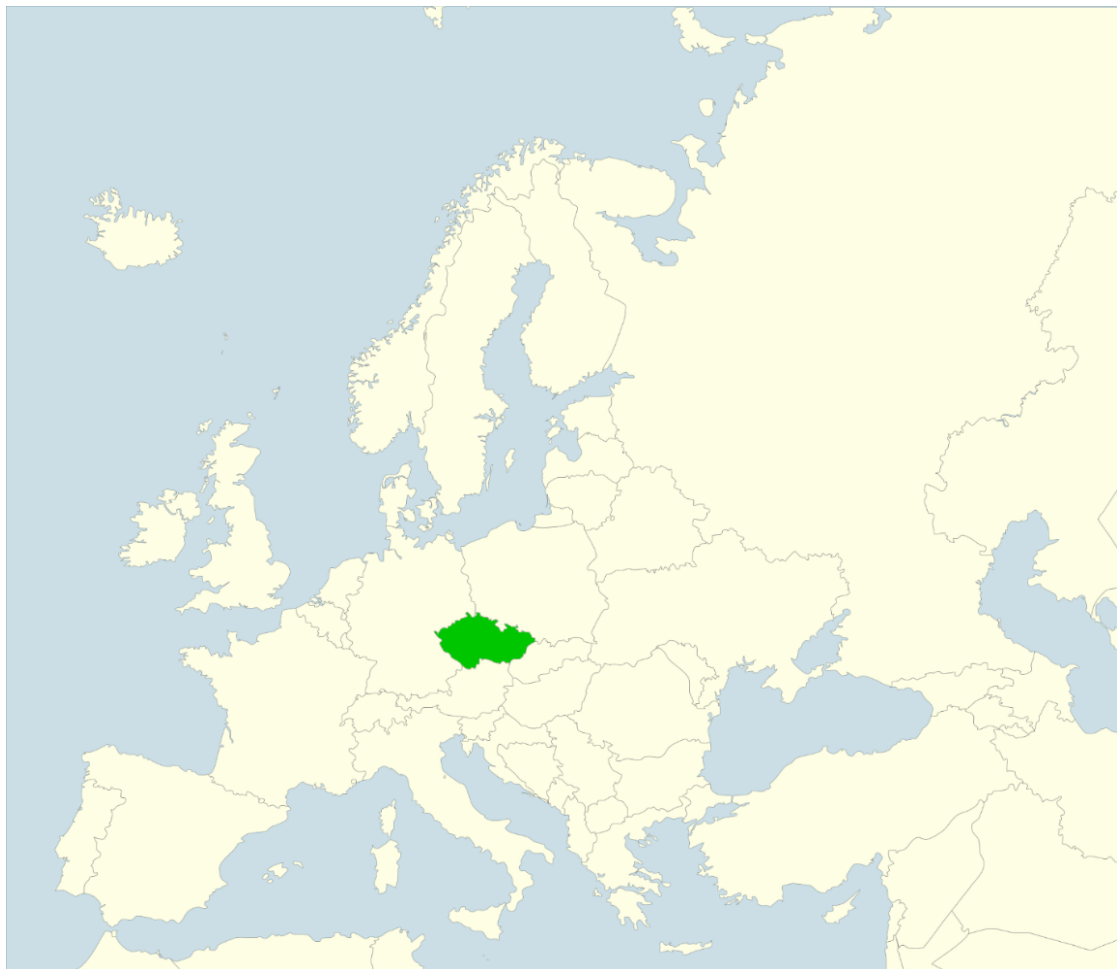


BARRIERS TO THE IMPLEMENTATION OF SMART PROJECTS IN RURAL AREAS, SMALL TOWNS, AND THE CITY IN BRNO METROPOLITAN AREA

Michal Ševčík, Markéta Chaloupková,
Ilona Zourková, Lenka Janošíková¹



¹ Michal Ševčík, research associate, Department of Regional Development, e-mail: xsevci16@mendelu.cz, ORCID: 0000-0002-9999-4337; Dr. Markéta Chaloupková, postdoctoral research assistant, Department of Regional Development, e-mail: marketa.chaloupkova@mendelu.cz, ORCID: 0000-0002-3536-8118; Ilona Zourková, research associate, Department of Environmental Studies and Natural Resources, e-mail: xzourko2@node.mendelu.cz, ORCID: 0000-0002-0300-6438; Lenka Janošíková, research associate, Department of Regional Development, e-mail: lenka.janosikova@mendelu.cz, ORCID: 0000-0003-4362-5097, Mendel University in Brno, Czechia

Abstract: The implementation of smart projects can contribute to solving the current development problems of municipalities and cities of varied sizes. Although the concept of smart development is a vague term in the literature, in practice it refers to projects based on the use of modern technologies, to improve the quality of life considering economic, social, and environmental dimensions. However, not all local governments in the Czech Republic implement smart projects, even though the smart city concept is currently receiving considerable attention from national governments and from the European Union. This paper characterizes the perception of barriers to the implementation of smart projects from the perspective of fifteen representatives and officials of local governments located in the Brno Metropolitan Area in the Czech Republic. The research was conducted using semi-structured interviews with these fifteen territorial actors. It was found that the barriers to the implementation of smart projects are related to internal factors in the municipalities, such as the lack of interest of municipal leaders and officials or potential technical complications accompanying the implementation of projects. However, external factors such as the Czech government's vague grasp of the smart cities concept or cyber threats also play a role. Perceived barriers were categorized according to their type and schematized.

Keywords: smart city, smart project barriers, rural areas, metropolitan area

Abstrakt: Realizace smart projektů může přispívat k řešení aktuálních rozvojových problémů obcí a měst různých velikostí. Ačkoliv je koncept smart v literatuře poměrně nejasným termínem, v praxi se pod tímto termínem realizují projekty založené na využívání moderních technologií, s cílem zvýšit kvalitu života, se zohledněním ekonomické, sociální a environmentální dimenze. Ne všechny samosprávy v České republice však smart projekty realizují, a to přesto, že je konceptu smart v současnosti věnována značná pozornost ze strany národních vlád a Evropské unie. Článek charakterizuje vnímání bariér zavádění smart projektů z pohledu patnácti představitelů a úředníků územních samospráv, nacházejících se v Brněnské metropolitní oblasti, v České republice. Výzkum se uskutečnil s využitím techniky polostrukturovaných rozhovorů s uvedenými územními aktéry. Autoři dospěli ke zjištění, že bariéry zavádění chytrých projektů jsou spojeny s vnitřními faktory v obcích, jako je nezáměr představitelů a úředníků samospráv či potenciální technické komplikace provázející realizaci těchto projektů. Roli hrají také externí faktory, jako je neurčité uchopení konceptu smart vládou České republiky či kybernetické hrozby. Vnímané bariéry byly typizovány dle svého druhu a zaneseny do schématu.

Klíčová slova: smart city, bariéry smart projektů, rurální oblasti, metropolitní oblast

Highlights

- The lack of interest of mayors and officials hampers the implementation of smart projects.
 - Smart projects may not be economically viable, especially for small municipalities and towns.
 - The problem of developing smart technologies is faced mainly by small municipalities.
 - Information regarding smart cities is not sufficiently available to municipalities.
 - The adoption of smart projects is hampered by a lack of support from the government.
-

1. Introduction

The smart city (SC) concept is currently one of the ways how countries approach the issue of sustainable development of municipalities or regions. The concept is most often put in the context of the introduction

of modern practices in the management of local governments (smart projects), mainly the use of digital technologies (Castelnovo et al., 2016). However, the requirements for promoting social cohesion of the population (e.g., through civic participation) and environmental sustainability (e.g., efforts to minimize environmental burden due to human activities) are not neglected. Fulfilling these requirements should subsequently contribute to a comprehensive improvement of life quality in the area (Caragliu et al., 2011; Shapiro, 2006). Cities that are renowned for their smartness" in Europe include metropolises such as London, Vienna, Copenhagen, and Oslo (Dufek et al., 2017), but smaller cities and municipalities are also trying to implement smart projects (Mohanty et al., 2020; Vaishar and Šťastná, 2019). The application of the SC concept is currently growing in importance in the context of support for the adoption of modern technologies and innovations by nation-states and intergovernmental organizations (such as the EU) (Jucevičius et al., 2014). To encourage the adoption of smart solutions by local governments, policy documents and grant programs are being developed and implemented at different territorial levels of the states (Angelidou, 2014). The Czech Republic is no exception in this respect.

However, as stated by Dufek et al. (2017), the Czech Republic, whose settlement structure is characterized by several smaller towns and villages, also requires the application of the Smart Village (SV) concept. This concept has only recently started to gain importance in the EU, in conjunction with the Cork 2.0 declaration (2016), focusing on a better quality of life for rural residents (Martinez and McEldowney, 2021). Since then, however, the EU has increasingly supported it (Slee, 2019). The SV concept is based on the desire to improve the economic, social, and environmental aspects of rural settlements and to involve the local population in their development (Martinez et al., 2021). Smart Village then focuses on the use of various telecommunication and digital technologies that help to develop traditional and even new services (Zavratnik et al., 2018).

