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Methodology for Integration of Smart City Dimensions in the Socialised Process of Creating City Development

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Abstract:

Purpose: *The purpose of this article is to develop a methodology for integration of smart city dimensions in the socialized process of creating city development.*
Design/Methodology/Approach: *For achieving the objective of this study, a foresight research was proposed. The presented methodology consists of five phases. The paper discusses in detail the operationalisation of each phase of the methodology in which the following main methods were used: desk research, factors analysis, (social (S), technological (T), economic (E), ecological (E), political (P), relating to values (V) and legal (L) (STEEPVL)), Delphi, scenarios, mactor method, social impact assessment (SCI).*
Findings: *In the vast majority of publications, the authors attempted to define the concept of "smart city" focus only on the technological aspect. Such approach does not take into account all dimensions of smart city and thus does not consider the multifaceted and multi-variant nature of the smart city. This article presents numerous barriers hindering the implementation of smart city concept. In the contemporary perception of the smart city concept, there is a return to the needs and preferences of the inhabitants. The answer to these needs seems to be urban foresight, the essence of which is to create and build a vision of the future in cooperation with the city authorities and a wide range of stakeholders forming the local community.*
Practical implications: *The proposed methodology would be a practical contribution to the development of smart city implementation.*
Originality/Value: *Foresight research methodology has not been developed yet, taking account the integration of all dimensions of the smart city concept.*

Keywords*: Smart city, smart city dimensions, foresight.*

JEL codes: *R11, R58, O18.*

Paper Type: *Research paper.*

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1. Introduction

Contemporary cities around the world are constantly changing their structure and economic position in a network of urban centres (Stawasz and Sikora-Fernandez, 2016). The development of cities is determined by the constantly growing migration of people from rural to urban areas (Winkowska *et al.*, 2019). Over the last few years, the development of smart and sustainable cities has become a global trend. The smart city concept is present to solve complex problems and challenges that arise in contemporary cities (Roychansyah and Sushardjanti Felasari, 2018). Among the problems of modern urban areas, the following stand out: out-of-control sprawl of cities (Kovács *et al.*, 2019; Halmy, 2019; Yu *et al.*, 2019; Mahmoud and Divigalpitiya, 2019), environmental pollution (Caparros-Midwood *et al.*, 2019; Alam *et al.*, 2019; Munoz-Pandiella *et al.*, 2018; Kosheleva *et al.*, 2018), waste management (Bugge *et al.*, 2019; Amritha and Kumar, 2019; Dlamini *et al.*, 2019), ageing society (Jayantha *et al.*, 2018; Fang and Lai, 2018; Onoda, 2018; Greenfield, 2018; Jarocka and Wang, 2018), disparities in wealth levels (areas of poverty and deprivation), (Muktiali, 2018; Lanjouw and Marra, 2018; Ma *et al.*, 2018; Aguilar and López, 2016), urban logistics (Nataraj *et al.*, 2019; Firdausiyah *et al.*, 2019; Bjørgen *et al.*, 2019; Cleophas *et al.*, 2019; Faramehr *et al.*, 2019; Mesjasz-Lech, 2014; Tomaszewska and Florea, 2018), technical infrastructure (Petrova and Prodromidou, 2019; Faramehr *et al.*, 2019; Pham and Phan, 2018), low participation of residents in managing public issues (Mavrodieva *et al.*, 2019; Sou, 2019; van Holm, 2019; de Castro Pena *et al.*, 2017).

Cities need to be managing in a manner that drives economic development, as well as ensuring social cohesion and environmental sustainability (Aletà *et al.*, 2016). Building a smart city is a long-term process and requires rethinking the way all its system areas function (Stawasz and Sikora-Fernandez, 2016). Currently, urban projects are categorized according to six clusters known as dimensions: Mobility, Environment, Government, Economy, People and Life (Aletà *et al.*, 2016). The authors of this study presents the methodology for integration of smart city dimensions in the socialised process of creating city development.

2. Theoretical Background

2.1 Smart City

Reviewing the literature, it was noticed that numerous attempts were made to formulate a definition of a smart city. There are many alternative terms for smart city concept, such as: “digital city” (Tan, 1999), “information city” (Fietkiewicz *et al.*, 2017; Sproull and Patterson, 2004; Stolfi and Sussman, 2001), “wired city” (Targowski, 1990), “sensing city” (Mone, 2015), “ubiquitous city” (Shin, 2009). In the great majority of publications, authors try to define the concept of a smart city concentrated on the technological aspect (Winkowska *et al.*, 2019). For example, Guo *et al.* (2017) stated that a smart city is urban development based on the

integration of multiple information and communication technology (ICT) solutions to manage the city's resources. In turn, Peng *et al.* (2017) defined a smart city as a city that uses a set of advanced technologies, such as wireless sensors, smart meters, intelligent vehicles, smartphones, mobile networks or data storage technologies. These definitions of a smart city highlight the role of technology.

However, a city cannot become smart just because of technology (Nam and Pardo, 2014). Ortiz-Fournier *et al.* (2010) included inhabitants in the definition of a smart city. Therefore, citizens and residents should be at the heart of the design of smart urban solutions. They will be the end users and the solutions must have beneficial effects on their daily lives. Strategies that involve many stakeholders, including end-users in cooperation aimed at co-creating common benefits is now increasingly used in development, new solutions for smart cities (Paskaleva *et al.,* 2015; Pereira *et al.,* 2017).

