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Challenges for sustainable smart city development: A conceptual framework

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Abstract

Sustainable smart city development experience various challenges, such as legislation and policies, funding, infrastructure, and technological aspects. Numerous studies have highlighted the importance of sustainability concepts in smart cities' development. However, there is scarce research focusing on the challenges faced for the development of sustainable smart cities. This study aimed to develop a conceptual framework that provides critical challenges faced by private and government organisations, and the respective solutions of the challenges for the development of sustainable smart cities. Pakistan has been chosen as a case study that yields a total of 17 respondents from the executive, managerial, and operational levels of private enterprises and government organisations involved in smart city development. This research is a preliminary step towards providing insights and significance of infusing sustainability in the development of smart cities. The proposed conceptual framework can act as a practise guideline for practitioners to prepare themselves for sustainable smart city development.

KEYWORDS

conceptual framework, implementation challenges, Smart City, sustainability

1 | INTRODUCTION

Sustainability is a general concept that is driving innovation and transformation across all levels of society (Chofreh & Goni, 2017). It incorporates a broad range of challenges, including urban development (Elmqvist et al., 2019), energy management (Wan Alwi, Klemeš, & Varbanov, 2016), information systems (Goni et al., 2017), waste management (Lee, Rozali, Van Fan, Klemeš, & Towprayoon, 2018), and people's health and safety (Zeinalnezhad et al., 2018). Sustainability has become a core interest in advanced cities. The internet of things (IoT) and smart city technologies are one of the solutions to success in this field (Khan, Silva, & Han, 2016).

The quick stride of urbanisation is bestowing state of the art opportunities to apply growing technologies to recognise sectors in

the challenges of city management (Nyberg, 2018). The unification of technology and urban governance, tagged as a smart city, is handled by an international private organisation and by national governments looking to build up economic agonistic and enhance the quality of life (Malik et al., 2019). Although studies have highlighted the importance of sustainability concepts for the development of smart cities (Vu & Hartley, 2018), there is scarce research focusing on the challenges faced by the practitioners in developing sustainable smart cities in Pakistan.

Smart city technologies show a chance to administer the effects of rapid urbanisation. This study focuses on the case of Pakistan as an example of an initiative towards urbanisation and smart city development. Pakistan Vision 2025 estimates that Pakistan will have smart

cities that integrate and manage the dimensions of sustainability (environment, economy, and society). This vision is carried out together with the increasing complexity and need for knowledge transmission, increasing population, and city size (Planning Commission, Ministry of Planning, Development and Reform, 2016). The sustainable city focuses on policymaking and its implementation in terms of public transportation, community infrastructure and facilities, and green space. Smart city technology plays a vital role in the roadmap of a sustainable city.

The World Urbanisation Prospects 2018 revealed that growing urbanisation and increasing revenue trends indicate that the percentage of urban communities will grow in Pakistan by 2050 (United Nations, 2018). Figure 1 shows the statistics of population in rural and urban areas between the years of 1950 to 2050.

The blue curve in Figure 1 shows the decline of population in the rural area that subsequently increases population number (shown in the red curve) in urban areas between the years of 1950 to 2050. Statistics show that the population is proliferating in Pakistan in the coming decades. With a progressive increase in population, the urban population also gradually increases. It is observed that new cities emerged while existing cities massively increased the size of their population. The time serving citizens will be more difficult due to the increase in the urban population. Therefore, it is necessary to build systems and technology that can guide local governments better to manage urban centres (Irfan, 2019).

Building smart cities require infrastructure support, technology, and policies and strategies of government agencies. Various issues related to policies, funding, human resources, and technology are often magnified and could hinder the implementation of smart cities. Stakeholders from the executive, managerial, and operational levels in private companies and government organisations must face and overcome these challenges for the successful development of sustainable smart cities. By predicting the emerging challenges, the practitioners can better prepare the development of sustainable smart cities and provide more efficient and better-integrated services (Vu & Hartley, 2018). Ignoring the facts of these challenges and their solutions will lead to delays and failure to handle the implementation of smart cities. This study investigates the main challenges faced by developers from private companies and government agencies in Pakistan for sustainable smart cities with their strategic solutions. It is a preliminary step towards providing insights and significance of infusing sustainability in the development of smart cities. This study proposes a conceptual framework of critical challenges faced by the

practitioners and the several solutions that can act as a practise guideline for practitioners to prepare themselves for the sustainable smart city development.

Pakistan is taken as a sample in this investigation. Following Pakistan's Vision-2025, this country will have smart governance with contributions from all community levels of Pakistan, where professionals will participate in the network. This working network will advance the existing city management models towards smart cities. In complementing this work, an initiative for urban uplift (URAN) is also developed. These initiatives prepare Pakistan in the direction of smart cities, and this can be an appropriate selection to become a case study. Other reasons Pakistan is chosen as a case study because this country has taken substantial steps to ensure the city becomes smart in terms of resources, governance, and infrastructure by handling sustainability aspects by 2025 (Planning Commission, Ministry of Planning, Development and Reform, 2016).

