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DATA- AND KNOWLEDGE-DRIVEN SMART CITY STRATEGIES: RESEARCH ON IMPLEMENTATION CHALLENGES OF LOCAL GOVERNMENTS IN TURKEY[1]

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ABSTRACT

The present study sought an answer to the question, "What kind of challenges do local governments in Turkey confront while implementing data- and knowledge-driven smart city strategies?". It seems noteworthy to explore tacit links between such implementation challenges through a field study employing an exploratory design. Thanks to the original theoretical framework enriched with empirical findings, this research is expected to bring practical and theoretical contributions to the smart city literature. The data were gathered through face-to-face, semi-structured interviews with 23 personnel of Sakarya Metropolitan Municipality (SMM), which has become the very first local government in Turkey to have introduced a smart city strategy and action plan. In this field research employing a single case, the content analysis technique was utilized to interpret the findings. Accordingly, SMM is faced with basically data-driven difficulties such as data security, poor technological and physical infrastructure, insufficient budget and high costs, dubious legal regulations and bureaucracy, resistance to change, lack of human resources and high turnover, and digital divide while implementing its smart city strategy.

Keywords: *Data-driven Smart City, Knowledge-driven Smart City, Local Governments.*

Jel Codes: *O18, O33, R58.*

[1] This study is derived from the doctoral thesis titled "Smart City Strategies in Enhancement of Quality of Life: Example of Sakarya Metropolitan Municipality and a Model Proposal for the Local Governments in Turkey".

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1. INTRODUCTION

Cities contemporarily tend to grow rapidly due to unprecedented population growth, which, in turn, paves the way for diversification and intensification of the difficulties in urban areas. Recent years have witnessed city management strategies to alleviate such difficulties to create more livable cities. Smart city strategies differ from other city management strategies as bearing an innovative approach that underpins data and knowledge obtained through technological tools.

Considering the historical background of city management strategies, it is likely to be asserted that sustainable and livable city approaches have become popular since the 1950s, wired and digital city projects have become prominent after the 1990s, and, finally, smart city strategies have gained fame since the early 2000s (Eremia, Toma and Sanduleac, 2017). Referring to the city management strategies that yield technology-based solutions for more efficient execution of public services, the concepts *digital city* introduced by Dutton (1987) and *wired city* coined by Osborne and Gaebler (1992) have underpinned today's smart city terminology. Data and information extracted via digital technologies to be efficient governance tools in Amsterdam, accepted as the world's first city to adopt smart city practices (Alberts, Went and Jansma, 2017), have brought a diverse dimension to the technology-city interaction. The exemplary success of Amsterdam and IBM's *Smarter Planet Strategy* (2008) has contributed significantly to the interest in smart city research since the early 2000s. On the other hand, some scholars suppose that this field of study does not sit on a rich theoretical ground but is fed by multidisciplinary studies (e.g. Kitchin, 2015:131; Madakam, Ramaswamy and Date, 2017:1-3). Thus, it may be difficult to utter a generally accepted definition of smart cities since scholars from different disciplines adopt their own perspectives while addressing the subject. While some emphasize technological and physical infrastructure (Hall, 2000:1), human resources (Giffinger et al., 2007:11), and governance (Caragliu, Del Bo and Nijkamp, 2011:70) to define the concept, others ground on data and knowledge in their definitions (Kourtit and Nijkamp, 2012:93). What is shared in all definitions may be that smart cities are considered just strategies targeting to improve the urban quality of life through technological opportunities. In this context, whereas accepting the significance of all the elements mentioned above, a unique smart city strategy definition was needed in this research attempting to explore data- and knowledge-driven smart city strategies. Accordingly, the concept of a smart city can be defined as "*a city management strategy that addresses the internal dynamics of the city and makes use of technological developments, various data sources, and the knowledge obtained by deploying an appropriate process to improve the quality of life of its stakeholders in line with the priorities.*"

Within the definition of smart city strategy presented above and through empirical findings, the present study sought an answer to the question, "*What kind of challenges do local governments in Turkey confront while implementing data- and knowledge-driven smart city strategies?*". Yet, assuming that smart city strategies contribute to improving urban quality of life, the discussion of the interaction

between the two elements was excluded from the scope of the research. In addition, this field research was limited to local governments that are considered among essential stakeholders in implementing smart city strategies in Turkey. The basis for such a limitation may be shown as the fact that local governments are the principal actors in improving the technological and physical infrastructure facilities needed in smart city projects (Giffinger and Gudrun, 2010:7) and its capability to enable more effective use of governance channels through data-knowledge (Bria, 2012:66).