A growing number of scientific publications are being written on research topics related to SC and SV (Araral, 2020; Jaňurová and Chaloupková, 2018). These publications deal with various aspects related to the application of the concepts in the territory. For example, they deal with the conceptualization of the term SC (Desdemoustier et al., 2019; Kummitha and Crutzen, 2017), case studies of SC and SV from different cities or regions (Klusáček et al., 2020; Noori et al., 2021; Talbot, 2016) or the assessment of smart projects at different stages of their life cycle, from the perspective of selected stakeholders (Bosworth et al., 2020; Caird, 2017; Macke et al., 2018; Mora et al., 2017). However, across research using both quantitative and qualitative methodologies, there has been little focus on barriers to smart project adoption. The few authors who have addressed this issue include Bjørner (2021) and Razmjoo et al. (2021), but their research on barriers did not focus on smaller municipalities in rural areas and the hinterland of larger cities. Jaňurová et al. (2020) then addressed the barriers to the implementation of smart strategies in selected cities in the Czech Republic. Although this problem has not received much attention in the literature so far, it can be said that the identification of perceived barriers to the implementation of smart projects can be crucial for effective and efficient support for the implementation of the smart concept.

The article focuses on the perception of barriers to the implementation of smart projects from the perspective of mayors, other representatives, and officials of local government units in the Brno Metropolitan Area (BMA), Czech Republic. The article aims to characterize and typify the factors that these actors perceive as barriers to the implementation of smart projects, in the context of municipalities of distinct size. For this purpose, the researchers used the technique of semi-structured interviews with these leaders and officials.

2. Selected area and research context

A metropolitan area is characterized by the connection of several settlements, shaped by a city or metropolitan area and its agglomeration (Chavhan and Venkataram, 2020). Based on the Regional Development Strategy of the Czech Republic 2021+, three metropolitan areas are currently defined – Prague, Ostrava and Brno (Ouředníček et al., 2020). The designation of metropolitan areas was conducted for the needs of the EU cohesion policy (Brno Metropolitan Area, 2020), which is implemented in these

areas through the special instrument of integrated territorial investment (ITI). The BMA is a „functional region” (Figure 1), i.e., an area characterized by a high intensity of internal economic, social, and transport links, covering an area of 1 978 km² (Brno Metropolitan Area, 2020). Of the 673 municipalities of the South Moravian Region (SMR), 184 municipalities (about 27%) are part of the BMA and together more than 800 000 inhabitants live there. Brno represents the so-called dominant core in the BMA, where about half of the population of the area is concentrated (Ouředníček et al., 2020).

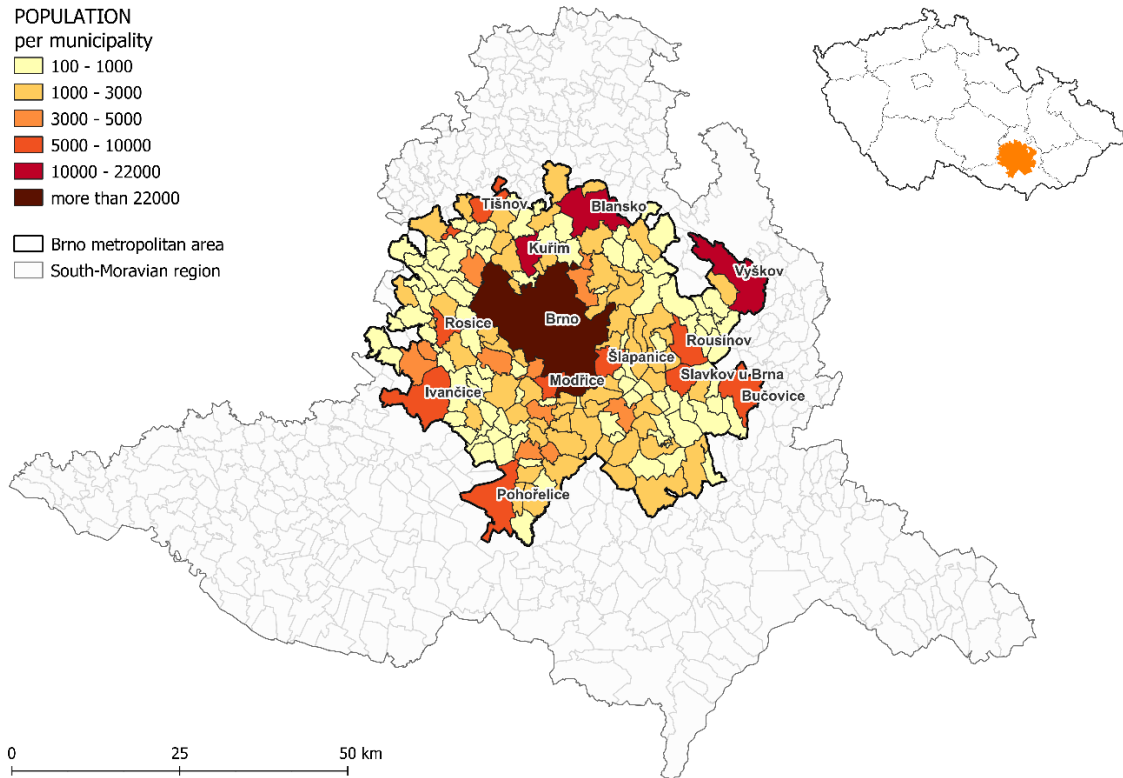


Fig 1. The territory of BMA. Source: Authors' own processing based on data from Czech Statistical Office (2021). Map base: ArcČR version 3.3

Public support for the implementation of the SC concept in BMA municipalities is based on the existence of strategic and methodological documents and grant programs. Table 1 lists some of the current documents and tools used to support SC agenda, although the list is not exhaustive. Some other Czech organizations provide methodological or implementation support to local governments when introducing the SC concept (e.g., the Union of Towns and Municipalities of the Czech Republic).

The conceptual provision of the SC agenda in the Czech Republic is the responsibility of the Ministry for Regional Development, which in cooperation with other public authorities creates SC strategic documents. These documents are mainly informative and aim to introduce the SC concept to local government staff and outline its key pillars. The methodological documents subsequently present indicators that municipalities should meet to be considered as SC or SV. At the national level, several other general government documents focus indirectly on the SC concept and can help local governments with its implementation.

At the level of the SMR, there is no strategic or methodical document dealing with purely smart development, although the basic strategic direction of the SMR in this area is summarised in two documents prepared by the SMR Office. The BMA itself is guided by its own strategic document, which is implemented through integrated territorial investments in the various municipalities of the area. Although the document makes no direct reference to smart solutions, some of the integrated territorial investments projects target sustainable mobility, social inclusion, etc., related to a higher quality of life. At the municipal level, development documents oriented towards smart agenda are limited (especially for smaller towns and municipalities). However, for the territory of Brno, it is possible to mention

the current strategic document addressing, for example, the issue of sustainable transport, innovation, or circular economy.

Tab 1. Current documents and grant programs covering the implementation of the SC concept in BMA. Source: Authors' own processing

	Strategic and methodological documents	Grant programs
European and Czech central government level	<ul style="list-style-type: none"> • SC Conception • Sustainable Smart Cities Assessment Methodology – SC • SC Methodology • National Strategy for Artificial Intelligence • Innovation Strategy of the Czech Republic 	<ul style="list-style-type: none"> • operational programs (OP) of European Funds (Integrated Regional Operational Programme, OP Technologies and Applications for Competitiveness...) and other European programs (HORIZON 2020, LIFE...) • national grant programs (PANEL 2013+, EFEKT, National Environment Programme, Smart Parks for the Future...)
Regional level	<ul style="list-style-type: none"> • Regional Innovation Strategy of the SMR 2021–2027 • SMR Development Strategy 2021+ 	<ul style="list-style-type: none"> • regional grant titles (Smart Accelerator in SMR II (with EU support))
BMA level	<ul style="list-style-type: none"> • BMA Integrated Development Strategy 2021+ 	<ul style="list-style-type: none"> • specific support from OP of European Funds – ITI
Municipal level	<ul style="list-style-type: none"> • strategic development documents of municipalities and cities (Strategy Brno 2050+...) 	–

The range of documents in the BMA is complemented by grant programs. The EU supports the realization of the SC concept financially through the Cohesion Policy OP and other specific programs. In terms of ministerial grant programs in the Czech Republic, there are opportunities for financing projects in the field of modernization of municipal public lighting, reduction of energy consumption of buildings, water management or regeneration of brownfields, and improvement of infrastructure to reduce its negative climate impacts. The grant titles of the SMR regarding smart development are mostly focused on supporting the innovation ecosystem. Finally, ITI projects are relevant for BMA. BMA is eligible for ITIs as it meets the following conditions: 1) its population is more than 300,000 and 2) has a prepared Integrated Development Strategy. Several OPs are used for the implementation of ITIs, such as Integrated Regional OP, OP Transport, or OP Environment.

3. The concept of smart development smart projects, and barriers to their implementation

As far as the theoretical definition of smart development is concerned, there is no precise definition of this term. Each author adapts the definition of the smart concept according to his/her needs and perspective (Hollands, 2008; Lebieczik, 2020). Smart cities are generally striving to ensure a high-quality life for their citizens by providing modern services (Kummitha and Crutzen, 2017). This is done by the implementation of smart projects whose common denominator is the use of ICT (Monzón, 2015) and innovations in local governance, the economy, or the environment (Caird, 2017). Successful implementation of the SC concept in the cities relies on mutual dialogue and consideration of the needs of all stakeholders, i.e., residents, business, and social partners as well as visitors, tourists, and other groups (Fernandez-Anez et al., 2018). The idea behind the SC concept is therefore to apply a bottom-up approach to local development (Komninos, 2016).