Smart City is a city that is able to use human resources, social capital and information and communication technologies (ICT) to achieve sustainable economic growth and high quality of life, with wise management through community involvement (Caragliu *et al.,* 2009). Smart City is a leading city in the economy, human resources, government, mobility, environment and social life, which is built in a completely intelligent, independent and people-conscious way. The six major key indicators for implementing smart cities are: smart economy, smart environment, smart mobility, smart living, smart people, smart governance (Kurniawiati *et al.,* 2019). The smart economy involves several elements, in particular the creation of innovation clusters, mutual collaboration between businesses, research units and citizens, whose role is to develop and promote innovation through the concept of the smart economy (Bakici *et al.,* 2013).

Smart environment can be seen on the basis of attractiveness of natural conditions (climate, accessibility of green open space, etc.), pollution, resource management, as well as environmental efforts (Giffinger, 2007). Smart mobility aims to find innovative and sustainable ways to ensure the mobility of people in cities – by developing clean public transport, technology-supported fuels and propulsion systems and citizens' proactive behavior (Neirotti *et al.,* 2014). Smart living covers a number of actions that improve the quality of life, such as cultural, educational and tourism events, and highlight the quality of the health care system (Hameed, 2019). Smart people are the inhabitants of the smart city and they are highly educated and intelligent, allowing them to create "smart technologies" and to use them actively. Customised and creative thinking, high intellect and a willingness to work in innovative sectors of the economy is also an unquestionable attribute of smart people living in a smart city (Mishchenko *et al.,* 2018). Smart governance is crucial for the improvement of governance systems, engaging different stakeholders, ensuring a level playing field for the involvement of citizens and transparent information for appropriate information exchange mechanisms (Kourtit, 2012).

According to some business and political discourses, a smart city seems to be the city of the future (Molpeceres Arnáiz, 2017). Presently, the concept of the smart city appears not only on the discussion level, but also in some cases cities have entered the implementation phase. Many of the promised profits will be realised for city dwellers if the city applies the concept. On the other hand, many professionals and scientists still have doubts about the city's readiness to apply the concept (Roychansyah and Felasari, 2018), due to certain barriers hindering its implementation (Dohler *et al.*, 2011). From among the challenges that occur when implementing the smart city concept, several are distinguished (Ravetz, 2017; Naphade *et al.*, 2011; Krukowska, 2018; Winkowski, 2019; Proseedmag, 2017; What are the..., 2018; Sikora-Fernandez, 2017; Bashynska and Dyskina, 2018):

- excessively focused on investing in advanced technologies without real perception of urban conflicts and problems;
- changes relating to the adoption of the smart city concept, which are mainly technological in nature, may have a negative impact on the loss of the existing nature and unique appeal of certain agglomerations, in particular those valued for their traditional character;
- the application of smart technologies in cities with a complex set of societal problems can contribute to the deepening of social inequalities;
- incorrectly or unintentionally used services by so-called digital illiterates can result in many personal and systemic damages;
- cities provided with modern technologies, e.g. in the field of housing, or newly built, do not attract the attention of the residents because of high costs of living and lack of social ties;
- most investments in the development of the smart city concept concentrate on the creation of new facilities instead of the modernization of old ones;
- the infrastructure development of a smart city requires huge investments, which are indirectly borne by the citizens (e.g. in the form of a higher tax rate or at the cost of abandonment of other, more desirable undertakings by the inhabitants);
- the lack of a holistic view of cities in terms of meeting needs in all areas of their functioning;
- the lack of solutions for involving the local community in the city co-management;
- urban management is a great challenge and requires, above all, intelligence, responsibility and wisdom, which cannot be replaced by modern technologies.

Cities now need to start the transformation process by formulating strategies to tackle these challenges. It is essential, therefore, to manage and plan for city development by promoting economic growth and competitiveness, while preserving social cohesion and environmental sustainability. This includes many stakeholders, a high level of interdependence and different areas of activity, objectives and social

and political complexity, and therefore a holistic and multidisciplinary approach is needed (Aletà *et al.*, 2016).

2.2 Foresight

In the light of the identified barriers to the implementation of smart cities, there is a need to develop a comprehensive approach to the process of implementing the smart city concept in cities based on a multi-faceted and multi-variant vision of the future. Anticipating the future by taking into account the variability and variability of the environment enables foresight (Nazarko and Kononiuk, 2014). Among many definitions of foresight, the most suitable one in the context of the city is, according to the authors, the definition developed within the FOREN (Foresight for Regional Development Network) project, whereby foresight is seen as a systematic, participatory process of building a medium- and long-term vision of the future directed at today's decisions and mobilisation for joint activities (Keenan and Miles, 2001). In the context of this definition, five main elements of foresight were also identified: anticipation and design of the future, participation, social networks, strategic vision and current decisions and action (Gavigan *et al.*, 2001). Saritas and Loveridge (2009) point to the need to involve new stakeholder groups in research, going beyond traditional research experts. Cassingen Harper also attaches great importance to the issue of participation and consensus building. This distinguishes foresight from other approaches focused on exploring the future (UNIDO, 2005).

