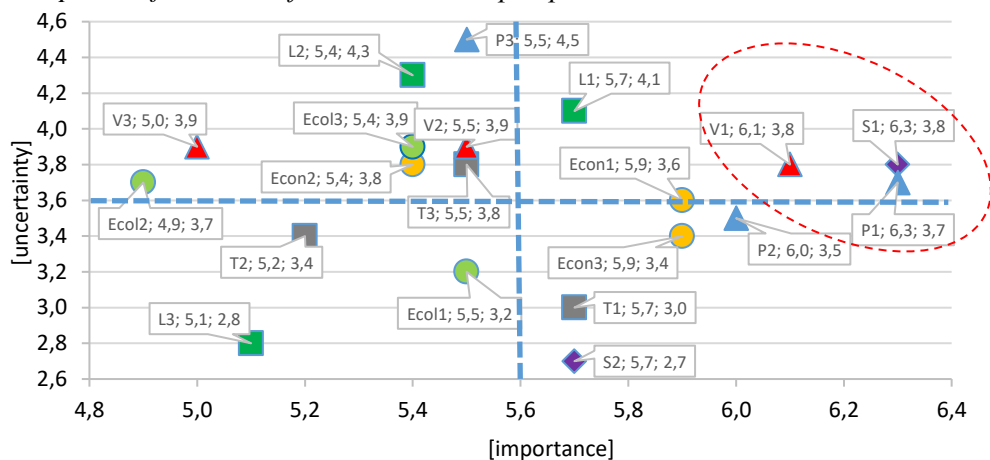
Source: Own elaboration.

In the opinion of stakeholders, the highest uncertainty in the 2040 perspective is shown by groups of political (3.9) and values factors (3.9), while the lowest, i.e. the highest predictability – the group of social factors (2.8). The highly uncertain factor in the 2040 perspective is P3 – state policy on urban development (4.5), and highly predictable (with the lowest uncertainty) S3 – population ageing (2.0).

The result of the research is the identification of factors that may be considered as driving axes determining the future development of the town of Zambrów. Such

factors are characterised by a high degree of importance and high uncertainty (low predictability) at the same time (Figure 6). Among all the considered factors, the stakeholders considered the following as factors of high importance and uncertainty determining the development of the town of Zambrów in the perspective up to 2040 S1 –urban labour resources, P1 –efficiency of town authorities, V1 –entrepreneurship of town inhabitants. However, on the basis of the obtained results it is not possible to unequivocally identify two factors of the highest values, both in terms of importance and uncertainty. In order to select them, a structural analysis was carried out, which made it possible to identify key factors from among all the factors influencing the analysed research area.

Figure 6. Importance and uncertainty of STEEPVL factors determining the development of the town of Zambrów in the perspective until 2040



Source: Own elaboration.

The next research stage entailed determining interrelations between 21 factors generated by the STEEPVL analysis. The strength of mutual influence of factors was assessed by a group of stakeholders on a four-level scale, where: 0 – no influence, 1 – weak influence, 2 –medium influence, 3 –strong influence. Each stakeholder's completion of the direct influence matrix form made it possible to identify relations between factors affecting a given research area (Table 3).

On the basis of individual interaction matrices completed by each stakeholder, a resulting matrix of mutual interactions of STEEPVL factors was prepared. Stakeholders participating in the study identified 441 relations between the factors (variables).

Values occurring in the resulting matrix were obtained on the basis of the dominant of stakeholder assessments with regard to influence forces of particular factors on other factors. Table 4 presents the degree of mutual influence of individual factors of Zambrów town development determined in this manner.

Table 3. Characteristics of the direct influence matrix

Indicator	Value
Dimension of the matrix	21
Number of zeros (no influence)	144
Number of 1s (weak influence)	155
Number of 2s (medium influence)	105
Number of 3s (strong influence)	37
Degree of completion	67%

Source: Own elaboration.