The more recent SV concept focuses on the use of modern digital technologies in rural areas and small urban communities (Van Gevelt et al., 2018). Rather than for development in public transport or citizen awareness per se, technologies in SV are more oriented towards facilitating agricultural work (Taylor, 2017), or making efficient use of available local resources (Atkočiūnienė and Vazonienė, 2019). Rural

development through the SV concept responds to the gradually disappearing agricultural sector, underdevelopment in relation to cities, as well as social and economic disparities in the development of rural settlements (Atkočiūnienė and Vaznonienė, 2019). When implementing SV aspirations, smaller municipalities can benefit from cooperation with other communities and actors not only from other rural areas but also from cities located in their vicinity (European Commission, 2020). This idea is central to the smart territory concept (Garcia-Ayllon and Miralles, 2015).

In the literature dealing with the implementation of the smart concept, two main thematic areas of smart projects are often characterized – hard and soft infrastructure projects (Masik and Stępień, 2021; Masik et al., 2020). The hard infrastructure category includes projects that primarily serve to increase the technological advancement of transport, waste and water management or energy (Anthopoulos, 2015), such as the digitalization of water and heat supply, mobile applications for drivers to find a free parking space nearby (Bjørner, 2021) or public lighting system, with luminance control based on pedestrian or vehicle movement in its vicinity (Gagliardi et al., 2018). Projects classified as soft infrastructure then contribute directly to the development of participatory governance, human capital, or social inclusion in the territory (Angelidou, 2014). Examples include participatory budgeting projects, city web portals with open data, or smart mobile applications for handling administrative tasks for citizens (Masik et al., 2020) but also cooperation with local entrepreneurs, innovations related to social care, and educational activities (Lebiedzki, 2020).

According to the literature, the implementation of smart projects in the locality has many positive attributes, which are based on modernization and digitalization (Ho et al., 2014), that ensure a better future and quality of life for the population of municipalities. Literature also pays attention to the downsides of smart projects which, in some cases, can outweigh the positive attributes and may represent a barrier to the introduction of smart projects in a municipality. For example, the high financial costs of smart projects are often mentioned in the literature (Mosannenzadeh et al., 2017; Rana et al., 2018). Indeed, smart projects often require large investments, for which the rate and payback period are not always clear (Ferraris et al., 2020; Razmjoo et al., 2021). Related to this, there is a lack of adequate financial resources when municipalities try to implement the smart concept, which mainly concerns the smaller ones (Sikora-Fernandez and Stawasz, 2016).

Furthermore, the lack of support from national policies can be mentioned (Mosannenzadeh et al., 2017). National policy frameworks aimed at developing the smart concept either do not exist or are only present to a small extent and do not provide sufficient information about the possibilities of a smart agenda (Gorzalak and Smetowski, 2018). Smart project managers have also noted an implementation barrier related to the binding regulations around GDPR (Bjørner, 2021). Kitchin (2015) and Philip and Williams (2019) further criticized the approach of governments that promote only one model of smart concept for all cities and municipalities. These authors argue that it is necessary to deal with specific cases and not only apply one solution to the development of communities with different populations. If the development of smart technologies is not done with a site-specific application, the subsequent implementation of projects that will use these technologies can lead to social polarization in the municipality (Kummitha, 2020). This needs to be considered especially in a situation when towns and villages in a designated area have undergone rapid political, economic, or social changes in recent decades (Gorzalak and Smetowski, 2018). That is why some authors (e.g., Naldi et al., 2015) advocate the application of a place-based approach that emphasizes the diversity of cities and municipalities.

Top-down and hierarchical strategic management can also be counted among the shortcomings (Ferraris et al., 2020). The state and the higher territorial units, which are responsible for the development of smart development strategic documents, do not necessarily have an overview of which solutions are suitable for the municipalities of the lower territorial levels. Thus, some authors note that bottom-up planning may lead to a greater alignment of the needs of local governments with potential support from higher levels (Sikora-Fernandez and Stawasz, 2016). Furthermore, the implementation of smart projects, which are driven by private sector interests, often prioritize corporate profit over political and social issues in the locality (Hollands, 2015; McNeil et al., 2017) or companies promise more than they can complete (Bjørner, 2021).

One of the biggest challenges to the realization of smart projects is to break the existing rigid organizational structure of the offices and to make the departments and operations work synergistically (Bjørner, 2021; Khan and Haleem, 2015). In practice, there may also be situations where smart projects are managed only by a small group of officials who believe in the idea of smart development (Ferraris et al., 2020). It has also been suggested that digital illiteracy among older civil servants (Sikora-Fernandez and Stawasz, 2016) or workers with few skills (Alawadhi et al., 2012; Razmjoo et al., 2021), can be a barrier to successful initiation and employment of smart projects. Smart projects may, unfortunately, be characterized by complicated and time-consuming management processes that are difficult to understand (Mosannenzadeh et al., 2017) and apply (Desdemoustier et al., 2019). Smart projects are also multidisciplinary in nature and their successful implementation may depend on the existence of teams composed of specialists in different disciplines, which is not always the case (Ferraris et al., 2020).

Furthermore, the literature identifies low awareness of the existence and content of the smart concept itself (Sikora-Fernandez and Stawasz, 2016), among policymakers both at the national and sub-national levels and citizens (Razmjoo et al., 2021). Low citizen awareness coupled with disinterest then leads to a lack of acceptance and use of smart projects and threatens the fulfillment of the concept's vision (Mosannenzadeh et al., 2017). Municipal leaders, on the other hand, may have great difficulty convincing residents of the benefits of smart projects (Ferraris et al., 2020).

In terms of the application of the smart concept in the Czech Republic, several problems vary depending on the type of territory. Peripheral and rural municipalities most often suffer from a lack of finances, along with a lack of staff time, but also from the fact that representatives cling to traditional values and procedures when dealing with municipal problems (Janovský et al., 2019). Grega et al. (2018) investigated the perceptions of barriers and risks to the implementation of smart projects by officials of regional and district towns in the Czech Republic. The results of their research are summarized in Table 2.

Tab 2. Barriers and risks to the implementation of smart projects in offices of regional and district towns in the Czech Republic (% of total responses according to the type of town and barrier/risk. Only the top five responses with the highest % are shown for each type of town and barrier/risk.) Source: Grega et al. (2018)

	Offices of regional towns	Offices of district towns
Barriers to the implementation of smart projects	<ul style="list-style-type: none"> • Legislation (7,2%) • Budgetary limits (4,8%) • GDPR regulations (2,4%) • Lack of will and effort of politicians regarding SC (2,4%) • Communicating the uncertain benefits of smart projects to citizens (2,4%) 	<ul style="list-style-type: none"> • Budgetary limits (6,5%) • Lack of will and effort of politicians regarding SC (3,9%) • Platform and format compatibility (3,9%) • Infrastructure obsolescence (2,6%) • GDPR regulations (1,3%)
Risks to the implementation of smart projects	<ul style="list-style-type: none"> • Technology obsolescence (17,4%) • No national smart development concept (13%) • Information security (8,7%) • Inefficiency and costliness (8,7%) • Changing demands and lack of interest from citizens (4,3%) 	<ul style="list-style-type: none"> • Inefficiency and costliness (17,5%) • Technology obsolescence (7,9%) • Lack of synergy of technologies (7,9%) • Information security (6,3%) • Implementation of the SC concept pushed by the supply side (6,3%)

Although all regional towns were interested in implementing the smart concept, city officials cited the unproven nature of smart projects and the inability to coordinate these projects across office departments (Grega et al., 2018). According to the authors, most of the participating officials from district towns expressed similar interests in SC. In the case of lower interest, reasons such as a lack of understanding of the SC concept or long-term payback for many smart projects were mentioned (Grega et al., 2018).

4. Methodology

The research was conducted using qualitative methodology, namely the technique of semi-structured interviews with selected territorial actors (hereinafter referred to as narrators). This technique was chosen to identify the attitudes and opinions of narrators from diverse types of BMA municipalities regarding their perceptions of barriers to the implementation of smart projects. This method is advantageous since it allows one to obtain a wide range of information on the issue with the possibility for the researcher to directly influence the course of the interview (Mišovič, 2019). The research was conducted in the following stages: 1) question formulation, 2) determining the research sample of narrators and addressing them, 3) conducting and transcribing interviews, 4) data analysis and interpretation.

In the first phase, questions were formulated into semi-structured interview topic guides. The questions posed during the semi-structured interviews were chosen to reflect a wide range of sub-topics related to the topic of SC. These included questions about the definition and perception of the content of the SC concept, experience with the implementation of smart solutions, smart projects financing, or the approach of distinct levels of public administration in the Czech Republic to the implementation of this concept. Although the research included narrators from local governments that cannot be considered cities due to their size, the questions in all interviews were strictly related to the SC concept. Although the existence of the SV concept has been described above, as a smart development alternative for smaller towns and villages, in line with Zavrtnik et al. (2018), our research does not consider smart villages as independent territorial entities and focuses on the spatial context of barriers to smart projects in the metropolitan area. For these purposes, it can be argued that it is more appropriate to refer to the original and more established concept of SC, as Masik and Stępień (2021) have done. The data presented in this paper relates only to findings directly related to discussions about barriers and limits to the implementation of smart projects in BMA, a process which took place during 2021 in the municipalities of the South Moravian, specifically in Olomouc, Zlín, and Vysočina regions. Findings on other topics will be published elsewhere.

