The economic and social impacts of smart cities: multi-stakeholder pre-study results

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Abstract

Smart cities are getting increasingly popular and being seen as one answer to several challenges. The smart city framework is seen as a popular answer to numerous challenges. There is no common definition of a smart city and the theoretical understanding is framed in multiple ways in practice. To better understand the phenomenon of smart cities it is important to see how it is viewed in practice by different stakeholders. Objectives This paper contributes to collecting and analyzing the stakeholders' visions to develop the definition of smart cities and classify their social and economic effects as a basis for further advanced study in this direction. Prior work The previous findings have determined the double-sided effects of smart cities in social and economic domains that could be balanced through different tools. In terms of the fundamental importance of ensuring citizen-oriented and sustainable utilization of smart city as a tool purporting to improve quality of life, it is needed to critically assess how stakeholders perceive these impacts and what tools could be applied to prevent negative outcomes. Methodology The paper applies a literature review, in-depth interviews with the smart city experts and survey answers analysis involving the city stakeholders including local and regional authorities and the real citizens to determine the personalized visions of smart city definition and impacts as well as open source analysis. Results Based on the data collected, the classification of the social and economic impacts of smart cities is proposed as well as study-based definition of smart city is provided. It is argued that considering social and economic impacts of smart cities needs further attention in terms of the multi-stakeholder perspective and continuation of the work started in this paper. In doing so, the paper does not only contribute to the theoretical comprehension of smart city but provides the basis for further strategy development to maximize social and economic positives of its application while minimizing the negatives.

Keywords: social and economic impacts, smart city, public administration, city stakeholders.

1. Introduction

In terms of its growing popularity, the smart city framework is viewed as a tool for resolving different urban challenges. At the same time, with the lack of a common definition, the real effects of smart cities can be far from the supposed by design causing challenges, rather than resolving them. Having a look at the stakeholder dimension of perceiving the practical effects and understanding smart cities are likely to have significant practical and theoretical value in terms of further strategy mapping and avoiding the undesired outcomes.

As pointed out by Michael Batty, in his book The New Science of Cities, we live in the era of cities. [1] The cities are increasingly utilizing the ICT Internet of Things (IoT), big data and cloud computing technologies, and other innovative solutions to deal with the diverse challenges and aim to improve public services. The increasing population in cities means the need for searching for ways of doing things more effectively. Digitizing and attempts to optimize the city's performance are in trend. The last 20 years have been characterized by the rapid development of smart cities and regions. [2] Smart city initiatives are viewed as a tool to deal with the crisis and limitedness of resources and services including education, transportation, medicine, and the environment. The current energy crisis, increasing traffic in the cities and black swans such as the cases of more than 90% of urban

infrastructure completely ruined in Ukraine, and increased conventional energy prices also prove the urgency of finding out-of-the-box solutions in the field of sustainability, not the least with an aim of cities recovery. Green energy as a smart city component, in terms of energy-efficient building design and smart grid systems, has a huge potential. [3]

At the same time, the lack of understanding and comprehensive definition of smart cities can also lead to negative consequences of implementation. Often a smart city is viewed very optimistically by design but its real implementation can be much more controversial. At the same time, the one-sided technological approach to smart city implementation while failing to be citizen-oriented can lead to serious concerns. Smart cities create both opportunities and challenges for local and regional governance. [4] Prosser viewed cybersecurity, social divide, not the least gentrification consequence, and non-sustainability as the key dark sides of the smart city model [25] Anvenniemi and other researchers have emphasized that studying the implications of smart cities on the social life of the people is highly relevant. [5] Therefore, it is vitally relevant to pay attention to the "real" effects of the "ideal" smart city policy through the analysis of the multi-stakeholder vision. As the negative implications of smart cities may be derived from the concept misinterpretation, lack of awareness, and comprehensive people-oriented definition, particular attention should be paid to considering the multi-stakeholder approaches to understanding what a smart city is.