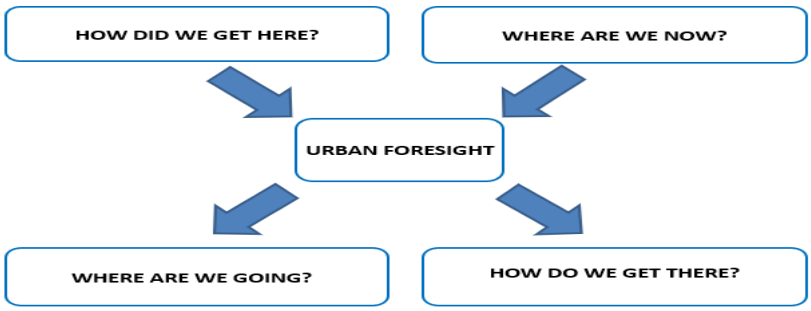
It is assumed in the literature that the aim of foresight is to indicate and assess future needs, opportunities and threats related to social, economic and technological development, as well as to prepare appropriate anticipatory actions concerning science and technology, taking into account more general social, economic and technological conditions (Kuciński, 2010). Foresight objectives are achieved using a variety of tools and methods, both strictly scientific and heuristic, based on expert intuition. The iterative nature of the process means that foresight can be treated as a permanent approach to thinking about the future and function as a useful tool when trying to manage it (Magruk and Jańczuk, 2009; Szpilko, 2016). The purpose of the foresight process is to simultaneously implement three intentions: to rethink the future, conduct a specialist debate on it and formulate recommendations for actions to shape the future (thinking, debating, shaping), (Kuciński, 2010). The foresight process broadens the perception of the future in all four ways. First, it helps to assess the consequences of current actions and decisions. Secondly, it helps to detect problems before they occur and avoid them. Thirdly, it helps to consider the current consequences of possible future actions. Finally, it helps to determine the characteristics of the desired scenario for the future (Brown *et al.*, 2010).

The practice of foresight research takes into account the different objectives, the environment in which it is carried out, the factors of influence, etc. Therefore, there are different types and forms of foresight. Among the types used in practice and most common in the world literature, technological and regional foresight is the

most popular (Safin, 2011). Regional foresight is about creating a vision of development in a territorially limited space. The main advantage of regional foresight is a large, both practical and theoretical knowledge of the project participants about the situation in the region, its potential, conflicts and economic or institutional barriers. The level of this knowledge increases in local space - the city, where it is easier to identify the determinants of human behaviour and reaching consensus (http://www.foresight.pl/foresight-regionalny.html).

Initiating the foresight process of the city, Ames suggests the following key questions (Figure 1):

Figure 1. *Key questions in the process of planning urban development using foresight*



Source: *Authors' elaboration on the basis of 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), pp. 89–100.*

The background for foresight at city level was the first clear attempts to combine research on the future, urban research and ecological thinking with with parallel agendas for analysis of complex systems, innovation, transition and technology assessment (Ravetz and Miles, 2016). As a result, many "video planning" activities in the USA and the United Kingdom emerged during this period. In the USA, the involvement of stakeholders and their participation in a common vision (for example Atlanta Vision 2020) started to be promoted. In the UK, on the other hand, a vision of Glasgow was created, described as an example of a co-created vision of the city (Dixon *et al.*, 2018). Urban foresight focuses on the need for a coherent vision of the city to plan and manage future long-term changes and create opportunities for new investments in the local urban economy (Dixon *et al.*, 2018).

In the literature can be found examples of urban foresight, which were conducted in different contexts. Marvin (2000) describes British urban foresight, which was carried out in order to build a future vision of urban management. The projects developed a new integrated policy framework that can shape the future of cities as

centres of human activity based on common principles, economic strength, environmental responsibility and social well-being. In turn, Gould (2005) describes the case study Maroochy 2025 Community Visioning and Action, in which the use of foresight research was aimed at creating a strong social response to the challenges posed by the significant demographic changes resulting from the expected dynamic population growth. Guell and Redondo (2012), on the example of Spanish cities, indicate a number of benefits of using foresight tools for urban planning. In turn, Eames *et al.* (2014), describe the background and conceptual framework of the interdisciplinary Urban Foresight and Transition Management (Retrofit, 2050) project, which aims to address climate change and resource constraints.

Gudovsky *et al.* (2017) present the use of urban foresight to plan the future of cities that should be adapted to the needs of an ageing population. Dixon *et al.* (2018) propose to use foresight research to identify the consequences of breakthrough innovations for the urban energy sector. Mahmud (2011) in his publication presented the case study Bulungan Development Plan (2002), which aimed to formulate a 25-year vision of the city. Based on the scenarios built up, stakeholders formulated a vision of the city's preferred future: Excellence in the agricultural industry supported by qualified human resources. The project summary showed that in contrast to traditional forecasts or market research, foresight methods, especially scenario planning, are an appropriate and effective planning tool for integrated regional development.

3. Materials and Methods

In the search for relations between urban foresight and the concept of smart city, attention is drawn in the literature to the growing interest of urban leaders and local stakeholders in "smart city" initiatives, which widely use technology to solve urban problems (Fernandez-Guell *et al.*, 2016). Complexity, diversity and uncertainty are the three key attributes of modern cities (Fernandez-Guell *et al.*, 2016) that hinder conceptual and technical progress in such initiatives. Many publications point to the need to develop an integrated and holistic approach to smart cities (Chourabiet *et al.*, 2012; Perboli *et al.*, 2014; Gil-Garcia *et al.*, 2015). In fact, the concept is evolving from a simple integration of technology in the city to the development of solutions to urban challenges in an interconnected and synergistic way (Lombardi *et al.*, 2012; Mattoni *et al.*, 2015).