The selection of potential narrators was based on a stratified purposive sampling technique. Through this technique, a core set of narrators who meet a certain criterion is selected and this set can be divided into subsamples based on other criteria (Mišovič, 2019). The basic criteria for the selection of narrators were their highest possible position in decision-making on development projects or their implementation in municipalities, as well as assumed familiarity with the topic (Rubin and Rubin, 2005) of the SC concept. The most suitable candidates to meet these criteria were mayors, municipal officials, and members of the city and SMR council. In accordance with the method described above, 29 narrators were purposively selected from the BMA. The core set of narrators was then divided into subsamples, according to the narrators' affiliation with the local government category (Patton, 2014). 9 narrators were from small municipalities (191 to 2002 inhabitants)², 12 of them were from towns (3823 to 20676 inhabitants), 7 of them were from Brno (a member of the Brno City Council, 4 mayors of municipal districts (MD) and 2 officials of the Brno City Hall) and one from the SMR Council. All narrators were contacted via a formal email stating the aim and scope of the research. In case the narrators did not respond to the email, they were contacted by phone after a week.

Of the 29 contacted, 16 narrators were interviewed (approximately 55%), although one of them did not provide any relevant information on the topic. The final sample (Table 3), therefore, comprises a total of

² The population is given according to the Czech Statistical Office (2021) as of January 1st, 2021.

15 narrators, 5 of whom are from small municipalities (191 to 1367 inhabitants), 5 from towns (3823 to 9854 inhabitants), 4 are part of the local government or hold an official position in Brno and 1 narrator is a representative of the SMR Council. The sample is thus illustrative of the different territorial contexts found within the BMA and can be considered representative from the perspective of narrators from different territorial levels (Merton, 2007). In two cases, the contacted mayors (A4 and B2) recommended other persons for the interview.

The interviews were conducted between May 27, and November 29, 2021. Thirteen interviews were conducted by a direct encounter between the interviewer and a specific narrator. Two interviews were conducted online, through the MS Teams application. Interviews ranged in time from 16 minutes to 98 minutes, with an average interview length of 51 minutes. In the research, emphasis was placed on adherence to ethical standards (Merriam, 2009). The narrators were made aware of the fact that the interviews were being recorded. They were also guaranteed complete anonymization of all statements. After answering all questions, narrators were allowed to comment on the topic of SC off the record and to comment on the whole interview process. Narrators were also offered a copy of the final report from the research. After data collection was completed, all fifteen interviews were transcribed verbatim, creating a complete written record of the interaction.

Tab 3. Characteristics of the narrators in the research. Source: Authors' own processing

ID	Local government type	Position
A1	Small municipalities in BMA	mayor
A2		mayor
A3		mayor
A4		deputy mayor
A5		mayor
B1	Towns in BMA (excluding Brno)	mayor
B2		secretary of the municipal office
B3		mayor
B4		mayor
B5		mayor
C1	City of Brno	mayor of the municipal district of Brno
C2		member of the Brno City Council
C3		manager of the Strategic Development and Cooperation Dept. of the Brno City Hall
C4		manager of the ITI Management and Metropolitan Cooperation Dept. of the Brno City Hall
D	SMR	SMR Council representative

The analysis and interpretation of the interview results were based on the descriptive method. Specifically, clustering and simple enumeration techniques were used. The main technique in the research was the technique of clustering. It is used to group phenomena and conceptualize them based on their mutual similarity (Mišovič, 2019). Thus, this analytical technique allows for the creation of general categories of the phenomena under study (Čermák and Štěpánková, 1998). The technique of simple enumeration can then be used to express the characteristics of a phenomenon in terms of frequency of occurrence (Mišovič, 2019).

5. Barriers to the implementation of smart projects from the perspective of actors in BMA

BMA narrators identified various barriers to smart project implementation, which can be categorized according to their type (Figure 2). Based on the analysis, two main categories of barriers can be identified (Jaňurová et al., 2020). The first category of internal barriers is related to development priorities and technical or economic conditions of municipalities. Here, if the narrators explicitly commented on the barriers to the implementation of a particular type of project, it means that this project has not been implemented in the municipality. The second category is related to the perception of external barriers to the implementation of smart projects, i.e., awareness of the SC concept and conceptual, legislative, administrative, or security limits to the implementation of these projects. Subcategories of barriers can further be classified within these two categories of barriers. These subcategories (listed as headings in italics in the following text) further typify and cluster narrators' perceptions of single barriers (Tab. 4–9).

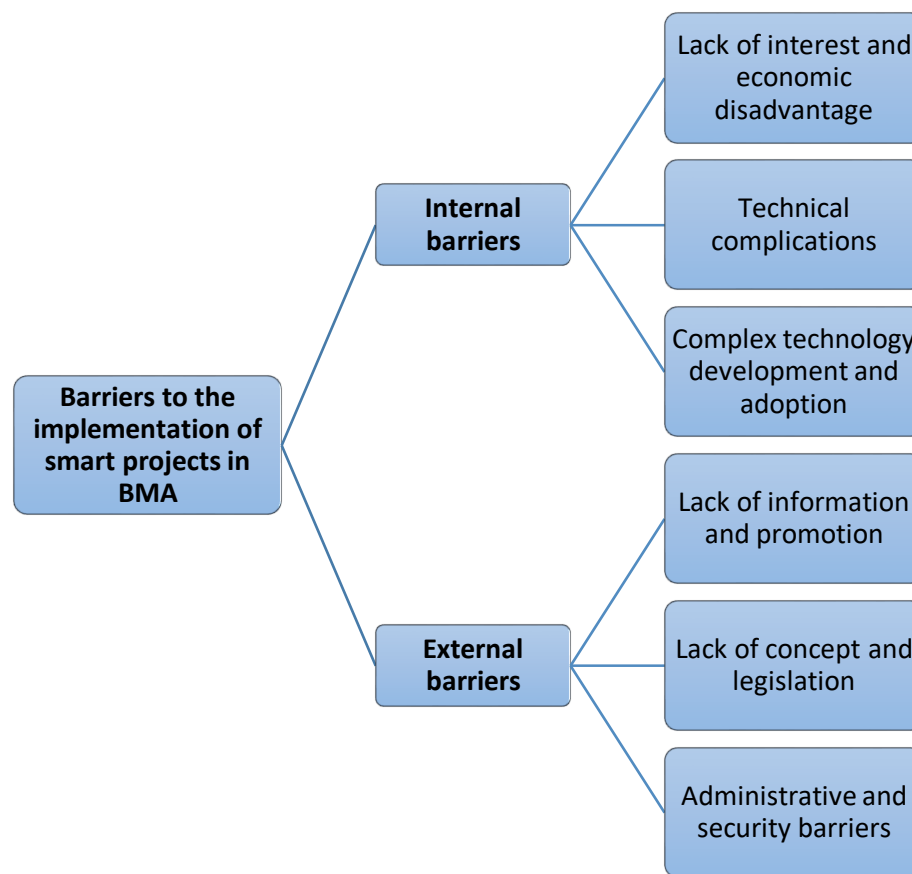


Fig 2. Categorized barriers to the implementation of smart projects in BMA. Source: Authors' own processing

5.1 Internal barriers

Lack of interest and economic disadvantage

One of the reasons why municipalities are not implementing smart projects is the lack of need or interest. The high opportunity cost of SC projects is cited, which means the municipalities rather spend available financial resources on other purposes which are more in line with citizen demand. Mayors expressed that they do not need smart projects because it would not make their citizens happier. According to the narrators, it is sufficient for the municipality to provide standard but quality services. However, it was said that citizens' preferences may change over time. The SC topic also does not feature much in BMA level debates and projects. Although various BMA conferences and debates on the direction of ITI projects are organized at this level, the demands for digitalization and implementation of the SC or SV concept are not heard from the BMA actors from the municipalities and the SMR. It is possible that the actors are

sensitive to the concept of SC or do not know it. Moreover, the issue of digitalization is not a specific territorial problem of BMA, which municipalities should focus on within the ITI because digitalization is a problem of the whole public administration in the Czech Republic.

Some mayors are considering implementing smart solutions, or at least have in the past. The narrators have ready-made proposals for development projects around green energy support from the past, although they have not been implemented yet. According to them, it is not clear whether citizens will understand the point of a project costing hundreds of thousands of dollars with a long-term payback. Therefore, the money would be better spent repairing pavements and roads, which citizens can see for themselves immediately. These narrators will only focus on smart projects once they have fixed everything in the village. The mayors would be more willing to implement smart projects if there is a possibility to draw subsidies, for example, to produce their own electricity in the municipality. Some may argue that the main motivation for these smart solutions is environmental protection regardless of financial resources. However, mayors dispute that if the implementation is not linked to economic benefits for the municipality, no one will be keen on implementing them.

The research also identified narrators who have a negative attitude toward the SC concept. They claim that they are not too keen on SC and stated that isolated smart projects in municipalities are useless:

„And I can tell you that rather than buying smart stuff worth hundreds of thousands, I will rather support five cultural events here in town over the summer.“ (B1)

Some smart projects, however, are attractive and interesting even to narrators who evaluate the SC concept negatively. These are, for example, projects related to modern public lighting, where microchips or sensors can be applied to obtain data, such as „door-to-door“³ waste collection.

The introduction of smart projects is not always met with interest from administrative staff, who may not be keen to learn new ways of doing things. Narrators encountered disinterest from senior officials in the introduction of „door-to-door“ collection bins in the municipality. These officials were „too busy“ and did not even want to implement the project. Nevertheless, it was said that if young officials come to the village and give the SC the necessary attention, the village leadership would only support it.

