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Exploring Data Driven Initiatives for Smart City Development: Empirical Evidence from Techno-Stakeholders' Perspective

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Abstract

The aim of this article is to provide a critical understanding of techno-stakeholders' perspective by considering data driven initiatives for smart city development. Particularly, a model is proposed based on a systematic literature review to explore techno-stakeholders' perspective in smart cities. Findings from this study identifies that data driven initiatives that influence techno-stakeholder's perspectives for smart city development comprises of stakeholder involvement, data ownership, data access, policies, regulations, trust, and data privacy. Evidence from this study offer insight into techno-stakeholder's perspectives by proposing a model that could be utilized as a governance tool to benchmark and evaluate urban data transformation.

Keywords: Urban development; Smarter cities; Techno-stakeholders perspective, Techno-politics; Multi-stakeholders; Data driven initiatives.

1. Introduction

Over the last decades, smart cities have received considerable attention since they are considered a response to multifaceted challenges faced by modern cities (Nam and Pardo, 2011; Ståhlbröst et al., 2015a). Smart cities deploy technologies to efficiently manage resources and services provided to stakeholders (citizens, enterprises, technology providers, researchers, local governments, urban planners, municipalities, etc.) (Ardito et al., 2019; Anthony Jnr et al., 2020). A city is smart when it provides secured, open data driven services provided by businesses and entities (Bresciani et al., 2018; Jnr et al., 2018). Importantly, smart cities aim to improve services delivered to citizens both in terms of social (efficiently addressing stakeholders' desires and needs), economic (better productivity), and environmental (conserve nature) impacts (Khan and Kiani, 2012; Ferraris et al., 2019). Similarly, Axelsson and Granath (2018) argued that the governance processes in cities has become immeasurably complex as they include ecosystems of several technologies that are mostly driven by different interests, which makes it an interesting and timely area to explore.

Researchers such as Calzada and Cowie (2017); Calzada (2017) argued that presently the development of smart cities is mostly based on the conception that smart cities are merely systems of data, systems of systems, or systems of algorithms. These technologies deployed by different stakeholders in smart cities are currently positioned and portrayed as data driven systems and inherently reshapes how cities are planned and managed (Ablon and Golay, 2017). Highlighting the association between technology and stakeholders termed as techno-stakeholders. Techno-stakeholder's perspective aims to design and develop data driven initiatives that will not only guarantee stakeholder engagement, security, and privacy, etc. but also achieve balance between stakeholders and technology usage (Calzada, 2017). Techno-

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stakeholders thus demonstrates that it is never possible to make clear distinctions between stakeholders and technology in urban context as there are plethora of technological solutions adopted by stakeholders to address societal problems (Kitchin, 2017). Besides, in smart cities technological solutions have been developed without considering the needs and involvement of stakeholders leading to a misalignment within the technologies and stakeholders involved in urban development (Calzada, 2017). Respectively, techno-stakeholder perspective in smart cities offers unexplored opportunities by facilitating the implementation of existing urban policies for stakeholders in municipalities by providing innovative data driven initiatives (Ablon and Golay, 2017). Hence, for cities to become smarter it is essential to consider technological aspects of stakeholders' involvement termed as techno-stakeholder's perspective (Bouzguenda et al., 2019; Anthony et al., 2020).

But cities are face with certain challenges such as understanding techno-stakeholder's perspective (Jayasena et al., 2019; Voordijk and Dorrestijn, 2019; Ferraris et al., 2020). While, areas such as the economic, social, and environmental aspects of smart cities has been addressed in the literature (Mora et al., 2017; Ferraris et al., 2018b), the vital role of techno-stakeholder's perspective in smart cities has not fully researched (Axelsson and Granath, 2018; Ferraris et al., 2018a; Gutiérrez Polidura et al., 2018). This has led to cities not fully attaining their objectives (Ibrahim et al., 2017; Axelsson and Granath, 2018). Likewise, in smart city domain, researchers have underlined the significance to explore stakeholder's perspective in smart cities (Bhattacharya et al., 2018; Cowley et al., 2018). Yet, only fewer studies have attempted to identify the data driven initiatives that influences techno-stakeholders' perspective in smart cities (Ståhlbröst et al., 2015a). Hence, there is need to understand the techno-stakeholder perspective in making cities smarter.

Additionally, smart city development often does not optimally achieve their objectives if the data driven initiatives that influence techno-stakeholder's perspectives are not considered in urban development (Jayasena et al., 2019). In this respect, the data driven initiatives that impacts techno-stakeholder's perspective offers a key input for informed planning decision (Sandulli et al., 2017; Axelsson and Granath, 2018; Appio et al., 2019). But, the challenge here is to identify the data driven initiatives that impacts techno-stakeholder's perspective in order for cities to be smarter (Bouzguenda et al., 2019). Therefore, this study aims to contributes to existing body of knowledge by presenting the identified data driven initiatives that influences techno-stakeholders' perspective in smart cities by means of a systematic literature review. Additionally, based on the identified data driven initiatives a model is proposed to provide initiatives that are relevant for smart city development. Findings from this study could be utilized by urban developers and policy makers as a basis to benchmark different data driven solutions as well evaluating smart city development. Moreover, the proposed model and derived propositions can be adopted by municipality administration as a governance tool for orchestrating data driven solutions to help define techno-stakeholder's role towards making cities smarter. The rest of the paper is organized as follows. Section 2 is the materials and methods. Section 3 describes the findings and discussion. Section 4 is the implications of study. Section 5 is the conclusion, limitations, and future works.

2. Materials and Methods

This study employed Systematic Literature Review (SLR) method as recommended by (Jr et al., 2017) as a research method based on different stages as seen in Figure 1.

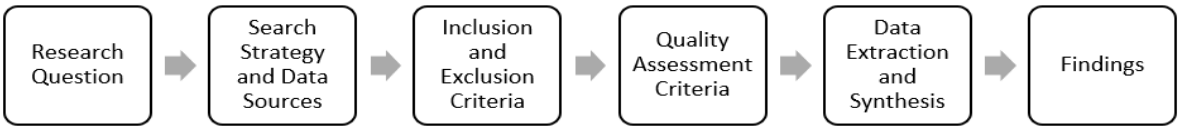

Figure 1. Research method employed in this study

Figure 1 shows the research method which comprises of six activities: development of research questions, search strategy and data sources, inclusion and exclusion criteria, quality assessment criteria, data extraction and synthesis, and report of findings. Each of this phase are explicitly described below;

2.1. Research Questions

The first phase of the SLR aimed to design a protocol which entails the research questions that guides the selection of relevant papers, inclusion and quality criteria, the search strategy, synthesis and extraction method (Jnr et al., 2017). The review process was driven by the following research questions:

RQ1: What are the data driven issues that relate to techno-stakeholders perspective which influences smart city development?

RQ2: What are the data driven initiatives to be adopted to improve techno-stakeholders perspective for smart city development?

2.2. Search Strategy and Data Sources

The search strategy was started by creating search strings that were then employed to form keywords. During the search, keywords comprising of “data driven initiatives” “technology” “stakeholders” and “smart cities” were combined. Other search terms included: data, policies, regulations, privacy, trust, data ownership, and data access. The data sources included electronic databases such as Google scholar, Scopus, ISI Web of science (Clarivate Analytics), Science direct, ProQuest, ACM, Emerald, Taylor & Francis, Inderscience, Springer, Sage, Wiley, and IEEE Xplore. The search was initiated on 1st August 2019 and was last searched on 27th April 2020. Figure 2 depicts the SLR study selection process employed in selecting suitable papers to be utilized in providing answers to the research questions.

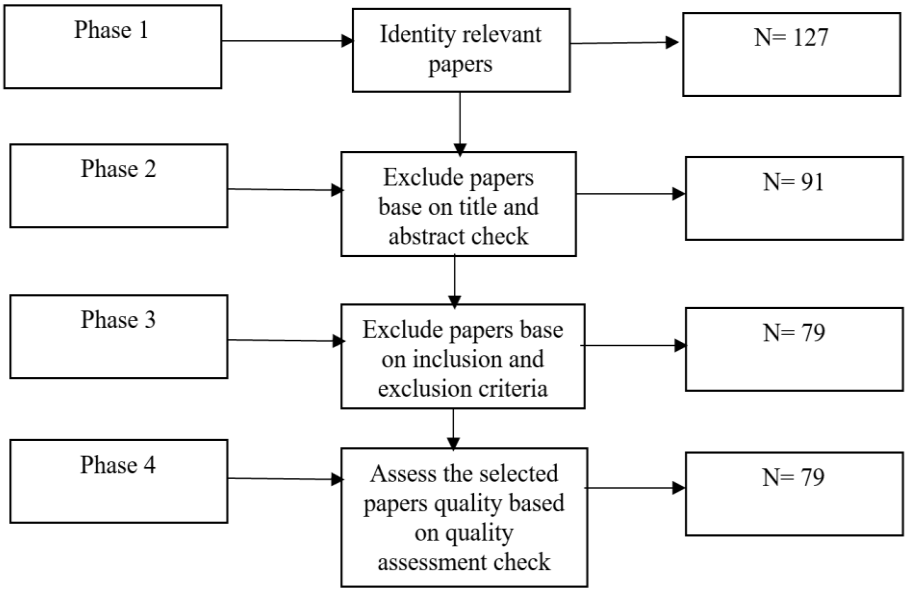

Figure 2 Study selection flow

As seen in Figure 2 in the first phase a total of 127 papers were identified. In the second phase all papers titles were checked in order to manually assess their relevance to this study. In this stage, papers that did not fully relate to technology and stakeholder's perspective in smart cities were excluded which led to 91 papers. Also, in the second stage, all remaining papers were also checked in terms of their abstracts and scope as related to the explored research questions. Next, in phase 3 the selected 91 papers were screened based on the inclusion and exclusion criteria and 12 papers were excluded. The remaining 79 papers were further evaluated for quality assessment (see section 2.4).

