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People-Centric Governance for Smart Cities Development –Theoretical Analysis and Analytical Hierarchical Process (AHP) And Outcomes.

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Abstract
The Gulf Cooperation Council (GCC) nations—Saudi Arabia, the UAE, Kuwait, Bahrain, Qatar, and Oman—are key players in the global energy landscape, holding 45% of proven oil reserves, 25% of oil exports, and 18% of proven natural gas reserves. These countries are heavily investing in advanced urban planning and megaprojects that emphasize renewable energy, aiming to promote a modern, sustainable vision. However, ambitious initiatives, like Masdar City, have faced challenges in achieving their sustainability goals. In Oman, smart city development is still emerging, hindered by limited industry-level studies, a lack of frameworks, and an insufficient focus on citizen-centric governance, affecting quality of life. Current research tends to prioritize technology and innovation over local cultural values, leaving gaps in a people-centered approach. Furthermore, there is no empirical research examining the impact of citizen involvement on public-private partnerships in smart city projects. This gap underscores the need for a conceptual model to emphasize the role of residents in smart city planning. The proposed research aims to assess the effectiveness of participatory governance in enhancing residents' quality of life, encouraging innovation, and promoting sustainable, inclusive outcomes.

Keywords: Smart**,** Cities, Government, Policies, People, Quality of Life**.**

Introduction

Smart cities are gradually seen as essential solutions to the challenges of fast urbanization, advancing mutually the government and inhabitants (Mamlook et al., 2019; Ministry of Housing and Urban Affairs Government of India, 2021; Prakash, 2019). Metropolises often are deficient in fundamental indices like quality of life and sustainability, which can be accomplished through premeditated infrastructure developments accentuating sustainability, facilitated by IoTs and Big Data. A "smart" city aims to provide an efficient, livable, and sustainable environment (Joshi et al., 2016). Academic exploration on smart cities principally emphases on using information technology to enhance economic efficiency through metropolitan administration, integrating society and infrastructure to improve societal amenities (Al-Kindi & Al-Khanjari, 2020).

Smart cities combine cutting-edge technologies and important amenities to enhance and sustain community processes, stimulating wealth generation, energetic, and healthy living. This integration includes six core components: People, Economy, Mobility, Living, Governance, and Environment. The success of a smart city is closely linked to the Quality of Life (QOL) of its citizens, defined by the World Health Organization as "an individual's perception of their position in life, in relation to their goals, expectations, standards, and concerns, within their cultural and value systems" (Chen & Chan, 2022; H. Kumar et al., 2018).

Government's acceptance of smart city technologies is continually increasing. However, this is matched by citizens' discontent regarding the appropriate use of technology, information protocol regulations, education, empowerment, and opportunities for participation. To ensure democratic engagement and reliance, the government must integrate citizen behavior with the policy effectiveness (Twist, Ruijer, & Meijer, 2023). Modern urbanization is focused on the interaction between technology, automation, and sustainability. While human intelligence combines with technological advancements to generate synergies, the collaboration between automation and innovation creates smart urban plan that provide simplicity, convenience, productivity, and functionality. (Huda, Ahmed, Adnan, Ali, & Naeem, 2024).

Persistent progressions in Information Technology, the concept of a smart city has advanced over time, beginning with the notion of an "intelligent," "digital," and "smart" city, to the current emphasis on "smart sustainability." The Six Smart

Components, as outlined in the table below (Apanaviciene et al., 2020; Chen & Chan, 2022; Janurova et al., 2020; Sameer et al., 2022), represent the core elements of this evolving definition.

Components of Smart City	*Associated to Urban Life*
Smart Economy	Industry, Innovation and Competitiveness
Smart People	Education, Creativity and Social Capital
Smart Governance	E-democracy, Participation and Empowerment
Smart Mobility	Logistics, Infrastructures and Transportation
Smart Environment	Efficiency, Sustainability and Natural Resources
Smart Living	Security, Quality and Culture of Life

Table 1: Components of Smart City

ICT is vital in facilitating collaboration between inhabitants, industries, and various government shareholders, resulting in the enlargement of smart governance e-programs. Hence these programs encourage local collaboration to address community issues, allowing the government to interact with citizens nurturing a participatory atmosphere (Sekar & Sasipriya, 2021). Local competencies are leveraged through innovation to draw digital influencers to promote urban progress and competitive atmosphere. Success of smart city are specifically custom-made through policies addressing the distinctive complications and requirements recognized through systematic scrutiny of individual city (Marchesani, Masciarelli, & Bikfalvi, 2023).