The disadvantage of implementing smart solutions concerning the size of the municipality is also perceived. Narrators from small municipalities agree that smart projects make sense in bigger towns and cities, but for small municipalities, there are limited possibilities for implementation, which applies for example to projects regarding parking and waste management. However, this problem is also perceived by mayors from larger municipalities:

„We're an overgrown village. We have 3,500 residents, so we don't have enough space for big smart solutions like traffic control or anything like that.“ (B5)

Mayors are often approached by companies that offer special applications to communicate with citizens, such as „Mobile Radio“⁴ („Mobilní rozhlas“). Despite the company's claims about the usefulness of the application, mayors of smaller municipalities refuse to buy it since the application does not make sense in a small municipality:

„When I talk to other mayors from small villages, they say that in a village of two thousand people, a hundred people register, which I do not think is a big contribution. But the company is very insistent on offering its product.“ (A3)

³ It is a collection of sorted waste based on scanning the barcode on the waste container/tank. The code, which contains information about the owner of the container, the quantity of waste, and its composition, is read by the collection company during collection. In the context of the „door-to-door“ collection, some municipalities have introduced a mechanism to subsidize citizens who sort their waste. In the Czech Republic, the subsidies can be financed through the money that municipalities receive from specialized EKO-KOM, a.s. company for waste sorting.

⁴ „Mobile Radio“ is one of the communication applications offered to municipalities in the Czech Republic by private companies. The application works in such a way that the municipality pays a fee to the company for the possibility of maintaining an online account from which it is possible to inform citizens about what is happening in the municipality via e-mail, SMS, or mobile application. The application also offers the possibility of managing suggestions from citizens or creating surveys.

Other reasons why municipalities do not implement smart projects include the fact that municipalities can better address their development priorities using „classical” measures. Smart projects can be more expensive than normal solutions. One of the municipalities was considering the purchase of smart technology for car drivers that would report the occupancy of parking spaces in the parking lot via a mobile application. The municipality concluded that the system works great but is expensive. Instead, an electronic sign was placed in the parking lot to report whether a space was available or fully occupied. Since this is a high-capacity parking lot, there is plenty of space to park, so 100% occupancy is rare. It was also noted that using dimming LED lights technology based on sunlight levels⁵ for public lighting, municipalities will not save anything by introducing it. The reason is that the control rooms for this technology are financially challenging. Municipalities may not even have a use for the smart technology of sensors reporting the fullness of garbage containers. Most problems with overfilled containers can be solved by a well-planned collection schedule and enough containers were mentioned as a barrier to implementing this technology. Likewise, using the already mentioned „door-to-door” technology, special collection companies have to be paid and the costs have to be passed on to the citizens by the municipality through the waste fee, which seems to the narrators to be a politically risky solution:

„I'm saying, the citizens vote for me, I can't raise the fees.” (B4)

The narrators also talk about the unsatisfactory conditions of the companies that supply smart solutions. An example could be the company offering the „Mobile Radio” application. One of the mayors said that although he sees immense potential in the company and its product and met the founders several years ago when the company was a start-up, after 6 years they have not yet agreed on the delivery of the product. This is because the mayor has specific requirements for the use of the application modules that the company cannot meet. The following was also said about the unnamed smart technology:

„Some guy offered us to put a smart panel on the light poles that would report on our cell phones if the lights were malfunctioning. He stated that this solution has a 25-year lifespan. So, I wrote to him to see whether he could give us a 25-year warranty on the technology. He has never replied. So that's a beautiful demonstration of a smart solution.” (B1)

Tab 4. Barriers perceived by narrators in the subcategory Lack of interest and economic disadvantage. Source: Authors' own processing

Perceived barrier	ID
Citizens' lack of interest or understanding of smart projects	A1, A2, B4, C4
Long payback period	A1
Lack of subsidies	A1, A2
Need to finance other higher priority projects	A1, B1
Narrator is not a fan of the smart concept	B1
Lack of interest of officials	B3, D
Inappropriateness of smart solutions	B4
Financial requirements of smart projects	B4
Complicated negotiations with companies offering smart solutions	B1
Solution is inappropriate for the narrator's municipality category	A1, A3, A4, B5

Technical complications

In some municipalities, smart solutions may not even be technically feasible. For example, mayors cannot imagine using sensors to report the fullness of trash containers because they export waste cyclically. A narrator from Brno said that in the case of fiber optic technology, a certain company wants to connect the whole country with the fastest internet, but for the municipality, this means digging up housing estates and pavements and cutting down trees in the protection zone. Citizens will grumble that

⁵ Monitoring and control take place directly on the municipality's side (the so-called control rooms) or on a central server (cloud storage) on the side of the system provider (Porsenna o.p.s., 2017).

everything is dug up and the municipality will be the target of criticism. The people may be happy in the end, but it will add a lot of trouble to the local government.

Tab 5. Barriers perceived by narrators in the subcategory *Technical complications*. Source: Authors' own processing

Perceived barrier	ID
Inappropriateness due to the already established processes in the municipality	A5, B1
Additional burden with landscaping	C1

Complex technology development and adoption

The problem of the size of the municipality is also mentioned in the question of the development of smart solution technologies and their adoption. According to the narrators, the local government must develop smart solutions together with companies. Without applying the solution to specific local conditions of the municipality, it cannot be done. Primarily, however, there must be a demand on the part of the larger city, as small municipalities as a small markets are rarely targeted by companies. Therefore, smart technologies should be first devised for cities, and then offered to small municipalities as an option for their development. However, such a situation has not yet arisen in the Czech Republic. The narrator from Brno explains this by the fact that the development of new smart solutions in the Czech Republic is approached reluctantly:

„People in the Czech Republic are not quite used to experimenting and prefer to wait for what works elsewhere and then adopt it.“ (C2)

Tab 6. Barriers perceived by narrators in the subcategory *Complex technology development and adoption*. Source: Authors' own processing

Perceived barrier	ID
Smart solutions must be firstly developed by larger cities	A2, A4, D
Reluctance in the development of smart solutions in the Czech Republic	C2

5.2 External barriers

Lack of information and promotion

In the interviews, problems were often raised concerning the lack of promotion of smart solutions by the government and the professional public. This problem causes a low awareness of smart solutions among the representatives and citizens of the municipality. It was expressed by the narrators that despite many invitations to seminars and discussions on SC, there is not enough information and awareness about the concept. In fact, according to the mayors, the best example of good practice of smart projects is to see successful SC projects in another municipality and, even better, if the pitfalls that accompany the implementation of these projects are explained to them. It is important not only to read about the projects, but also to discuss them with relevant actors. Such meetings can also be part of the implementation plan of the SC Conception, as knowledge transfer is the third pillar of the urban agenda in addition to legislation and finance. The narrators would also appreciate an online academy. Holding these online forms of promotion can support both the national level and individual municipalities.

It was suggested that a wider range of people in the Czech Republic should be involved in sharing information about the SC, which would bring more benefits. The implementation of the SC concept should be better advertised by professionals, especially to municipal representatives. However, it is necessary to be realistic when advertising smart solutions because smart solutions are not always cheaper, faster, or easier. According to the narrators, people should know how smart solutions could be useful and this information should be communicated to citizens in the most convenient way.

Tab 7. Barriers perceived by narrators in the subcategory Lack of information and promotion. Source: Authors' own processing

Perceived barrier	ID
Lack of information and awareness	A1, A2, B2, C2, C3, D
Wider range of people should be involved in sharing information about the SC	B4

Lack of concept and legislation

Another perceived problem is the lack of conceptual support for SC developments in the Czech Republic. It was stated that the Czech public administration talks a lot about SC but fails to implement its smart strategies in practice. If the state provided municipalities with targeted and step-by-step guidance on the implementation of smart strategies, narrators would be willing to implement smart solutions. It was also expressed that the topic of smart development resonates quite a lot at the political level, but not every politician and official grasps what it does – or could – mean. The narrators stated that staff in government ministries do not know what they are talking about and imagine the SC concept only in conjunction to technological applications and do not think rationally about the SC concept:

“To think smartly is tied to one's personal life experience. I have to say that there is a lot of unstable staff in ministries.⁶ Every new politician means a completely new SC concept.” (B5)

The narrators also identify a barrier in terms of the lack of a pure SC implementation document, where financial resources are clearly specified, in the Czech Republic that would provide clear guidance and enable cities to apply for a pilot smart solution:

“Let us say that municipalities fail to implement a certain smart solution, so it is not so smart after all. With EU grants, the city cannot afford to fail, there are given output and result indicators.” (C3)

For BMA, it would be interesting to expand an existing smart solution in Brno, i.e., participatory budgeting. The introduction of the tool in BMA, unfortunately, faces legislative obstacles. Brno has its own budget with clearly defined spending rules, but for the BMA budget, it is not known how this issue should be approached and which municipalities would be allowed to vote on projects, or on which mechanism of money distribution the participatory budget would work. According to the narrators, metropolitan cooperation is a big topic. Unfortunately, the Czech Republic has no experience in metropolitan cooperation at a legislative level. Any metropolitan cooperation is only possible thanks to the EU, and specifically thanks to the ITI. This allows integrated territorial investment projects that have an impact on metropolitan cooperation by allowing it to be financed.