Therefore, the study is designed in three parts. The first part discusses the place of data and knowledge in smart city strategies and reveals three basic approaches to the subject. The second part addresses the smart city strategies of local governments in Turkey and the possible risks and challenges to be faced in the process of transforming data into knowledge in these strategies. The last part identifies the implementation challenges, which cause the deficiencies touched upon in the second part, through the findings and addresses the implicit and/or explicit interactions between some implementation challenges.

2. DATA AND KNOWLEDGE IN SMART CITY STRATEGIES

Smart city strategies attempt to utilize data as an effective mediator while constructing more livable urban areas. Producing immediate solutions to social risks and problems, even settling such risks and problems before occurring, and offering efficient and transparent public services to city stakeholders seem to be possible only thanks to superior data sources. Although state-of-art devices facilitate access to data, information pollution due to unreliable data sources may be shown among the significant problems of modern societies. On the other hand, city stakeholders' correct and appropriate interpretation of the information elicited from reliable data sources is closely related to the level of human and social capital of that city (Lnennicka et al., 2022). In this sense, there are different approaches to the place of data and information in smart city strategies.

2.1. Key Performance Indicators (KPIs) Approach

The KPIs approach is based on the measurement of smart city performance through data sources within predetermined indicators. The accuracy of the scope of performance indicators may directly affect the efficiency of the KPIs approach. As Özdemir, Kourtit, and Nijkamp (2019:251) previously emphasized, KPIs aim to measure an entire smart city system in a broad sense or focus on monitoring one/few sub-indicators of the system in a narrow sense. Similarly, each smart city stakeholder can set their own KPIs, and all stakeholders may rally around and settle KPIs at the city scale (Chowdhury and Dhawan, 2016:337). According to Airaksinen et al. (2017:720), four criteria should be noted to be able to determine KPIs accurately:

- The objectives in the smart city strategy should overlap the determined indicators.
- Indicators should be measurable.

• Data acquisition on indicators should be available.

• The data acquired should be reliable.

In addition to the criteria above, International Telecommunication Union (2014) suggests that indicators should be intelligible and comparable. Besides, some institutions carried out research comparing the smart city performances of different cities within their own KPIs. Table 1 presents an overview of such studies.

Table 1. Comparative Urban Studies

Title	Issuer	Content
The Urban Audit	EUROSTAT	European cities
The Urban Indicators Database	HABITAT	236 cities worldwide
Urban Indicators for Managing Cities	Asian Development Bank	Cities in Asia
The Global Sustainable Urban Development Indicators	The White House of Urban Affairs	Cities in the USA
Digital Cities Survey	Center for Digital Government	Smart cities in the USA
Smart Cities: Ranking of European Medium-sized Cities	Vienna University of Technology, University of Ljubljani, and Delft University of Technology	94 medium-sized European cities
Innovation Cities	2thinkknow	445 smart cities worldwide

Source: Dameri (2017:75); Gil-Garcia, Pardo and Nam (2015:67-68).

As clear in the table, the research structured with comparative analyses of cities based on KPIs is often carried out by large research teams or international organizations with big budgets. Although such research compares the performance of smart cities, some scholars remain chary to these comparative analyses. Kourtit and Nijkamp (2017:29-33) stated that it may be difficult to compare the quality-of-life performance of smart cities. These difficulties often stem from the lack of data on similar content from different cities. In addition, the priority order of performance indicators adopted by smart cities may differ. Hence, smart cities may be better to assess their performance by KPIs suggested according to their own priorities. In this context, the KPIs of a smart city can focus only on selected indicators such as technological infrastructure (e.g. Hemment et al., 2016), safety and health (e.g. Hara et al., 2016), and energy and environment (e.g. Picioroaga et al., 2018) or may also be designated to include multidimensional content covering all indicators (Angelakoglou et al., 2019). Although the KPIs approach focuses on priority indicators in the evaluation of smart city performance, in some cases, city administrators may adopt an approach that considers not only priority indicators but also all kinds of data sources in identifying, maintaining, and developing a smart city strategy.