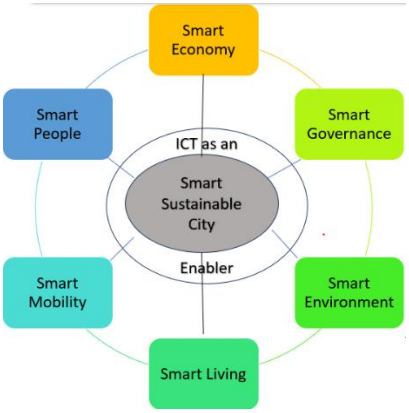

Figure 1: Smart Sustainable City Six Dimensions and ICTs (Ibrahim et al., 2018)

This paper intends to articulate the need for a People-Centric approach for Smart Cities in the modern era. Hence a deep dive into how the smart city concept have evolved till date, motivation behind this study and contributions to the future smart city development will be comprehensively realized in this article. Major inferences based on thematic literature review **(Mathew & Bangwal, 2024)** are further scrutinized to perform theoretical analysis based on Participatory Governance Theory, Social Capital Theory, Sustainable Development Theory, innovation theory and Complexity theory. Based on the constructive theoretical review, underpinning theory for the research is determined to generate a conceptual model for people-centric governance model to articulate the research methodology for the research.

Background of the Study

The Gulf Cooperation Council (GCC) nations—comprising of the Kingdom of Saudi Arabia, the UAE, Kuwait, Bahrain, Qatar, and Oman—are aggressively influencing their future by adopting innovative design that highlights modernism and affluence through advanced urban planning and innovative developments utilizing the latest technologies (al Jabri et al., 2022; Ali & al Hinai, 2018; Al-Kindi & Al-Khanjari, 2020; Al-Saidi & Zaidan, 2020; Asmyatullin et al., 2020; Hamed et al., 2020; Sameer et al., 2022). These countries possess substantial energy reserves, accounting for about 45% of the world's proven oil reserves, 25% of global oil exports, and 18% of proven natural gas reserves (Hereher & El Kenawy, 2020). This energy surplus has driven rapid economic growth and increased energy consumption, trends that are expected to continue with ongoing population growth and industrialization in the region (Al-Saidi & Zaidan, 2020; Mondal et al., 2016).

The economic crises of 2008 and 2014 significantly impacted oil-exporting countries like Oman due to the strong connection between low oil prices, persistent government expenditure, and the high proportion of oil revenue in total government income (Sameer et al., 2022). The decline in oil prices from 2014 to 2016 adversely affected Omani exports

and GDP, leading to a credit rating downgrade due to its reliance on oil. In response, Oman removed fuel subsidies, restructured corporate taxes, and introduced a 5% VAT. Oman faces two main challenges: oil price volatility and depletion. To address these, Oman and other GCC countries have initiated planned cities focused on sustainable development and economic diversification, which are key components of their National Visions (Al-Saidi, 2020).

Ever growing energy demand in line with the growing populace, calls for untapped renewable energy sources like solar and wind to drive development. Wind energy is more proficient than solar. The transition to renewables not only diversify the economy, but also will reduce dependence on hydrocarbons (Al Lawati, 2022; Al-Saidi, 2020; Azam et al., 2018). Oman's geographic location is ideal for wind and solar power, positioning it to become a renewable energy leader. This shift will also aid in technology transmission and climate change adaptation, benefiting water management, agriculture, tourism, health, biodiversity, and energy production. A clear roadmap with targets is essential for this transition (Al Hatmi et al., 2014). Studies show integrating solar, tidal, and wind energy via smart grids is promising for Oman (Al-Badi et al., 2020; Khalil, 2021), though momentous challenges persist (Al-Saidi, 2020).

In the GCC region, most distributed solar capacity is concentrated in planned cities like Masdar City in the UAE and Education City and Musheireb in Qatar. The region's energy-related megaprojects also include nuclear power plants, such as the Barakah nuclear plant in the UAE, with a capacity of around 5,000 MW, and planned nuclear projects in Saudi Arabia. Given that these megaprojects are crucial for the energy transition in the GCC, it is crucial to consider having significant extrinsic values for these central and large scale projects (Al-Saidi, 2020; Al-Saidi & Zaidan, 2020).

Megaprojects benefit GCC countries promote a nationalist image integrating global city imageries, best practices, and modernism while attempting to preserve local culture and uniqueness. However, sustainability challenges arise due to high carbon emissions, waste and water demand. The grand designs and sustainability claims of these projects have faced criticism, such as the non-realization of Masdar City's carbon-neutral goal. Several city projects are in various implementation phases as outlined in the Table 2 (Al-Saidi, 2020; Al-Saidi & Zaidan, 2020; Asmyatullin et al., 2020).

Sl. No.#	***Partial or in final phase of implementation (Total Investment: $141.25 Billion)***	***In initial phase of implementation (Total Investment: $693.35 Billion)***
1	Lusail City, Qatar ($45 Billion)	South Al-Mutaa City, Qatar ($ 20 Billion)
2	Al-Ralidah Digital City, S.A ($70 Billion)	Prince Abdulaziz bin Mousaed Economic City, S. A ($ 8 Billion)
3	FinTec Bay, Bahrain ($100 Million)	Medina Knowledge Economic City, S. A ($ 7 Billion)
4	Innovation Park, Oman ($ 120 Million)	King Abdullah Economic City, S. A ($ 100 Billion)
5	Sharjah Entrepreneur Center, UAE ($130 Million)	Jeddah Economic City, S. A ($ 20 Billion)
6	Musherireb City, Qatar ($ 5.5 Billion)	Jazzan Economic City, S. A. ($ 23 Billion)
7	MASDAR City, UAE ($ 20 Billion)	Qiddiya Water Theme Park City, S. A. ($ 750 Million)
8	Education City, Qatar ($ 400 Million)	King Salaman Energy Park, S. A. ($ 1.6 Billion)
9		Neom, S. A. ($ 500 Billion)
10		Madinat Al Irfan, Oman. ($13 Billion)