Tab 8. Barriers perceived by narrators in the subcategory Lack of concept and legislation. Source: Authors' own processing

Perceived barrier	ID
Limited understanding of the smart concept by political leaders or officials	B5, C2
Missing concept of SC in the Czech Republic	B2, B5, C3
Legislative barriers	C2, C4

Administrative and security barriers

Some of the barriers to SC projects are put in the context of the limited possibilities of implementation within Brno. According to the Czech legislation, Brno belongs to the category of statutory cities, where according to a legally binding document (the city statute), the competencies, powers, and financial resources are divided between the city council and the councils that administer MDs. However, the law does not specify a completely binding way where competencies and finances are divided between these levels of administration. In terms of barriers to the introduction of SC projects, according to the mayor of the Brno MD, the problem is that the MD has money for operations, i.e., to provide certain services that are given by the city statute, but not for investments. The mayor is not opposed to the introduction of SC, but they are bound by the economic situation. The decision of the Brno City Council would have to be

⁶ Narrator B5 meant that there is a high turnover of staff in ministries.

taken even if a subsidy for SC is granted. The mayor claims that if they come to the Brno City Council with a specific request, they will get the money. But if they have more needs, they choose things other than a smart bench (outdoor seating with embedded charging points). In addition, he does not know if people even need to charge their mobile phones that way. However, another narrator from the city of Brno claims that the Brno MDs have the same options as Brno itself in terms of SC. The SC concept contains numerous possibilities that could be adopted by individual MDs, but implementation decisions lie with the elected representatives of the MD. Not all MDs have such a large budget as Brno, but in principle, if an MD suggests a meaningful project that can move life in the municipality forward using technology and data, funding can be secured. However, requesting funding depends on whether the SC agenda is a prominent issue for the MD council concerned.

Finally, the narrators are also aware of challenges related to cyber security and the implementation of smart projects. The solution to this problem may lie in the fact that smart solutions must not control the critical infrastructure of cities. To collect and manage data, municipalities should have a dedicated, closed network with limited personal access. The question is whether the SC agenda in the Czech Republic should be under the surveillance of the National Cyber and Information Security Authority. If municipalities wanted to implement smart projects and technologies, all providers must be certified. Moreover, in the case of data collection processes, all municipal personnel would have to obtain security clearances.

Tab 9. Barriers perceived by narrators in the subcategory Administrative and security barriers. Source: Authors' own processing

Perceived barrier	ID
Lack of competence and funding to implement SC projects	C1
Cyberthreats	B1

6. Discussion

The most frequently mentioned barrier is related to the lack of interest in smart projects and their economic disadvantage. The research has confirmed the findings of Desdemoustier et al. (2019) that small towns and municipalities may not be interested in smart projects because the smart concept addresses development priorities that are not or are perceived to not be relevant to them. Municipalities prefer other projects which they think are more important to their citizens, instead of smart solutions (Razmjoo et al., 2021; Sikora-Fernandez and Stawasz, 2016) despite the availability of various grant programs (Table 1). As noted by the narrators of small municipalities, existing grant opportunities may not match their specific development needs (Kitchin, 2015). In line with Sikora-Fernandez and Stawasz (2016), the lack of interest from officials in SC issues was also identified in BMA. This barrier was also perceived by the SMR council representative. This may be a risk for the further development of the smart concept in the SMR since the role of higher territorial units is crucial in the implementation of SC ideas in the wider geographical area (Garcia-Ayllon and Miralles, 2015). Within ITI projects, the issue of SC is not specifically raised and is not even demanded as a focal point. The reason for lack of interest could be unfamiliarity with the smart concept or reluctance to implement it (Mosannenzadeh et al., 2017). The expense of smart projects is an obstacle for small towns and municipalities (Grega et al., 2018). Cities with large populations may have an advantageous position since they may profit from economies of scale when implementing smart solutions (Araral, 2020; Neirotti et al., 2014). This is probably the reason why the budgetary barriers were not mentioned by the narrators from Brno. The marketing proclamations of companies offering smart solutions also carry no weight if a municipality does not have the funds to consider adopting what is advertised to them (Cardullo and Kitchin, 2018; Lebieczik, 2020). Smart solutions can represent a rather sophisticated tool, although it is questionable whether the deployment of such projects in municipalities is always appropriate. Narrators cited some cases where the desired goal could have been achieved more cheaply, using "classical" measures, whereas smart projects may be burdened with several indirect, and possibly long-term, financial costs (Janovský et al., 2019).

The second set of internal barriers is the technical complications that the introduction of smart projects would cause for municipalities. Often, municipalities can perform their activities in a specific and already

proven way. Smart solutions that can be effectively used elsewhere may simply be unsuitable in another context Przywojska et al. (2019) or may be associated with complex and difficult landscaping in the area.

The local specificity and uniqueness are also related to the difficulty of the development and adoption of smart technologies by small municipalities and towns. The literature suggests that smart projects need to consider the local characteristics of municipalities (Kitchin, 2015; Philip and Williams, 2019), which, according to the narrators, is not yet happening in the Czech Republic. Small municipalities and towns in BMA often cannot financially afford to develop tailor-made solutions and therefore must rely on the implementation of projects that have already been deployed elsewhere, often in cities (Lam and Givens, 2018). However, there still appears to be a significant risk in this respect, consisting of the different contexts of smart projects in a city and a small municipality. Thus, mayors of small municipalities and towns may face the problem that copying a solution that was successful elsewhere may not benefit the municipality, especially if a cost-benefit analysis is considered.

In terms of external barriers, the lack of information about the SC concept and its low promotion level is highlighted (Gorzalak and Smetowski, 2018; Sikora-Fernandez and Stawasz, 2016). Despite this, however, narrators mention the importance of practical demonstrations of different smart projects and expressed a demand for online modes of promotion and sharing of good practice examples. The latter may be more valuable as a means of demonstrating the potential contribution of smart solutions, especially if illustrative examples come from municipalities of the same size category. Awareness of potential projects is quite crucial in their implementation as it can provide information on the costs and benefits of these projects and thus influence citizens' and representatives' engagement (Mosannenzadeh et al., 2017). One possible solution is the establishment of an online platform for sharing municipalities' experiences with smart projects. The existence of such a platform can also be aimed at initiating cooperation between the various actors of the "smart ecosystem" in the BMA.⁷

Another set of barriers perceived purely by narrators from small towns and Brno is related to the insufficient conceptual and legislative grasp of SC issues (Neumannová, 2020). This problem is perceived despite the number of readily available strategic and methodological SC documents (Grega et al., 2018) mentioned above. Narrators often referred to the central government's vague and time-varying notion of the implementation of the SC concept, which does not consider local characteristics and focuses mainly on modern technologies. From the perspective of one of the mayors, modern technologies may not be the very aim and purpose of the SC concept (Caird, 2017). The absence of an SC implementation document, with earmarked funds for pilot SC projects in municipalities, has also been criticized. The expansion of some proven smart solutions in BMA may also be hampered by the absence of Czech legislation in this respect. Insufficient appreciation of the potential of smart projects in the wider territory is mentioned, for example, by Garcia-Ayllon and Miralles (2015), who also suggested the introduction of territorial legislation and cooperation to implement the smart territory concept. Andersson (2021) mentions the forms that such territorial cooperation in SC projects can take, citing, for example, the possibility of establishing a metropolitan government or a consortium of municipalities.

Finally, the perceived barrier is the administrative aspect, related to the limitations brought by the statute of Brno. A narrator from Brno MD points to the lack of funds that can be devoted to smart projects as Brno MDs don't have enough money to fund smart investments. On the other hand, the city management states that opportunities exist for the MDs and the problem is the low prioritization of smart projects by the MD. Concerns have also been noted about the cybersecurity of municipalities, with the availability of data generated by certain smart projects (Chang, 2021; Lytras and Visvizi, 2018).

7. Conclusion

This paper addressed the issue of factors that prevent territorial actors in BMA to implement smart projects. We found that barriers to the implementation of smart projects in sample BMA municipalities

⁷ The European Union, for example, uses the Smart Cities Marketplace initiative, which aims to bring together city stakeholders, investors, and companies to jointly implement smart projects. In the Czech Republic, only the regional cities of Prague, Brno and Zlín and the towns of Litoměřice, Kladno and Písek are involved in this initiative.

are related to factors such as lack of interest from residents, mayors, or officials, costliness, technical inappropriateness of the projects, and problems with the development or adoption of smart technologies. One of the main findings of this paper is that these barriers are perceived especially by narrators from small towns and municipalities. Other perceived barriers are related to the lack of awareness of the smart concept and its promotion, legislative and conceptual shortcomings that hinder the implementation of smart projects, and, finally, administrative and security barriers. Except for the lack of awareness of the smart concept and its promotion, these external barriers are perceived only by narrators from smaller towns and Brno.

The authors suggest mapping barriers in other metropolitan areas or agglomerations of the Czech Republic as an extension of the research reported here. To assess barriers more comprehensively, the possibility of exploring the attitudes of other groups of territorial actors, e.g., residents, businesses, or local action groups, is offered. The technique of semi-structured interviews is a useful tool to explore the broader context of attitudes and opinions, although it cannot reveal the frequency or severity of certain phenomena. Further mapping of barriers to the implementation of SC projects in the Czech Republic may therefore involve the application of quantitative research methods to provide different more generalizable insights. Such research can then serve the Czech political representation to identify key problems and eliminate these barriers to promote the implementation of SC projects across municipalities of distinct sizes. In line with one of the main ideas of the SC concept, smart projects implementation should not consist of the application of predefined top-down management schemes and procedures created by the government (Sikora-Fernandez and Stawasz, 2016). Rather, the application of a place-based approach that will consider the diversity of municipalities' needs when applying smart projects can be recommended (Fernandez-Anez et al., 2018).