2.3. Inclusion and Exclusion Criteria

Due to the relevance of the selection stage in determining the validity of the literature review, several inclusion and exclusion criteria were employed. Papers were eligible for inclusion if they focused on the theme of data, techno-politics, technology and stakeholder's perspective in smart cities. Papers were selected from 1995/2005 onwards, since 2005 is the year when research in smart cities started to evolve. Besides, the review included studies published in academic outlets, such as journals, conference proceedings, books, and book chapters. Dissertations and online sources were excluded from this review, as were papers that were not written in English. Lastly, given that the scope of the study is on data, technology, and stakeholder's perspective in smart cities, qualitative, quantitative, and experimental studies were included.

2.4. Quality Assessment

Each of the selected 79 papers selected after the third phase (see Figure 2), were independently evaluated by the corresponding author. Papers were assessed in terms of scientific rigor, research methods adopted, credibility of findings, and relevance of the study in relation to data driven techno-stakeholders' perspective in smart cities. Also, the selected 79 paper were assessed based on a higher level of rigorousness employed to check if the papers were indexed

in ISI Web of Science or/and Scopus database as a means for evaluating the quality of the studies selected (see Figure 2). The check suggest that more than half of the selected papers are indexed in ISI Web of Science and/or Scopus database.

2.5. Data Extraction and Synthesis

This stage of the SLR aims to synthesize and categorize the selected papers based on their scope as related to techno-stakeholder's perspective. First, the data driven initiatives were specified from each paper. The data driven initiatives were then systematized in order to enable mapping across studies. The clustering was made based on the following identified data driven initiatives (stakeholder involvement, policies, regulations, data privacy, trust, data ownership, and data access) as developed by Petersen et al. (2019). The clustered data driven initiatives as related to techno-stakeholders' perspective are shown in Figure 6. Thus, the selected 79 studies were reviewed in detail and relevant data were extracted, analyzed, and synthesized to develop the model to provide data driven initiatives that are relevant for techno-stakeholders involved to achieve smart city development (see Figure 9).

3. Findings and Discussion

3.1. Methods, Countries, Contexts, and Publication Year of Studies

With regard to the selected secondary sources included for this study, the findings for distribution of studies based on year of publication is presented in Figure 3. As shown, the studies are ranged from 1995/2005 to 2021. Findings from Figure 3 indicate that there seems to be an increase in studies on data, technology and stakeholder's perspective of smart cities over the last few years as seen from 2005 to 2021, with 2019 being the highest with publications related to techno-stakeholder's perspective of smart cities with (N=18). It is evident that the frequency of these publications in 2019 could be accredited to the fact that the intensity of data, technology and stakeholder's involvement in urban development increased in 2018 with (N=15) studies and also in 2019 in developed and developing countries.

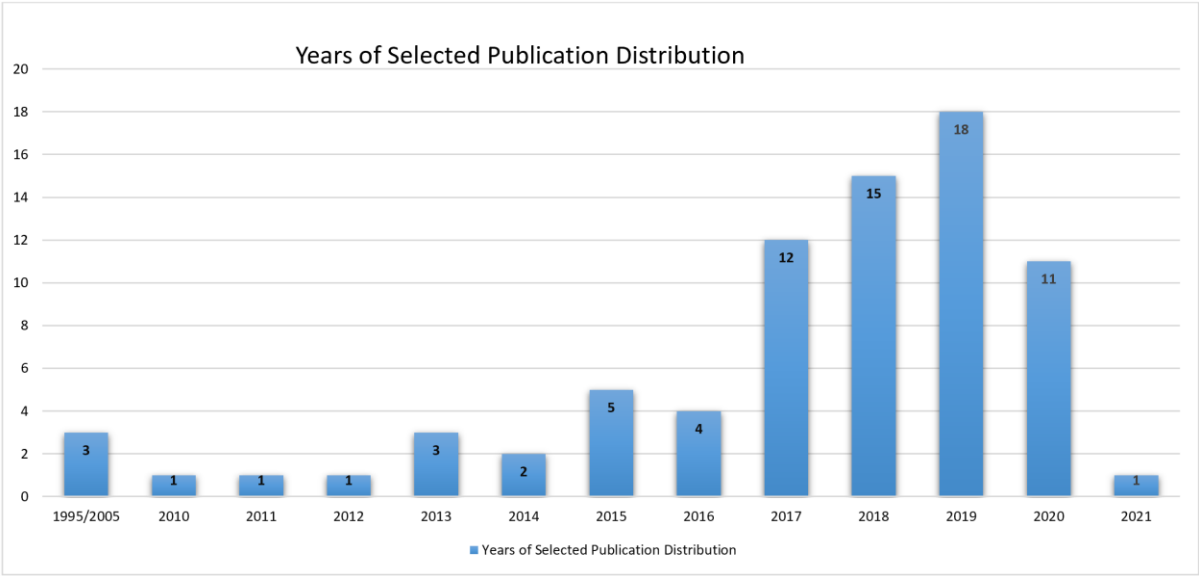

Figure 3 Distribution of selected studies in terms of years

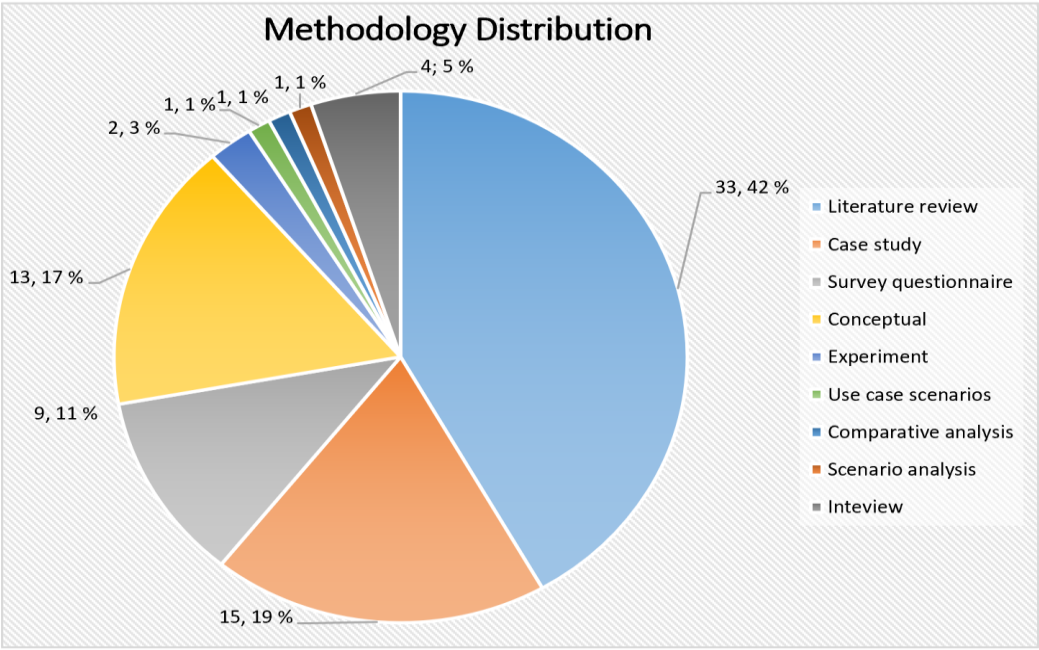

Figure 4 Distribution of selected studies in terms of methodology

Considering the methodology applied in the 79 studies, findings from Figure 4 show that literature review is the most employed method for data collection with N = 33, (42%), followed by studies that employed case study method with N = 15, (19%). Next, is studies that adopted conceptual approach with N = 13, (17%), and survey questionnaire with N = 9, (11%). Studies that employed interview is reported as N = 4, (5%) and studies that adopted experiments for validation with N = 2, (3%). Lastly, the remaining studies N = 1, (1%) employed use case scenarios, comparative analysis, and scenario analysis respectively. These findings are analogous with the prior review studies conducted by (Ahmed et al., 2019; Bouzguenda et al., 2019) where the authors stated that literature review was the main approach employed in smart cities studies. Moreover, this finding is consistent with the fact that

secondary data are considered the most suitable empirical evidence employed in prior smart cities studies (Marrone and Hammerle, 2018; Jayasena et al., 2019).