Table 2: Smart Cities in GCC

Due to the insufficiency of dependable data relating to the GCC countries, it is hard to precisely assess the cataloguing of the existing and new mega-projects' urban development. Furthermore, these projects have a significant impact on the environment due to their substantial fossil fuel consumption, contrary to the sustainability goals, overlooking the cultural traditions and heritage of the local communities (Al Hatmi et al., 2014b; Papa et al., 2017; Sameer et al., 2022). The GCC local population mainly resides in luxurious residential homes deterring the realization of a low-carbon future (Al-Saidi & Zaidan, 2020; Mamlook et al., 2019).

GCC citizens' confidence in technology, concerning corporate welfare, surveillance, and privacy are unexplored. The restricted demographic participants stresses the need for future research to enhance generalizability and representativeness. Additionally, there is a pressing need for sensible communication and stakeholder engagement policies in ensuring sustainable smart city (Mutambik, 2023).

The advancement of information and communication technologies (ICT) has overwhelmingly impacted all aspects of human activity, leading to the emergence of terms like e-commerce, e-mail, e-learning, e-university, and e-government. This technological evolution has given rise to the e-society, as cities are hubs for various activities increasingly reliant on technology, their structures are evolving to meet these new demands (Chen & Chan, 2022; Fletcher, 2020). Consequently,

many cities are now recognized as digital, electronic, virtual, informational, and smart. The dependence of society and the contemporary economy on ICT drives the development of cities that use electronic data, applications, and services to solve complex problems and collaborate online (Alam & Siddiqui, 2021; Joshi et al., 2016).

Oman's Vision 2040 aims to establish a comprehensive smart city, integrating collective intelligence, technology exchange, creativity, and community development. This 20-year national guide serves as a reference for multi-sector planning and development goals (Oman Vision 2040 - Vision Document, 2020). Vision 2040 also aims to enhance Oman's economic competitiveness and social well-being by fostering a knowledge-based society, advanced healthcare, an active lifestyle, and lifelong learning. Education and Sustainable Cities are two of the 12 national priorities identified (Sameer et al., 2022). Education technology reforms are vital for collaboration between IT and communication, crucial for global education advancements (Al Lawati, 2022a; Al-Kindi & Al-Khanjari, 2020; Bibri, 2021). While the planned city architecture in the region is impressive, the final economic and urban development model is still evolving. The role of planned cities in promoting a low-carbon future needs re-evaluation (Al-Saidi & Zaidan, 2020; Mamlook et al., 2019).

Motivation and Contribution of the Study

The global focus on Information and Communication Technologies (ICTs) for Smart Cities has often overlooked the actual occupants of these cities, leading to many failed initiatives. Addressing barriers and inefficiencies in governance and citizen collaboration is crucial for successful implementation and growth. Past experiences show that without effective governance and citizen engagement, Smart City projects struggle to deliver benefits. Hence it is prudent to develop a conceptual framework for smart city development with a people-centric approach for Public Private Partnership to identify and rank the key barriers to successful implementation.

Oman lacks comprehensive studies and frameworks for Smart City development, particularly those that integrate Smart city with citizen participation. Furthermore, there is an absence of empirical research to test and validate the influence of people on Public-Private Partnership enterprises in the development of Smart Cities. Existing researches often stresses technology over local cultural sentiments and lack of people-centric approach. There is a need for a conceptual model that highlights the influence of people fostering a more inclusive and effective Smart City development in Oman.

Scope of the research

To create and assess a people-centric governance model that will identify the obstacles to enhancing the quality of life for citizens in a smart city and determine the most effective solutions for overcoming these barriers in order to establish a sustainable smart city ecosystem.

Major Themes

Theme-based search was performed on Scopus, Google Scholar, Emerald, Elsevier, Springer, UNESCO, Science Direct, Sage, Wiley, etc. to identify various sources of literature conducted in the past related to the key words: Smart, Cities, Government, Policies, People, Quality of Life. Sources which were reviewed are research articles and papers, newspaper articles and industry reports. 94 Literatures were collected from the above search is compiled and segregated according to the following themes.

Sl. No.	Description
1	Transforming GCC/Oman economy dependency on Oil & Gas into sustainable Smart Cities economy.
2	Smart Cities – ICT/Big Data Management governance model with passive citizen participation.
3	Smart Cities - Poor Quality of Life based on poor people centric governance.
4	Smart Cities - infrastructure for sustainable ecosystem.
5	Smart Cities with Public-Private Partnership.

Table 3: Major Themes of the Literature Review

The systematic review, thematic analysis, and findings related to the people-centric governance model for smart city development underscore cultural disparities within local communities, which create gaps in the intended people-centered approach. Additionally, no empirical research currently validates the influence of residents on Public-Private Partnership (PPP) enterprises within smart city initiatives. This gap points to the need for a conceptual framework or model to elucidate how community input impacts smart city outcomes. This lack of integration is stalling innovation and limiting quality of

life improvements (Mathew & Bangwal, 2024).