1.1. Prior Work

Taylor has mentioned that the smart city practices that are popular examples can also lead to uneven impacts on the places where they have been adopted. [6] Dhere and Bendale stressed that the extent to which smart cities can help the community is debatable when the focus is only on the economic aspect while the social aspect is completely ignored or lacking. [7] The valuable contribution was made by Patel and Doshi and other researchers who concluded that the massive application of IoT devices can create cybersecurity and privacy concerns. [8] Trencher mentioned that the more advanced forms of the smart city such as 2.0 can be used as a tool for dealing with social challenges subject to comprehensive planning and design. Based on the example of Japanese Fukushima, the researcher considered smart cities as a tool for dealing with endogenous social challenges. [9] In the previous research conducted by the author of this paper using concrete examples of leading smart cities, it is mentioned that the blind application of technologies can lead to various effects when the sustainability side is missed. [10] Kumar and De Vass focused on particular smart city components such as logistics on sustainable city performance. [11] The huge work in the field of defining smart cities was conducted by Dameri, Russo, and others. [12, 13, 14] The social and economic consequences of smart cities were analyzed by researchers such as Popescu, Visvizi, Lytras, Khalifa, Trencher, and many others. [15, 16, 17, 18, 19, 20] The difference between theoretical and practical implementation was presented by Shelton. [32] The quality of life is presented in the definition but whether the real smart city leads to it automatically? As pointed out by the Congress of Local and Regional Authorities in the related report, along with their potential, the main threats of smart cities lie within the domains of data privacy, the use of artificial intelligence, and the digital divide. [4] However, there is still a need to systemize existing findings and expand the theoretical discussions in this direction, not the list in terms of attempting to classify

the impacts, searching for policy-efficient well-balanced definitions, bearing in mind the topic relevance as well as to bring the citizens, stakeholders voices to the table. Despite the relevance, there is not yet comprehensive research that focuses on this issue, especially when different stakeholders.

1.2. Paper Scope

The paper aims to provide multi-stakeholder perspectives on considering the social and economic impacts of smart cities through using unique classification of positive and threatening effects and determining the real-world perception by people from different countries as well to provide smart city definition based on the pre-study conducted. The paper highlights the preliminary results of the survey, discusses ways for improvement to be further continued by the author.

1.3. Methodology

This paper employs the basic methods such as literature review, expert interviews and multi-stakeholder survey study to consider the approaches to defining smart cities and personal perspectives of smart city stakeholders as well as to systemize the classification of the most tangible positive and negative social and economic effects triggered by the smart city model. The research questions were what is a smart city (1), what are the main social consequences (2), what are the main economic consequences (3). The survey was mainly disseminated through public groups, the city associations in Europe, Finnland, Ukraine, UK, Hungary, in particular. As it is a pre-study, no country distinction was made, so the results were considered comprehensively while the further study will require considering country specifics. In general, 55 responses were collected, while the survey form was filled by two key stakeholder groups such as municipality representatives and citizens, revealing the key tendencies for further research. This number is sufficient for tracking the basic dynamics and to lay the basis for further research of higher scale. In addition, 5 consultations were conducted based on expert involvement from Finland and the UK to strengthen the relevance of preliminary interpretation of the data collected.

2. Main findings

2.1. Defining smart city

The last 30 years have been characterized by the terminology revolution. Despite numerous attempts, the smart city boundaries were not well-defined as well as one definition is rather lacking. There is no common smart city definition. The terminology uncertainty rather prevents the authorities from finding proper implementation paths. [12] It is important to determine what is the city itself and what are the purposes of it. While applying complexity theory to understanding cities, Batty emphasized the system approach and viewed it as the functions of interacting populations determining economic and social interactions. He considered a city as a subsystem of interactions rather than a place. Locations are important but only to the extent of anchoring interactions. A city is not a machine but rather a living organism, a kind of social contract. [1] Dameri distinguished between the terminologies of digital and smart city mentioning that from a comparison of these definitions, both smart city and digital city are addressed to the citizens, aiming to improve social inclusion, e-services, economic and political efficiency, and urban development, to enhance citizen quality of life. So, both smart cities and digital cities are two urban strategies aiming at