Table 4. Degree of mutual interaction of 21 factors of Zambrów town development

	S1	S2	S3	T1	T2	T3	Econ1	Econ2	Econ3	Ecol1	Ecol2	Ecol3	P1	P2	P3	V1	V2	V3	L1	L2	L3
S1	0	2	1	1	1	2	2	2	2	0	0	0	1	1	0	3	1	0	0	0	1
S2	2	0	1	1	1	2	1	0	2	0	0	0	2	1	0	3	1	0	0	0	0
S3	3	3	0	2	2	2	2	2	2	1	2	1	2	2	1	3	2	2	0	0	2
T1	1	1	1	0	3	1	2	0	1	1	1	2	2	0	0	2	1	1	0	0	2
T2	1	1	1	3	0	1	1	0	1	1	1	0	2	0	0	2	1	1	0	0	1
T3	2	1	0	1	1	0	3	1	3	1	0	0	1	0	0	3	1	1	0	0	0
Econ1	2	0	1	3	3	1	0	1	2	2	1	2	3	2	0	3	1	1	0	0	1
Econ2	1	1	0	1	1	2	2	0	2	1	1	1	3	1	0	3	1	0	0	0	2
Econ3	2	2	1	2	2	1	1	2	0	1	0	1	2	1	0	2	1	1	0	0	1
Ecol1	0	1	1	0	1	0	1	0	1	0	1	0	1	0	0	2	0	2	0	0	1
Ecol2	0	0	1	1	1	1	1	0	1	2	0	2	1	0	0	1	0	2	0	0	1
Ecol3	0	0	0	1	0	0	1	0	1	1	0	0	1	0	0	2	0	1	0	0	1
P1	2	2	1	3	3	2	3	3	3	2	2	2	0	3	1	2	1	1	1	0	3
P2	1	1	0	2	2	1	2	1	2	1	0	1	3	0	0	2	0	0	0	0	1
P3	2	1	0	2	2	1	2	1	2	2	1	1	2	2	0	2	0	1	2	2	3
V1	3	3	1	2	2	3	2	2	3	1	1	2	2	2	0	0	1	1	0	0	1
V2	2	2	0	1	1	1	1	1	1	0	1	1	2	1	0	3	0	2	0	0	0
V3	1	0	1	1	1	1	0	0	0	0	1	1	2	1	0	2	1	0	0	0	0
L1	2	0	0	1	1	1	2	1	2	2	1	1	3	3	2	3	1	0	0	3	2
L2	2	0	0	1	1	1	2	1	2	1	0	1	3	3	2	3	1	0	2	0	2
L3	1	0	0	1	1	1	0	1	2	2	0	2	2	2	0	2	0	1	0	0	0

Source: Own elaboration.

Total results of the calculations concerning influence forces and direct relations are presented in Table 5. The obtained results indicate that a strong direct influence on other factors is exerted by the following political factors P1 –efficiency of town authorities and P3 –state policy on urban development; among social factors S3 – population aging; values V1 –entrepreneurship of town inhabitants; legal L1 –clear and transparent legislation in Poland and L2 –stability of legal regulations in Poland; economic Econ1 – level of using external (including EU) financing by the town.

Factors most dependent on the other ones are those relating to values V1 – entrepreneurship of town inhabitants; political P1 – efficiency of town authorities; economic Econ3 – level of urban economic development and Econ1 – level of using external (including EU) financing by the town; social S1 – urban labour resources;

technological T1 –urban infrastructure development level and T2 –level of infrastructure development for the needs of an ageing population (Table 5).

Table 5. Total forces of direct influences between structural analysis factors

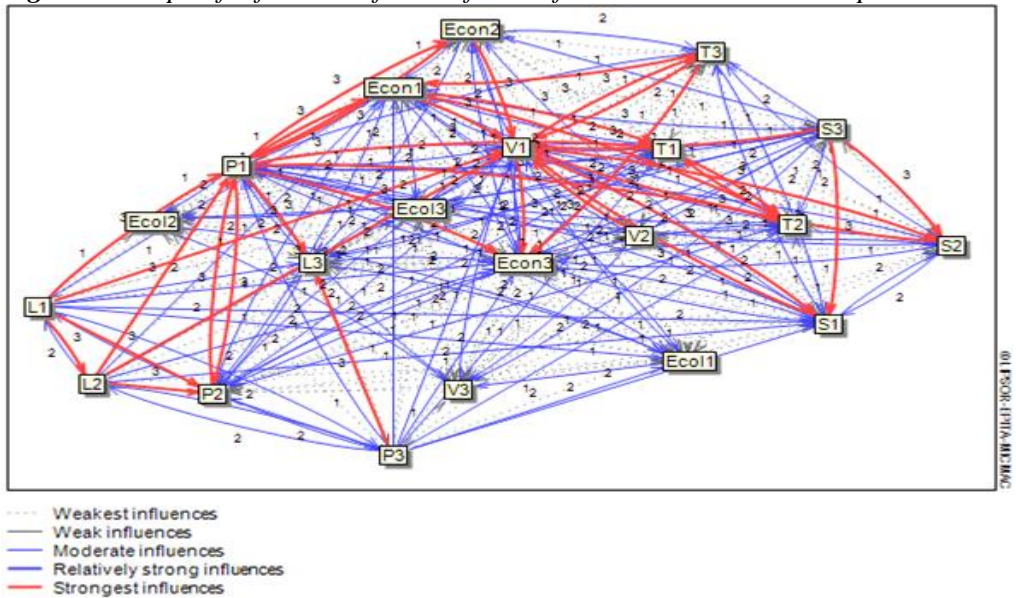
Acronym	Total influence	Total strength of dependence
S1	20	30
S2	17	21
S3	36	11
T1	22	30
T2	18	30
T3	19	25
Econ1	29	31
Econ2	23	19
Econ3	23	35
Ecol1	12	22
Ecol2	15	14
Ecol3	9	21
P1	40	40
P2	20	25
P3	31	6
V1	32	48
V2	20	15
V3	13	18
L1	31	5
L2	28	5
L3	18	25