Theoretical Premise of the research

Smart cities boost economic growth around the world by changing to the smart environment, smart economy, smart technologies, smart human capital, smart infrastructure, and smart governance to improve economic growth and better use of limited resources. Through green economy approach and the managerial relations of innovative smart projects are implemented within the public–private partnership (PPP) by effective management decisions in the implementation of the "smart city" concept and to carry out continuous public–private monitoring of the effectiveness of innovations in implementing smart PPP projects. Further indices for effectiveness of managerial decision-making are developed considering the quality of the information received during the implementation of innovative PPP projects, which allows calculating the degree of utilization of the potential capabilities of a company participating in a PPP(Sergi et al., 2019).

Smart cities projects are constrained due to demand to innovate technologically, public spending limitations, budget constraints, ageing facilities, and alignment of multiple stakeholders with varied interests. Smart cities can handle intricacy, improve productivity, cut expenditures, and deliver better quality of life by tapping into range of opportunities like ICT, good practices in urban planning, PPP and policy amendments thereby putting people first. Hence cities have initiated Public Private Partnerships to progress with Smart City projects. PPP forges a medium to long term joint effort between public and private and non-profitable establishment to overcoming funding constraints, innovation utilizing latest technology to optimize project cost, maximize utilization of existing facilities to unlock more value and collaboration of the major companies by sharing key objectives to advance smart city projects. PPP strategy thereby transfers risks to the private sectors associated with technical, construction and operations delivers infrastructure without upfront public funding utilizing sector expertise delivering improved quality (Selim et al., 2018). Government futuristic emphases on developments which are sustainable and inclusive, thereby can be replicated in other ambitious cities. Instruments with potential funding and financing were found based on the financial inflows and outflows of the PPP by adding the term of People converting the technique to Public–Private-People Partnership (PPPP) (Liu et al., 2021). Results could provide key stakeholders of smart cities with a progressing development. Moreover, Government initiatives are to utilize PPP framework to motivate Foreign Direct Investment (FDI) for Smart Cities projects (Milenkovic et al., 2017; Selim & ElGohary, 2020).

Diverse strategies of PPP providing financial and development programs applicable for smart city development like ICT systems, Build-Operate-Transfer (BOT) or Design-Build-Finance-Operate (DBFO), pilot innovative concepts for public facilities. Strategy choice depends on the nature of smart infrastructure and related services provided. As the smart city agenda continues to grow, more innovative business models will emerge to accommodate the evolving requirements of smart initiatives in the process of urbanization(Bibri & Krogstie, 2020; Liu et al., 2021).

The GCC countries overdependency on oil and gas economies based on Government public investment needs to be averted to promote economic diversification from non-hydrocarbon division by encouraging private participation in developing public infrastructure like smart cities. Accordingly, these countries formulated their nationwide visions based on economic diversification through transition into knowledge-based economy and sustainable development for the post petroleum era through public and private investments. Since both the public and private wealth are generated from hydrocarbon economics, to deliver economic diversification these countries need to increase their dependency on non-oil economic sectors such as technology products, manufacturing of spare parts, electronics, and home appliances rather than on hydrocarbons to deliver a sustainable living condition and economics. Thus, the government needs to articulate a sound eco-system with focus on people centric approach to establish robust institutions, vibrant decision-making organization providing quality of life prevailing over risks and financing failures in Public and Private partnership in GCC countries including Oman (Ari et al., 2019; Dupont et al., 2015).

Proposed sustainable public-private-people partnership framework (Liu et al., 2021) achieving sustainability is the primary goal of the smart city development and establishing and maintaining collaborative partnerships among the ecosystem consisting of local authorities, private entities, institutions and citizens, where citizen is at the center of promoting smart city PPPs. These needs to be developed based on targeted end in mind at start, evaluate the available inventory assets, pre-determine corporate model, develop funding plan, define third-party unit, identify the decision-making value drivers and potential partners (Skowron et al., 2018).

The proposed framework is focused on five emerging themes as recommended strategies for effective PPP application in

smart city development(Liu et al., 2021).

1. High level of technological innovation is likely to have an increased risk profile(Mamlook et al., 2019).
2. Both city governments and private sector partners need to develop and maintain relational partnerships (Dupont et al., 2015; Lam & Yang, 2020; Milenkovic et al., 2017).
3. Potential problems of information security in smart city PPPs, it is essential that effective regulations are in place and exact specification on data ownership is provided to prevent the private sector utilizing citizens' data for their commercial purposes (Moustaka et al., 2019).
4. Smart city development involves multiple stakeholders, including municipal authorities, citizens, and private and not-for-profit organizations (ecosystem) with varied interests and requirements. There can be conflicting issues between public and private parties resulting in compromised outcome which may not result in a sustainable solution (Lam & Yang, 2020).
5. To attain the environmental and social sustainability objectives, smart citizen engagement and participatory governance are highly advocated. It is essential to establish an innovation ecosystem in which public, private, business, and citizens cooperate and perform creative activities collectively towards a successful smart city project (Bibri, 2020; F. Yang et al., 2021).