improving the quality of life for citizens, but they utilize different technologies, and instruments, addressing different citizen targets. [12, 21] There are three stages of smart cities. Smart city 1.0 is characterized by the presence of certain smartness components that are overall not interconnected. Smart city 2.0 involves a general policy strategy and utilizes the interconnection principle to maximize its effectiveness. As mentioned by Batty, it is easy to define smart city 1.0 but it is much more complicated to define. Smart city 3.0 refers to the synergy of components focusing on sustainability (more software than hardware orientation).
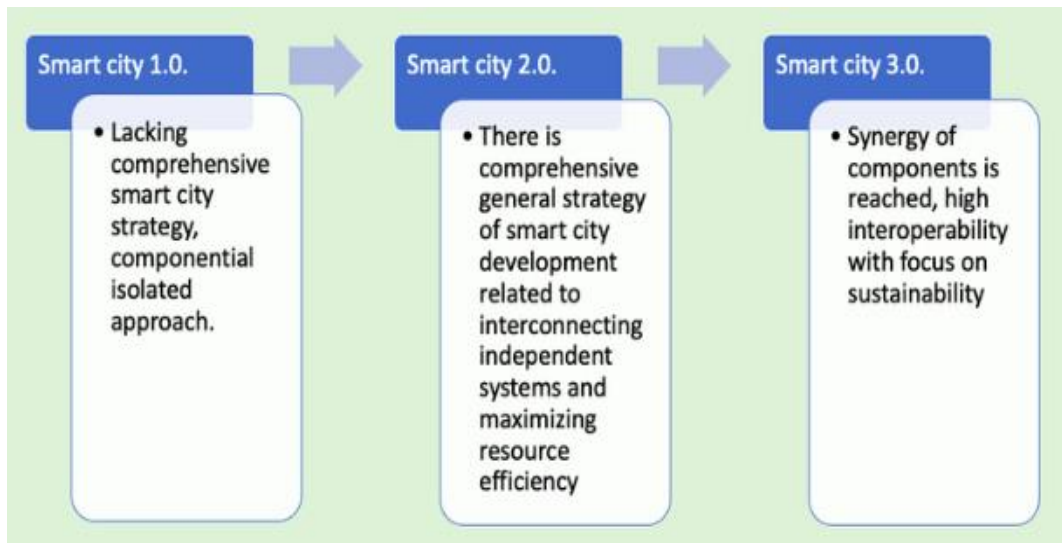

Fig. 1. SMART city concept evolution
Source: Author own work

The literature review has revealed that the scientists-provided definitions involve technological, human, knowledge, and environmental orientations. Nevertheless, there are one-sided definitions bearing in mind only the technological paradigm (smart city 1.0. especially). [22] Based on the review, Ramaprasad distinguished between definitions related to the information technology field (the focus was on infrastructure) and those related to urban design being outcome-oriented (mostly emphasizing sustainability and quality of life). [13] The componential definition of smart cities is commonly viewed as the interaction of various blocks such as people, governance, economy, mobility, environment, etc. [23] For this research, it is deemed relevant to mention some of the following definitions of a smart city. Gilffinger and others viewed a smart city as "a well-performing city built on the „smart" combination of endowments and activities of self-decisive, independent and aware citizens". [24] The generalized nature and comprehensiveness of this definition while missing technological components draws focus on improved performance, people participation, and learning. Moreover, it refers to the decentralized (independent) manner of interactions within the city determined by citizens.

There are definitions viewing a smart city as an abstract concept and definitions referring to cities as geographical areas, infrastructure, place, etc. For instance, Dameri considers a

smart city a "well-defined geographical area, in which high technologies such as ICT, logistics, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development". [12] At the same time, as already mentioned, Batty referred to the city as a network rather than space, area or geographical object. [1] Khalifa described smart cities as a lifestyle based on employing the newest technological developments (AI, big data, etc) to improve quality of life, increase safety and make life easier. [15] This defining approach is also reflective of quite a popular terminology structure (noun… based on ICT.. to... (improving and citizen orientation)). In this definition an important optimization role of the smart city model is mentioned, safety, easiness, and improving quality of life along with the people-orientation component.

Keeping in mind the importance of stakeholder co-creation of smart city models, it was interesting to look at the perception of smart city definition by the people. In the framework of the pre-study with the Google form distributed survey, the question was open, so the respondents could share their vision laying the basis for developing definitions at the further research stages. Then, the definitions collected were subject to linguistic analysis to determine the most frequently mentioned words and their variations (synonym based).