2.2. Data-Driven Approach

Smart cities are considered as strategies in which social, economic, and political processes are handled through data and that stakeholders may obtain information on these processes simultaneously (Rabari and Storper, 2015:27). Some believe that smart cities are those with simultaneous data

acquisition systems; a city's extensive data acquisition capacity contributes to the development of relations between stakeholders in terms of access to information, communication, cooperation, and participatory democracy (Gil-Garcia et al., 2015:73). According to the data-driven approach, such a multidimensional development in smart cities seems possible not only with the follow-up of priority indicators but also with an understanding in which all kinds of data sources are considered important. Thus, smart city strategies are accepted as a reflection of an approach that values all data sources in understanding the demands, perceptions, and behaviors of individuals as well as maintaining public services (Turner et al., 2013:28). Technological advancements in today's cities allow these data sources to be increasingly diversified. Thanks to information and communication technologies (ICTs), smart cities have turned into data-producing facilities. It is not necessarily a coincidence that the rapid development of smart city terminology has started to gain popularity at the same time with the increasing visibility of smart devices in daily life, particularly since the beginning of the 2000s. Table 2 shows the increasing trend in the use of smart devices worldwide.

Table 2. Increase in Smart Device Usage

Years	Total World Population (Billion)	Total Number of Smart Devices (Billion)	Number of Smart Devices (Per Person)
2015	7,25	15,41	2,13
2016	7,33	17,68	2,41
2017	7,41	20,35	2,75
2018	7,48	23,14	3,09
2019	7,56	26,66	3,53
2020	7,63	30,73	4,03
2021	7,71	35,82	4,65
2022*	7,78	42,62	5,48
2023*	7,85	51,11	6,51
2024*	7,92	62,12	7,84
2025*	7,99	75,14	9,40

*Estimated Data

Source: Statista (2021); The World Population (2021).

According to the table above, it is not prudent to expect that the total number of smart devices worldwide and the number of smart devices per capita will increase about two times within the next five years. Given that every single action through smart devices also turns into a new data source, it can be predicted that ICTs will continue to be the most prominent data source for smart cities.

In smart cities, ICTs provides city stakeholders with a chance to obtain data independent of time and space. In addition, instant elicitation of the outcomes saves time and reduces the cost of data acquisition processes (Vhaduri and Poellabauer, 2016:179). Among the ultimate benefits of ICTs-based data acquisition to contemporary urban strategies, there may be the ability to be instantly informed about environmental and safety challenges and the quick collection and analysis of the demands and complaints of the city residents, the widespread use of governance and participatory democracy practices, and the opportunity to hold immediate and effective decisions in production, urban planning, and transportation (Sebastian et al., 2018:127-128). Large, complex, and unstructured data sets, on the

other hand, mean nothing more than meaningless piles of information. The transmission of data at the right place and time to the right people through the most appropriate means can be shown as the ultimate factor leading to the success of a data-driven smart city strategy. In this way, city stakeholders are likely to be aware of the latest updates, produce instant solutions to problems, and observe the strengths of the strategy with up-to-date data. As a significant tool of a data-driven approach, geographic information systems are frequently utilized by local governments, particularly in the surveillance of infrastructure facilities, natural resources, illegal structures, and public transportation systems (Odendaal, 2003). With data stacks not converted into reliable information, it is not surprising not to be able to maintain such far-reaching, error-free public services. Thus, even though smart city strategies consider data an inseparable part of delivering public services, maintaining such strategies successfully seems only possible with an approach that prioritizes the appropriate information sources.