Source: Own elaboration with the use of MIC-MAC software.

As part of the conducted analyses and with the use of MIC-MAC software, the authors created graphs to illustrate all direct interactions of the factors (Figure 7) and only strong direct influences of the distinguished factors (Figure 8). The analysis of the graphs indicates that the most strongly affected factors are those that are under strong influence of other factors: V1 – entrepreneurship of town inhabitants and P1 – efficiency of town authorities.

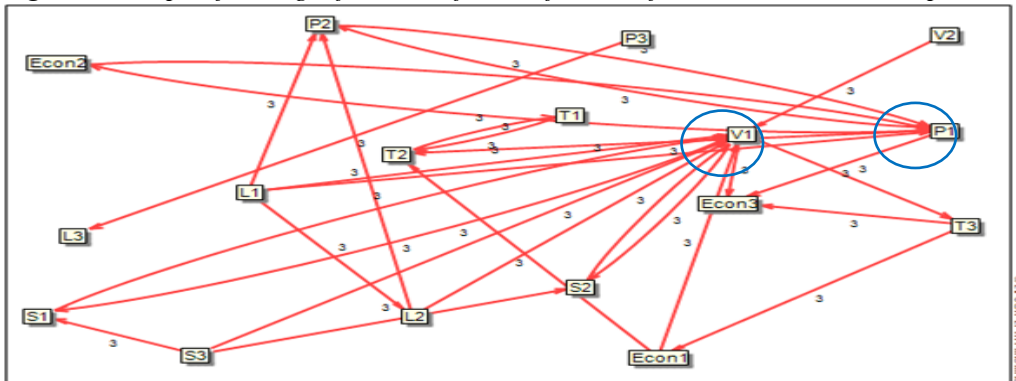
Factor V1 – entrepreneurship of town inhabitants affects S1 –urban labour resources, S2 –outflow of inhabitants from the town, Econ1 –level of using external (including EU) financing by the town, Econ3 –level of urban economic development. At the same time, its development is strongly dependent on such factors as V2 –openness of inhabitants to changes, S1 –urban labour resources, S2 –outflow of inhabitants from the town, S3 –population ageing, T3 –ability to create innovative products and services by entrepreneurs, L1 –clear and transparent legislation in Poland, L2 –stability of legal regulations in Poland (Figure 9).

Figure 7. Graph of influences of direct factors for Zambrów town development



Source: Own elaboration with the use of MIC-MAC software.

Figure 8. Graph of strong influences of direct factors of Zambrów town development



Source: Own elaboration with the use of MIC-MAC software.

Factor P1 –efficiency of town authorities has a strong direct influence on the development of factors P2 –efficiency of town management system, Econ2 - cooperation of town authorities with business environment, Econ3 –level of urban economic development, T2 –level of infrastructure development for the needs of an ageing population. At the same time, it belongs to the factors dependent on others. It is strongly influenced by factors: L1 –clear and transparent legislation in Poland, P2 – efficiency of town management system, Econ2 - cooperation of town authorities with business environment. Strong direct influences were not observed for four factors: Ecol1 – condition of natural environment (including air quality) in the town,

Ecol2 –ecological awareness of inhabitants, Ecol3 –obtaining energy from unconventional sources, V3 –healthy lifestyle.

In the next part of the conducted analyses, according to the methodology of structural analysis and using MIC-MAC software, the researchers broke down the factors on the influence-dependence plane (Figure 9). Thanks to that analysis, it was possible to separate groups of factors influencing the town's development into crucial, determinant (determinants), regulatory, supplementary, autonomic, aim and result as well as external factors.