Table 1. Linguistic analysis result, key words in definitions provided by respondents

Most frequently mentioned key words			
Sustainable (sustainability)	future	digital (digitizing) technologies	citizens (generations, people orientation)
optimization (optimized, optimum)	inclusivity, (inclusion)	equal participation people in control of	resilient, secure, safe,
natural (clean, environmental)	easy (easier, effective, efficient, convenient, accessible)	strategy, model, concept solutions or technology applications	ability to think and design

Source: Author own work

It is important to note that the collected definitions were checked in terms of plagiarism, no definition was directly copied from the Internet, while the respondents were asked to provide their perception rather than some "right answer". Interestingly, one of the key expectations associated with smart cities was increased sustainability. It means that smartness includes sustainability association. In the vast portion of definitions, technologies are mentioned. Interestingly, there were no nouns used like space or area while the smart city was viewed as an abstract framework to program the outcomes related to other keywords such as sustainability, citizens, etc.
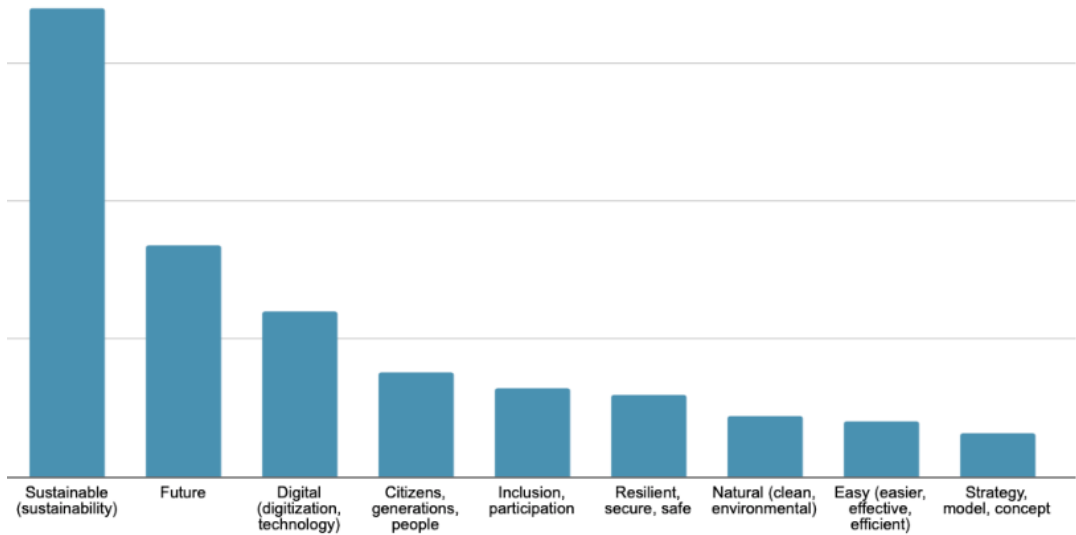
Fig. 2. Comparative frequency of key words mentioned graph
Source: Author own work

The pre-study derived joint definition is as follows: smart city is a future, people and environment oriented, inclusive, resilient sustainable strategy of optimizing performance, increasing safety through applying digital technologies and other innovative tools.

2.2. Social Impacts of Smart city

Russo highlighted that adopting smart cities' solutions at the European level is understood as the way to tackle the major societal challenges in urban life. As mentioned by Trencher, the more advanced forms of the smart city such as 2.0 can be used as a tool for dealing with social challenges subject to comprehensive planning and design. [15] Kar and others distinguished the positive impacts of smart cities as improved learning, creativity, participation, more opportunities, qualification, higher quality of life, interactiveness, and accessibility. [26] In addition to a higher quality of life, Dameri views a smart city as a mechanism for delivering better public and private services in particular domains including local public transport, health services, and so on. [12] Yeh and others emphasized that social networking systems present high potential in terms of educating people on how to use smart services properly and avoid biases. [31] However, a one-sided technological approach to smart city implementation can lead to serious social concerns. [4]

Mancebo made an interesting observation based on the cases of Amsterdam, Barcelona, and Paris which showed that behind the official line promising a more participatory society, the inhabitants are rather turned into users or clients of a city that belongs no more to them. [28] Data privacy and security concerns, including cybersecurity, were mentioned as one of the main threats in several surveys. [17, 18, 29, 30, 25] The smart city also poses huge risks for inclusion of the marginalized communities. [25, 16] Based on the literature review and consultations, the following classification of the positive smart city impacts was presented for analysis as a pre-survey.