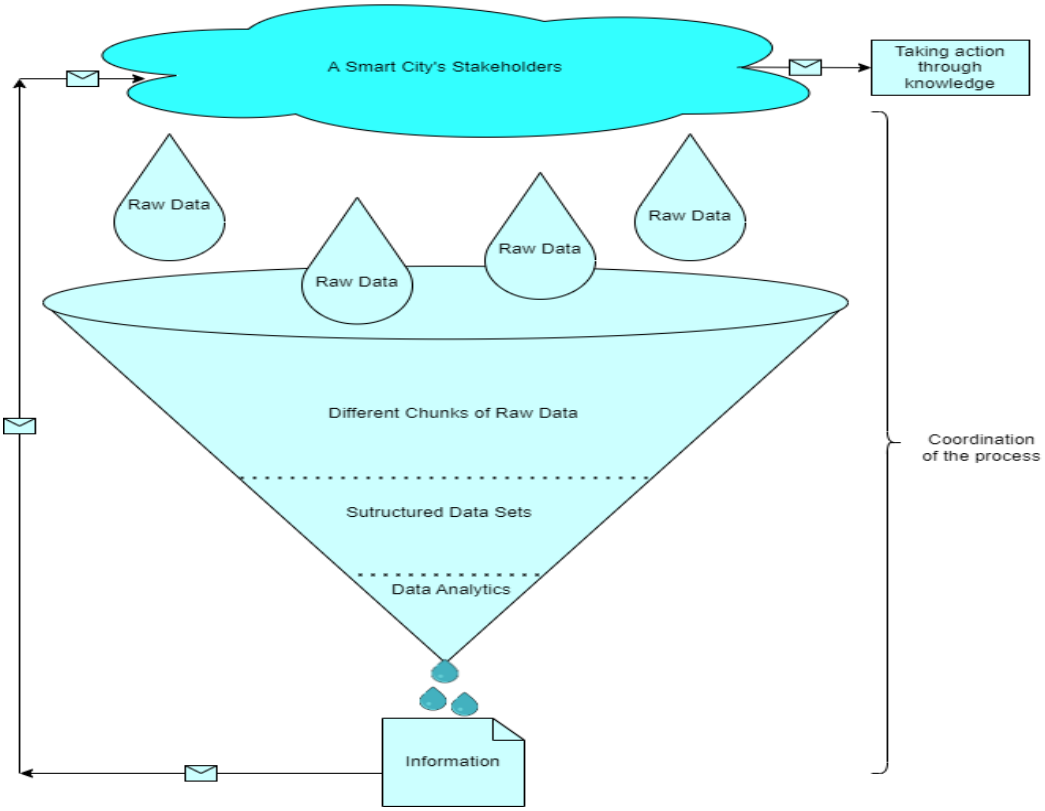
2.3. Knowledge-Driven Approach

In smart cities, unstructured data obtained through various tools need to be processed and transformed into meaningful information sets. This process first begins with the systematic storage of the acquired data. Yet, the dynamic nature of urban life may cause alterations in the content of the data sets stored over time. Thus, the acquired data needs not only to be stored but also to be updated. In addition, these data are expected to reflect the current state accurately. Next, researchers or institutions need to check the reliability of the data and appropriately assess the data's power of representation of the phenomenon explored. Accessing meaningful and holistic data sets prior to relevant analyses, particularly by allowing the integration of data from different sources, lays the groundwork for understanding the relationship between phenomenon and data. Then, the data is ready to be analyzed. Drawing insights from the data and establishing relations between inferences and facts seem to require human resources with a good command of data analytics and the research subject. A coordinated sharing of the information with the city stakeholders after data analytics and acting in line with reliable information shared can be considered the principal objective of a knowledge-driven smart city strategy (Bunders and Varró, 2019; Kourtit and Nijkamp, 2018). Overall, smart cities can be conceived of as strategies allowing the construction of more livable urban areas thanks to the technology-data-information triad.

Cloud computing systems now facilitate the storage of large-volume data sets with blurred boundaries that are sensitive to the latest developments. In this sense, institutions authorized to maintain smart city strategies (e.g. local governments) are increasingly interested in cloud computing services for systematic storage and updating of data (Prajapati, Sharma, and Badjuvar, 2018). Some scholars assert that 80% of the data collected through ICTs in smart cities is not structured at the time of acquisition. In addition, the non-observable nature of data sources may lead to manipulated data stacks irrelevant to the current state (Mayer-Schönberger and Cukier, 2013:8). Technological tools are just relied on to alleviate

such technology-oriented risks in smart cities. For example, artificial intelligence and machine learning are the means that are capable of making inferences rather close to reality thanks to algorithms from large data sets. These systems also allow the analysis of the current situation and future risks in the delivery of public services within seconds (Kumar and Jaiswal, 2022). As Frith (2017:177) stated, *knowledge creation centers* and *open data platforms* may be encountered in successful smart cities to coordinate complex processes involving many variables and stakeholders. Figure 1 summarizes the process of transforming data into knowledge in smart cities.

Figure 1. The Process of Transforming Data into Knowledge in Smart Cities



Source: Özdemir (2022:68).