2 | SMART CITY DEVELOPMENT

The literature revealed that the current study in smart city development is generally focused on the challenges of rapid urbanisation. Urbanisation is an ineradicable strength, founded on the latest drifts in Asia. The impacts of urbanisation on national economic development are diverse (Lytras & Visvizi, 2018). Urbanisation, on the one hand, can encourage productivity, efficiency, and revolution via specialisation, and global connectivity. If urbanisation is poorly controlled, it can lead to sustainability problems like socio-economic inequality (Cohen, 2006), public health, and pollution (Chofreh et al., 2019).

The increase in population can be exposed smartly through smart cities development and urbanisation. Getting prepared for urbanisation through smart city development is one of the feasible solutions and has been discussed in the literature. Various studies have addressed the importance of smart city development, though some of them have highlighted the challenges towards the development of smart cities. The list of existing studies that reported the challenge for the smart city development is described in Table 1.

Growing technologies of ICT, IoT, and big data analytics are the basic infrastructure support (Malik et al., 2019), incorporating those utilised for smart city development, provides possible resolutions to these and other urbanisation challenges. It is a foundation for economic development and competitiveness (Lytras & Visvizi, 2018). Dobbs et al. (2016) have reported the significance of ICT core for the

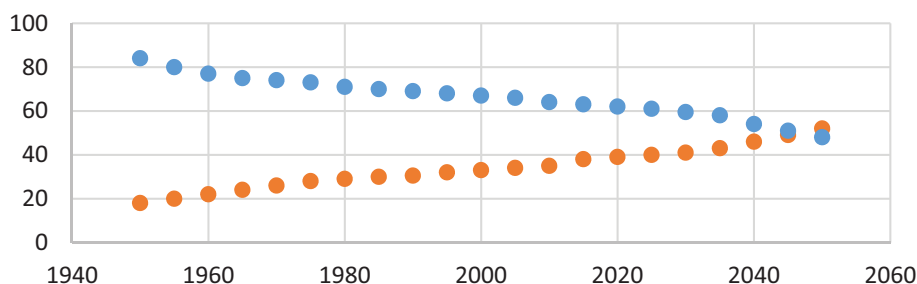


FIGURE 1 Statistics of the population in rural and urban areas between the years of 1950 to 2050 (adapted from United Nations (2018)) [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Existing studies and reported challenges

Challenges	Description	Reference	Research focus
ICT infrastructure support	Lack of ICT support and its under-utilisation both considered a challenge for the development of smart cities. Though ICT is well-thought-out as the backbone of smart city development, but if it lacks any support for its policy development, it can be a hindrance to developing the region.	Hashem et al. (2016)	Importance of big data support for the development of the smart city
		Dobbs, Manyika, and Woetzel (2016)	The industrial revolution of technology and data as a trendsetter for urbanisation
		Akçura and Avci (2014)	The basic paradigm of ICT for the establishment of smart and global cities
Speedy urbanisation and lack of wisdom from government	Urbanisation is one of the critical challenges as it reveals the failure and lack of knowledge of government.	Nyberg (2018)	Sectors development by smartness using energy infrastructure and information engagement for urbanisation
		Arenas, Goh, and Urueña (2019)	Contribution of I.T. design for smart tourism ecosystem
		Vu and Hartley (2018)	Encouraging smart cities in urbanisation and emphasising on policy development
Lack of coordination and externalities	Lack of collaboration and coordination refers to the referring to the facilitation of infrastructure, rulings, and juridical actions. It can affect the quality of decisions and aligns the stakeholders' interests.	Warwick (2013)	Highlighting the rulings and policy for industrial policy and smart city
		Lin (2014)	Discussing prosperity and well-coordinated efforts towards policy development for economy development
Public-private partnerships	Successful sustainable smart city development projects need a significant public-private partnership. Such a partnership, if ignored, can create a challenge for smart city development.	European Commission (2013)	Importance of establishing innovative partnership smart city development projects
		Lee, Hancock, and Hu (2014)	Discussing the role of stakeholders as a framework for building smart cities
		Tavares, Galvane, and Ranck (2016)	Exemplifying effectiveness of partnership role for building successful smart cities
Sustainable smart cities implementation issues	Smart city development and its sustainability is a progressive policy issue in countries.	Lytras and Visvizi (2018)	Arguing the critical role of policymaking for sustainable smart city development
		Planning Commission, Ministry of Planning, Development, and Reform (2016)	Highlighting the vision of achieving sustainability through sustainable smart cities

development of smart cities. They discussed that ICT would act as a major force in the 21st century for shaping global development. It is reported in the study that a 90% rise in the world urban population will be in Asia and Africa regions (Dobbs et al., 2016). The study has placed information and communication technologies as major smart city development policy interest for several regions. Other researchers also reported information and communication technologies as an instrument that not only provides ways to support urbanisation but also helps cities to achieve development goals (Akçura & Avci, 2014).