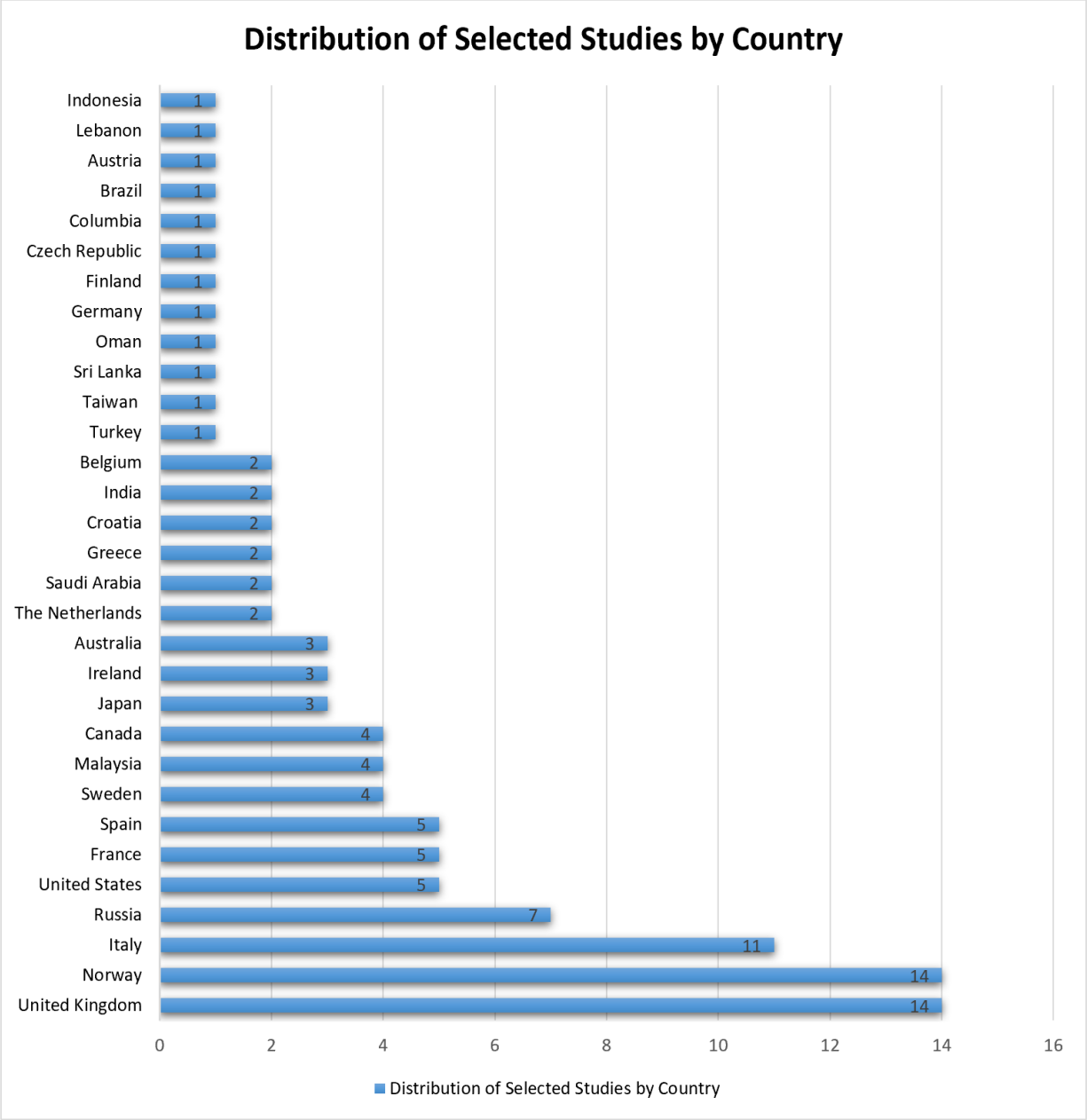

Figure 5 Distribution of selected studies in terms of country

Regarding the selected studies country distribution, findings from Figure 5 show that most studies are conducted in United Kingdom (UK) and Norway (N = 14) respectively, Italy (N = 11), and Russia (N = 7). This is because most of the smart city project are currently being deployed in Europe. Next, research articles related to data, technology and stakeholder's perspective in smart cities was carried out in Spain, France and United States with (N = 5) studies individually. Then, the next countries are Malaysia, Sweden, and Canada with (N = 4) respectively. Next, (N=3) studies were individually conducted in Australia, Ireland, and Japan. Whereas, Belgium, Saudi Arabia, The Netherlands, Croatia, India, and Greece recorded (N=2) individually as seen in Figure 5. Lastly, (N = 1) study was each conducted in Indonesia, Oman,

Austria, Turkey, Lebanon, Czech Republic, Colombia, Sri Lanka, Taiwan, Germany, Brazil, and Finland.

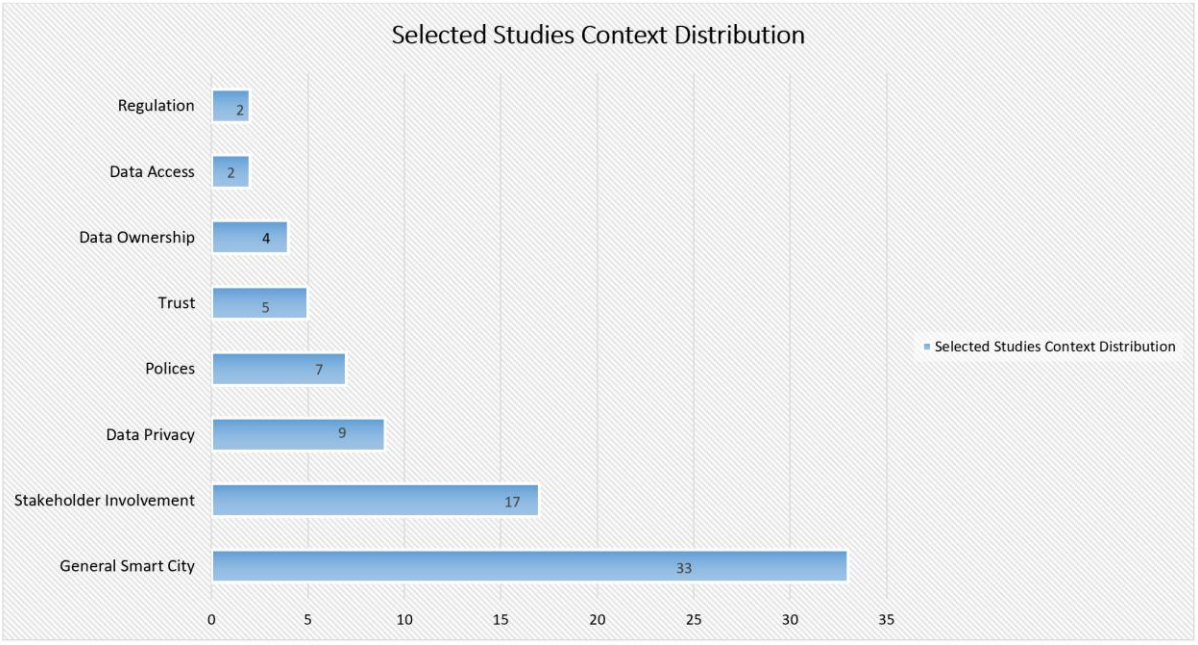

Figure 6 Distribution of selected studies context

Considering the selected studies context distribution of data, technology and stakeholder's perspective in smart city. Findings from Figure 6 indicate that (N = 33) studies mainly examined the general theory and practice of smart cities. This finding is consistent with results from prior studies (Bhattacharya et al., 2018; Jnr et al., 2018) which advocated for the need for developing model that examine smart city development. Furthermore, the findings suggest that (N = 17) studies mainly explored stakeholders' participation in making cities smarter. Similarly, this finding is analogous with results from studies conducted by prior researchers (Ståhlbröst et al., 2015a; Marrone and Hammerle, 2018; Jayasena et al., 2019) which revealed that there is need to include stakeholders such as citizens to be involved for sustainable urban development. In addition, findings from Figure 6 reveal that (N = 9) studies mainly examined data privacy in smart cities. This finding is very consistent with results from the literature (da Silva et al., 2018; Vaidya and Mouftah, 2018), where the authors mentioned the need for studies that investigate current level of data privacy in smart cities.

Additionally, findings from Figure 6 show that (N = 7) studies individually examined policies and (N = 4) studies examined data ownership related to data usage in making cities smarter. This aligns with findings presented by Mashhadi et al. (2014); Martucci et al. (2017); Curzon et al. (2019), where the authors called for the need for empirical evidence on policies and data governance. Besides, (N = 5) studies examined trust among stakeholders as factor to be considered for smart city development as suggested in the literature (Ahmed et al., 2019; Keymolen and Voorwinden, 2019; Kundu, 2019; Trutnev and Vidiasova, 2019). Lastly, (N = 2) studies exclusively investigated data access, and regulation. This finding suggests that there are limited studies that examine issues such as General Data Protection Regulation (GDPR) as mentioned by (Kawada et al., 2013; Lučić et al., 2018; McKenna, 2019; Calzada and Almirall,

2020). Accordingly, this review presents the data driven initiatives for techno-stakeholders that influence smart city development based on the selected studies context reported in Figure 6.

3.2. Smart City, Data, and Techno-stakeholders Perspective

This section provides background discussion on smart cities, overview of techno-stakeholders, and review of data, techno-politics and multi-stakeholders in smart cities.

3.2.1. Overview of Smart Cities

Currently, approximately 75 percent European population resides in municipal areas and are likely to increase to over 80 percent by 2030 (Jnr et al., 2018). Moreover, the constant increase in urban population puts strains and pressure on the inadequate resources of a city and thus municipal governance becomes an issue and cities are faced to provide needed services to stakeholders (Dhungana et al., 2015; Komninos and Mora, 2018). Hence, technologies are deployed in cities to provide substantial change in municipalities' governance. Mainly to provide stakeholders with services needed to vigorously manage the urban environment (Mashhadi et al., 2014). Accordingly, smart city can be referred to as a city that invests in technologies, improved governance, and participatory strategies to specify appropriate urban services and investments, that can safeguard sustainable socio-economic development, improved quality-of-life and ambient management of natural resources (Bibri and Krogstie, 2017). Besides, smart city aims to resolve urban issues for efficient use of natural resources such as electricity, water, etc. to decrease carbon footprints for less environmental damage (Bouzguenda et al., 2019), efficient energy utilization, and better citizens empowerment and well-being to improve sustainability and resilience of municipalities (Ibrahim et al., 2017).