Flawless progress of data acquisition in smart cities, the correct structuring of the available data, and the analysis with the most appropriate methods, people, and/or computer software are the factors that influence the quality of information. Local governments have substantial responsibilities in successfully coordinating this process from raw data to information and to knowledge. It needs to be noted that the quality of the human resource of a city can be considered another important indicator in the correct perception of the information prior to taking action.

3. THREATS AND CHALLENGES FOR SMART CITIES IN TURKEY

Yet, it needs to be emphasized that smart technologies rely on people to fulfill their assigned roles to contribute to improving the urban quality of life. To put it another way, human is considered the

principal factor in the production, improvement, and use of these technologies. Although this study did not attempt to settle the "smart cities or smart people" debate by Capdevila and Zarlenga (2015), smart cities highly depend on smart people in the use of sometimes complex technological tools and correct interpretation of data. Empirical findings previously demonstrated that qualified human resources contribute to the transformation of a city into a smart city, albeit regions already bearing smart city features also attract desired human resources (Shapiro, 2006). In this study, *smart people* refers to qualified human resources that can use technological tools to raise their own standards of living and/or improve these tools. The definition above also overlaps the definition of smart people by Giffenger et al. (2007), a frequently cited scholar in the smart city literature.

Income distribution, educational and employment opportunities, and social and physical environment in a city both develop and are developed by people. On the other hand, improvements in these or similar indicators are closely linked with the macro policies pursued by the central administration rather than local policies. In cases where national smart city strategies are appraised more, the likely differences in vision between local governments and the central administration sometimes pave the way for ignoring local priorities and needs (Giffenger, Haindmaier, and Kramar, 2010:299). Besides, in countries where public institutions are highly politicized, problems are likely to come out in the equal distribution of the expected outputs of smart city strategies throughout the country. Thereby, strategies to be shaped only within local priorities and needs may have a more robust structure than national strategies in terms of practicability. In this sense, it can be claimed that local governments are granted a narrow scope of freedom in smart city strategies in countries, such as Turkey, which adopt centralist understanding in public administration and where the activity areas of local governments are clearly limited by legal regulations.

Smart city strategies are considered a necessity for large-scale cities and a room of opportunity for small and medium-sized ones to improve the urban quality of life (Borsekova et al., 2018). With extensive disparities in regional development, underdeveloped regions in Turkey may have difficulty allocating their local budgets to high-cost smart city projects. For example, in data- and knowledge-driven smart city strategies, the establishment of cyber security systems to ensure data security may be more costly than other technological equipment and data acquisition (Nautyial, Malik and Agarwal, 2018:25). Most local governments in Turkey may not compensate such a budget for installing an effective cyber security system, which needs to be considered a prime implementation challenge. Indeed, the National Smart Cities Strategy and Action Plan Report (2019:112-122) highlights that 92% of the cities in Turkey do not have a mechanism to assess smart city strategies, 87% are deprived of performance monitoring and evaluation systems, and almost all of the cities do not have an organizational structure to ensure regular information sharing and coordination between stakeholders.

Disseminating smart city projects across a country may help reduce regional development disparities and alleviate social injustices. Otherwise, smart city strategies may exacerbate socio-

economic inequities between individuals, cities, and regions and lead to the emergence of the digital divide, a type of inequality stemming from technological developments (see Ragnedda and Muschert, 2013). Similarly, the concentration of urban-scale technological infrastructure investments in central areas may lead to the digital divide in different parts of the same city. In this sense, how these implementation challenges appear in practice is explained as a case study in the following parts of the present research.

4. METHODOLOGY

Research methodology is a whole referring to the preferences, techniques, and tools that inform how a study is carried out within a specific process. In this study, the researcher adopted an inductive approach with an exploratory and meaning-seeking perspective and focused on the participants' experiences and interpretations of the research problem. As Creswell (2016:201) suggests, in qualitative research approaches, a detailed and transparent explanation in field research is always needed to fortify the consistency between the empirical findings and the research problem.

Research Approach: The present study adopts a qualitative research approach. Qualitative research attempts to unveil the latent variables and patterns behind phenomena, thus, seeks an answer(s) to *how* and *what* questions (Creswell, 2007:107-109). Ultimately, the nature of the research problem in this study led the researcher to report the findings of the field research with the help of words and visuals instead of precise and measurable numerical indicators (Merriam, 2013:13-19).