The processes that support the development, change and daily functioning of cities are complex and as such urban environments should be seen as complex sociotechnical systems (Elzen *et al.*, 2004). In the publications, it is stressed that new approaches that integrate urban change and involve a wide range of stakeholders and actors both in defining the problem and in finding solutions and conditions to develop common visions should be identified (De Laurentis *et al.*, 2018). The answer to these needs seems to be urban foresight, the essence of which is to create and build a vision of the future in cooperation with the city authorities

and a wide range of stakeholders forming the local community. Due to the identified problems related to the implementation of the smart city concept in cities, in the opinion of the authors there is a need to include foresight research into the process of planning the future of smart cities. The tools and methods for future research have a wide range of applications. It therefore seems appropriate to develop a foresight methodology for planning the future of a smart city in which citizens are both users and co-creators of smart cities.

In the opinion of Magruk (2012), in foresight projects the method of research methodology selection is neither unambiguous nor systematic. The criteria for the selection of research methods and their configuration are very rarely reliably justified and explained. The selection of methods is a task that should not be undertaken by simply copying the methods used in previous studies (Eerola and Miles, 2011). The use of any method in foresight projects must always be reinforced by an in-depth knowledge of the foresight process itself, which is influenced by many factors (Slaughter, 2004). Only a considered combination of methods can result in positive foresight results (Aaltonen and Sanders, 2006). Foresight projects are carried out with the use of various tools and methods forming its research instrumentarium. They are created by system as well as analytical, algorithmic and heuristic, quantitative and qualitative methods. The set of methods that are used in the foresight process is currently very diverse and as a result of continuous development of foresight is still open (Nazarko, 2013). While selecting methods for a particular foresight study, it is important to maintain the principle of triangulation, i.e. making the study more reliable, resulting from considering different methods or different perspectives. Triangulation is usually distinguished (Nazarko 2013):

- data – consists in using various sources, in foresight projects based on the expertise should involve researchers from different research centres;
- researchers – involving a wide variety of specialists from a variety of backgrounds: scientific, political, business, business environment institutions and the media according to the structure adopted;
- theoretical – involving the participation of experts from as many scientific disciplines as possible or using different theories to interpret the collected research material;
- methodological – which consists in using multiple research methods to assess the same phenomenon.

Based on the review and analysis of the literature on the concept of smart city and foresight, including in particular urban foresight, it can be concluded that there is a need to integrate foresight studies into the process of creating smart cities. Its satisfaction requires the development of a methodology for creating the development of a smart city based on foresight studies. In order to achieve such a goal it is necessary to acquire new knowledge, resulting from the identified research gap:

- The current state of research indicates that the implementation of the smart city concept in cities is poorly embedded in a multi-faceted and multi-variant vision of the future.
- The foresight research methodology has not been developed yet, taking into account the integration of all dimensions of the smart city concept.

The initial assumptions for the research were formulated as two research hypotheses:

- Integration of the main dimensions of the smart city concept in urban foresight studies can be achieved through the identification and involvement of stakeholder groups most strongly identified with particular dimensions of the smart city system.
- For the success of the implementation process of the smart city concept it is important to involve not only "active" stakeholder groups, represented by city authorities, experts, NGOs, representatives of science, business, public administration, media, but also "passive" participants - city residents with different needs.

4. Operationalisation of the Methodology for Integration of Smart City Dimensions in the Socialised Process of Creating City Development

The methodology for integration of smart city dimensions in the socialised process of creating city development consists of five phases (Figure 2):

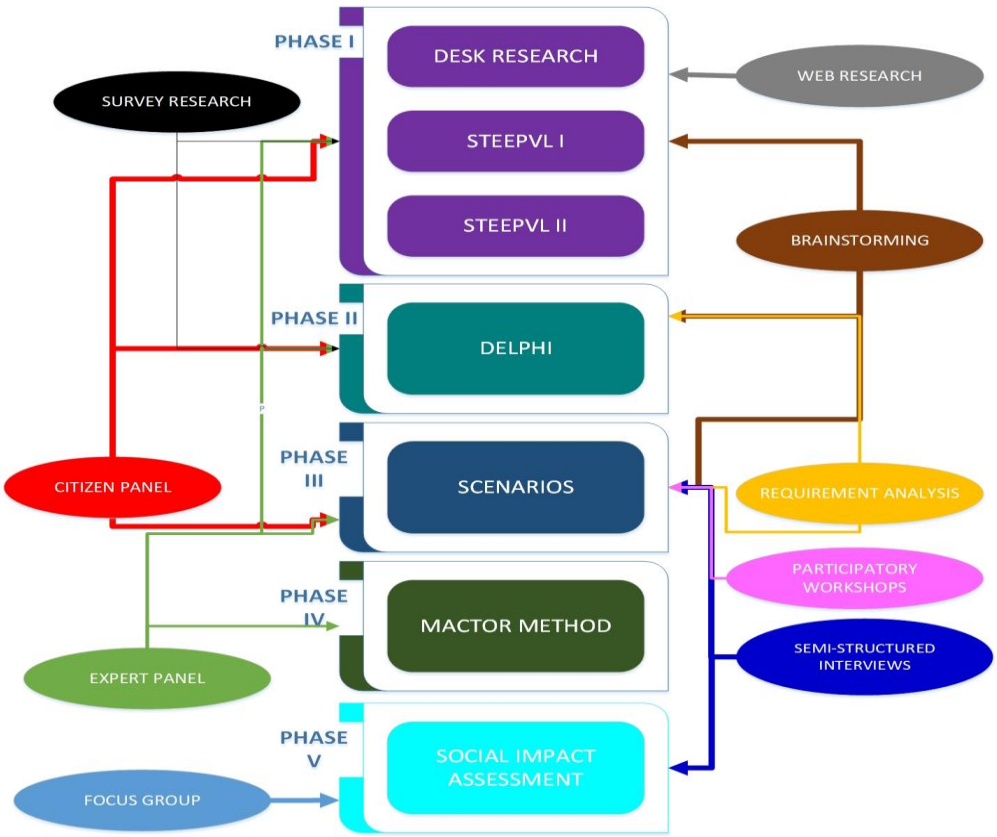
- Phase I – Desk Research, STEEPVL analysis (I), STEEPVL analysis (II),
- Phase II – Delphi method,
- Phase III – Scenario method,
- Phase IV – Stakeholder analysis – MACTOR,
- Phase V – Social impact assessment.