Smart cities use technologies to provide environmental monitoring data generated from several local sources for collaborative decision-making, planning decisions, urban governance development, municipality management, and raising citizens' awareness and engagement (Morales-Gualdrón and Roig, 2005; Ståhlbröst et al., 2015b). In the above context, smart cities mainly deploy technological solutions for local governance management to achieve combined information intelligence about city components including structural fitness of buildings, socio-economic (Bouzguenda et al., 2019; Anthony Jnr et al., 2020). It also aims to improve public health, road transport networks, environment, utility services, energy usage, noise reduction, water management, and waste management for decision makers, policy, and urban planners for sustainable development and better governance of cities (Khan and Kiani, 2012). Hence, technologies are important in cities as the use helps to provide citizens with access to context-based information such as environment, services, etc. (Khan and Kiani, 2012; Anthony Jnr, 2020b).

3.2.2. Background of Smart City Dimensions

A smart city is a city that address the needs of its present residents without affecting the ability of other inhabitant or future generations to reach their own needs. Such city does not over utilize its local resources, and is mostly supported by technologies (Bouzguenda et al., 2019;

Anthony Jnr, 2020c). Also, a smart city refers to a city that is supported by a pervasive use of advanced technologies that is connected to various systems within the city (Bibri and Krogstie, 2017; Anthony Jnr, 2020a). Nevertheless, the development of smart cities does not exclusively address social, economic, and environmental issues. It also includes technological dimension, which is the least researched as related to sustainable development of smart cities (Bouzguenda et al., 2019). Thus, the development of smart cities involves employing technological tool in relation to the economic, social, and environmental dimensions towards achieving a sustainable smart city development (Anthony Jnr et al., 2020), as seen in Figure 7.

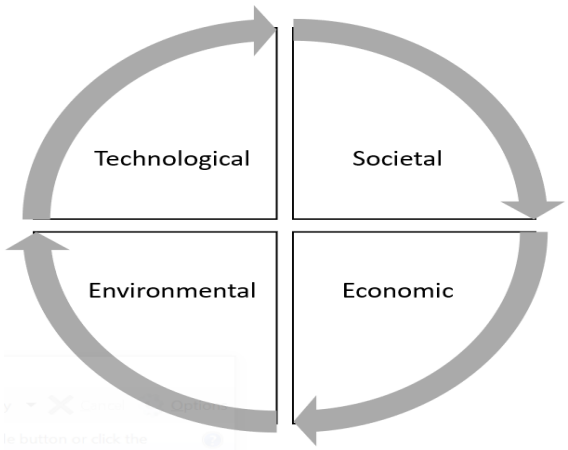

Figure 7 Smart city dimensions

Additionally, a holistic and integrated approach to urbanism is required to be employed in order to achieve a sustainable smart city development. This can be achieved by employing a strategic approach in realizing long-term goals of urban sustainability supported by advanced technologies (Bibri and Krogstie, 2019). In smart cities technologies are employed to effectively collect, analyze, and synthesis data from different systems deployed in the city (Bibri and Krogstie, 2017). It entails how systems in different domains interrelates in enabling cities to provide data driven services to citizens (Anthony et al., 2019). According to Bibri and Krogstie (2017) technology plays a major role in sustainable development of smart cities, which includes contributing to sustainability, and supporting cities during provision of data driven services. As seen in Figure 7 the actualization of smarter cities vision embodies societal, economic, environmental, and technological dimensions within the municipalities, where stakeholders play a major role (Bouzguenda et al., 2019; Anthony Jnr, 2020d). The stakeholders that uses technologies in smart cities comprises of government, citizens, academic institutions, and enterprises as seen in Figure 8.

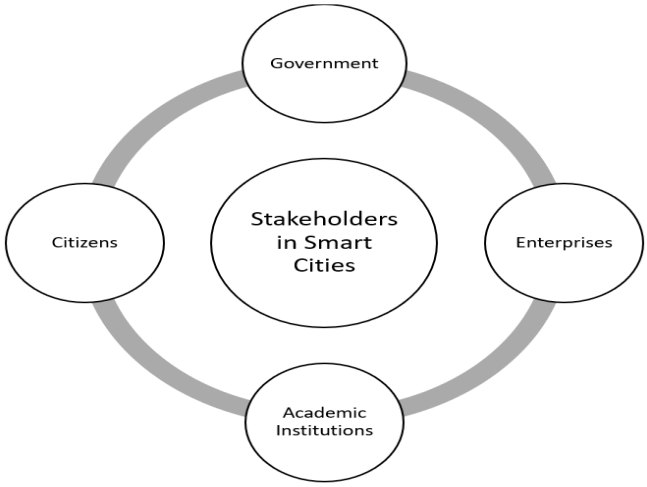

Figure 8 Quadruple helix of stakeholders in smart cities

As mentioned by Calzada and Cowie (2017) techno-politics of data has arisen as an important area of debate for smart city development in addressing the different role of diverse stakeholders as shown in Figure 8. Likewise, Calzada and Cowie (2017) stated that as regards to power interdependencies between stakeholders, new forms of knowledge and open innovation are emerging between the helixes. This is evident based on use of data driven solution for urban development across regions (Kawada et al., 2013; Chowdhury and Dhawan, 2016; Lučić et al., 2018). The quadruple helix of stakeholders illustrated in Figure 8 utilizes technologies and data to provide services in smart cities. Therefore, this study aims to explore smart cities from the lens of stakeholders and technology. This study does not consider the social, economic and environmental impact as this has been addressed in the literature (Bibri and Krogstie, 2017; Sandulli et al., 2017; Ferraris et al., 2017; Bhattacharya et al., 2018; Ferraris et al., 2018b; Jnr et al., 2018; Appio et al., 2019; Bibri and Krogstie, 2019; Bouzguenda et al., 2019;Voordijk and Dorrestijn, 2019).

Additionally, the role of collaboration in the quadruple helix comprising of government, citizens, academy and enterprises in improving citizens well-being in smart city is also not addressed in this study as this has been investigated in prior studies (Mayangsari and Novani, 2015; Ståhlbröst et al., 2015a; Fernandez-Anez, 2016; Calzada and Cowie, 2017; Ibrahim et al., 2017; Sebastian et al., 2018; Jayasena et al., 2019). Instead the data driven initiatives that influence the technological impact of the stakeholders termed as "techno-stakeholders" in smart cities is explored. Respectively, the scope of this current study is more aligned to data driven initiatives for the technological dimension of smart city development (see Figure 7) as regards to stakeholders coined as "techno-stakeholders" similar to prior studies (Calzada and Cowie 2017; Calzada, 2021) which explored the techno-politics and multi-stakeholders in smart cities as discussed in section 3.2.4.

3.2.3. Techno-stakeholders in Smart Cities

The term "Stakeholder" was originally defined in 1963 by the Stanford Research Institute, where the word referred to those groups that without their involvement an enterprise may cease to exist (Freeman, 2010). Similarly, Freeman (2010) defined a stakeholder as an individual or any group who can affect or is affected by the accomplishment of an enterprise objectives. Ever

since the significance of stakeholders has developed in several domain such as public policy, enterprise management, and development projects such as in urban development. In smart city domain researchers such as Ibrahim et al. (2017) referred to stakeholders as those who are impacted or could be impacted by an anticipated development initiative. Smart cities comprise of complex technological systems which provides different services to diverse stakeholders (Ståhlbröst et al., 2015a; Petersen et al., 2019).

Furthermore, the rapid development of technology which enables the connection of devices used by stakeholders generates data in urban space (Ruppert et al., 2017). Thus, technology adoption in cities has become a social and political issue not only because it concerns stakeholders (Joss and Durant, 1995). But also, because it impacts the relationships between all stakeholders (government, citizens, academic institutions, and enterprises) as seen in Figure 8. Hence, the role of techno-stakeholders is explored in this study. Accordingly, in smart cities a techno-stakeholder may include technologies and data provided by individuals, consumers, groups of individuals, citizens, public/private organizations, institutions, researcher, etc. Techno-stakeholders in smart cities comprises of technological actors who have stake in the city transformation development (Marrone and Hammerle, 2018). Techno-stakeholders play a substantial role in smart city for sustainable development as they provide a wide range of data, information, and knowledge to municipality growth. Accordingly, findings from the literature (Ibrahim et al., 2017; Axelsson and Granath, 2018; Appio et al., 2019) revealed that techno-stakeholders increase the successfulness of smart city development.

Thus, techno-stakeholders perspective relates to social innovation which provides opportunities for improving the existential and living conditions of citizens towards fostering social innovative and political empowerment of stakeholders (Moulaert et al., 2013). Accordingly, social innovation in urban context offers technological and societal state to systematically capture the essence of innovative initiatives that have been recently or historically more engaged for addressing social issues such as urban transformation (Moulaert et al., 2013). Hence, social innovation for techno-stakeholders can enhance the quality of policy making, if they have in-depth understanding of city development goals and objectives (Ståhlbröst et al., 2015a). Besides, technologies employed by stakeholders such as open data increases transparency and enhances citizens openness, decreasing oppositions and guarantees that municipality administration opinions are geared towards sustainability (Ruppert et al., 2017; Marrone and Hammerle, 2018). Moreover, in smart city development establishing a good relationship among various stakeholders that provide data utilized to provide services ensure that crucial changes can be resolved at the beginning stage of urban transformation (Ibrahim et al., 2017).