Some studies have focused on the support of stakeholders, both direct and indirect, for the development of smart cities. Involving government, private enterprises, and policy developers are considered

key roles for success. Smart city development is considered as a platform to treat government failures regarding speedy urbanisation. Smart city development should also support sustainability dimensions (economic, social, and environmental) in addressing the challenges that are most commonly faced during rapid urbanisation (Vu & Hartley, 2018). One of the most common government failures regarding urbanisation is related to coordination and externalities. Another source of government failures towards urbanisation is its intervention resulting in failures regarding information restrictions. Externalities come out fundamentally from the inconsistency amongst privately-owned gains and influence on external or government parties (Warwick, 2013). There should be support from the government for the

entrepreneurs in terms of incentives so that they invest in projects resulting in social and economic benefits (Lin, 2014).

Smart city development can assist cities in handling the issue of lack of support from the government by involving public-private partnerships, giving support to entrepreneurs for assuming risk in generating smart city development applications (Vu & Hartley, 2018). European Innovation Partnership on Smart Cities and Communities (European Commission, 2013) reported that it is highly significant to have public-private partnerships for successful sustainable smart city development projects. A wide range of literature has reported about the role of public-private partnerships in successful smart city development projects (Lee et al., 2014).

Lack of coordination is another main barrier to smart city development (Lee et al., 2014), referring to the facilitation of infrastructure, rulings, and juridical actions. Such steps force private enterprises to invest simultaneously, generating visible effects on economics (Vu & Hartley, 2018). Coordination comprises of arrangements from institutions supporting collaboration not only between agencies but also amongst public and private sectors. This act of collaboration improves the quality of decisions and aligns stakeholders' interests (Vu & Hartley, 2018).

It is found that state of the knowledge regarding smart city development is in the conception stage that needs further investigation.

Publications regarding sustainable smart cities in specific to southeast Asia are few; including projects regarding the smart city in Kuala Lumpur (Yau, Lau, Lin, & Rahman, 2014), lessons learned from smart city development in Singapore (Calder, 2016), smart cities in India (Rana et al., 2019), smart cities in Saudi Arabia (Abubakar & Aina, 2018), and smart cities and infrastructure in Pakistan (Khan, 2016).

The development of sustainable smart cities can be obstructed by the various challenges (Vu & Hartley, 2018). There is limited theoretical support available regarding the challenges that are experienced for the successful implementation of sustainable smart city development. This study attempts to fill this knowledge gap by investigating the key challenges for sustainable smart city development.

3 | METHODOLOGY

This study attempts to respond to the following research questions: What are the key challenges for sustainable smart city development in Pakistan? and How can these challenges be resolved for the development of sustainable smart cities in Pakistan? Pakistan is taken as an exemplifying instance to take account of what challenges and their solutions can be for the development of smart cities focusing on the

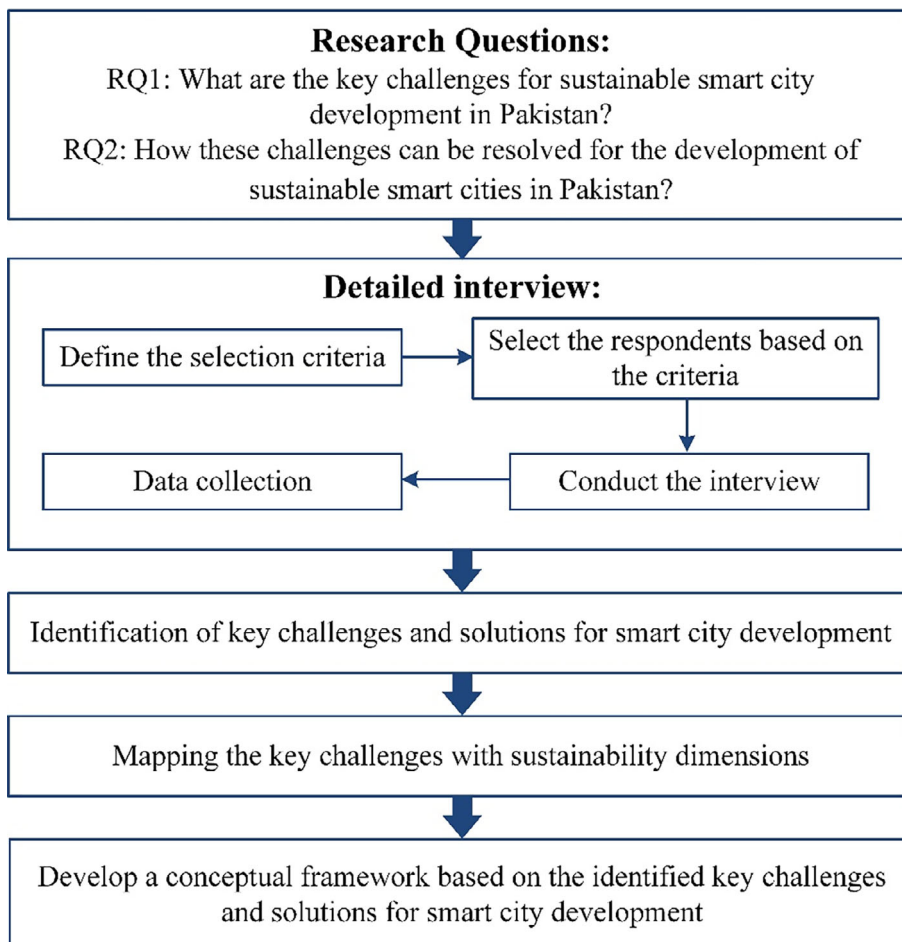


FIGURE 2 Process flow [Colour figure can be viewed at wileyonlinelibrary.com]