Table 2. Positive social impacts of smart city with the most impactful selected by stakeholders highlighted

Positive social impacts of smart city	
Improved learning process & awareness	Promoting green agenda and sustainability initiatives
Improved networking, connecting citizens	Facilitating human potential and skills
Better Quality of Life	Social resilience and peace potential
Improved Communication	Improved city security
Design for better inclusion and social equity	Less bureaucracy
Social security	Creation of new workplaces
Better inclusion & social equity	Other

Source: Author own work

The classification distinguished between design for better inclusion (i.e. the basis for reaching this goal that is not anyway reached) and real reaching of social inclusion. The participants were asked to select the three most impactful factors. The pre-study revealed that the most impactful factors were promoting green agenda and sustainability initiatives, improved networking, connecting citizens as well as a design for better inclusion and social equity. Interestingly, no one selected less bureaucracy. The interviews have revealed that the existence of a comprehensive smart city strategy that involves sustainability and social dimension does not mean its socially positive consequences (the difference between declarations and reality).
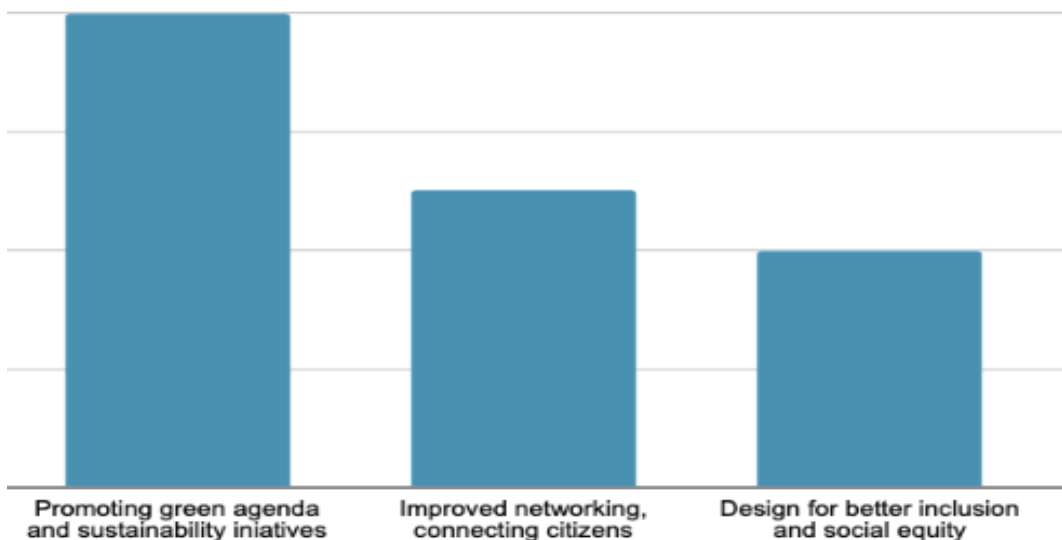

Fig. 3. The most selected positive social impacts of smart city proportionally
Source: Author own work

Table 3. Negative social impacts of smart city with the most impactful selected by stakeholders highlighted

Negative impacts of smart city
Privacy Concerns
Increased unemployment due to replacement of jobs by technology
Social marginalization, exclusion, leaving those with lower technological expertise behind
Improved Communication
Data monopolization that could lead to misconduct
Loss of social connections
Lack of reference to direct human decision making or a chance to appeal to a human [eg when the algorithm/ automated machine says 'no']
Domination of AI and technologies in the crucial fields
Risk of glitch, blackout, technological breaks
Gender gap increase
Bias in the programming of AI, whether cultural or other assumptions. Eg racial profiling in facial recognition.
' Ageism' - leaving older citizens behind due to digital divide
Income related exclusion: lack of digital access in an automated society reliant on web based services.
Neglect of nature based solutions for technological ones [not following SDGs]

Source: Author own work

The improved communication option was also included to avoid blind selection and increase the attentiveness of the respondents. The pre-survey results determined social marginalization, exclusion, leaving those with lower technological expertise behind, privacy concerns, data monopolization that could lead to misconduct, and neglect of nature-based solutions for technological ones [not following SDGs]. Among the less selected were the gender gap increase, improved communication (naturally as it was a positive impact), and loss of social connections. In table 3, neglect of nature-based solutions for technological ones [not following SDGs] was also highlighted as it was almost equally selected along with the data monopolization.