Acknowledgments

This paper was supported by the internal grants of the Faculty of Regional Development and International Studies, Mendel University in Brno, titled "The state of implementation of the concept of "Smart Cities" in selected cities of the Czech Republic" (FRRMS_IGA_2021/017) and "The role of the region in the development of polytechnic education through leisure centres" (IGA-FRRMS-22-013).

Academic references

- [1] Alawadhi, S., Aldama-Nalda, A., Chourabi, H., Gil-Garcia, J., Leung, S., Mellouli, S., Nam, T., Pardo, T., Scholl, H. & Walker, S. (2012). In Scholl, H. J., Janssen, M., Wimmer, M. A., Moe, C. E. & Flak, L. S., eds., *Building Understanding of Smart City Initiatives. Electronic Government EGOV* (pp. 40–53). Berlin: Springer. DOI: 10.1007/978-3-642-33489-4_4.
- [2] Andersson, M. (2021). Smart city and metropolitan governance. In Vacca, J. R., ed., *Solving Urban Infrastructure Problems Using Smart City Technologies*, (pp. 235–246). DOI: 10.1016/B978-0-12-816816-5.00011-5.
- [3] Angelidou, M. (2014). Smart city policies: A spatial approach. *Cities* 41, S3–S11. DOI: 10.1016/j.cities.2014.06.007.
- [4] Anthopoulos, L. G. (2015). Defining Smart City Architecture for Sustainability. In Tambouris, E., Scholl, H. J., Janssen, M., Wimmer, M. A., Tarabanis, K., Gascó, M., Klievink, B., Lindgren, I., Milano, M., Panagiotopoulos, P., Pardo, T. P., Parycek, P. & Sæbø, Ø, eds., *14th IFIP Electronic Government and 7th Electronic Participation Conference 2015* (pp. 140–147). DOI: 10.3233/978-1-61499-570-8-140.
- [5] Araral, E. (2020). Why do cities adopt smart technologies? Contingency theory and evidence from the United States. *Cities* 106, Article 102873. DOI: 10.1016/j.cities.2020.102873.
- [6] Atkočiūnienė, V. & Vazonienė, G (2019). Smart Village Development Principles and Driving Forces: The Case of Lithuania. *European Countryside* 11(4), 497–516. DOI: 10.2478/euco-2019-0028.

- [7] Bjørner, T. (2021). The advantages of and barriers to being smart in a smart city: The perceptions of project managers within a smart city cluster project in Greater Copenhagen. *Cities* 114, Article 103187. DOI: 10.1016/j.cities.2021.103187.
- [8] Bosworth, G., Price, L., Collison, M. & Fox, C. (2020). Unequal futures of rural mobility: Challenges for a “Smart Countryside”. *Local Economy: The Journal of the Local Economy Policy Unit*, 35(6), 586–608. DOI: 10.1177/0269094220968231.
- [9] Caird, S. (2017). City approaches to smart city evaluation and reporting: case studies in the United Kingdom. *Urban Research and Practice* 11(2), 159–179. DOI: 10.1080/17535069.2017.1317828.
- [10] Caragliu, A., Del Bo, C. & Nijkamp, P. (2011). Smart Cities in Europe. *Journal of Urban Technology* 18(2), 65–82. DOI: 10.1080/10630732.2011.601117.
- [11] Cardullo, P. & Kitchin, R. (2018). Smart urbanism and smart citizenship: The neoliberal logic of ‘citizen-focused’ smart cities in Europe. *Environment and Planning C: Politics and Space* 37(5), 813–830. DOI: 10.1177/0263774X18806508.
- [12] Castelnovo, W., Misuraca, G. & Savoldelli, S. (2016). Smart Cities Governance. *Social Science Computer Review* 34(6), 724–739. DOI: 10.1177/0894439315611103.
- [13] Chang, V. (2021). An ethical framework for big data and smart cities. *Technological Forecasting and Social Change* 165, Article 12055. DOI: 10.1016/j.techfore.2020.120559.
- [14] Chavhan, S. & Venkataram, P. (2020). Prediction-based traffic management in a metropolitan area. *Journal of Traffic and Transportation Engineering* 7(4), 447–466. DOI: 10.1016/j.jtte.2018.05.003.
- [15] Desdemoustier, J., Crutzen, N. & Giffinger, R. (2019). Municipalities' understanding of the Smart City concept: An exploratory analysis in Belgium. *Technological Forecasting and Social Change* 142, 129–141. DOI: 10.1016/j.techfore.2018.10.029.
- [16] Dufek, Z., Chorazy, T. & Apeltauer, T. (2017). Analysis of the approach of the municipalities to the Smart City conception and selected examples of its applications. In *Smart City Symposium Prague* (pp. 1–6). Piscataway, NJ.: IEEE. DOI: 10.1109/SCSP.2017.7973840.
- [17] Fernandez-Anez, V., Fernández-Güell, J. & Giffinger, R. (2018). Smart City implementation and discourses: An integrated conceptual model. The case of Vienna. *Cities* 78, 4–16. DOI: 10.1016/j.cities.2017.12.004.
- [18] Gagliardi, G., Casavola, A., Lupia, M., Cario, G., Tedesco, F., Scudo, F. L., Gaccio, F. C. & Augimeri, A. (2018). A smart city adaptive lighting system. In *2018 Third International Conference on Fog and Mobile Edge Computing (FMEC)* (pp.258–263). New York, NY: IEEE. DOI: 10.1109/FMEC.2018.8364076.
- [19] Garcia-Ayllon, S. & Miralles, J. L. (2015). New strategies to improve governance in territorial management: evolving from “smart cities” to “smart territories”. *Procedia Engineering* 118, 3–11. DOI: 10.1016/j.proeng.2015.08.396.
- [20] Girardi, P. & Temporelli, A. (2017). Smartainability: A Methodology for Assessing the Sustainability of the Smart City. *Energy Procedia* 111, 810–816. DOI: 10.1016/j.egypro.2017.03.243.
- [21] Gorzelak, G. & Smetkowski, M. (2018). Regional development dynamics in Central and Eastern European countries: Development processes and policy challenges. In Gorzelak, G., Bachtler, J. & Smetkowski, M., eds., *Regional Development in Central and Eastern Europe* (not paged). DOI: 10.4324/9780203855386-4.
- [22] Grega, L., Miškolci, S., Zdráhal, I. & Pastvová, D. (2018). *Analýza aktuální úrovně zapojení ČR do konceptu smart city a smart region v souvislosti s novými trendy, včetně návrhů opatření* [research study]. Brno: Medelova univerzita.
- [23] Ho, S., Hashi, H. & Lim, J. (2014). Integrated biomass and solar town concept for a smart eco-village in Iskandar Malaysia (IM). *Renewable Energy* 69, 190–201. DOI: 10.1016/j.renene.2014.02.053.

- [24] Hollands, R. (2015). Critical interventions into the corporate smart city. *Cambridge Journal of Regions, Economy and Society* 8(1), 61–77. DOI: 10.1093/cjres/rsu011.
- [25] Hollands, R. (2009). Will the real smart city please stand up? *City* 12(3), 303–320. DOI: 10.1080/13604810802479126.
- [26] Janovský, V., Kandusivá, V., Kuzmič, M., Kytka, I., Sýkorová, M., Vavřichová, B. & Včelák, J. (2019). *Analýza potřeb a předpokladů pro řízení konceptu Smart Cities ve Středočeském kraji* [Final report]. Praha: Středočeské inovační centrum.
- [27] Jaňurová, M. & Chaloupková, M. (2018). Koncept smart cities ve veřejné správě v České a Slovenské republice. *Geografické informácie* 22(1), 180–190. DOI: 10.17846/GI.2018.22.1.180-190.
- [28] Jaňurová, M., Chaloupková, M. & Kunc, J. (2020). Smart City Strategy and its Implementation Barriers: Czech experience. *Theoretical and Empirical Research in Urban Management*. 15(2), 5–21.
- [29] Jucevičius, R., Patašienė, I. & Patašius, M. (2014). Digital Dimension of Smart City: Critical Analysis. *Procedia – Social and Behavioral Sciences* 157, 146–150. DOI: 10.1016/j.sbspro.2014.11.137.
- [30] Kaczmarek, T. & Kociuba, D. (2017). Models of governance in the urban functional areas: Policy lessons from the implementation of integrated territorial investments (ITIs) in Poland. *Quaestiones Geographicae* 36(4), 47–64. DOI: 10.1515/quageo-2017-0035.
- [31] Khan, U. & Haleem, A. (2015). Improving to Smart Organization: An integrated ISM and fuzzy-MICMAC modelling of barriers. *Journal of Manufacturing Technology Management* 26(6), 807–829. DOI: 10.1108/JMTM-05-2014-0062.
- [32] Kitchin, R. (2015). Making sense of smart cities: addressing present shortcomings. *Cambridge Journal of Regions, Economy and Society* 8(1), 131–136. DOI: 10.1093/cjres/rsu027.
- [33] Klusáček, P., Konečný, O., Zgodová, A. & Navrátil, J. (2020). Application of the smart city concept in process of urban recycling – case study of Špitálka in Brno, Czech Republic. *DETUROPE – The Central European Journal of Tourism and Regional Development* 12(1), 22–40. DOI: 10.32725/det.2020.002.
- [34] Komninos, N. (2016). Smart environments and smart growth: Connecting innovation strategies and digital growth strategies. *International Journal of Knowledge-Based Development* 7(3), 240–263. DOI: 10.1504/IJKBD.2016.078536.
- [35] Kummitha, R. K. R. (2020). Why distance matters: The relatedness between technology development and its appropriation in smart cities. *Technological Forecasting and Social Change* 157. Art. 120087. DOI: 10.1016/j.techfore.2020.120087.
- [36] Kummitha, R. & Crutzen N. (2017). How do we understand smart cities? An evolutionary perspective. *Cities* 67, 43–52. DOI: 10.1016/j.cities.2017.04.010.
- [37] Lam, D. & Givens, J. W. (2018). Small and Smart: Why and How Smart City Solutions Can and Should be Adapted to the Unique Needs of Smaller Cities. *New Global Studies* 12(1), 21–36. DOI: 10.1515/ngs-2018-0011.
- [38] Lebieczik, M. (2020). Application of the Global Concept of “Smart City” at the Local Level of the Karviná District. *Sustainability* 12(17), Article 7186. DOI: 10.3390/su12177186.
- [39] Lytras, M. & Visvizi, A. (2018). Who Uses Smart City Services and What to Make of It: Toward Interdisciplinary Smart Cities Research. *Sustainability* 10(6). DOI: 10.3390/su10061998.
- [40] Macke, J., Rodrigo M., Casagrande, R., Sarate, J. & Silva, K. (2018). Smart city and quality of life: Citizens’ perception in a Brazilian case study. *Journal of Cleaner Production* 182, 717–726. DOI: 10.1016/j.jclepro.2018.02.078.
- [41] Masik, G., Sagan, I. & Scott, J. (2020). Smart City strategies and new urban development policies in the Polish context. *Cities* 108, Article 102970. DOI: 10.1016/j.cities.2020.102970.