Thus, techno-stakeholders provides data that ease the implementation of smarter cities operations and help in urban evaluation and monitoring. Feedbacks from the techno-stakeholders are crucial for continuous improvements and sustainability of cities (Axelsson and Granath, 2018). Hence, techno-stakeholders perspective helps in avoiding possible issues, such as neglecting important interests and needs of the city. As stated by Calzada and Cobo (2015) technological development in smart city has resulted to reductions in the cost of connectivity, due to increased deployment of data-driven approaches by stakeholders. Thus, techno-

stakeholders approach may provide an unplugging novel trend that delivers a corporate, top-down direction for smart city development in favor of a transition towards the adoption of digital technologies which enables the attainment of a more democratic society (Calzada and Cobo, 2015). However, these technological evolutions occur at different rates, suggesting significant techno-stakeholders misalignment (Calzada, 2021). Noting this limitation, this current study considers an interesting contribution to the understanding of techno-stakeholders.

3.2.4. Data, Techno-politics and Multi-stakeholders in Smart Cities

Presently data is generated from different technologies employed by stakeholders in smart cities. According to Kitchin (2017) technologies deployed in smart cities generate data that have significant direct and indirect impact on stakeholders. In other words, there has been a radical growth in the range, volume, and granularity of data being produced as regards to stakeholders in urban environment (Joss and Durant, 1995; Kitchin, 2017). The result is a fine-grained, deluge of real-time, actionable, and contextual data which are routinely produced about municipalities and their citizens upon which data driven services can be provides towards smart city development (Kitchin, 2017; Ruppert et al., 2017). The means in which data is collected, owned, and exploited should be politically and ethically challenge by both researchers and policymakers to offer transparent democratic accountability in cities (Calzada and Cowie, 2017).

In cities, the way data is managed have serious and significant democratic implications for stakeholder's governance (Kitchin, 2017), accessibility and usability for the intended use. Thus, techno-politics of technology or data was suggested by Calzada (2017) as a prominent area of debate for stakeholders in smart city. Given the current situation of data driven services provided to government, citizens, academic institutions, and enterprises in cities. The politics of technology can be used to actively manage and provide effective solutions to tackle urban developmental issues (Calzada, 2017). The notion of techno-politics helps to address technology politics by considering stakeholders as decision-makers rather than only data owners or providers (Calzada, 2019).

In smart cities, the use of technologies has given rise to availability of data. But, orchestrating the governance and ownership of these data is important. However, the development of smart city is mostly based on the understanding that smart cities are merely connected systems. Techno-politics as presented by Calzada (2017) suggest that it is difficult to make clear distinctions between politics and technology in urban context. This is because politics employs technological standards to be more active than laws, and at the same time that technological proficiency acquires political influence that was not initially intended (Calzada, 2021). The domain of technology and stakeholders are deeply intertwined in smart cities (Anthony Jnr and Abbas Petersen, 2020). This is evident as technologies often influence how stakeholders adopt initiated policies. Technology also facilitates the application of existing urban policies by stakeholders via offering innovative solutions for compliance and regulation (Ablon and Golay, 2017).Therefore, with the increased pace of technological inventions in cities, many studies (Bresciani et al., 2018; Appio et al., 2019; Bouzguenda et al., 2019) have

focused on exploring how emerging technologies can impact the ways in which citizens live, and work (Ablon and Golay, 2017).

Furthermore, there is need for a more inclusive democratic understanding of the usage of technology and stakeholder's involvement for a progressive policy towards smartness in cities grounded on a constructive approach (Calzada, 2017; Calzada, 2019). Another reason why interest in stakeholders' involvement in smart cities has been a center of debate is because the technological dimension has been explored without fully considering the needs and participation of stakeholders or the techno-stakeholders misalignment within smart city context (Ibrahim et al., 2017). However, little work has been done to explore how technology and stakeholders interact. Effective interaction between technology and stakeholders as "techno-stakeholders" is crucial for social innovation (Moulaert et al. 2013) towards developing solutions that can benefit the society in making cities smarter. Therefore, this study elaborates on the idea that policy agendas based on smart city development should be driven by techno-stakeholders, as this area in smart cities research offer still unexplored opportunities for investigation.

3.3. Research Model and Propositions Development

This section presents the identified data driven initiatives that impacts techno-stakeholder's perspective based on findings from the literature for smart city development. The identified data driven initiatives (as seen in Figure 6) which comprise of data access, data ownership, policies, regulations, trust, stakeholders, and data privacy that influences techno-stakeholders' perspective in smart cities are discussed below;

3.3.1. Data Access

In smart city context data access refers to providing data to only appropriate stakeholders based on contracts between data owners and data consumers (Kawada et al., 2013). Additionally, in smart cities there are issues relating to city data access such as who controls data generated, who can access city data generated, the time period regarding the sharing of stakeholder's data, etc. (Petersen et al., 2019). This gives rise to data ownership issue which needs to be addressed especially in motivating stakeholders to be involved in smart city development (Chowdhury and Dhawan, 2016). Accordingly, McKenna (2019) described data access as a requirement for achieving future smart cities. Similarly, findings from Kawada et al. (2013) suggested that access to data by systems that provide services in smart cities is a persistent issue.

Findings from researchers such as Mashhadi et al. (2014) revealed that citizens lack awareness on who has accessed data from their devices. But citizens should be able to willfully access their data collected by devices deployed by municipalities, and the captured data must be utilized only to realize the planned operation. This is because data collected regarding any stakeholders can reveal a lot and may lead to privacy issues (Petersen et al., 2019). Hence, in relation to techno-stakeholder's perspective data access initiatives can be employed which include specifying who can access what data and how the data is being specified at their gateway level (Chowdhury and Dhawan, 2016). Employing access control techniques such as

Role-Based Access Control (RBAC) need to be proposed to ensure confidentiality (McKenna, 2019). The employed access control mechanisms should be deployed with appropriate data protection techniques such as anonymization techniques based on data suppression, randomization or other data cloaking mechanisms which perturb data (Chowdhury and Dhawan, 2016). Based on the proceeding discussion, the following proposition is made:

P1. Data access strategies initiated will significantly influence techno-stakeholders' perspective for smart city development.

3.3.2. Data Ownership

In smart cities ownership is an absolute right termed as "erga omnes" which means "towards all" or "towards everyone" that is a right that gives rise to legal protection of data (property) against everyone (Janeček, 2018). Ownership refers to absolute dominion involving all the listed rights over an object. It also comprises a variety of different rights over same possession or asset (Petersen et al., 2019). Respectively, ownership is explored as an initiative due to increased amount of data collected. Hence, there is need to determine who owns the data and this calls for the need to address data ownership aspect in smart cities (Mashhadi et al., 2014). Presently, stakeholders in smart cities produce data that is either explicitly produced e.g. by citizens themselves (Kitchin, 2017; Jnr et al., 2020), for instance when they share their location while using metering or sensor devices or is implicitly collected via sensing devices such as energy sensors that monitor residential electricity consumption (Anthony et al., 2019).

Thus, ownership of data underpins one of the issues revolving around techno-stakeholder's perspective in making cities smarter and it possess implications for data trading towards economy sustainability (Janeček, 2018). According to Janeček (2018) ownership can be gradual, where a stakeholder may have less or more ownership depending on the asset's rights relating to collected data utilized to make city smarter. Accordingly, examples of ownership initiatives include specifying for which purpose the exposed data items can be used, for how long, and at what cost (Mashhadi et al., 2014). Data providers should be able to determine how long they want to expose and at what cost and should be notified when their data is being consumed and by whom (Petersen et al., 2019). Stakeholders should be given back control of their data so that they will be able to choose what data they want to make available. Providing a medium to enable stakeholders to review/withdraw and interact with their data (Mashhadi et al., 2014). Based on the above, the following proposition is stated:

P2. Data ownership strategies initiated will significantly influence techno-stakeholders' perspective for smart city development.

3.3.3. Policies

Urban policy plays a significant role in changing and shaping the local, state and even global connections of cities (Lin et al., 2013). The coordination of policies across different levels of governance is vital to techno-stakeholder's perspective for smart city development (Nam and Pardo, 2011). Although, findings from the literature suggest that smart cities research are more aligned to technological aspects, while issues related to governance policy have not been fully explored (Praharaj et al., 2018). Thus, smart city policies should support partnership and

collaboration among technology and stakeholder as a strategy to improve urban transformation, where cities can become a testbed for cooperation among different functional sectors within different jurisdictions (Nam and Pardo, 2011). Moreover, Caragliu and Del Bo (2016) called for research on smart city aimed to improve policy implications towards stimulating growth in urban space.

Along these lines, Lin et al. (2013) argued that there are inadequate studies that systematically address policy regarding smart city deployment which makes it difficult for techno-stakeholder's perspective to be fully achieved in smart city development. Likewise, Lin et al. (2013) recommend for policies that facilitates potential gains and acting as incentives for stakeholders. Although, findings from Caragliu and Del Bo (2016) suggested that smart city policies are more likely to be adopted in municipalities which are already environmental champions/stewards. Accordingly, examples of policies' initiatives include data sources utilized must be adaptable to the privacy laws of the countries where it is used. Consent should be clearly distinguishable from other matters and easily understandable to citizens and parties involved (Lin et al., 2013). Citizens personal information should not be used for research purposes (Praharaj et al., 2018). Data sources must protect privacy of children and the consent of the child`s guardian must be obtained. Data should only be collected from stakeholders by lawful and fair means (Nam and Pardo, 2011). Based on the aforementioned discussion the following proposition is stated:

P3. The current policies initiated will significantly influence techno-stakeholders' perspective for smart city development.