In the framework of the interviews as well as other survey option sections, the following remarks were highlighted. Access to new forms of open data enabling innovation and creative solutions, a sense of community, making more out of less, attractiveness of the region, and new efficiencies in daily activities in cities with high population concentrations were mentioned as other positive social impacts of a smart city. Digitalization has a massively negative ecological footprint, and the incapability of resolving key challenges if

failing to preserve sustainability. The potential diversion of scarce resources away from social services may also happen.
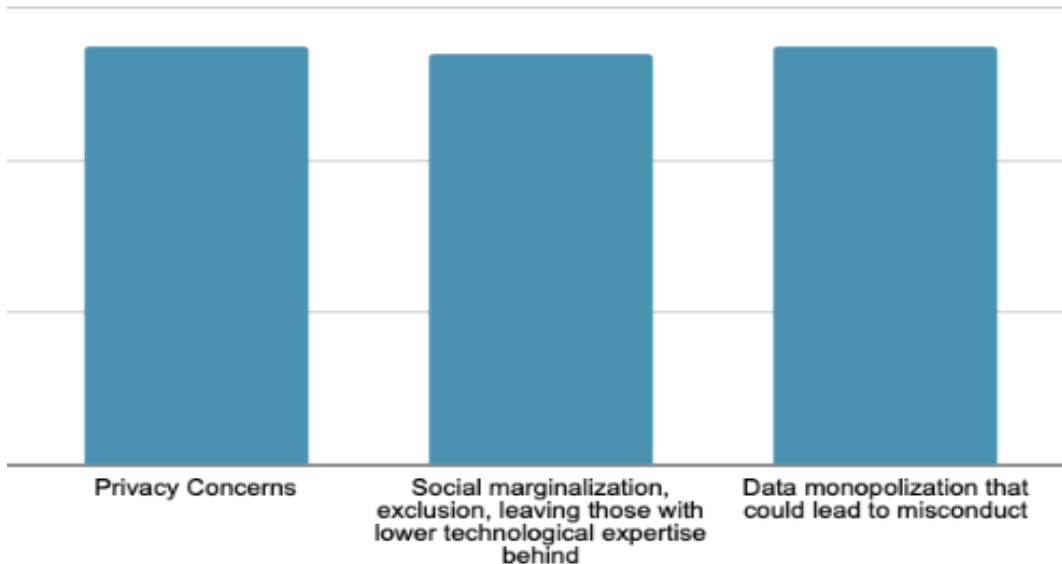

Fig. 4. The most selected negative social impacts of smart city proportionally
Source: Author own work

2.3. Economic Impacts of Smart Cities

Popescu highlighted that the economic consequences of the smart city proposals are business production, job generation, personnel development, and enhancement in productivity. [19]

Masera and others mentioned cybersecurity concerns related to smart energy. [33] Shelton and others viewed expanded smartness could be viewed as bringing the positives to the local economic scheme creating a vehicle for restoring the local economy. Smart city has the potential of improving knowledge operations, contributing to the rising capacity and local economic restructuring. Smart cities may contribute to facilitating local talents and localizing economic magnets. It also can improve operational performance creating higher investment attractiveness of the smart areas. Smartness has especially huge potential in a period of austerity. [34] The capacity to further economic growth is essential for a smart city model employing science and technology as a solution to overcoming economic depression. There are practical cases of improved macroeconomic indicators in industrial cities employing a smart framework. [10] The smart city model by definition can mean more partnerships and stakeholder involvement resulting in establishing a co-creative, user-driven economy. [36]

At the same time, smart cities are likely to lead to an increased divide of the rich-poor, leaving communities with fewer resources behind, and stealing funds from other industries. [20] The traditional threats include threats targeting critical infrastructure and government assets, such as banking and finance systems, hindering people's privacy. They also include

spying on people, institutions, and organizations, utilizing cyber warfare, competing to dominate cyberspace, and breaking e-commerce and vital economic sectors in the city. [35] Based on the literature review and consultations, the author proposed the following classification of smart city economic positive and negative impacts.