Based on the Smart Cities Mission initiatives, at least one Smart Solution needs to be developed and applied city-wide for replication in other cities. These solutions can be retrofit, redevelopment or greenfield smart city area-based development (Kandpal, 2018).

The PPP Smart City development model is devised to deliver social benefits and sustainable steady economic progress through Build Own and Operate (BOO) model. This enterprise-PPP model connects brand marketing with the demand of smart cities in the locality, country, or region. However, these e-PPP developments of smart cities are work in progress and will have a long way to go to successfully implement PPP model needing to solve many problems worth discovering (J. Q. Yang & You, 2019). Special PPP models for Smart Infrastructure development identifies the relevant needs, drivers, barriers and challenges in different countries, the various interacting force fields can be harnessed to develop the envisaged PPP models that can complement non-PPP procurement models (Jayasena et al., 2020).

The complexity of the project, the comprehensive quality of project personnel, and the differences in ideological and cultural concepts have become the main factors. Project social benefit, project quality compliance rate, project profit rate or rate of return become the most important result factors. Government behavior is the primary influence and restriction of the interest conflict in the construction of smart city PPP projects. In addition, interest conflicts are closely related to other project stakeholders, especially the private sector, social capital, and public behavior. Therefore, the government's decision-making behavior and incentive and restraint mechanism must first examine the interests of stakeholders and their behavior strategies, especially the behavior evolution trend under the government's incentive and restraint mechanism, which implement a flexible incentive and restraint mechanism (Zhang, 2022).

Alignment with local partners improves trust and commitment to Smart City initiatives, facilitates better project management and shared responsibility and loosen bureaucratic control which are key to the success of Smart City development. To achieve the objectivity of been "smart", the partners need to demonstrate their competences in compatibility, complementarity, and commitment in Smart Urban strategy expansion. The experimental analysis needs to be tested for the specific alliances and institutions to determine the relational bonds between partners to devise competitive advantage so as to avoid exit strategy. Strong Intellectual Property (IP) control needs to be established in order to avoid knowledge spillovers with competitors and at the same time increase revenue through knowledge transfer. Robust political backing and a well-defined development roadmap are key to attracting more partners having demonstrated strong technical and project management skills with emphasis on people centric approach to Smart City development (Ielite et al., 2016; Sandulli et al., 2017).

Smart City deploys digital technologies, communication tools, and data analytics to craft an efficient service environment to improve quality of life and sustainability. Governance applications deliver transparency, accountability, and citizen engagement. By leveraging IoT devices and sensors, smart city optimizes infrastructure utilization, offers real-time traffic management, enhances safety, and reduces congestion. This fosters interaction and collaboration between citizens and the government, stirring trust and overall quality of life (Gracias, Parnell, Specking, Pohl, & Buchanan, 2023).

The following theories are evaluated to underpin the thesis objective of developing an integrated framework for the

expansion of corporate, institutional, communal, and basic infrastructure through citizen participation and collaboration with various stakeholders in the context of smart cities.

1. Participatory Governance Theory

Participatory Governance Theory is a variant or subset of governance theory that puts emphasis on democratic engagement, through deliberative practices. It is applicable to the development of smart cities as it emphasizes the importance of involving citizens in decision-making processes to ensure that their needs and aspirations are represented in policy and governance. In the context of smart cities, participatory governance can help to build trust, enhance accountability, and create more responsive and effective policies (Ruhlandt, 2018).

The development of smart cities involves the use of advanced technologies and data-driven solutions to address social, economic, and environmental challenges. However, the implementation of these solutions can have significant implications for residents, including changes in their daily lives, access to public services, and exposure to new risks and vulnerabilities (Pereira et al., 2018; Qian et al., 2019). As such, it is important to involve citizens in the development and implementation of smart city initiatives to ensure that their perspectives, needs, and concerns are considered (Dameri & Benevolo, 2016).

Participatory governance can take various forms in the context of smart cities, including citizen engagement platforms, public consultations, and co-creation processes. These approaches can help to foster collaboration and cooperation among stakeholders, build trust and social cohesion, and facilitate the exchange of knowledge and resources (Castelnovo et al., 2016). Moreover, involving citizens in decision-making processes can help to ensure that smart city initiatives are more responsive to their needs, preferences, and values, leading to more effective and sustainable outcomes.

In summary, Participatory Governance Theory related to the development of smart cities as it promotes citizen participation, collaboration among stakeholders, and responsive and effective policies. By involving citizens in decision-making processes, smart city initiatives can be designed and implemented in a more inclusive and sustainable manner, leading to better quality of life for residents.

2. Social Capital Theory

Social Capital Theory is associated with the development of smart cities as it emphasizes the importance of social networks and relationships between individuals and groups in achieving positive social and economic outcomes. In the context of smart cities, social capital can help to foster collaboration and cooperation among stakeholders, build trust and social cohesion, and facilitate the exchange of knowledge and resources (Crucke & Slabbinck, 2021).

The development of smart cities involves the use of advanced technologies and data-driven solutions to address social, economic, and environmental challenges. However, the success of these solutions depends on the engagement and participation of diverse stakeholders, including citizens, businesses, non-governmental organizations, and public authorities (Le Van et al., 2018). As such, it is important to foster social capital in smart cities to promote collaboration and cooperation among these stakeholders (H. Zheng et al., 2014).