The group of crucial factors includes two factors P1 – efficiency of town authorities, V1 – entrepreneurship of town inhabitants. One factor was included in the group of aim factors: Econ1 – level of using external (including EU) financing by the town.

The results of the system under examination are comprised of four factors S1 – urban labour resources, T1 – level of urban infrastructure development, T2 – level of infrastructure development for the needs of an ageing population, Econ3 – level of urban economic development.

Autonomic factors constitute Ecol1 – condition of natural environment (including air quality) in the town, Ecol2 – ecological awareness of inhabitants, Ecol3 – obtaining energy from unconventional sources, V3 – healthy lifestyle. The group of external factors may include: P3 – state policy on urban development, L1 – clear and transparent legislation in Poland, L2 – stability of legal regulations in Poland. The influence of those factors on the system is stronger than the influence of autonomic factors, and at the same time the influence of the system on these factors is small.

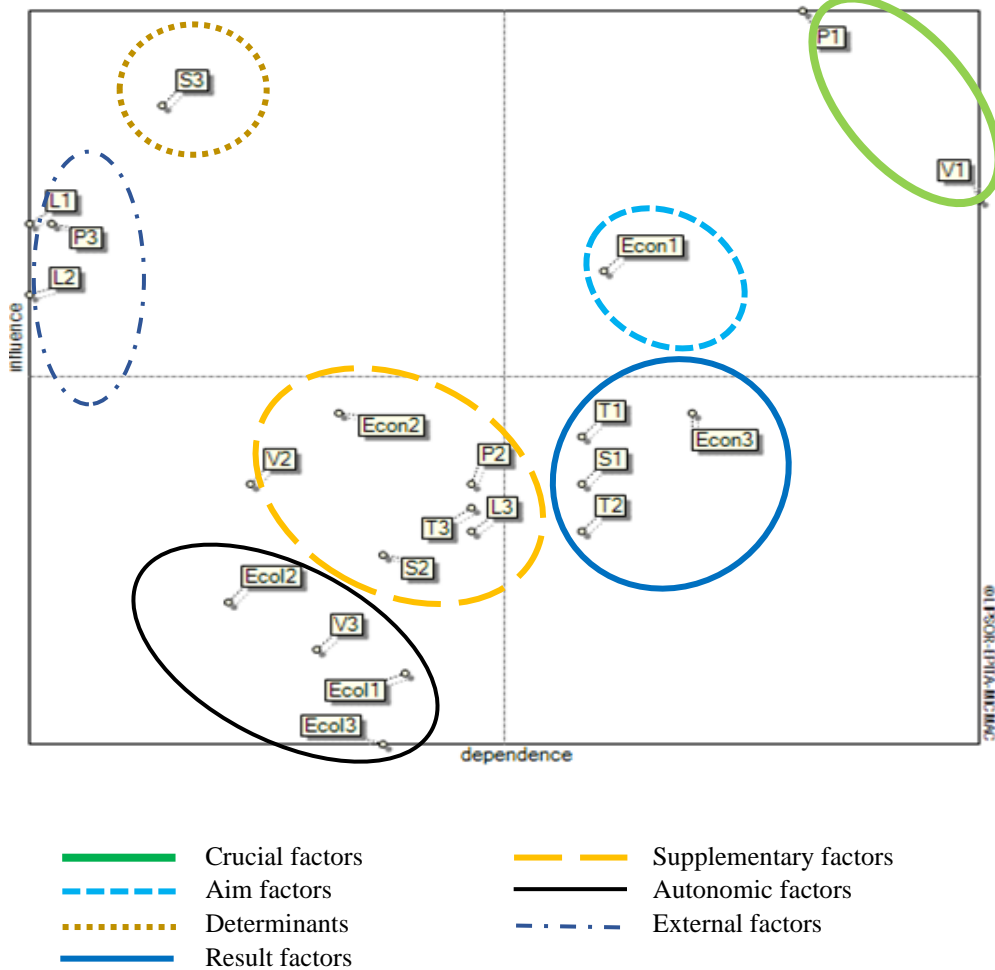
Supplementary factors are Econ2 – cooperation of town authorities with business environment, T3 – ability to create innovative products and services by entrepreneurs, P2 – efficiency of urban management system, L3 – urban spatial development plans, V2 – openness of inhabitants to changes, S2 – outflow of inhabitants from the town. However, the determinant of the examined system is factor S3 – population aging (Figure 9).