Within each phase, auxiliary methods have been nested. Most of the methods are closely related to social participation, which is an indispensable element of foresight research (Szpilko, 2020). The selection of stakeholders should be done in accordance with the triangulation principle. This means that people from different backgrounds should be involved in research in order to interpret the same phenomenon (Nazarko, 2013). The method of stakeholder selection is to support the integration function of foresight research, expressed as in involving representatives of various social groups. Among the auxiliary methods in the methodology of integration of smart city dimensions in the socialised process of creating city development, the following methods were included:

- Web research,
- Brainstorming,
- Citizen panel,

- Expert panel,
- Survey research,
- Requirement analysis,
- Participatory workshops,
- Semi-structured interviews,
- Focus group.

Figure 2. *Scheme of methodology for integration of smart city dimensions in the socialised process of creating city development*

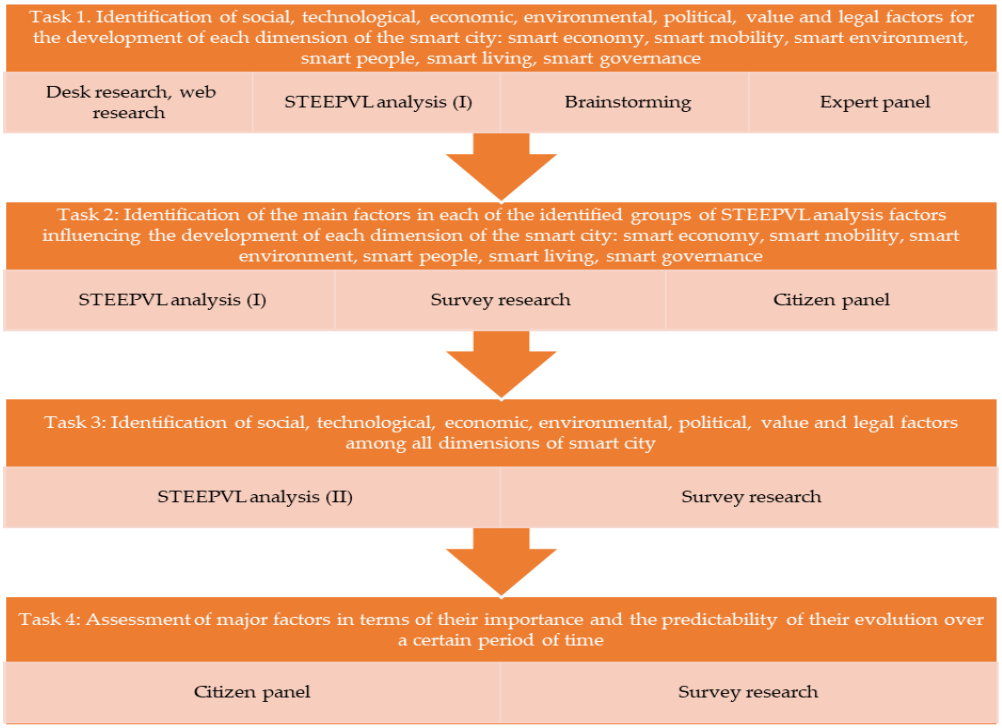


Source: *Authors' elaboration.*

The structural and methodical complexity required an operationalisation of the research methodology in order to precisely plan the individual elements of the research process. The operationalisation is a requirement to concretise the description of the research subject (Stabryła, 2006). The research process will be carried out in five phases, according to the sequences provided for in the research scheme.

The scheme of operationalization of the first phase of the research process is presented in Figure 3. Four research tasks are presented in connection with seven research methods: desk research, web research, STEEPVL analysis, brainstorming, expert panel, citizen panel, survey research.

Figure 3. *Operationalisation scheme for Phase I of the research process*



Source: *Authors' elaboration.*

Many factors directly and indirectly affect the development of the smart city. As part of the first research task, the factors determining the development of each of the six dimensions of the smart city concept should be identified: smart economy, smart mobility, smart environment, smart people, smart living, smart governance. For this purpose, the STEEPVL analysis will be used to identify the social, technological, economic, ecological, political, value and legal factors that influence the development of a given research area (Nazarko and Kędzior, 2010). The identification of STEEPVL analysis factors (I) will be performed by an expert panel with the use of brainstorming, based on the results of desk research and web research analysis, in order to identify the conditions for the development of the city according to the smart city concept. The list of factors of the STEEPVL (I) analysis, developed for each of the six dimensions of the smart city, is a basis for the next step.