Social capital can take various forms in the context of smart cities, including networks of trust, shared values, and collaborative practices. These approaches can help to build relationships and trust among stakeholders, enhance accountability and transparency, and promote the exchange of information and resources (Wu et al., 2020). Moreover, by fostering social capital in smart cities, stakeholders can work together to address common challenges and achieve shared goals, leading to more effective and sustainable outcomes(Warren et al., 2015).

In summary, Social Capital Theory is related to the development of smart cities as it promotes collaboration and cooperation among stakeholders, builds trust and social cohesion, and facilitates the exchange of knowledge and resources. By fostering social capital in smart cities, stakeholders can work together to address common challenges and achieve shared goals, leading to more inclusive, sustainable, and resilient cities.

3. Sustainable Development Theory

Sustainable Development Theory is rational to the development of smart cities as it promotes a holistic approach to development that seeks to balance economic growth, social development, and environmental protection to achieve long-term sustainability (Suárez-Eiroa et al., 2019). In the context of smart cities, sustainable development can help to address social, economic, and environmental challenges by promoting the use of advanced technologies and data-driven solutions

in a way that is socially inclusive, economically viable, and environmentally responsible (Ismagilova et al., 2019).
Smart cities use technology and data to optimize the use of resources, reduce waste and emissions, and enhance the quality of life for residents. However, the development of smart cities can also have unintended negative consequences, such as social exclusion, privacy violations, and environmental degradation (Klarin, 2018). As such, it is important to adopt a sustainable development approach that considers the social, economic, and environmental impacts of smart city initiatives and promotes equitable and sustainable outcomes.
Sustainable Development Theory can take various forms in the context of smart cities, including the use of renewable energy sources, green infrastructure, and sustainable transportation. These approaches can help to reduce greenhouse gas emissions, improve air quality, and enhance the resilience of cities to climate change (Trindade et al., 2017). Moreover, sustainable development can promote social inclusion by ensuring that the benefits of smart city initiatives are shared equitably among all residents, regardless of their income, gender, or ethnicity (Konstańczak, 2014).
In summary, Sustainable Development Theory is relevant to the development of smart cities as it promotes a holistic approach to development that balances economic growth, social development, and environmental protection. By adopting a sustainable development approach, smart cities can address social, economic, and environmental challenges in a way that is socially inclusive, economically viable, and environmentally responsible, leading to more sustainable, resilient, and livable cities.

4. Innovation Theory

Innovation Theory is associated to the development of smart cities as it emphasizes the importance of using new ideas, approaches, and technologies to create value and solve problems. In the context of smart cities, innovation can help to address social, economic, and environmental challenges by promoting the use of advanced technologies and data-driven solutions in a way that is innovative, efficient, and effective (Maye, 2019).
Smart cities use technology and data to optimize the use of resources, reduce waste and emissions, and enhance the quality of life for residents. However, the development of smart cities requires continuous innovation to address new challenges and opportunities that arise over time (Sepasgozar et al., 2019). As such, it is important to adopt an innovation-oriented approach that encourages experimentation, learning, and adaptation in the development and implementation of smart city initiatives (Han & Hawken, 2018).
Innovation Theory can take various forms in the context of smart cities, including the use of open innovation platforms, co-creation processes, and user-driven innovation. These approaches can help to foster creativity and collaboration among stakeholders, build a culture of innovation, and promote the development of new solutions and business models (Meijer & Bolívar, 2016). Moreover, innovation can help to create new economic opportunities, such as the development of new industries, the creation of new jobs, and the attraction of new investments (Capra, 2016).
In summary, Innovation Theory is connected to the development of smart cities as it promotes a culture of experimentation, learning, and adaptation in the use of technology and data-driven solutions to address social, economic, and environmental challenges. By adopting an innovation-oriented approach, smart cities can continuously improve and evolve over time, leading to more effective, efficient, and sustainable outcomes.

5. Complexity Theory

Complexity Theory is also relevant to the development of smart cities as it emphasizes the importance of understanding the complex, dynamic, and interconnected nature of urban systems (Batty, 2013). In the context of smart cities, complexity theory can help to address social, economic, and environmental challenges by promoting the use of systems thinking, network analysis, and adaptive management in the design and implementation of smart city initiatives(Tzioutziou & Xenidis, 2021).
Smart cities are complex systems that involve the integration of various technological, social, economic, and environmental factors. These systems are characterized by non-linear relationships, feedback loops, and emergent properties that can make them difficult to predict and control (Komninos et al., 2019). As such, it is important to adopt a complexity-oriented approach that recognizes the interdependencies and interactions among different components of the smart city ecosystem (Grimaldi & Fernandez, 2017).
Complexity Theory can take various forms in the context of smart cities, including the use of network analysis to understand the relationships among different stakeholders, the use of scenario planning to anticipate and prepare for future uncertainties, and the use of adaptive management to learn from and adjust smart city initiatives over time(Tachizawa et

al., 2015). Moreover, complexity theory can help to foster resilience by promoting the development of flexible and adaptable systems that can respond to unexpected events and disruptions (O'Sullivan et al., 2013).