5. Conclusion

Cities striving for development need strategies that will make it possible, among other things, to socialise the vision of development or to identify trends affecting its activity as well as its social and economic condition. These visions can be successfully designed with the use of foresight methods which allow for identifying changes in the micro and macro environment, interpreting their influence on the city, and formulating a strategy that will ensure long-term city development. Foresight research uses a wide range of quantitative and qualitative methods of scientific and heuristic character, involving many stakeholders, successfully used in building a vision of the development of countries, regions, institutions and enterprises (Popper *et al.*, 2007;

Nazarko *et al.*, 2013; Ejdys and Nazarko, 2014; Szpilko, 2015; Ejdys *et al.*, 2019; Kozłowska, 2020).

Figure 9. Breakdown of structural analysis factors based on direct influences



Source: Own elaboration with the use of MIC-MAC software.

The results of the structural analysis indicate how a group of stakeholders perceives the system under investigation, i.e., the process of development of the town of Zambrów. The conducted structural analysis, based on the resulting direct and indirect influence matrices, made it possible to identify key factors which have a strong influence on other factors and are also strongly dependent on other factors. As part of the conducted research process two key factors were identified P1 – efficiency of town authorities, V1 – entrepreneurship of town inhabitants. At the same time, as a result of the STEEPVL analysis, the identified key factors were also considered to have the highest level of importance and uncertainty.

Factors P1 and V1, due to their strong influence and high degree of dependence on other factors, as well as a high level of importance and uncertainty of shaping in the long term, tend to be the driving forces of Zambrów town development.

The research carried out for the purpose of this paper brings several important issues to the subject of city management. Their main advantage is the application of a new approach to the identification of the driving forces of urban development with the use of STEEPVL and structural analysis methods belonging to the catalogue of foresight methods. An undisputable value of the conducted research is also the involvement of a wide range of local stakeholders in determining the vision of city development. Moreover, the research allows for the verification of the application of the indicated methods in relation to a small city, which is a novelty with regard to previous publications on foresight projects implemented exclusively in large and medium-sized cities.

At further stages of the research process, the authors plan to conduct research using the scenario method and Delphi. Their aim will be to test the usefulness of research methods in relation to city development planning. At the same time, with the use of current and planned research results, the authors intend to develop alternative scenarios for the development of the town of Zambrów in the perspective of 2040 and indicate the probability of their occurrence.

According to the authors, the application of foresight methods in the process of managing the future of cities may be a direction for further research, the results of which will constitute an important contribution to the area of local unit management. The research conducted for the purpose of this article has certain limitations. The main limitation concerns the use of the STEEPVL analysis and structural analysis methods only for one city. Another limitation is related to a high degree of complexity of the influence matrix of individual factors on one another which was completed by stakeholders. There is a risk that some stakeholders may have approached this task too superficially.

References:

- Ahvenniemi, H., Aapo, H., Pinto-Seppä, I., Airaksinen, M. 2017. What are the differences between sustainable and smart cities? *Cities*, 60(A), 234-245. Doi: 10.1016/j.cities.20.
- Anderson, J. 1997. Technology foresight for competitive advantage. *Long Range Planning*, 30(5), 665-677.
- Arcade, J., Godet, M., Meunier, F., Roubelat, F. 1994. Structural analysis with the MICMAC method and actors' strategy with Mactor method. Paris: AC/UNU Millennium Project Futures Research Methodology.
- Barker, D., Smith, D.J.H. 1995. Technology foresight using roadmaps. *Long Range Planning*, 28(2), 21-28.
- Bell, W. 1997. Foundations of Futures Studies. History, Purposes, and Knowledge. *Human Science for a New Era*, 1. Piscataway, Transaction Publishers.