sustainability aspects. This investigation can assist the existing and new organisations in overcoming the challenges with their solutions. A qualitative method using the in-depth interviewing technique is applied to address the identified research questions. The results are then summarised in the form of a conceptual framework for smart city development challenges, along with their respective solutions. Figure 2 provides the process flow of the conduction of research in this study.

This study uses an in-depth interview technique for the observation. It is a qualitative research technique, including systematic interviews at an individual level, with a smaller number of respondents to identify their perspectives on a certain situation (Crouch and McKenzie, 2006). In-depth interviews are considered worthier when comprehensive information regarding the opinions and views of the individual is required or want to investigate novel issues in detail (Crouch and McKenzie, 2006).

Respondents were identified based on selection criteria that included stakeholders. These stakeholders include officials from the federal and provincial governments, national information technology councils (NITB), private companies, national databases and registration authorities (NADRA) and smart city projects involved in smart city development. They should have more than 5 years of experience in smart city development. For the identification of respondents, 21 experts from the domains mentioned above are contacted; however, only 17 experts were willing to participate. These respondents are managerial and technical staff in the public and private organisations, who are directly involved in smart city development. The demographic data of respondents is attached in Appendix. Bryman (2016) argued that in-depth interviews are generally conducted with a minimum of 10 and a maximum of 30 respondents. Consequently, the sample selection in this study satisfies detailed interviews conduction criteria.

At this stage, the interview session is conducted with 17 stakeholders. The interviewee's approval is initially taken, and then the purpose of the interview is explained again. The reason for their selection, with the interview session's expected duration, is notified to them. Once the interview session is finished with the interviewee, the key findings are immediately reported.

4 | RESULTS AND DISCUSSION

This section provides a detailed analysis of the identified challenges for smart city development. Further to this, the identified challenges are also mapped to four sustainability dimensions, including social, economic, technological, and environment (Chofreh & Goni, 2017). The aim of the mapping is to find out whether the challenges address sustainability or not. The detail is reported in the following subsections.

4.1 | Smart City development challenges analysis

A total of 12 challenges to sustainable smart city development are identified via interviews conducted with 17 respondents from various private enterprises and government bodies. The results show that the

highest mentioned challenge by the respondents is "Budgetary constraint" and "Lack of resource." The least shared challenge by the respondent is "Lack of smart city operational framework. The detailed frequency chart of the key challenges is reported in Figure 3. The explanation of the identified key challenges for smart city development based on the respondents' perspective is described as follows.

4.1.1 | Budgetary constraint

The budgetary constraint is found one of the most crucial challenges for smart city development (Vu & Hartley, 2018). The results correlate with the existing studies that deploying sensors, developing information systems at the enterprise level, integration of systems, and creating ICT infrastructure in cities require sufficient budget allocation (Hashem et al., 2016). The respondents in this study from the executive management level have emphasised that the technical support and facilities are tagged with the release of sufficient budgets not only for installing them but also for maintenance and up-gradation of the existing infrastructure. Thus, procuring technology, tools, and building infrastructure requires financial resources that become one of the key challenges, acting as a strong barrier. The opinion of the executive managers correlates with the findings of the work of Khan (2016).

Respondents of this study, from the federal government, also highlighted that Pakistan is currently facing financial budget deficits. Under such financial and political concerns, it is a challenge for the government to make available the sources of funding to initiate such big scale projects. They emphasise that although they have established some accounts for the development of smart cities, however, private enterprises have also initiated technology funding schemes for the establishment of smart cities and technology infrastructure.

4.1.2 | Lack of resources

The results of this study revealed that lack of resources, including technology, equipment, sensors, human, and finance as a challenge that directly impacts the development of sustainable smart cities, hence correlating with the actual work of Calder (2016). The respondents of this study underline that a country like Pakistan is always challenged with the availability of resources. They further elaborated that the limitation of such resources can lead to the failure of the ongoing projects. According to them, the delay of such projects not only impacts the organisation but also affects the overall development of sustainable smart city development, which is supported by the existing work of Arenas et al. (2019).