- [42] Masik, G. & Stępień, J. (2021). Smart Local Governance: The Case of the Gdańsk-Gdynia-Sopot Metropolitan Area in Poland. *Journal of Urban Technology*. DOI: 10.1080/10630732.2021.1930841.
- [43] McNeil, M., Arribas-Ayllon, M., Haran, J., Mackenzie, A. & Tutton, R. (2017). Conceptualizing imaginaries of science, technology, and society. In Felt, U., Fouché, R., Miller, C. A. & Smith-Doerr, L., eds., *The Handbook of Science and Technology Studies*, 4th ed. (pp. 435–463). Cambridge MA: The MIT Press.
- [44] Merriam, S. B. (2009). *Qualitative research. A guide to design and implementation*. San Francisco CA: Jossey-Bass.
- [45] Merton, R. K. (2007). *Studie ze sociologické teorie*. Praha: SLON (Sociologické nakladatelství).
- [46] Mišovič, J. (2019). *Kvalitativní výzkum se zaměřením na polostrukturovaný rozhovor. Studijní texty*. Praha: SLON (Sociologické nakladatelství).
- [47] Mohanty, S., Bhagyashree, M., Pragyana, N., Siddhartha, S. & Srikanta, P. (2020). Smart Village Initiatives: An Overview. In Patnaik, S., Siddhartha, S. & Magdi, S. M., eds., *Smart Village Technology* (pp. 3–24). Cham: Springer. DOI:10.1007/978-3-030-37794-6_1.
- [48] Monzon, A. (2015). Smart Cities Concept and Challenges: Bases for the Assessment of Smart City Projects. In Helfert, M., Krempels, K., Klein, C., Donellan, B. & Guiskhin, O., eds., *Smart Cities, Green Technologies, and Intelligent Transport Systems* (pp. 17–31). Cham: Springer. DOI: 10.1007/978-3-319-27753-0_2.
- [49] Mora, L., Deakin, M., Reid, A. & Angelidou, M. (2017). How to Overcome the Dichotomous Nature of Smart City Research: Proposed Methodology and Results of a Pilot Study. *Journal of Urban Technology* 26(2), 89–128. DOI: 10.1080/10630732.2018.1525265.
- [50] Mosannenzadeh, F., Di Nucci, M. & Vettorato, D. (2017). Identifying and prioritizing barriers to implementation of smart energy city projects in Europe: An empirical approach. *Energy Policy* 105, 191–201. DOI: 10.1016/j.enpol.2017.02.007.
- [51] Naldi, L., Nilsson, P., Westlund, H. & Wixe, S. (2015). What is smart rural development? *Journal of Rural Studies* 40, 90–101. DOI: 10.1016/j.jrurstud.2015.06.006.
- [52] Neirotti, P., De Marco, A., Cagliano, A., Mangano, G. & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. *Cities* 38, 25–36. DOI: 10.1016/j.cities.2013.12.010.
- [53] Neumannová, M. (2020). Měření chytrosti měst dle indexů smart city: komparativní regionální analýza visegrádské skupiny. In Klímová, V. & Žítek, V., eds., *XXIII. mezinárodní kolokvium o regionálních vědách*. Brno: Masarykova univerzita. DOI: 10.5817/CZ.MUNI.P210-9610-2020-29.
- [54] Ouředníček, M., Nemeškal, J. & Pospíšilová, L. (2020). *Vymezení území pro Integrované teritoriální investice (ITI) v ČR* [Final document, 3rd version]. Praha: Univerzita Karlova.
- [55] Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating Theory and Practice*. Thousand Oaks, CA: Sage Publications.
- [56] Philip, L. & Williams, F. (2019). Healthy Ageing in Smart Villages? *European Countryside* 11(4), 616–633. DOI: 10.2478/euco-2019-0034.
- [57] Przywojska, J., Podgórnjak-Krzykacz, A. & Wiktorowicz, J. (2019). Perceptions of Priority Policy Areas and Interventions for Urban Sustainability in Polish Municipalities: Can Polish Cities Become Smart, Inclusive and Green? *Sustainability* 11(14), Article 3962. DOI: 10.3390/su11143962.
- [58] Rana, N., Luthra, S., Mangla, S., Islam, R., Roderick, S. & Dwivedi, Y. K. (2018). Barriers to the Development of Smart Cities in Indian Contexts. *Springer Nature* 21(3), 503–525. DOI: 10.1007/s10796-018-9873-4.
- [59] Razmjoo, A., Østrgaard, P., Denaï, M., Nezhad, M. & Mirjalili, S. (2017). Effective policies to overcome barriers in the development of smart cities. *Energy Research & Social Science* 79, Article 102175. DOI: 10.1016/j.erss.2021.102175.

- [60] Rubin, H., J. & Rubin, I., S. (2005). *Qualitative Interviewing: The Art of Hearing Data*. Thousand Oaks, CA: Sage Publications. DOI: 10.4135/9781452226651.
- [61] Shapiro, J. M. (2006). Smart Cities: Quality of Life, Productivity, and the Growth Effects of Human Capital. *Review of Economics and Statistics* 88(2), 324–335. DOI: 10.1162/rest.88.2.324.
- [62] Sikora-Fernandez, D. & Stawasz, D. (2016). The concept of smart city in the theory and practice of urban development management. *The Journal of the Romanian Regional Science Association* 10, 81–99.
- [63] Slee, B. (2019). Delivering on the Concept of Smart Villages – in Search of an Enabling Theory. *European Countryside* 11(4), 634–650. DOI: 10.2478/euco-2019-0035.
- [64] Talbot, S. (2016). Creating a smart rural economy through smart specialisation: The microsphere model. *Local Economy: The Journal of the Local Economy Policy Unit* 31(8), 892–919. DOI: 10.1177/0269094216678601.
- [65] Taylor, M. (2017). Climate-smart agriculture: what is it good for? *The Journal of Peasant Studies* 4(1), 89–107. DOI: 10.1080/03066150.2017.1312355.
- [66] Timeus, K., Vinaixa, J. & Pardo-Bosch, F. (2020). Creating business models for smart cities: a practical framework. *Public Management Review* 22(5), 726–745. DOI: 10.1080/14719037.2020.1718187.
- [67] Vaishar, A. & Šťastná, M. (2019). Smart Village and Sustainability. Southern Moravia Case Study. *European Countryside* 11(4), 651–660. DOI: 10.2478/euco-2019-0036.
- [68] Van Gevelt, T., Canales Holzeis, C., Fennell, S., Heap, B., Holmes, J., Hurley Depret, M., Jones, B. & Safdar, M. T. (2018). Achieving Universal Energy Access and Rural Development through Smart Villages. *Energy for Sustainable Development* 43, 139–142. DOI: 10.1016/j.esd.2018.01.005.
- [69] Zavrtnik, V., Kos, A. & Duh, E. (2018). Smart Villages: Comprehensive Review of Initiatives and Practices. *Sustainability* 10(7). DOI: 10.3390/su10072559.

Other sources

- [70] Brno Metropolitan Area (2020). *Máme nové vymezení!* Brno: Magistrát města Brna. Available at: <https://metropolitni.brno.cz/mame-nove-vymezeni/>.
- [71] Public database (2021). *Počet obyvatel v obcích – k 1.1.2021*. Praha: Czech Statistical Office. Available at: <https://www.czso.cz/csu/czso/pocet-obyvatel-v-obcich-k-112021>.
- [72] Pilot project: smart eco-social villages: final report (2020). Luxembourg: Publications Office of the EU. DOI: 10.2762/100370.