In summary, Complexity Theory is highly relevant to the development of smart cities as it promotes a system thinking approach to understanding the complex, dynamic, and interconnected nature of urban systems. By adopting a complexity-oriented approach, smart cities can better understand and manage the interdependencies and interactions among different components of the smart city ecosystem, leading to more effective, efficient, and resilient outcomes.

Underpinning Theory for the Research

Based on detailed review of these theories to develop a comprehensive framework for the expansion of smart city infrastructure that integrates citizen participation, collaboration among stakeholders, sustainable development, innovation, and an understanding of the complex and dynamic nature of urban systems, the Participatory Governance model would be suitable for developing and testing a conceptual model to improve the quality of life in a smart city ecosystem.

Participatory governance, a branch of governance theory, underscores democratic involvement by fostering citizen engagement. This approach aims to enhance participation through practices like stakeholder and community involvement. Participatory governance involves empowering citizens in public decision-making, addressing democracy deficits, and enhancing accountability. Additionally, it encompasses the involvement of college faculty, staff, and students in significant institutional decisions.

A conceptual model can be developed through participatory governance theory inclusive of sustainability and social capital formation in a smart city ecosystem, with the ultimate goal of improving the quality of life for residents based on four perceptions that stands out. Notably, four perspectives emerge. The first centers around addressing the "institutional void" overlooked by representative government theory. The second focuses on citizens' meaningful involvement in intricate decision-making inherent to contemporary policy-driven politics. The third emphasizes enhancing service provision and social fairness. Lastly, we acknowledge the influence of participatory governance on professional practices. Empirical research test this model by analyzing the impact of smart city on exploring citizen participation and stakeholder collaboration contribute to sustainable and inclusive development.

People-centric Governance Conceptual Model

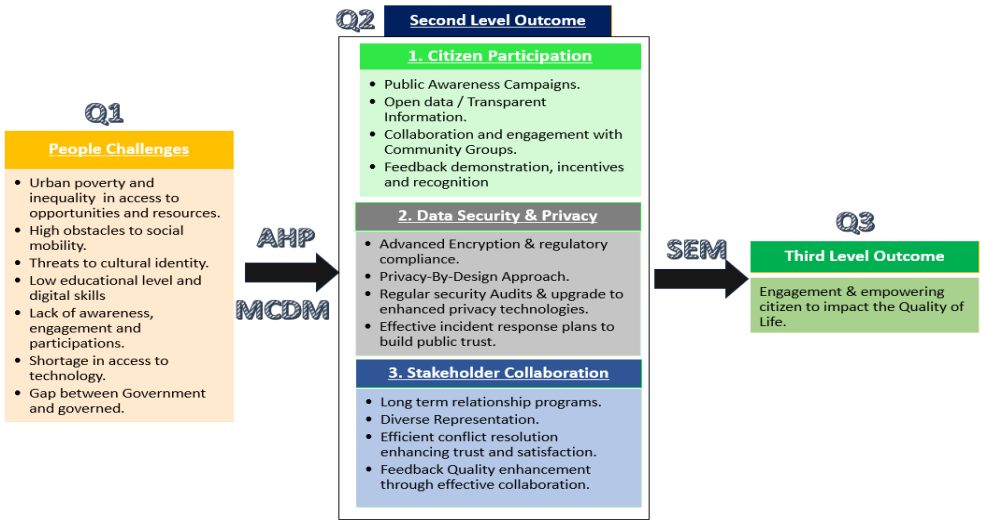

Figure 2: Conceptual Model

Analytical Hierarchical Process (AHP)

Identifying the factors influencing the decision making process for various complex and challenging economic scenarios enhances the quality of making decisions in relation to various attributes based on community, financial and scientific advances. The Analytical method of decision making focusses on optimum resources through strategic program to deliver maximum results thereby generating better business performance and earnings (Canco, Kruja, & Iancu, 2021; Dane, Rockmann, & Pratt, 2021)

The main intend of this analysis is to determine specific barriers to the success of people-centric smart cities and rank the findings based on focused research question interview with key individuals related to smart city development. The findings are correlated with outcomes from the literature review. With aim to demonstrate that the AHP facilitates the selection of the best alternative in decision-making based on individual judgments (Valaskova, Adamko, Frajtova-Michalikova, & Macek, 2021). This study is significant as it analytically examines decision-making using the Analytic Hierarchy Process (AHP) embodies quality decision making process related to multi-disciplinary theory based on potent scientific base to evaluate and select from alternatives dealing with qualitative and quantitative features (Singh, 2016; Emrouznejad & Marra, 2017). AHP ensure usability, rational structure, breakdown troublesome topics into smaller steps and doesn't depend on precise and authenticated data (Karthikeyan, Venkatesan, & Chandrasekar, 2016)

Meanwhile, AHP also comes with high computational necessities based on weightages leading to more time and effort. Furthermore, with increase in order of a matrix, the inconsistency issues increases exponentially including hierarchy levels (Munier & Honotoria, 2021). Decision-making with AHP is broad and complex, applicable in both physical and social domains. AHP operates as a hierarchical model, moving from a main focus to criteria, then to subdivisions of those criteria, and finally to alternatives (Akcan & Gyldeg, 2019; Gomes, et al., 2017).