Research Design: According to Yin (2003:2-3), frequently cited in case studies, a sample may be worth being investigated alone if it differs from other possibilities thanks to its originality. In this sense, Sakarya Metropolitan Municipality (SMM) was included in the study due to being the very first institution that kicked off the first smart city strategy and action plan among local governments in Turkey (see SASEP, 2019). To put it another way, it can confidently be claimed that SMM has substantial experience with smart city strategy, which would offer a chance to collect and observe comprehensive data in the empirical process. Moreover, a discourse covering *data, information, and quality of life* in the strategic plan of SMM encouraged the researcher to select this research design (see SASEP, 2019:6). Furthermore, the fact that the implementation challenges are uttered in only a few words in the strategic plan became proof of the need for a field study and helped identify the research problem.

Sample: Some scholars consider non-probabilistic sampling more compatible with the subjectivity of qualitative research (Neuman, 2016:320; Punch, 2011:183). It refers to a subjective identification and recruitment of a section/part that is thought to represent the problem the best. Yet, the sample preference needs to be justified in detail in the qualitative approach since the representative power of the sample cannot be revealed by statistical calculations.

Departments in the municipality are the direct implementers of SMM's smart city strategy. In this study, the boundaries of the non-probabilistic sampling reached only 23 departments of the municipality and one department affiliated with the Sakarya General Directorate of Water and Sewerage. The researcher visited all the departments and attempted to understand their place in implementing the smart city strategy. As a result of these preliminary visits, 19 departments were scheduled for interviews. Since being in charge of maintaining in-organization services and not directly being involved in the city-wide services, some departments were excluded from the interview schedule. Since each department is involved in a different smart city practice within its field of activity, it was believed to be helpful to diversify the interviewee units. Hence, snowball sampling, a non-probabilistic sampling technique, was utilized to identify the participants in the departments. This technique allows incrementing the number of participants in a sample through the advice of participants directly or indirectly connected (Neuman, 2016:324-325). In this regard, the heads of the mentioned departments were first interviewed and were informed about the research. Following the briefing, it was sought who might be the managers or personnel in the department engaging in implementing the smart city strategy. Then, face-to-face interviews were held with a total of 23 participants, including 14 department heads, 8 department chiefs, and 1 specialist.

Data Collection: The participants were recruited for face-to-face interviews with semi-structured interview questions. To test the intelligibility of the questions, preliminary interviews were held with five departments prior to the main interviews. Following the initial interviews, the questions were finalized through an interview guide. In the interviews, leading and multiple questions were strictly avoided (Merriam, 2013:97). Each question is designed as non-biased and exploratory to make participants make a free, long speech on the subject.

Data Analytics: The findings were obtained using the content analysis technique. Content analysis is a technique that includes associating the data, revealing the highlights, and reporting the data by systematically classifying them, making it more comprehensible and simplified (Coşkun et al., 2015:324). The MAXQDA computer-assisted qualitative data analysis software was utilized in the content analysis. Creswell (2016:195-196) highlights that computer-assisted qualitative data analysis programs bring significant helps to the researcher, especially during the analysis of extensive data sets, in simplifying the findings with the help of visuals, and in making the patterns more comprehensible.