4.1.3 | Lack of awareness amongst residents of smart cities

The respondents of this study reported the challenge of a lack of smart city awareness amongst residents. The awareness of sustainable

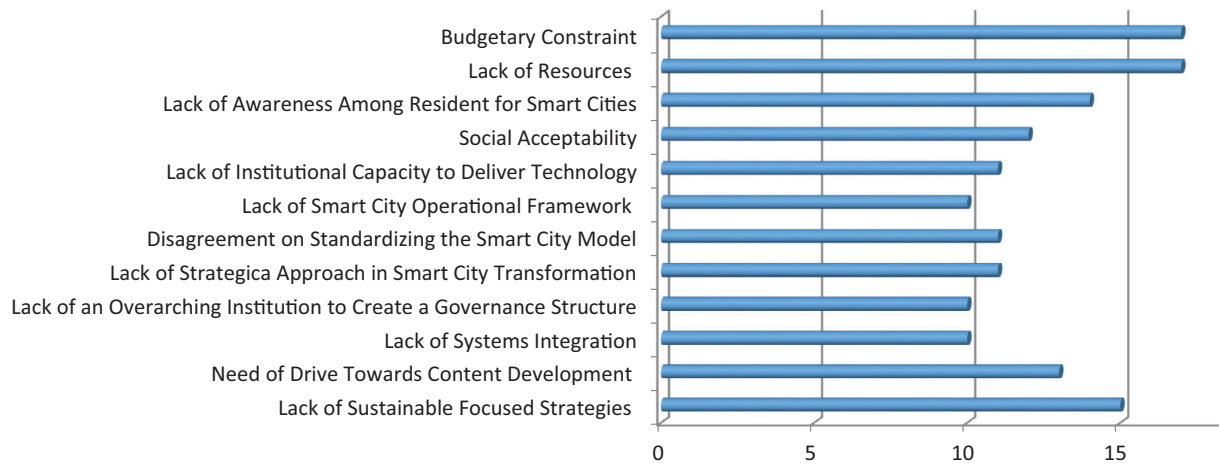


FIGURE 3 Frequency chart of key challenges of smart city development [Colour figure can be viewed at wileyonlinelibrary.com]

smart cities amongst citizens is the real challenge (Warwick, 2013). The respondents of this study reported that they had collected a public opinion from major cities of Pakistan. They shared that majority of the residents are unaware of the services and features of the smart city. They also highlighted the fact that awareness of smart cities amongst residence is essential to acquire sustainable smart city maximum benefits. Such a response is also observed in the existing literature that also highlights that the residents must be equipped with a basic understanding to yield the maximum benefits (Rana et al., 2019).

4.1.4 | Social acceptability

The social acceptability based on the satisfactory services of smart cities is another key challenge. Social acceptability of new technologies that can reshape their lifestyle is always challenging (Arenas et al., 2019). As not all residents are educated and fully aware of such technology initiatives, they feel that it is useless or sometimes ignored. Residents' awareness level on services of smart cities plays a key role in the social acceptance of smart cities. To improve the resident's well-being, and quality of life, efforts of smart cities, and their services must correspond to social needs (Warwick, 2013). Awareness about smart agriculture, smart healthcare, smart parking, smart education, and other smart services are important for the improvement of social life (Lytras & Visvizi, 2018).

4.1.5 | Institutional capacity to deliver technology

Respondents also highlighted the lack of capacity to deliver the technology needed for smart city development. They highlighted that smart city development required a set of skills and experience from the institutions which are directly and indirectly involved. It is a fact that the development and delivery of technology for the development of smart cities requires extensive knowledge, expertise, and the capacity of organisations (Hashem et al., 2016). They further

suggested that organisations should take steps to build the right capacity to support the development, maintenance, and enhancements of smart cities.

4.1.6 | Lack of smart cities operational framework

Lack of an operational framework is another important challenge for sustainable smart city development (Vu & Hartley, 2018), especially in Pakistan (Khan, 2016). Respondents of this study argued that the government organisation and private enterprises are generally unaware of the operational working archetype of smart cities. They also highlighted that lack of any specific operational framework results in a challenge towards the operations and maintenance of smart cities. Some of the executive level respondents shared the criticality of lack of any operational framework while facing any natural disasters or other unfortunate situations. It is highly important to have any framework that can act as a guideline for developing, deploying, and smooth working of smart cities (Nyberg, 2018).

4.1.7 | Disagreement on standardising the smart city model

Due to various stakeholders involved in the development of smart cities, some issues related to social, political, technological, and governance raised regardless of country and region (Lee et al., 2014). Respondents argued that getting the consensus of stakeholders on a unified smart city model is a key challenge in a country. They further added that various concerns and limitations of stakeholders are contributing to this challenge. Besides, the technology transfers and government policy is core not only in the international community (Lytras & Visvizi, 2018), but respondents also highlighted this as one of the major reasons for lack of consensus. Furthermore, they also highlighted a concern for the transfer of technology to build a standardised model for smart city development. Such emerging concern is also observed in

various countries like Singapore (Calder, 2016), Saudi Arabia (Abubakar & Aina, 2018), Malaysia (Yau et al., 2014).

4.1.8 | Lack of strategic approach for smart cities transformation

One of the emerging challenges is the strategic approach for smart city transformation. Respondents from this study share their view that the transformation of cities into smart cities cannot be done in one go, but a strategic plan is needed. These plans provide a roadmap to the development of smart cities (Warwick, 2013). It is further explained that the first instance of smart city development is the infrastructure for communication and networks. It is pointed out that professional skills are essential for the development of infrastructure (Hashem et al., 2016). Respondents also highlighted that there is a strong need for devising any plans and processes that can guide a strategic approach to build smart cities. It could act as a platform for stakeholders to outline their operations.