3.3.4. Regulations

In this age of data, personal data protection is one of the critical issues to be addressed by municipalities and organizations, given the significance of transparency and risk related to data breaches (Weber and Podnar Žarko, 2019). Thus, data protection has received high attention particularly by enterprises which processes huge data regarding stakeholders that consumes services (Praharaj et al., 2018). To this end, in April 2016 the European Union (EU) Parliament introduced the GDPR which is a data protection law designed to harmonize data privacy laws within Europe to empower and protect EU citizen data privacy and to reform the way enterprises across the region handle data privacy (Petersen et al., 2019). The GDPR came into effect on 25th of May 2018 and its procedure also implies that several changes will need to implement, particularly in terms of personal data processing and protection of EU residents (Lučić et al., 2018). In response to GDPR, stakeholders in smart cities such as businesses need to review their existing data protection compliance in order to determine next steps. They need adapt to changes relating to data policies towards improving services provided by municipalities (Nam and Pardo, 2011).

Researchers such as Weber et al. (2019) believed that there is need for additional study in regulatory aspects of smart city in order improve urban services. Caragliu and Del Bo (2016) suggested a set of regulatory initiatives to facilitate techno-stakeholder's perspective during the process of planning and designing of smart city solutions for widespread replicability as well as immense deployment of smart city solutions. Respectively, examples of regulation's

initiatives include allowing citizens to have the right to protect their personal data (Nam and Pardo, 2011). Personal data should be processed lawfully, fairly, and in a transparent manner. Personal data should be collected for specified, explicit, and legitimate purposes (Lučić et al., 2018). Data subjects should be provided with the prescribed information regarding the data controller and processor (Praharaj et al., 2018). Data subjects should be aware of their rights on personal data access, withdrawal, and erasure (Weber and Podnar Žarko, 2019). Based on these arguments, the following proposition is made:

P4. Current regulations initiated will significantly influence techno-stakeholders' perspective for smart city development.

3.3.5. Trust

Trust refers to the attitude of positive expectancy that a person's vulnerabilities will not be exploited and is mostly considered as one of the most important initiatives that contribute to smart city development (Ahmed et al., 2019). Trust is viewed as an important factor for improving social relations in the society, needed for harmony and economic prosperity (Trutnev and Vidiasova, 2019). Hence, the level of trust among stakeholders impacts the collaboration among actors, which is the foundation for positive development towards making cities smarter (Trutnev and Vidiasova, 2019). Therefore, trust closely relates to mutual understanding among stakeholders regarding smart city goals and methods for achieving sustainability (Riegelsberger et al., 2005). Likewise, the development of smart city depends on the level of stakeholder's trust in such strategies and the ability of city partners and administrators to ensure transparency and improve quality of life (Trutnev and Vidiasova, 2019). Trust eliminates bad outcomes and enabling stakeholders to create social ties. In this regard, trust among stakeholders allows cities to function in a collaborative way that supports different actors to engage in data exchanges that improves city development (Ahmed et al., 2019).

Respectively, findings from the literature (Kundu, 2019) revealed that stakeholders' readiness to participate in smart city's development highly depends on their trust on municipal authorities. Similarly, Keymolen and Voorwinden (2019) maintained that mutual trust among stakeholders is one of the key enablers of smart cities. In relation to techno-stakeholder's perspective trust is not just about trust between stakeholders, but also relates to trust in the technologies adopted to provide services in the city (Keymolen and Voorwinden, 2019). Therefore, examples of trust's initiatives include implementing measures so that only the data provider is able make inferences and observe the use of lookup system (Trutnev and Vidiasova, 2019). Deploy measures such that citizens are aware of the fact that it is likely that their data is being monitored and analyzed (Ahmed et al., 2019). Citizens must be informed about what type of data that is being collected, how much data that is collected and for which purpose it is collected (Riegelsberger et al., 2005). Aggregating or reasoning of disclosed data should not lead to infer the identity of citizens. Provided data source should be able to be trace back the

source to avoid forgery (Trutnev and Vidiasova, 2019). Hence, based on the above the following proposition is stated:

P5. Trust among stakeholders will significantly influence techno-stakeholders' perspective for smart city development.

3.3.6. Stakeholder Involvement

Based on the definition of Freeman (2010) a stakeholder is any individual or group who can impact or is impacted by the accomplishment of an organization's objectives. Smart city aims to address specific issues of stakeholders (Voordijk and Dorrestijn, 2019). Therefore, the stakeholder's perspective is indispensable for providing more effective services (Petersen et al., 2019). Likewise, stakeholders can be referred to as people or small groups with the authority to negotiate with, respond to, and alter the strategic future of urban planning and development (Bouzguenda et al., 2019). In smart cities the stakeholders may include the citizens (the people who utilize the smart city services), (Bokolo and Petersen, 2019), enterprises (those who provide smart city services), research institutions (those who carryout research on smart city services) and governments (those who initiate policies on smart cities) (Axelsson and Granath, 2018). Therefore, a smart city comprises of a multi-stakeholder ecosystem where stakeholder involvement is important for the success (Anthony and Petersen, 2020). Thus, it is important to incorporate all stakeholders in order to plan and implement city processes (Jayasena et al., 2019). Although, aspects of smart cities such as the technological domain have been researched in the literature, but the essential role of stakeholders in city development has often been ignored (Marrone and Hammerle, 2018).

A prerequisite for actualizing smarter cities is mainly depends on societal participation (Jnr et al., 2020). The involvement of different stakeholders for data driven solution in cities from the beginning to consolidate diverse communities within the urban ecosystem is necessary to define city strategies, engage, and mobilize stakeholders such as citizens who are users of final services to participate in city design (Bhattacharya et al., 2018; Cowley et al., 2018). In parallel, stakeholders should also be included in ongoing discussions for the development of their local environment. These create a trustable environment, in which both city administrators, citizens, and organizations can interact to improve existing city services (Gutiérrez Polidura et al., 2018). Accordingly, examples of stakeholder's initiatives include enhancing synergy and collaboration of stakeholders by improving data users' experience, employing constant evolution informed by new technologies based on feedback from citizens (Ståhlbröst et al., 2015a; Voordijk and Dorrestijn, 2019). Improving citizens participation by engaging them in smart city activities and uphold commitment to using open source standards whilst guaranteeing access for citizens (Jayasena et al., 2019). Thus, this study proposes that:

P6. Stakeholders involvement will significantly influence techno-stakeholders' perspective for smart city development.

3.3.7. Data Privacy

Privacy is a fundamental human right which is protected by national and international laws (Cavoukian, 2014). Privacy can basically be defined as a person's right to not be disturbed or

observed (Al-Turjman et al., 2019). Privacy refers to the right of individuals to conceal their private information and have some measure of control over the use of any individual information released to others (Mazhelis et al., 2016). Privacy is an important value for human, and it relates to social sustainability (Ståhlbröst et al., 2015b). In smart cities context, in preventing privacy breaches and protecting of stakeholders' information. It is essential to integrate a set of measures that passably protect individual information (Curzon et al., 2019), while allowing data driven innovation (da Silva et al., 2018; Vaidya and Mouftah, 2018). Although, the invasion of individuals privacy is not intentional but mostly due to city designer's inability to foresee how collected data could be utilized and how this may impact stakeholders (Cavoukian, 2014; Ståhlbröst et al., 2015b).

Accordingly, there is a need to investigate how privacy can be improved in smart city service development processes. This can be achieved by adopting privacy by design strategy to ensure that individuals' privacy is protected and considered early in the design phase of smart city development (Ståhlbröst et al., 2015b). Living in smart cities implies that citizens need to provide some details of their private lives, leading to risk in loss of privacy (Mazhelis et al., 2016; Curzon et al., 2019). This can make citizens more susceptible and thus, the importance of safeguarding their privacy becomes increasingly significant (da Silva et al., 2018). It is therefore mandatory to understand how to create innovative ICT solutions in smart cities that do not expose stakeholder's privacy (Cavoukian, 2014). Hence, due to sensitive data collected about stakeholders (such as citizens data) privacy issues is one of the key factors to be address in techno-stakeholder's perspective within smart cities (Martucci et al., 2017). A smart city should be able to establish security also in handling sensitive data of stakeholders and provide privacy assurances (Curzon et al., 2019).

Besides, other examples of techno-stakeholder's privacy initiatives include embedding privacy notices systems in user-friendly ways at appropriate times and restrict the retention periods of data. Providing menu of privacy settings which are in clear language and user friendly (Vaidya and Mouftah, 2018). Sensitive data can be encrypted in Transport Layer Security (TLS) protocol while it is transferred to the data storage system (Vaidya and Mouftah, 2018). Data sources that do not support TLS encryption should be deployed with security scheme such as Constrained Application Protocol (CoAP) (Ståhlbröst et al., 2015b). Data should be pseudonymize before storage in database using hashing operators such as MD5 message-digest-algorithm (Cavoukian, 2014). Thus, this study proposes that:

P7. The privacy of stakeholders will significantly influence techno-stakeholders' perspective for smart city development.

Based on the identified data driven initiatives for techno-stakeholder's perspective a model is proposed as seen in Figure 9 to provide strategies that are relevant for techno-stakeholder's perspective towards smart city development.