Table 4. Positive economic impacts of smart city with the most impactful selected by stakeholders highlighted

| Positive Economic Impacts classification (created by author based on literature review) |
|---|
| Increased investments |
| Intensified economic growth |
| Facilitating public-private partnerships |
| Up-skilling labor resources = increased productivity |
| Increased competitiveness of the municipality |
| Improved data system management, analytics impacting economic solutions |
| Increased salaries |
| Switch from low-skills to higher skills economy |
| Fostering small scale solutions, local innovation within municipality rather than outsourcing |
| Supporting local talent resources |

Source: Author own work
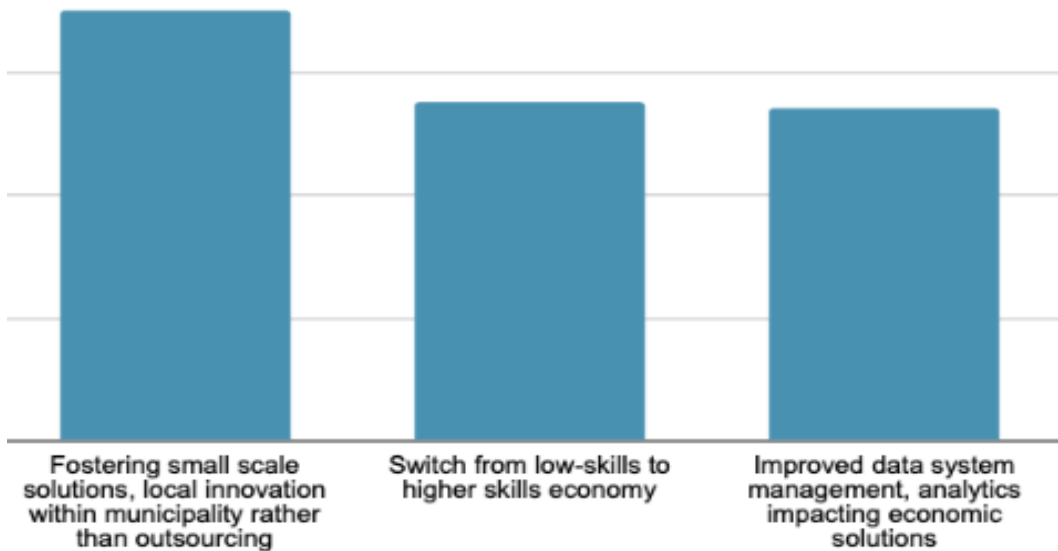
Fig. 5. The most selected positive economic impacts of smart city proportionally
Source: Author own work

The most selected were fostering small-scale solutions, local innovation within the municipality rather than outsourcing, switching from low-skills to a higher skills economy, improved data system management, and analytics impacting economic solutions. The pre-survey results show the tendencies discussed by the academics such as mentioned in terms of city operational utility through better data system management, improving skills and upgrading the labor force quality as well as empowering the local solutions while the municipality accumulates and targets the resources from within. It is noteworthy that no one has selected increased salaries.

Table 5. Negative economic impacts of smart city with the most impactful selected by stakeholders highlighted

| Corruption |
| --- |
| 'Stealing resources' = diversion of resources from existing sectors and services. [lack of a just transition for those left behind' |
| Lack of funding possibilities for non-smart city related projects |
| Increased poverty on those lacking technological expertise |
| Economic risks related to cyber crimes |
| Increased economic gap rich-poor |
| Economic inaccessibility to smartness without additional resources for poor municipalities |
| Urban rural divisions increased from focus on metropolitan smart infrastructure |
| Reliance on proprietary technologies; dependence on legacy technologies when systems in place are superseded/ outmoded by new ones. |
| Lack of compatibility of systems or hardware [technical monopoly] |