4.1.9 | Lack of an overreaching institution to create a governance structure

Another challenge is a lack of comprehensive governance structure to foster the development of smart cities, reported by the respondents of this study. A governing body is required that can overreach its spans of controls and responsibilities to set up smart cities (Arenas et al., 2019). It is further communicated that smart cities projects involve various stakeholders like government, enterprises of the country, infrastructure builders, telecommunications authorities, and others (Lee et al., 2014). The respondents further highlighted that to communicate and take them all basic entities on board, and a complete governance structure is essentially required.

4.1.10 | Lack of system integration

System integration in smart cities is a complex system that needs to be interoperable and efficient enough to provide updated information (Nyberg, 2018). Such integration generally includes healthcare, security agencies, smart transports, mobile communication, and energy-efficient systems (Nyberg, 2018). Respondents of the study highlighted that systems development of smart education, healthcare, signals, parking, and others are somewhat in progress and developed in a country. They further added that their development in isolation could not accomplish the purpose of developing smart cities. The integration of city systems is a key challenge that has been less tackled to effectively generate purposeful information and provide quality of life in general (Arenas et al., 2019). Few respondents, from provincial government officials, also emphasise that system integration even becomes more challenging when it needs to cope with the province and national levels. They suggested that a strong focus is needed in

systems integration for developing smart cities both at the province and national levels.

4.1.11 | Need to drive towards content development

Respondents of this study underlined that smart city development is equally dependent upon the infrastructure, computing, and the right contents in information systems. They emphasised that enterprises need to deal with digital technologies to build data centres for content development. Smart healthcare, smart parking, smart signals, smart waste management, and smart agriculture are some of the examples in this regard (Hashem et al., 2016). Respondents have stressed that the lack of complete and efficient digital content is a challenge for the success of developing smart cities.

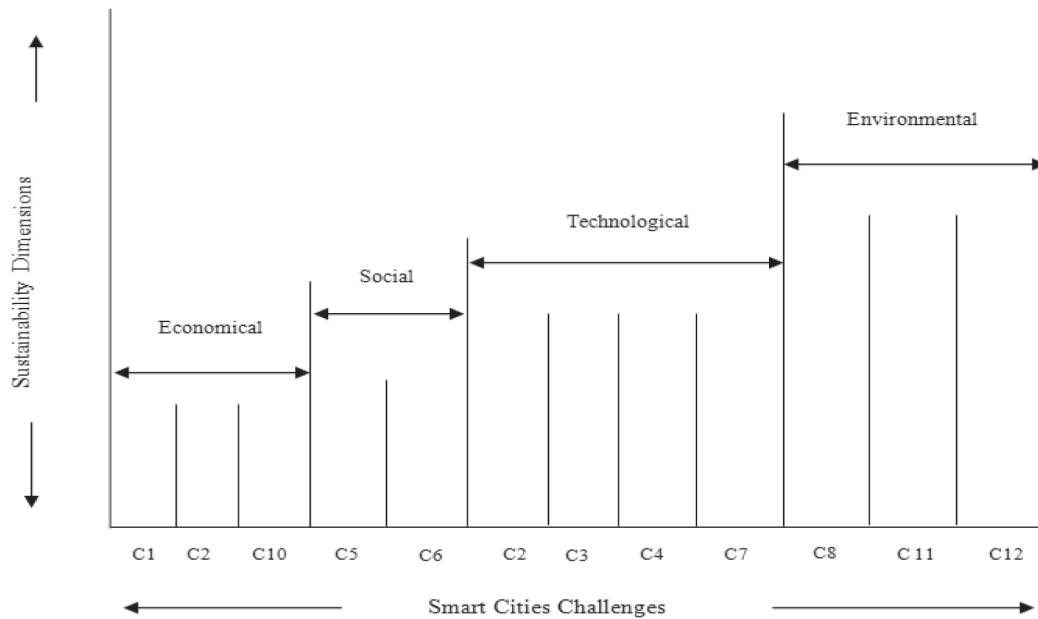
4.1.12 | Lack of sustainable focused strategies

Sustainability is the buzz word of the 21st century that must be addressed comprehensively in all fields (Chofreh et al., 2019), especially in smart city development (Lytras & Visvizi, 2018). Respondents underline that there is a lack of focus on sustainable inclusion of social, economic, technological, and environmental aspects into the strategies of smart city development. Pakistan is currently trying to initiate some missions in achieving the United Nation's sustainable goals development (Khan, 2016). The respondents further added to this aspect as smart city development is reported as one of the instances of sustainability initiatives in society, keeping given sustainability goals.

4.2 | Mapping challenges to sustainability dimensions

Challenges for smart city development varies amongst resources, skills, and governance. These challenges are even needed to find out whether they are addressing sustainability dimensions or not. Therefore, these key challenges for smart city development are mapped on four sustainability dimensions, including social, economic, technological, and environmental. Figure 4 illustrates the mapping of a challenge with sustainability dimensions.