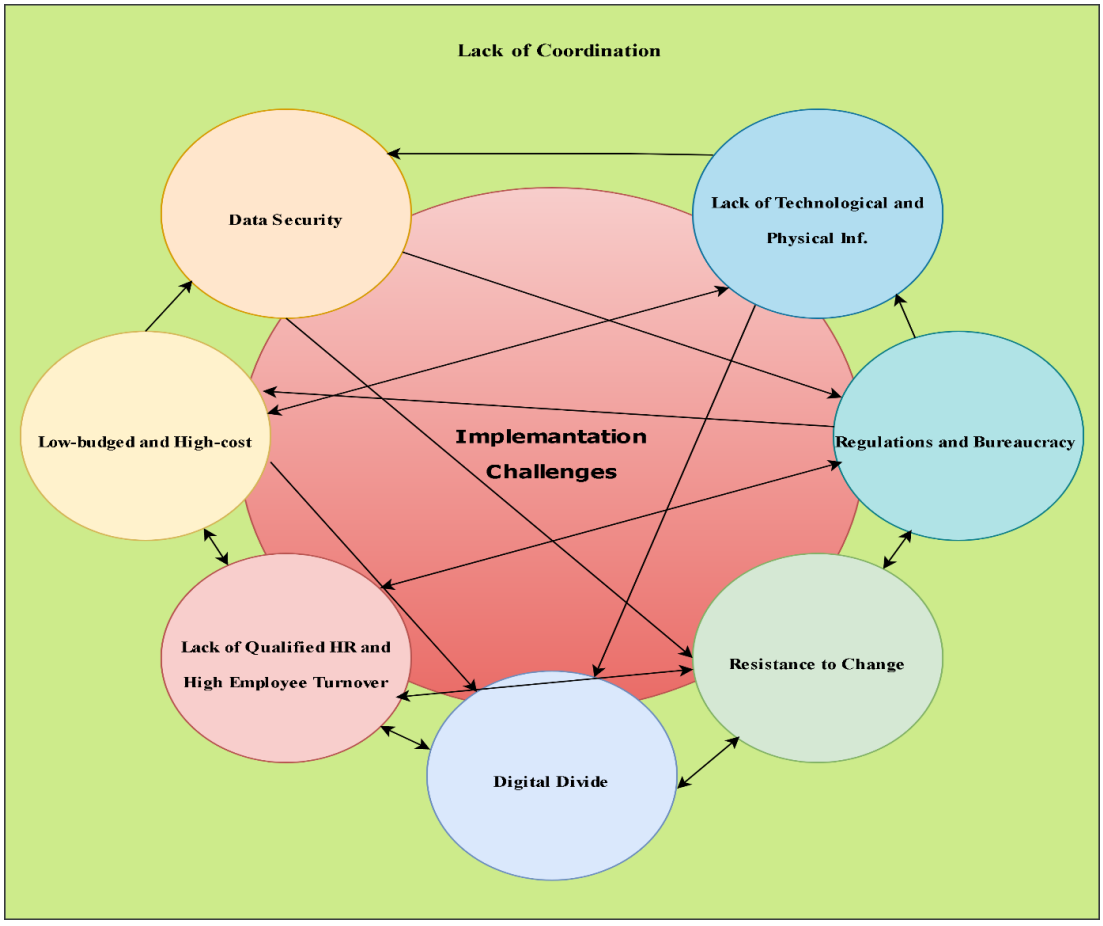
Validity and Reliability of the Research Process: Internal reliability in qualitative research refers to being able to conclude overlapping findings in the case of replicating the research. However, the dynamic nature of social life leads every single condition to be constantly reshaped. Therefore, reliability in qualitative research is highly controversial (Merriam, 2013:211-214). As a rule of thumb, the same findings are expected to be achieved under the same conditions unless recent developments significantly transform the overall structure of the sample and social life. External reliability, on the other hand, refers to the generalizability of research findings to other samples (Punch, 2011:290). Responsibilities and

areas of activity of local governments in Turkey are solely assigned within legal regulations that are issued by the central administration, which may imply that local governments can implement smart city strategies in rather similar areas. In addition to legal restrictions, considering the sample's wide-ranging smart city strategy and experience, its capacity to represent the universe seems robust. In addition, while designing the research, the researcher exchanged ideas with three faculty members with a sound experience in qualitative research. What is more, a faculty member provided support in the use of the mentioned data analysis software. Finally, the codes and categories of the findings were translated into English and submitted to two faculty members working in a smart city laboratory in the Netherlands to seek their recommendations.

5. FINDINGS

While reporting the findings, the focus always remained on the research problem. Besides, the expressions frequently uttered by the participants and the networks between these expressions were considered other important tenets of the focus during the reporting. The researcher had concerns about deviating from the ultimate purpose and research problem due to the large volume of the data set and, thus, simplified the implementation challenges encountered in smart city practices, as in Figure 2.

Figure 2. Implementation Challenges of SMM's Smart City Strategy



It may be asserted that SMM adopts a data-driven approach in its smart city strategy due to the lack of coordination in transforming data into knowledge. In addition to this shortcoming, it was concluded that the institution confronts seven implementation challenges in its smart city strategy. The content of these challenges and the single and/or multifaceted interaction between them are presented below.

Data Security: Concerns about data security not only constantly reshape the legal regulations on the subject in the macro sense but also give birth to prolonged bureaucratic processes. The restrictions lead some administrators to resist accepting the innovations brought by the smart city strategy.