- Bendyk, E., Król, J., Kuźmińska, A. (Eds.). 2018. *Foresight Lublin 2050*. Lublin, Urząd Miasta Lublin.
- Coates, J.F. 2000. From my perspective. *Scenario Planning. Technological Forecasting and Social Change*, 65(1), 115-123.
- Czajor, M., Koszewska, M., Król, J., Kuźmińska, A., Słupiński, M. 2015. What future for Konin? Konin, Pracownia Miejska.
- Czaplicka-Kolarz, K. (Ed.). 2007. *Scenarios of technological development of the fuel and energy complex to ensure national energy security*. Katowice, Główny Instytut Górnictwa.
- Ding, P. 2005. Envisioning local futures: the evolution of community visioning as a tool for managing change – an interview with consulting planner and futurist Steven Ames. *Journal of Futures Studies*, 9(4), 89-100.
- Dixon, T., Montgomery, J., Horton-Baker, N., Farrelly, L. 2018a. Using urban foresight techniques in city visioning: Lessons from the Reading 2050 vision. *Local Economy: The Journal of the Local Economy Policy Unit*, 33, 777-799.
- Dixon, T., Lannon, S., Eames, M. 2018b. Reflections on disruptive energy innovation in urban retrofitting: methodology, practice and policy. *Energy Research and Social Science*, 37, 255-259. Doi: 10.1016/j.erss.2017.10.009.
- Eames, M.A., Marvin, B., Hodson, M.B., Dixon, T., Guthrie P., Lannon, S. 2014. Briefing: Re-Engineering the City 2020-2050 – Urban Foresight and Transition Management. *Proceedings of the Institution of Civil Engineers: Urban Design and Planning*, 167(1), 1-4. Doi: 10.1680/udap.11.00032.
- Ejdys, J. 2013. Regional economic foresight. Scenarios for the local development of the Mazowieckie province. Warszawa, Związek Pracodawców Warszawy i Mazowsza.
- Ejdys, J., Gudanowska, A., Halicka, K., Kononiuk, A., Magruk, A., Nazarko, J., Nazarko, Ł., Szpilko, D., Widelska, U. 2019. Foresight in Higher Education Institutions: Evidence from Poland. *Foresight and STI Governance*, 13, 77-89. Doi: 10.17323/2500-2597.2019.1.77.89.
- Ejdys, J., Halicka, K., Nazarko, Ł., Kononiuk, A., Olszewska, A.M., Nazarko, J. 2017. Factor analysis as a tool supporting STEEPVL approach to the identification of driving forces of technological innovation. *Procedia Engineering*, 182, 491-496. Doi: 10.1016/j.proeng.2017.03.142.
- Ejdys, J., Nazarko, Ł. 2014. Economic foresight – an instrument of orientation for the future. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 340, 651-664.
- European Commission (EC). 2011. *Cities of tomorrow Challenges, visions, ways forward*, Brussel, Directorate General for Regional Policy.
- Gavigan, J.P., Scapolo, F., Keenan, M., Miles, I., Farhi, F., Lecoq, D., Capriati, M., Di Bartolomeo, T. 2001. *A Practical Guide to Regional Foresight*, Report EUR 20128 EN, Foresight for Regional Development Network (FOREN). European Communities. Available online: <http://foresight.jrc.ec.europa.eu/documents/eur20128en.pdf> [15.08.2019].
- Glińska, E. 2013. Foresight as an urban management tool. *Przedsiębiorczość i Zarządzanie*, 14(13), 79-96.
- Godet, M. 1994. *From anticipation to action: A handbook of strategic prospective*. Paris, UNESCO Publishing.
- Gould, S. 2005. Maroochy 2025 Community Visioning & Action: A Case Study of Anticipatory Action Learning Practices in Use Within Maroochy Shire, Queensland, Australia. *Journal Futures Studies*, 10(1), 125-131.

- Government Office for Science (GOS). 2016. Future of Cities: Foresight for Cities. A resource for policymakers. London. Available online: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/516443/gS-16-5-future-cities-foresight-for-cities.pdf.
- Gudowsky, N., Sotoudeha, M., Caparia, L., Wilfing, H., 2017. Transdisciplinary forward-looking agenda setting for age-friendly, human centred cities. *Futures*, 90, 16-30.
- Guell, J.M.F., Redondo, L. 2012. Linking territorial foresight and urban planning. *Foresight*, 14, 316-335. Doi: 10.1108/14636681211256107.
- GUS – Główny Urząd Statystyczny (Central Statistical Office). 2020. Available online: <https://stat.gov.pl/> [15.02.2020].
- Jakuszewicz, I., Kononiuk, A., Magruk, A., Nazarko, J. 2006. Foresight initiatives in Poland and in the world. In Kiełtyka, L. (Ed.). *Multimedia in business and education organizations*. Warsaw, Difin.
- Kamińska, K., Pięta-Kanurska, M., Snitsaruk, A. (Ed.). 2016. *Wrocław. Reverse. Scenarios for the city of the future Social Foresight Wrocław 2036/2056*. Wrocław, Miasto Przyszłości, Laboratorium Wrocław.
- Keenan, M., Miles, I. 2001. *A Practical Guide to Regional Foresight*, Institute for Prospective Technological Studies. Seville, FOREN Network.
- Keenan, M., Miles, I., Koi-Ova, J. (Eds.). 2003. *Handbook of Knowledge Society Foresight*. Dublin, European Foundation for the Improvement of Living and Working Conditions.
- Khanna, P. 2019. When cities rule the world. Available online: <https://www.mckinsey.com/featured-insights/urbanization/when-cities-rule-the-world> [23.06.2019].
- Klasik, A., Kuźnik, F. 2019. Foresight studies as a basis for the strategic policy of an urban region. In Klasik, A., Kuźnik, F., Ochojski, A. (Eds.). *The future of the metropolis and urban region*. Katowice, Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach.
- Klasik, A., Wrana, K. 2019. Attractiveness and competitiveness as pillars of sustainable urban development. *Biuletyn, KPZK PAN*, 273, 97-121.
- Kononiuk, A. 2010. The application of STEEPVL analysis in the project Technology foresight «NT FOR Podlaskie 2020». *Regional strategy of nanotechnology development. Ekonomia i Zarządzanie*, 2(4), 105-115.
- Kononiuk, A., Magruk, A. 2008. Review of research methods and techniques used in foresight programmes. *Nauka i Szkolnictwo Wyższe*, 2(32), 28-40.
- Kozłowska, J. 2020. Servitization of manufacturing: survey in the Polish machinery sector. *Engineering Management in Production and Services*, 12(1), 20-33.
- MIR – Ministry of Infrastructure and Development. 2015. *National Urban Policy 2023*. Warszawa. Available online: https://www.funduszeuropejskie.gov.pl/media/74967/Krajowa_Polityka_Miejska_2023.pdf [15.03.2019].
- Król, J. 2018. *Rustavi 2050. Final report*. Rustavi: Pracownia Miejska (Urban Workshop).
- Kuciński, J. 2006. *Organisation and implementation of foresight projects in the light of international experience*. Warszawa, Instytut Podstawowych Problemów Techniki PAN.
- LaColla, A. 1999. *Atlanta VISION 2020: the process and citizen participation a case study*. Atlanta, URP 5122.