Based on the above mapping, it is concluded that all the key challenges from various sustainability dimensions need to be overcome. However, it is revealed that the highest number of crucial challenges are related to technology. Therefore, much attention is required towards the availability of right and up-to-date technology for a smoother development of smart cities such as IoT (Al-Masri & Ijeh, 2019), computational intelligence based on enterprise data like healthcare, NADRA, and others. Technological changes are rapid in Pakistan, where e-government (Stergiou, Psannis, Plageras, Ishibashi, & Kim, 2018), e-healthcare (Memos, Psannis, Ishibashi, Kim, &



C1	Budgetary Constraint	C7	The need for a drive towards Content Development
C2	Lack of Resources	C8	Lack of Strategically approach in smart city transformation
C3	Lack of institutional capacity to deliver technology	C9	Lack of system integration
C4	Lack of Systems Integration	C10	Lack of an overarching institution to create a governance structure
C5	Social acceptability	C11	Lack of sustainable focused strategies
C6	Lack of Awareness level in the smart city among residents	C12	Lack of smart city operational framework

FIGURE 4 Mapping challenges to sustainability

Gupta, 2018), and e-agriculture are some of the initiatives. However, sustainability is the core of energy-efficient ICT system and must be addressed in all means.

4.3 | Challenges and solutions for sustainable smart city development

Based on the feedback from the interviewed respondents, the solutions for the challenges faced during smart city development are transformed into a framework. This proposed conceptual framework can act as a solution guide for the identified 12 challenges. Figure 5 shows the proposed conceptual framework for overcoming smart city challenges faced. The computational complexity of the conceptual framework focuses on classifying computational problem of challenges according to their intrinsic exertion. The computational issues are based on how much resources are allocated and how computational coordination is exercised to overcome challenges such as computation of healthcare data, based on NADRA, e-agriculture, and e-government in terms of policy development and funds allocation and others.

As shown in Figure 5, each of the identified challenges is provided with some overcoming solutions. Respondents from private enterprises and government organisations are also asked for their suggested solutions to overcome their reported challenges. The answers for each of the 12 challenges are subsequently detailed in the conceptual framework.

All the respondents considered "Budget Constraint" as a key challenge. According to respondents R1, R3, and R4, all the available funding sources should be considered to deal with challenges regarding the budget. According to them, once the sources are identified, a funder should be selected that have some previous experience, particularly for its buying process. Almost 95% of the respondents mentioned the way of multi-year payment plan as one of the solutions to overcome budget constraints.

"Lack of Resources" is another challenge having the highest quoted frequency. To overcome the challenge regarding resources, 90% of the respondents suggested first to hire people and then develop their skills for smart city development through training or workshops. In specific respondents, R2, R5, and R4 suggested generating a flexible policy and tax rebate for tools, equipment, and



FIGURE 5 A proposed conceptual framework of challenge and solutions [Colour figure can be viewed at wileyonlinelibrary.com]

technology. They further specified that technology is another significant resource that needs to be transferred timely for overcoming resource issues. It is mentioned that there is a need for a comprehensive policy for the timely transfer of technology.

Challenge "Social acceptability" is reported by 71% of the respondents. According to the majority of them, to deal with the challenge of social acceptability, people should be invited to an educational event, where they can learn about smart cities. Besides, they also mentioned the need to have volunteers for any work related to smart cities to treat this challenge. In specific respondents, R10, R15, R16, and R17 suggested adopting the technique of distributing the brochures. Furthermore, they

mentioned the need to bring together people having a common interest so that they can have a feeling of support from each other.

Lack of Awareness level on smart city amongst residents is reported by 83% of the respondents. According to the majority of them, the challenge of lack of awareness level amongst residents can be overcome by broadcasting the benefits on city radio or by having awareness programmes on print and electronic media. Respondent R1, R8, and R9 suggested sharing the benefits of smart cities at public places to increase awareness amongst residents.

"Lack of institutional capacity to deliver technology" is reported as a challenge by 65% of the respondents. According to the

respondents, the challenge of institutional incapability to deliver technology can be treated by sending people to industrial attachments. Respondents R5, R6, and R17 suggested conducting training for smart city professional skills and acquire recent technologies and hands-on practises for smart city development.

"Lack of Systems Integration" is one of the lowest frequency challenge mentioned by the respondents. It is reported by 59% of the respondents. For accurate system integration, the respondents suggested to first inline the design, development, and testing process of smart city development projects. They brought the attention towards generating a strategy for planning, design, and implementation of tests. Respondents R7 and R10 mentioned a need to execute effective technical reviews and engage designers from start to finish for accurate system integration.

"Need of drive towards Content Development" is the fourth highly cited challenge by the respondents. 76% of the respondents mentioned it as a challenge. The respondents mentioned the need for awareness about the benefits and advantages of having relevant, useful, and accurate content to overcome the challenges regarding the right content development. It is suggested to update the content regularly, and the developers should be aware of the advantages of the content timeliness. Another considered solution is information completeness and reliability. There is a need for dissemination of the benefit of complete information for accurate decisions towards content development.