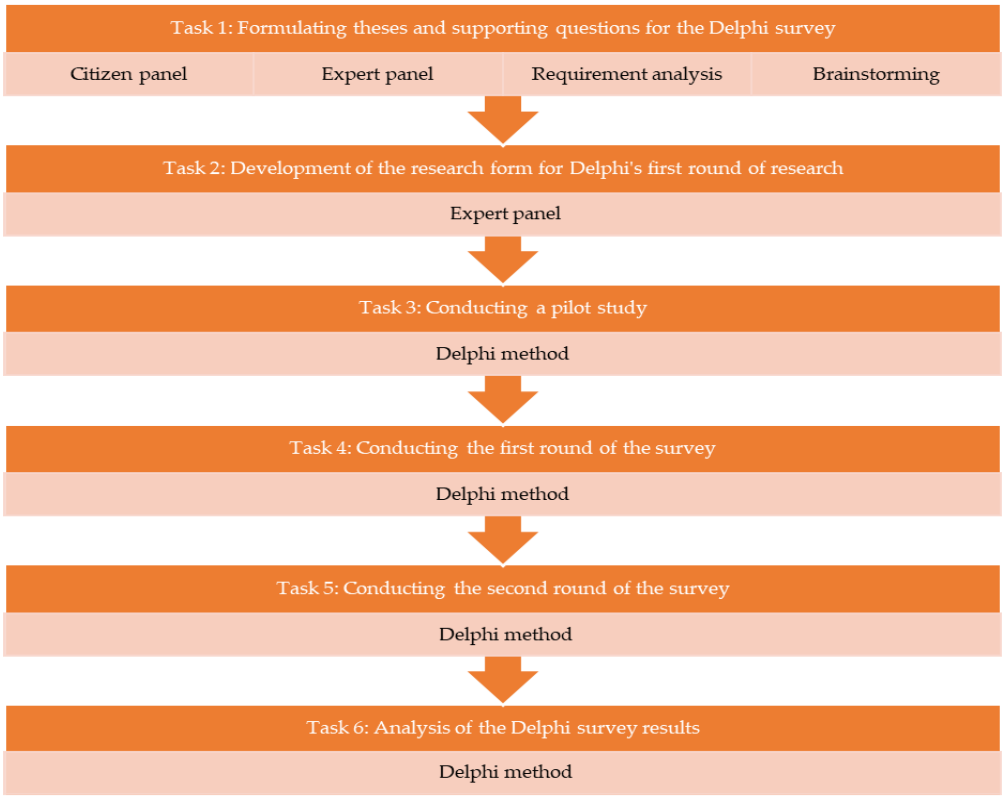
The aim of the activities undertaken under the second research task should be to identify the key factors in each of the identified groups of factors of the STEEPVL (I) analysis, for each dimension of the smart city concept. Their selection should be made by the city development stakeholders who are part of the citizens' panel. A wide range of stakeholders representing various social groups will be involved in the citizens' panel in order to support the integration function of foresight research. During the meeting of the panel, each of its members should select a specific number of factors in each of the groups which in their opinion are the most important from the point of view of the development of individual dimensions of the smart city. The number of most important factors may be limited from 3 to 5 in each group.

In the third research task, the key factors identified by stakeholders for the development of the various dimensions of the smart city concept will again be analysed by STEEPVL (II). At this stage, social, technological, economic, ecological, political, value and legal factors will be identified, which determine the development of the city according to the smart city concept in relation to all dimensions of the concept, as an integral whole. Stakeholders of the city's development who are part of the citizens' panel, representing various social groups, will be involved in this stage again. During the meeting of the panel, each of its members should select a specific number of factors in each of the groups of the STEEPVL analysis, in its opinion the most important from the point of view of the development of the smart city, perceived as an integrated system of six dimensions of this concept. The number of the most important factors may be limited to 3 in each group.

In the course of the fourth research task, the list of main factors of the STEEPVL analysis should be assessed in terms of their importance and predictability of their development in the context of smart city development. This approach serves primarily to identify the most important factors that constitute potential driving forces of scenarios. The assessment will be made taking into account a specific time perspective. In foresight studies, it is usually set at 10-20 years. The assessment of the importance and predictability of the factors should be made by members of a citizens' panel represented by a wide range of stakeholders from different social groups. The assessment tool will be a research questionnaire, in the form of a CAWI survey, in which a 7-level Likert scale will be used. On the basis of the surveys, factors with both high level of importance and low level of predictability will be identified. They will be used to develop scenarios.

The operationalisation scheme of Phase II of the research process is presented in Figure 4. The main research method is Delphi, which aims to provide material for the development of city development scenarios in accordance with the smart city concept and to collect data for the development of a map of stakeholders identifying themselves with the various dimensions of the smart city concept. It presents 6 research tasks in connection with the research methods: Delphi, citizen panel, expert panel, requirement analysis, brainstorming.

Figure 4. *Operationalisation scheme for Phase II of the research process*



Source: *Authors' elaboration.*

In the first research task, a set of theses and supporting questions for the Delphi method should be formulated as part of the work of the Citizens' and Expert Panel. The Delphi thesis is a forward-looking description of the relationship between issues arising from the specificity of the study, and the context determined by the research objective. This is a research question relating to the future, in the form of a thesis. The supporting questions should include such elements as: time of the thesis implementation, probability of its occurrence, factors conducive to the thesis implementation, barriers to the thesis implementation and expected effects of the thesis implementation (Loo, 2002; Skulmoski *et al.*, 2007; Steinert, 2009; Rowe and Wright, 1999; Szpilko, 2014). It is important that the members of the citizen panel are involved in the development of Delphi theses. The members of the citizens' panel will be divided into groups. The division into groups will be done using the requirement analysis method.