- Loveridge, D. 2002. The STEEPV acronym and process – a clarification, Ideas in Progress. Paper Number 29. Manchester: The University of Manchester, PREST Policy Research in Engineering, Science and Technology.
- Loveridge, D., Saritas, O. 2009. Reducing the Democratic Deficit in Institutional Foresight Programmes: A Case for Critical Systems Thinking in Nanotechnology. *Technological Forecasting and Social Change*, 76(9), 1208-1221.
- Loveridge, D., Street, P. 2005. Inclusive foresight. *Foresight*, 7(3), 31-47.
- Magruk, A. 2011. Innovative classification of technology foresight methods. *Technological and Economic Development of Economy*, 17(4), 700-716. Doi: 10.3846/20294913.2011.649912.
- Mahmud, J. 2011. City foresight and development planning case study: Implementation of scenario planning in formulation of the Bulungan development plan. *Futures*, 43(7), 697-706. Doi: 10.1016/j.futures.2011.05.011.
- Martin, B.R. 1993. Research foresight and the exploitation of the science base. London, Office of Science and Technology, HMSO.
- Mazurkiewicz, A., Poteralska, B. 2009. Sustainable Development of Poland. In Kleer, J., Wierzbicki, A. (Eds.). National Foresight Programme „Poland 2020”. Discussion of the assumptions of the scenarios, Foresight Committee “Poland 2000 Plus” at the Presidium of the Polish Academy of Sciences. Warszawa, Warszawska Drukarnia Naukowa Polskiej Akademii Nauk.
- Mendonça, S., Cunha, M.P., Kaivooja, J., Ruff, F. 2004. Wild cards, weak signals and organisational improvisation. *Futures*, 36(2), 206-207.
- Miles, I. 2002. Appraisal of Alternative Methods and Procedures for Producing Regional Foresight, Contribution to: Mobilising the Regional Foresight Potential. Available online: <http://pl.scribd.com/doc/36405036/Appraisal-of-Alternative-Methods-for-Foresight#scribd> [15.03.2019].
- MPiT – Ministry of Enterprise and Technology. 2018. Implementation of the Sustainable Development Goals in Poland Report 2018. Available online: https://www.mpit.gov.pl/media/54729/Raport_VNR_wer_do_uzgodnien_20180330.
- Nazarko, J. 2013. Regional economic foresight. Methodology and research instruments. Warszawa, Związek Pracodawców Warszawy i Mazowsza.
- Nazarko, J., Ejdyś, J., Halicka, K., Nazarko, Ł., Kononiuk, A., Olszewska, A.M. 2017. Structural analysis as an instrument for identification of critical drivers of technology development. *Procedia Engineering*, 182, 474-481. Doi: 10.1016/j.proeng.2017.03.137.
- Nazarko, J., Glinska, U., Kononiuk, A., Nazarko, Ł. 2013. Sectoral foresight in Poland: thematic and methodological analysis. *International Journal of Foresight and Innovation Policy*, 9(1), 19-38.
- Nazarko, J., Kędzior, Z. (Eds.). 2010. Conditions for development of nanotechnology in Podlaskie Voivodeship. Results of STEEPVL and SWOT analyses. Białystok, Oficyna Wydawnicza Politechniki Białostockiej.
- Nazarko, J., Kononiuk, A. 2013. The critical analysis of scenario construction. *Technological and Economic Development of Economy*, 19, 510-532.
- Nazarko, J., Wnorowski, H., Kononiuk, A. (Eds.). 2011. Structural analysis of factors of nanotechnology development in Podlaskie Voivodeship. Białystok, Oficyna Wydawnicza Politechniki Białostockiej.
- Paskaleva, K., Cooper, I., Linde, P., Peterson, B., Götz, C. 2015. Stakeholder Engagement in the Smart City: Making Living Labs Work. In Rodríguez-Bolívar, M. (Ed.). *Transforming City Governments for Successful Smart Cities*. Public Administration