Challenge "Disagreement on standardising the smart city model" is reported by 65% of the respondents. According to them, the Disagreement between the smart city stakeholders can only be removed through listening. It is found that all the respondents had a consensus on the need to have the ability to be a good listener for treating the disagreement challenge. Respondents R3, R9, and R17 suggested doing the factual listening about smart cities model standardisation. They mentioned a need for smart city stakeholders to have detailed information about smart cities model so that they can have empathic and generative listening for removing the disagreement regarding model standardisation.

Another challenge "Lack of Strategically approach in smart city transformation" is reported by 65% of the respondents. According to the majority of them, to overcome this challenge, there is a need to know the vision of smart city development. Furthermore, respondent "R5" notifies the importance of knowing the purpose of having smart cities, which, according to them, can act as a foundation to make it strategic. Respondent R7 suggests having an understating about where one lies in the smart city development process. Likewise, another respondent R14 reports about envisioning smart city objective by saying that *"...envision the smart cities objectives with financial goals, customer relation, operational method, and organisational member."*

Approximately 88% of the respondents notified the challenge "Lack of sustainable focused strategies." The majority of them had a consensus towards being a sustainable corporation as a solution for the challenge of less sustainable focused strategies. According to them, the smart city development organisations need to be a

sustainable corporation by creating profit for stakeholders with environment protection. Respondents R3, R5, and R7 suggested intersecting business and environment interests as a solution to treat this challenge. According to them, there is a need to intersect business and environmental interests. They suggested streamlining the work by believing the chance to be more successful tomorrow than today. It is recommended to find ways to come up with solutions solving environmental and social problems.

Challenge "lack of smart city operational framework" is found with the lowest frequency. Roughly 59% of respondents have mentioned it as a challenge for smart city development. Respondent R4 mentioned the need to have clear management or organisation structure for having an operational framework. Respondent R11 shared his views about smart city development policies. For overcoming this challenge, smart city development policies should be clearly defined and outlined. Besides, all core processes and procedures for smart city development should be outlined.

5 | FUTURE WORK

This study has some limitations, which should be subject to the further research. Firstly, the reviewed data quality relies on the interviewer's ability. The ability to conduct an interview and gathering accurate data varies from person to person. However, the researchers have tried to overcome this limitation by comprehensively following the interview protocol. Secondly, the sample size of the study is bounded to several qualified respondents within the area of smart city development in Pakistan, resulting in a lesser number of respondents. Thus, there is a possibility that the sample size can also affect the generalisation of the results.

Opportunities for further work appear from these limitations.

- i A next survey through questionnaire should be conducted with the public on smart city development awareness, where the qualifying measure will not be expert-level knowledge.
- ii Researchers plan could extend this research by providing the ranking of Pakistani cities in combination with challenges for urban development. Pakistan is taken as a case study in this research.
- iii The scope of the study can be extended to other countries, leading to consistency in findings and more generalised results.

6 | CONCLUSIONS

The objective of this study is to investigate the key challenges faced by developers from private and government in Pakistan for the development of sustainable smart cities with their solution strategies. The study has interviewed 17 experts from private companies and Pakistani government agencies. This process is intended to understand the challenges faced by governments and private companies for the development of sustainable smart cities. In total, 12 key challenges

are highlighted by the respondents. The solutions strategies to overcome these challenges are also identified. This research contributes by providing insights and significance of infusing sustainability in the development of smart cities. The developed conceptual framework of critical challenges faced by the practitioners and the respective solutions can act as a practise guideline for practitioners to prepare themselves for the sustainable smart city development.

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APPENDIX

DEMOGRAPHIC DATA OF RESPONDENTS

The “Respondents” column is representing the assigned ids of the interviewee from private enterprises and government organisations of Pakistan involved in the smart cities' development. The “Management Level” column shows the respondents' detail based on their position in the organisation hierarchy (executive, managerial, and operational). The column “Organisations” refer to the respondents' organisations. “Designation column” refers to the respondent's specific designation in the organisation. The column “year of experience” shows the total experience of each respondent.

Respondents	Management level	Organisation	Designation	Year of experience
R1	Executive level	NITB (National Information Technology Board)	Secretary IT & telecom	26
R2		Private enterprise	Executive director	21
R3		Safe City project	Director	19
R4		NADRA (National Database and Registration Authority)	DG projects	18
R5		Federal Govt.	Project director	22
R6		Province Govt.	Member Planning & Development	24
R7	Managerial level	Private enterprise	Manager	10
R8		Private enterprise	IS specialist	13
R9		Safe city	Assistant director	12
R10		NITB	Technical assistance	16
R11		NADRA	Assistant director	13
R12		Federal Govt.	Assistant regional planning directorate	17
R13	Operational level	Federal Govt.	Assistant urban planning	7
R14		Private enterprise	Managers operations	7
R15		NITB	System analyst	9
R16		Safe City project	IT in-charge	6
R17		Province Govt.	Planning officer Planning & Development	8