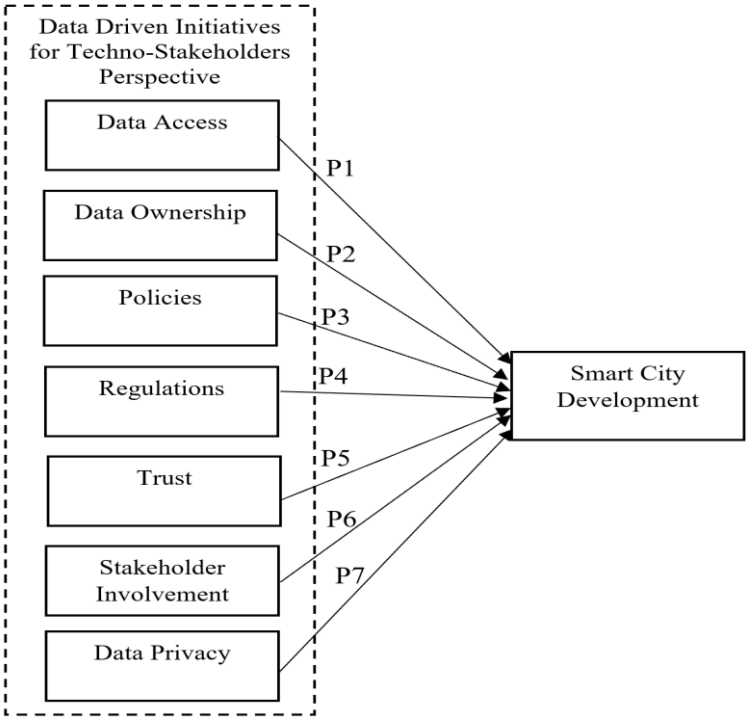

Figure 9 Research model for data driven initiatives towards techno-stakeholder in smart cities

Figure 9 depicts the research model for data driven initiatives towards techno-stakeholder perspective for smart city development. The context of data driven initiatives involve how data can be unpacked to be used actively to develop and deliver effective services to tackle global urban issues (Calzada, 2017). Therefore, the deployment of data driven initiatives in urban environment is transforming not only the way cities interact and are governed, but also how cities should deal with techno-stakeholder's issues. This is because stakeholders utilize technologies which provide data that is used by municipality to provide services to citizens. Hence, it is required to not only examine data driven initiatives in isolation without considering the techno-stakeholder's perspective for the well-being of citizens. Therefore, Table 1 present recommendations from the literature as data driven initiatives based on the derived propositions (P1-P7) to be adopted to improve techno-stakeholder perspective for smart city development.

Table 1. Data driven initiatives for techno-stakeholders towards smart city development

Data Driven Initiatives	**Recommendations for Techno-stakeholders Perspective**
Stakeholder involvement	• Employ identity management such as authentication, authorization, accountability, and revocation. • Incentivizing stakeholders (e.g., developers, analysts, businesses, citizens) in sharing and consuming data/services. • Enable data owners to easily participate in data trading. • Adequate training and awareness campaigns need to be done to make sure that citizens are aware and capable of protecting their own data and environment. • Data or service owners should specify usage policies to data or service consumers. • Data owners must have the opportunity to describe, publish, maintain and manage different versions of metadata. • Stakeholders should be able to specify what data and from whom they want to consume data.
Policies	• Citizens should be able to decide if data to be aggregated, sold, or in any other way reused in the creation of service.

	• Develop licensing checklists with the minimum standards that data providers could have in order to operate. • Provide incentives for the use of Open Source components, in order to enable communities to remain/become vendor independent. • Citizens can benefit from the data services without being overcharged for its operation. • Employ common vocabulary and semantics need to be used to express concepts and relationships they are understood by all stakeholders.
Regulations	• Provide and regulate open standards and interoperable data formats. • The consent of the involved members (organizations and end-users) should be requested before the execution of procedures which produce, use or offer personal data. • Adhere to GDPR by giving end-users back the control of their data by informing end-users about what data has been collected, for what purposes and under which policies the data is going to be processed and retained, or still by enabling end-users to choose to start (or stop) sharing specific data/service items. • In order to ensure that devices are easily integrated in services, a minimum set of standards to adhere to is required such as Internet Protocol (IP)-v4 or IP-v6.
Data privacy	• Privacy-aware communication for citizens and stakeholder's data should be provided. • Employ mandatory Identity and Access Management (IAM) for identification (claiming an identity), authentication (verifying an identity), and authorization (making access decisions based on an identity). • Provide privacy guarantee before the users unambiguously give their consent. • Provide privacy guarantees to establish trust of the data subjects and to gain their consent. • Employ anonymity of data (removing personally identifiable information), for the sake of protecting citizens' privacy. • Encrypt data and allow secure manipulations on encrypted data. • Keep track of the chronology of the data-ownership in order to ensure that the privacy rights of different stakeholders are respected along the chain of data processing. • Data subjects can withdraw their consent and request that data processors stop processing personal information and delete it. • Deploy perturbation techniques, such as multiplicative perturbation to protect against reconstruction attack and further maximize privacy protection. • Clearly identify and protect privacy rights of organizations and individuals. • Deploy identity management to safeguard the identity of citizens. • Every stakeholder participating in the database must have a unique identifier and a valid user profile to establish trust. • An identity management server needs to verify attributes before issuing access tokens. • Deploy two data sets from competitive entities (e.g., two mobility service providers) may never be aggregated or processed by the same service. • Citizens' consent must be ensured by providing strong privacy measures.
Trust	• An active and adequate decentralized trust management system must be designed. • Ensure users have sufficient control (e.g., revoke consent after data has been published) as they cannot review the data before its "publication". • Data must be open to facilitate flexible trust policies and granular access control mechanisms. • Employ digital signature, watermarking, certificates, and device authentication mechanism for safe sharing of data. • Ensure that the history of derivation, starting from the original data sources should be traceable. • Allow trustworthy identification and authentication of participants by using a central Public Key Infrastructure (PKI). • Participant must apply for a public key certificate that is registered in a central PKI and deployed in systems. • Data must be verified and signed by a trusted entity before it can be uploaded. • Personal data may only be used in an aggregated form by untrusted parties. • A sufficient number of distinct records must be aggregated to prevent deanonymization of individual records. • Data that allows personal identification (e.g., faces shown in camera images) must be replaced by an adequate substitute (e.g., a pixelized image) to ensure that the identity of individuals is not revealed. • Classified data may not be forwarded to third parties that do not have the respective clearance. • Critical data may not be modified by untrusted parties, as otherwise their integrity can no longer be guaranteed.
Data ownership	• Specifying for which purpose the exposed data/service items can be used, for how long, and at what cost.

	• Provide a provenance trail for the data for third parties from the device/subscription. • Data owners should use token as a parameter which is generated by authentication service that identifies the data.
Data access	• Specify who can access what data and how the data is being specified at their gateway level. • Enable citizens and stakeholders to choose what data/service items they want to make available/visible to the public. • The acknowledgement by citizens and stakeholders that others have authorization to access their sensitive personal data. • Access control techniques such as Role-Based Access Control (RBAC) need to be proposed to ensure confidentiality. • Access control mechanisms should be deployed with appropriate data protection techniques such as anonymization techniques based on data suppression or randomization or other data cloaking mechanisms which perturb data. • Deployed Application Programming Interfaces (API) should support authorized users in their search for a matching data or services in an adequate fashion.

Findings from secondary data as presented in Table 1 provides a techno-stakeholders' governance structure and dynamics within data driven services. Also, the data driven initiatives regarding techno-stakeholder perspective presented in Table 1 can support data collection, storage, and usage of data within cities and regions. In summary data driven initiatives in cities can be improved by understanding the role of techno-stakeholder involvement. As long as cities facilitates data ownership, data access, policies, regulations, trust, data privacy and stakeholder involvement towards smart city development.

3.4. Discussion

This study proposes a model based on SLR method to explore data driven initiatives (stakeholder involvement, policies, regulations, data privacy, trust, data ownership, and data access) that influences techno-stakeholders' perspective in smart cities. Findings from this study suggest that a significant relationship exists between data access strategies and techno-stakeholders' perspective for smart city development. Similar to prior studies (Kawada et al., 2013; Petersen et al., 2019), data access is an important initiative for techno-stakeholders' perspective in smart city development as it is the act of having complete control and legal rights and over a single piece or set of data elements (Chowdhury and Dhawan, 2016; McKenna, 2019). Therefore, there is need to manage access rights to data, information, applications, or systems that are relevant for providing services to stakeholders in urban environment. This result is also analogous with findings from the literature (Mashhadi et al., 2014) which suggest that data access defines and provides information about the rightful owner of data assets and the acquisition, use and distribution policy employed by the data owner. Thus, individual actors such as citizens should be able to specify and exercise access rights to their data.

Consistent with the findings of previous studies (Mashhadi et al., 2014; Janeček, 2018), there is a significant relationship between data ownership and techno-stakeholders' perspective for smart city development. This finding indicates that data ownership is relevant for urban development where third-party data, applications, services are utilized to provide services to citizens. This is based on the evidence that data may be saved on third party owned cloud

storage and data may be collected and provided by third parties (Petersen et al., 2019), prompting clarification of ownership of data used for providing city operations. Similarly, this finding is in line with the results of other studies (Kawada et al., 2013; Chowdhury and Dhawan, 2016), which mentioned the need to define and describe assess models, terms and conditions, and rights for granting access and sharing privately owned data with stakeholders involved in providing city services. Current policies adopted in municipalities has a significant effect on techno-stakeholders' perspective for smart city development. Where cities employ a plethora of policies from a number of governmental bodies, but these may often be poorly coordinated, overlapping, conflicting, or even fragmented, and thus leading to perverse outcomes. This result is similar with findings from previous study (Lin et al., 2013) which indicated that the role of policy is to alter the environment in which innovation takes place, such as the economic, social, environmental, or legal framework. These policies will be helpful toward developing cities based on business collaborations, data sharing and system integration (Nam and Pardo, 2011).