On the basis of the requirement analysis, individual stakeholders will formulate theses in relation to a specific dimension of smart city: smart economy, smart mobility, smart environment, smart people, smart living, smart governance (six theses in total, one thesis for each dimension). Subsequently, all members of the

citizens' panel will brainstorm 1-2 theses for the general area of smart city with regard to the most uncertain and critical factors. The work of the Expert Panel using the brainstorming will be concerned with the elaboration of auxiliary questions to the Delphic theses.

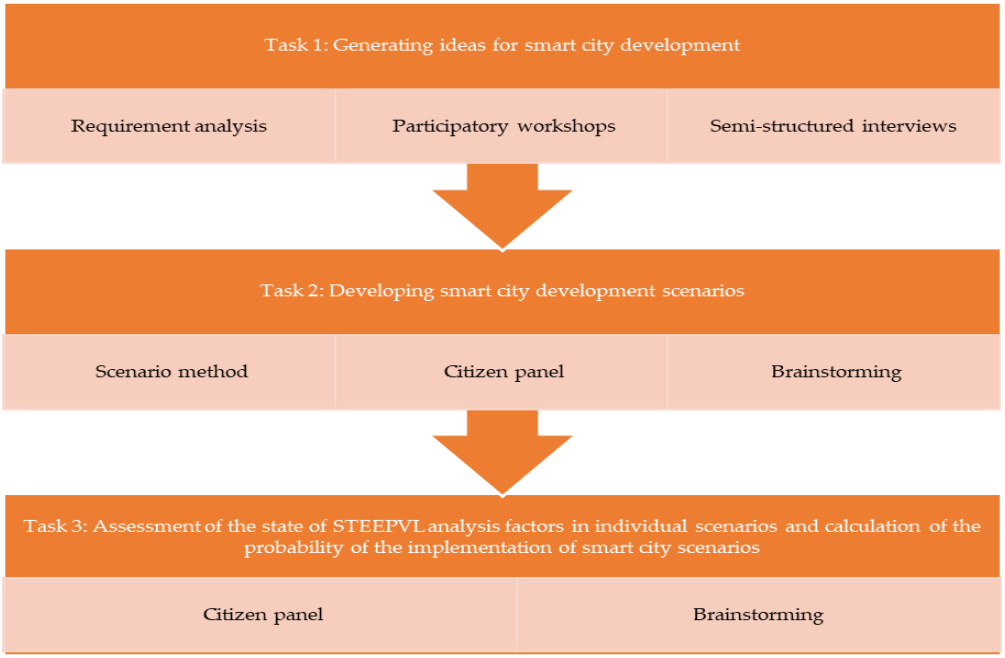
The second task should focus on preparing a research questionnaire for the first round of the Delphi survey. Research material obtained in first research task should be used in the preparation process. It should be selected and analysed by the implementation team with regard to its methodical and factual correctness by the expert panel. The task should also identify potential participants in the pilot and proper study from a wide range of stakeholders in city development. When selecting stakeholders for the Delphi survey, targeted recruitment and snowballing is recommended. The group should be diversified in terms of the represented professional sphere, education, gender and age.

The third research task is aimed at conducting a pilot study using CAVI survey within a group of several respondents. This measure allows for the verification of the questionnaire in terms of its comprehensibility, as well as the elimination of errors from its final version.

Research task 4 to 6 are related to the Delphi method. In its first round, the CAWI questionnaire should be dispatched to a specific group of city stakeholders. Once the results have been obtained, the form should be developed for round 2 of the survey, including summary statements and selected comments from round 1. In the second round of the survey, respondents will be able to change their opinion based on the knowledge of others (Rowe and Wright, 1999). The developed survey form should be sent only to those respondents who participated in the first round of the survey. After obtaining the results from the second round of the survey, members of the expert panel should make a final analysis and interpretation of the results. The obtained data will constitute the input to smart city development scenarios. By means of the Delphi survey, it is possible to verify the correctness of the definition for scenario axes. The obtained results illustrate the conditions of implementing individual scenarios and the probability of their occurrence.

The scheme for the operationalisation of Phase III of the research process is presented in Figure 5. It consists of three research tasks related to six research methods: requirement analysis, participatory workshops, semi-structured interviews, scenario method, citizen panel, brainstorming. In the first research task, a requirement analysis method should be used to generate ideas for actions aimed at the development of the smart city in participatory workshops and semi-structured interviews. This stage should also involve a wide range of urban stakeholders, diverse in terms of age, gender, education, professional sphere represented, so that the needs of the general public, not just selected social groups, are taken into account when generating smart city development ideas.