Poor Technological and Physical Infrastructure: Poor technological and physical infrastructure leads to gaps in data security. The super cost of infrastructure investments and the perception of the insufficient budget allocated to such investments shone out as other implementation challenges. Poor and non-widespread infrastructure facilities restrict the access of some vulnerable groups to public services, exacerbating social inequalities.

Regulations and Bureaucracy: The scope of activity restricted by legal regulations and prolonged bureaucratic processes become significant implementation challenges for SMM against expanding the physical and technological infrastructure in the city. Therefore, the personnel is likely to resist adopting innovations. The resistance, in turn, leads organizational processes to be prolonged more.

Resistance to Change: The scarcity of qualified human capital is considered another factor restricting the adoption of innovative processes. The late adoption of innovations may be associated with the high turnover among competent personnel. The slow-paced processes cause some citizens and employees to be unable to benefit from the high-quality standards of living introduced by technological innovations, contributing to the digital divide.

Digital Divide: Technology-led social inequalities always make it difficult to retain qualified human resources. Such a difficulty then exacerbates the digital divide between vulnerable groups and other social classes.

Lack of Qualified Human Resources and High Employee Turnover: The restrictive impacts of legal regulations on budget and corporate revenues seem to cause SMM not to be able to deploy and pay desirable amounts to competent personnel needed in the smart city strategy, which leads to a high turnover rate, particularly among the IT staff in the municipality.

Insufficient Budget and High Cost: Discrepancy between high costs of smart city projects and inadequate budget narrows the scope of investments needed to ensure data security. Low budget and high costs also cause some vulnerable groups to be deprived of smart city practices, making the digital divide more visible.

6. DISCUSSION

The present research addressed implementation challenges in data- and knowledge-driven smart city strategies within the framework of local governments in Turkey. The seven themes yielded by the findings and the multiple interactions between the themes were deemed sufficient to settle the research problem. The interactions between the themes demonstrate that local governments may engage in multifaceted projects to alleviate implementation challenges. Besides, local governments are not alone in combating such challenges. Smart city strategies involving all other stakeholders but focusing primarily on local priorities and needs are more likely to be successful. Implementation challenges and the priority levels of these challenges in question may differ for other city stakeholders. Thus, further exploratory research on the subject with other city stakeholders would allow a deeper insight into implementation challenges. On the other hand, all local governments in Turkey have similar by-law areas of responsibility, which paves the way for them to bear similar limitations in practice, albeit at varying rates. In this respect, the research findings seem to be generalizable for local governments in Turkey. Besides, it can be stated that there is still a need for multidisciplinary research with other stakeholders since smart city research adopts multidisciplinary approaches. The present study focuses on local governments, considered to be inevitable stakeholders of smart city strategies, and adopted a critical approach to implementation challenges. In this sense, it is expected to contribute to the relevant literature, prospective researchers, and city administrators.

7. CONCLUSION

Smart cities are the product of a strategic approach. The success of this approach is primarily associated with dealing with the risks and challenges to arise while implementing the strategy. The pre-detection of the problems to be confronted in practice seems only possible when all city stakeholders transparently submit their views and priorities during the formation of the strategy. Acquisition of data, information, and knowledge in smart city strategies is known to require a laborious and costly process. Due to such challenges, local governments in Turkey generally do not have the organizational capability to transform data into accurate information and share it with city stakeholders. It was found that SMM has to maintain a similar strategy. Although the budget constraints, shown as the reason why information centers cannot be established, may be appreciated as a short-term justification, maintaining strategic plans requiring long-term planning may cause social problems much more profound than material factors. Considering the content of the implementation challenges identified through the case study, the findings support the inference above. Even though this research, examining only one of the smart city stakeholders in-depth, may not allow a smart city strategy to be fully understood, it may guide prospective research with other stakeholders. While feeding smart cities with data, stakeholders can ultimately be fed with information and knowledge, contributing to the sustainability of a smart city strategy. Thus, it can be claimed that local governments are not the only but the most prominent actor

in this whole process. Local governments in Turkey do not have the luxury of making mistakes with limited budgets in high-cost smart city projects. Yet, the most effective means to avoid possible mistakes can be shown as information and knowledge. Designating strategic plans may not guarantee success in smart city projects; what is important is to have the right, appropriate smart city strategies shaped by information and knowledge.

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