- and Information Technology. Cham, Springer International Publishing. Doi: 10.1007/978-3-319-03167-5_7.
- Pereira, G.V., Cunha, M.A., Lampoltshammer, T.J., Parycek, P., Testa, M.G. 2017. Increasing collaboration and participation in smart city governance: A cross-case analysis of smart city initiative. *Information Technology for Development*, 23(3), 526-553. Doi: 10.1080/02681102.2017.1353946.
- Popper, R., Keenan, M., Miles, I., Butter, M., Sainz, G. 2007. *Global Foresight Outlook 2007*. The European Foresight Monitoring Network.
- Ravetz, J., Miles, I.D. 2016. Foresight in cities: on the possibility of a “strategic urban intelligence”. *Foresight*, 18, 469-490. Doi: 10.1108/FS-06-2015-0037.
- Ringland, G. 2007. *UNIDO Technology Foresight for Practitioners. A Specialised Course on Scenario Building*. Prague.
- Salmenkaita, J.P., Salo, A. 2004. Emergent foresight processes: industrial activities in wireless communications. *Technological Forecasting and Social Change*, 71(9), 897-912.
- Sikora-Fernandez, D. 2018. Smarter cities in post-socialist country: Example of Poland, *Cities*, 78, 52-59. Doi: 10.1016/j.cities.2018.03.011.
- Stawasz, D., Sikora-Fernandez, D. 2015. Management in Polish cities in accordance with the smart city concept. *Warszawa, Placet*.
- Szpilko, D. 2014. Structural analysis of the interactions between the factors of development of tourism in the podlaskie province. *Problemy Eksploatacji*, 4, 109-122.
- Szpilko, D. 2015. The Future of Tourism Development in the Podlaskie Voivodeship. *Procedia - Social and Behavioral Sciences*, 213, 977-984. Doi: 10.1016/j.sbspro.2015.11.514.
- Szpilko, D. 2020. Foresight as a Tool for the Planning and Implementation of Visions for Smart City Development. *Energies*, 13(7), 1782, Doi: 10.3390/en13071782.
- Szymańska, D. 2007. *Urbanization in the world*. Warszawa, Wydawnictwo Naukowe PWN.
- UNDP – Global Centre for Public Service Excellence. 2014. *Foresight as a strategic long-term planning tool for developing countries*, Singapore, UNDP.
- UNIDO – United Nations Industrial Development Organization. 2005. *Technology Foresight Manual. Organization and Method Volume 1*. Vienna, UNIDO.
- United Nations. 2019. *World Urbanization Prospects 2018: The 2018 Revision (ST/ESA/SER.A/420)*. New York, Department of Economic and Social Affairs.
- Webster, A. 2002. Foresight as a tool for the management of knowledge flows. *Proceedings of the strata consolidating workshop*. Brussels.
- Winkowska, J., Szpilko, D., Pejić, S. 2019. Smart city concept in the light of the literature review. *Engineering Management in Production and Services*, 11(2), 70-86. Doi: 10.2478/emj-2019-0012.
- Wójcicki, J.M., Ładyżyński, P. (Eds.). 2008. *Monitoring system and scenarios of medical technology development in Poland*. Warszawa, Konsorcjum ROTMED.
- Ziółkowski, B. 2009. *Foresight in the strategic development of the region's eco-innovation – first experiences of Poland*. Rzeszów, Wydawnictwo i Drukarnia Diecezji Rzeszowskiej.