Consistent with existing literature (Petersen et al., 2019; Weber et al., 2019), the regulations adopted in a city has an effect on techno-stakeholders' perspective for smart city development. Based on findings from Praharaj et al. (2018), existing regulation has a significant impact on businesses that provides services in urban environments. The introduction of new rights for citizens and stakeholders, such as Right to be Forgotten and the Right to Portability, as well as introduction of obligatory breach notification, may increase the regulatory burden for both businesses and governmental institutions in cities (Weber et al., 2019). This finding is also analogous with results from the literature which suggest that a regulation is normally understood as the laws, rules, and principles put in place by state, federal to control the actions and behaviour of business operating in city (Caragliu and Del Bo, 2016; Lučić et al., 2018). Thus, such regulation can impede or progress smart city development. Additionally, findings from the literature confirms that trust among stakeholders significantly impact techno-stakeholders' perspective for city development. This finding is consistent with earlier studies (Ahmed et al., 2019; Keymolen and Voorwinden, 2019), emphasizing that trust is an integral driver for economy growth. Likewise, findings from Kundu (2019) maintained that trust is the currency for citizens to have faith in a system, for a city to be governed transparently in agreement among its residents.

Empirical studies have shown that trust is important in order to achieve transparent urban governance (Ahmed et al., 2019). This means that in making cities smarter, there is need to publish all key strategies and vision documents openly available (Trutnev and Vidiasova, 2019). This will lead to a high level of trust among stakeholders. In this regard, trust among stakeholders allows city to function properly (Keymolen and Voorwinden, 2019), leading to productivity and better quality of life (Riegelsberger et al., 2005). Additionally, finding suggests that stakeholders involvement influence techno-stakeholders' perspective for smart city development. Consistent with the literature (Jayasena et al., 2019), stakeholders are identified as a core driver for making cities smarter. This finding supports results from Gutiérrez Polidura et al. (2018) which provides empirical evidence for the argument that in smart cities stakeholders should be engaged and motivated to participate, as they are the natural

influencers of the future co-creation process within the urban environment. Moreover, Axelsson and Granath (2018) argued that stakeholder's engagement activities should be included in city development to achieve a common smart city synergy. This will create a trustable environment in which both citizen and city officials can interact to improve urban development to create the city they want to live in (Marrone and Hammerle, 2018).

Finally, the results showed that the level of data privacy will significantly impacting techno-stakeholders' perspective for smart city development. This finding is analogous with the results reported by Martucci et al. (2017); Vaidya and Mouftah (2018); Al-Turjman et al. (2019). Likewise, da Silva et al. (2018) highlighted that privacy which is defined as one´s ability to control how, when, and to what extent personal information is collected is a driver that may impend citizens usage of data driven services. This is true as the development of technologies moves into the direction of becoming increasingly mobile, smart, and invisible, also other aspects of data privacy become important to consider since improper handling of such data can expose citizens to significant risks (Ståhlbröst et al., 2015). This is made even more pertinent by the advent of the new GDPR in EU, which provides precisely and stronger defined requirements in terms of privacy (Vaidya and Mouftah, 2018). Hence, privacy in smart cities should not depend on legal measures only, but also with the support of mechanisms, network, and computer security tools to enforce legal privacy principles (Martucci et al., 2017).

4. Implications of Study

4.1. Implications for Theory

Smart city development is strongly dependent on the deployment of data from technologies. Prior studies have captured the technological, social, economic, and environmental dimensions of smart city development. But has not fully explored the crucial role that stakeholders play in smart city development in relation to technology use in urban environment. Following this line of taught, this study explores the data driven technological aspects of stakeholders' involvement in smart city termed as techno-stakeholders. Theoretically, this study contributes to the body of knowledge in smart city development by identifying gaps in the literature, e.g., by starting the role of technological aspect of stakeholders' involvement in smart cities. The explored techno-stakeholder perspective addressed in this study provides a solid theoretical basis that stimulate further research to determine the collaboration of the quadruple helix of stakeholders that uses technologies as seen in Figure 8.

From the theoretical point of view, this study proposes a model for techno-stakeholder perspective in smart cities to promote a balanced implementation of smart cities data driven initiatives. The model can be employed specially as guidelines to support municipality administration and urban policy makers towards smart city development. This study offers implications for different stakeholders suggesting that data access, data ownership, policies, regulations, trust, stakeholders, and data privacy influences techno-stakeholders' perspective in smart cities. Additionally, this study explores the relevance of stakeholders in making cities smarter. The developed model (see Figure 9) can be utilized as a guide to help urban administrators and decision makers in deploying data driven solution for smart city attainment. The model can support cities to design and develop new data driven business models that can

help to provide services to citizens and businesses. The findings from this study discuss how to seize the opportunity of data driven initiatives in order to promote smart city development.

4.2. Implications for Practice

With increased urban populations, cities are facing societal issues in achieving sustainability. Thus, the need to address issues related to sustainability of cities are becoming pressing and relevant. Universal concerns of sustainability entails action from international community, respective countries and cities. While addressing sustainability issues, there are problems related to overpopulation in cities thus creating increases in pollution and noise, traffic congestion, along with other real or perceived decreases in quality of life. These issues entail the need for smart city development. Data driven initiatives required for techno-stakeholders are considered important for successful smart city development. Therefore, this study introduced the notion of techno-stakeholders and further presents identified data driven initiatives for techno-stakeholders to promote smart city development.

Findings from this study highlights that techno-stakeholders perspective in smart city development is worth investigating. This study's implication to practice is aligned to the data driven initiatives for techno-stakeholder's perspective to promote smart city development presented in Table 1 which can be employed as indicators by municipality administrators to evaluate data driven services being deployed in cities. Findings from this study provides a roadmap for integrating techno-stakeholder's perspective into smart city development, both the essential resources and the potential outcomes can be enhanced. Additionally, this study explores the relevance of techno-stakeholders perspective in making cities smarter. Findings from this study can also be used to understand data driven initiatives to be employed for making cities smarter.

4.3. Implications for Policy

Due to the need of technologies to develop smart cities, there is a persistent demand for comprehensive conceptual perspectives to understand and explore smart city initiatives from a techno-stakeholders point of view. Accordingly, this study addresses this gap and contributes to the literature on smart cities by exploring the data driven initiatives that impacts techno-stakeholders perspective for smart city development. This study offers empirical evidence related to data policies, regulations, privacy aligned to technologies employed by stakeholders in smart cities across different actors and services. Additionally, this paper contributes to the literature on smart cities, stressing that smart city development occurs mainly through deployment of technologies that uses data. Thus, this study adds to the literature discussing the interplay between technology and stakeholders' activities in the context of smart cities.

At the policy level, the model developed in this study can serve as a blueprint for studies in urban development to inform data governance and data regulatory guidelines. The proposed model encourages policy makers in achieving data driven solutions required for effective digital transformation of urban services. The presented model will be of interest to researchers, data analysts, city managers, urban designers, policymakers, and practitioners interested with adopting data driven initiatives to manage current and future cities. Additionally, the identified

data driven initiatives can be employed to evaluate the effectiveness of service provided to stakeholders in a systematic way. Also, the model can be employed to highlight the significance of deploying data technologies in urban space as a contributor to smart city development.

5. Conclusion, Limitations, and Future works

Over the years there have been several initiatives adopted across counties to enhance city development aimed at achieving sustainability. To address increased urbanization and other sustainability challenges, urban developers are now seeking to transform municipalities into smarter cities. In this context, stakeholders play an important role as in creating a sustainable and live-able city. Prior studies indicated the necessity of examining stakeholder's involvement in smart city development. Despite the importance of technology and stakeholders in urban planning, no studies sheds light on techno-stakeholder perspective in smart cities. Thus, it is important to consider data driven initiatives for techno-stakeholders in ensuring that data driven services are provided to citizens. Accordingly, this paper explores techno-stakeholders' perspective by considering data driven initiatives for smart city development. Grounded on a systematic literature review this current study contributes to existing body of knowledge by proposing a model and propositions to explore techno-stakeholders' perspective for smart city development. The model is based on data driven initiatives that impacts techno-stakeholder's perspective in order to foster smart city development.

The model provides recommendations (see Table 1) to municipality administrators and decision makers on how they can improve data driven initiatives for techno-stakeholder performance towards urban transformation. Findings from this study provide a holistic view on the main key data driven initiatives to be considered during urban transformation. The identified data driven initiatives can be adopted as indicators to benchmark and measure data driven services provided to stakeholders. This study has a few limitations that offers grounds for future research. First, only secondary data from the literature was used in this study, primary data was not collected to validate the model propositions. Secondly, this study explored a new research area techno-stakeholders perspective as such the evidence provided are limited and no practical evidence was provided in form of a case study. Lastly, other data driven initiatives such as risk assessment, data security, interoperability, and data governance were not fully explored in this current study.

Further studies can involves exploring how smart cities improve services delivered to citizens by considering the social, economic and environmental impact. Additionally, the role of collaboration in the quadruple helix comprising of government, citizens, academy and businesses in improving citizens well-being in smart city can also be explored. In addition, further research will involve conducting a longitudinal study over a period to examine the impact of the identified data driven initiatives for techno-stakeholders in two cities Trondheim (Norway) and Limerick (Ireland). This will help to explore the generalization of techno-stakeholders role for smart city development. Data will be collected from municipality administrators, practitioners and enterprises involved in providing data driven services using semi-structured interviews to validate the proposed model and for proof-of-concept in

achieving collaborative partnership. Besides, data driven initiatives such as risk assessment, data security, interoperability, and data governance that are relevant to techno-stakeholders perspective for smart city development will be explored in future research. Lastly, studies around open data are well-known, although implementation phases constantly fail due to the difficulties of implementation as related techno-stakeholders perspective in smart cities. Thus, as highlighted by Calzada and Almirall (2020) research related to definition on ecosystem-based development, citizen involvement on functionality development, open data strategy on whole city environment over required functionality, platform economy strategy on using open data, and interoperability, semantics definition, and management will be examined in future smart city research.

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