Source: Author own work
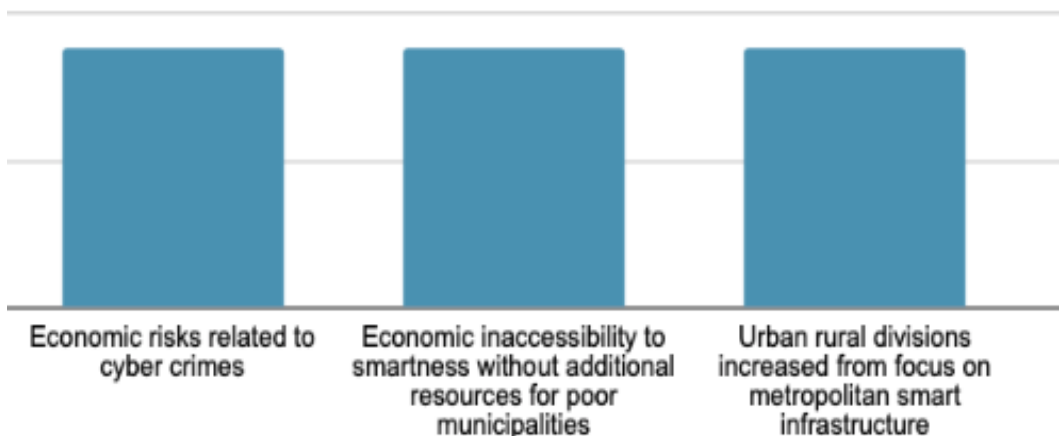
Fig. 6. The most selected negative economic impacts of smart city proportionally
Source: Author own work

The collected answers revealed the economic risks related to cyber crimes, economic inaccessibility to smartness without additional resources for poor municipalities as well as increased economic gap rich-poor. Quite a lot of respondents chose urban-rural divisions to increase the focus on metropolitan smart infrastructure. Lack of compatibility of systems or hardware [technical monopoly] was less selected though that was the option added in the context of consulting the expert from the UK and can have a presence in real-world circumstances. Nevertheless, among the other effects added was public facilities put in the hands of technological monopolies that have private not public interests (i.e. certain state function takeover and private monopoly). Among extra-positive impacts, the innovation culture (that if inclusive can support competitiveness and prosperity) was pointed out.

2.4. Survey limitations and directions for further study
The study is preliminary in design which significantly minimizes the bias's impacts. It searches the overall tendencies, putting the voices of various stakeholders being rather broad in nature and attempting to be continued. The google form was sufficient for its purposes but for its expansion, other survey tools might be employed, for instance, because they are more controlling the data input made several times by one person. Instead of selecting the only three options of impacts, the respondents could have been given the chance to rank them from most impactful to less which would allow them to trace the proportionality of impacts more thoroughly. Some respondents noted more than three though. In terms of the number of participants, its increase would be natural, especially while looking into the deep country cases rather than a more random generalized selection in different countries. There is a need for more research that is regionally oriented plus expanding in-person interviews to avoid bias of misinterpreting the data provided in the survey by the respondents. Stakeholder profile differentiation (i.e. municipality representatives, citizens, academics, male, female) would also be interesting for analysis. Considering differences in answers of different genders would present an interesting basis for evaluating social impacts that could be more specific such as the gender gap.

3. Conclusions, Recommendations
Firstly, the smart city definition was provided, and the economic and social perceptions of smart cities were determined. The pre-study derived joint definition is "Smart city is a future, people and environment-oriented, inclusive, resilient sustainable strategy of optimizing performance, increasing safety through applying digital technologies and other innovative tools".

Secondly, the pre-survey gave a more in-depth understanding of the social impacts of the smart city while the findings of the literature review were backed up by the data collected as a survey. From a social perspective, the most highlighted positives refer to sustainability and green agenda, building better connections and networks among the citizens as well as giving premises for facilitating inclusion and equity though not automatically but as a potential. Among the negatives, marginalization, privacy concerns, and data monopolization were deemed as the most significant correlating with those factors stated by smart city theorists.

Thirdly, the economic potential of a smart city may be revealed through fostering small-scale solutions and local innovation, facilitating skills and learning as well as increasing the competitiveness of the municipality through increased support of local talents. The negatives discussed in the literature also found a place in the answers collected, in particular, in terms of the cyber security risks and exacerbating divides (rich-poor, urban-rural etc.)

Finally, there may be many possible smart solutions and innovations but not a coherent approach to utilizing the benefits or managing the consequences. The path to tackling the negative outcomes while maximizing positive ones requires not only comprehensive strategy but real-world efforts on different levels. In other cases, the smart city's potential benefits could easily turn into challenges. The pre-study has shown a strong association between smart city and sustainability as an expectation of smartness and the ways for its practical embodiment should be researched and monitored.

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