Figure 5. *Operationalisation scheme for Phase III of the research process*



Source: *Authors' elaboration.*

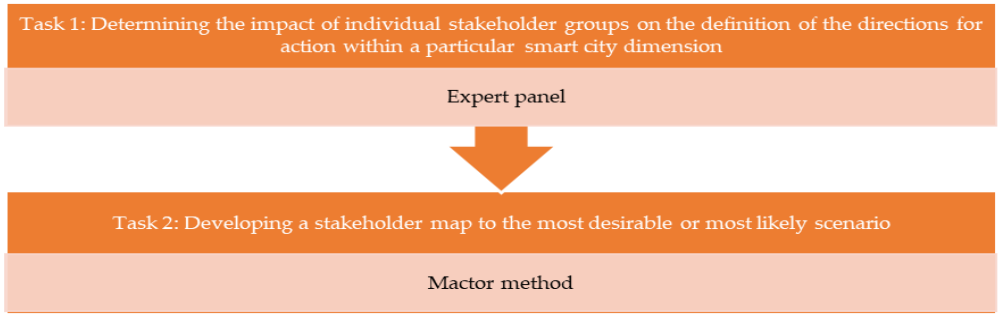
In the second research task, based on the results of the STEEPVL analysis, the Delphi method and the requirement analysis, smart city development scenarios should be formulated. These scenarios can be built on the basis of two key factors identified from the analysis of the results of the importance and uncertainty of STEEPVL factors. The identified factors should be applied on two axes, leading to the creation of a matrix. The upper right field will have a positive meaning and the lower left field a negative meaning. The other two fields will take the positive and negative values of the first or second factor, respectively. This will result in four scenarios showing di_erent visions of how the future of a smart city may develop. Alternative states of the future developed with the use of the scenario method should create a coherent, reliable picture of smart city development (Mendonca *et al.*, 2009; van't Klooster and van Asselt, 2006; Kononiuk and Nazarko, 2014). In this way, it is possible to show not only the most probable or desired developments, but also alternative versions. The three Ps, i.e., the division into visions: the predictable, the possible, and the preferred, is the most frequently applied method (Larsen, 2006).

Within the framework of the third research task, the citizen panelshould focus on assessing the status of other factors in the STEEPVL analysis in each scenario. It is also advisable to develop the characteristics of individual smart city development scenarios in a specific time perspective. Calculations can be made on the basis of the

results of the Delphi study in relation to two theses closely related to the axes of smart city development scenarios.

The scheme of operationalization of Phase IV of the research process is presented in Figure 6. It consists of two research tasks related to two research methods: the expert panel and Mactor method.

Figure 6. *Operationalisation scheme for Phase IV of the research process*



Source: *Authors' elaboration.*

During the first research task, the members of the expert panel, on the basis of data collected in all previous phases of the research process, will determine what impact a given stakeholder has on the achievement of a specific objective within a given smart city dimension. The results of the experts' work will constitute the input data for the next research task.

As part of the second research task, a stakeholder map will be developed for the most desirable or most likely scenario. The Mactor method aims to examine the balance of forces between stakeholders and to examine their convergence and divergence in the face of a number of interrelated objectives. It works for a wide range of stakeholders involved in the process. The developed stakeholder map will provide input to the final phase of the research process.

The scheme of operationalization of Phase V of the research process is presented in Figure 7. It consists of one research task related to three research methods: SIA, semi-structured interviews, focus group.

Figure 7. *Operationalisation scheme for Phase V of the research process*

Source: *Authors' elaboration.*

Due to the fact that the key element of the proposed methodology of integrating the dimensions of the smart city in the process of creating the city development is to socialise this process, in the last step the research should be evaluated in terms of social effects. The assessment of social effects of research has a significant impact on the way scientists conceptualise and develop their research (Reale *et al.*, 2017).

Social Impact Assessment (SIA) is a process that can be used to manage social issues and to reconsider how social impacts are taken into account in planning and decision making regarding the development of the situation (Esteves *et al*, 2012; Vanclay, 2003). It can provide an understanding of social impacts in urban projects, recognising that social impacts are spatially and socially dispersed (Pulido *et al.*, 2018).

Although the benefits of SIA are well known (Esteves *et al.*, 2012), there is much room for improvement in the way public authorities, project developers and communities use SIA, as social issues are usually considered less important than engineering, economic and environmental considerations (Ferrara and Banerjee, 2017; O'Faircheallaigh, 1999; Vanclay and Esteves, 2011). In the proposed methodology, as part of the SIA, semi-structured interviews will be conducted with selected stakeholders based on the map developed in the previous research task. In the next step there will be a discussion in the form of a focus group on the relevant social impacts of the research, with the participation of experts from the fields of sociology, urban planning and development and smart city. Then the data obtained should be analyzed and conclusions should be formulated on possible improvements of smart city development activities.

5. Conclusions

Based on a literature review of the smart city concept, the authors of this publication have identified a number of barriers to the implementation of this concept. The main problem is the excessive focus on the technological aspect, without taking into account all dimensions of the smart city concept such as: smart economy, smart mobility, smart environment, smart people, smart living, smart governance. Such approach do not consider the multifaceted and multi-variant nature of the smart city. In the contemporary perception of the smart city concept, there is a return to the needs and preferences of the inhabitants.

The answer to these needs seems to be urban foresight, the essence of which is to create and build a vision of the future in cooperation with the city authorities and a wide range of stakeholders forming the local community. The main objective of the proposed methodology is to integrate all dimensions of the smart city concept and to include a wide range of urban stakeholders in the creation of the city development vision. The presented methodology consists of five phases in which the following main methods were used: desk research, factors analysis: social (S), technological (T), economic (E), ecological (E), political (P), relating to values (V) and legal (L)

(STEEPVL), Delphi, scenarios, mactor method, social impact assessment (SCI). The paper takes into account the limitations of this research, i.e., that the proposed methodology has not been tested in practice yet. Its validation via its implementation in selected cities is a further step in the planned research process.

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