MCDM technique (AHP) addresses both quantitative and qualitative features of independent path having relative importance scale and hierarchical structure (Béland, Cantillon, Hick, & Moreira, 2021). A problem may have multiple tactics, even for a single solution, as decision-making necessitates choice. It spans simple to complex issues, requiring multidimensional analysis for effective solutions. Criteria importance is determined interactively with other technical and political stakeholders. Ranking, choosing, or sorting a finite set of alternatives on multiple criteria is essential across many real-world applications (Dong & Cooper, 2016).
MCDA supports decision-making by comparing a range of technical solutions for platform and combat systems. For highly multidisciplinary, MCDA relies on models to assist individual or joint decisions, incorporating value judgments and technical considerations to resolve real issues. Known for its broad application, AHP constructs decision models and priorities by comparing alternatives on a scale of absolute judgments and intermediate values, reflecting relative importance among options (Jitendra, 2018; Canco, Kruja, & Iancu, 2021).

Analytical Hierarchical Process (AHP) Methodology

Standard method of AHP Excel template with multiple inputs is a simple yet suitable for multiple inputs with individual and consolidated output for decision makers utilized to perform the Analytic Hierarchy Process for Multi-Criteria Decision Making in Corporate Enterprises. Application range from identifying weightage of key performance indicators (KPIs) in corporate management, ranking of growth strategies for a company and assortment of leadership proficiencies in a management development program (Goepel K. , 2018; Goepel K. D., 2013)

AHP Spreadsheet Template

Requirements

Input requirements with the template user-friendly are established. The input sheet are macro-free, sovereign of external workbooks, and flexible in terms of norms, number of participants, and customary inconsistency levels. Each set of questionnaire are deliberated to fit a single page for manual conclusion (Goepel K. D., 2013).

Realization

The resulting flexible template spreadsheet version MS Excel 2013 used for AHP includes (Goepel K. D., 2013):

1. Maximum 10 criteria and maximum 20 input sheets is utilized for pairwise comparisons having a consolidation sheet for conclusions, a summary graded sheet with reference tables identifying the random index, judgment scales and, GCI limits), and an eigenvalue-solving sheet using the eigenvector method (EVM).
2. Priorities identified in the input sheets are calculated utilizing the row geometric mean method (RGMM).
3. Consistency indices (CR and GCI) are stipulated utilizing an adjustable consistency threshold (α) between 0 and 1. If CR exceeds α, the top three inconsistent contrasts are emphasized for alteration.

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Response to the AHP questionnaire

Based on the feedbacks from the face to face interviews in line with the questionnaires issued to the selected interviewees on the topic of barriers to people-centric smart cities identified during the literature per below.

1. Urban poverty and inequality in access to opportunities and resources
2. High obstacles to social mobility
3. Threats to cultural identity
4. Low educational level and digital skills
5. Lack of awareness, engagement and participations
6. Shortage in access to technology
7. Gap between Government and governed

Based on the majority of responses the barriers to people-centric smart cities High obstacles to social mobility eliminated. Meanwhile Privacy & security threat and Dynamic citizen requirement are added into the revised barriers list to align with the latest market conditions and popular views.

1. Low educational level and digital skills
2. Shortage in access to technology
3. Threats to cultural identity
4. Urban poverty and inequality in access to opportunities & resources
5. Lack of awareness, engagement and participations
6. Privacy & security threat
7. Disconnect between the governing body and the populace
8. Dynamic citizen requirement

AHP Result Table

The result table will show all criteria with calculated weights and errors, using the EVM:

AHP Analytic Hierarchy Process (EVM multiple inputs)

K. D. Goepel Version **07.07.2022** | Free web based AHP software on: https://bpmsg.com

Only input data in the light green fields and worksheets!

n=	8	Number of criteria (2 to 10)	Scale: 1		AHP 1-9
N=	5	Number of Participants (1 to 20)	α: 0.1	Consensus:	######
p=	0	selected Participant (0=consol.)	2 7	Consolidated	
Objective	To rank the barriers associated to people centric governance model for Smart Cities				
Author	Benoie				
Date	8-Apr-24	Thresh: 1E-08	Iterations: 4	EVM check: 2.9E-09	

Table	Criterion	Comment	Weights	+/-
1	Low educational le		2.5%	0.5%
2	Shortage in acces		4.3%	1.3%
3	Threats to cultural		6.2%	1.5%
4	Urban poverty and		7.5%	2.0%
5	Lack of awareness		24.1%	6.8%
6	Privacy & security		16.4%	4.7%
7	Disconnect betwee		19.5%	5.1%
8	Dynamic citizen re		19.6%	4.7%
9		for 9&10 unprotect the input sheets and expand the	0.0%	0.0%
#		question section ("+" in row 66)	0.0%	0.0%

Based on above AHP table utilizing EVM, the ranking of the barriers to people-centric smart cities based on the weightages are as follows.

1. Lack of awareness, engagement and participations (24.1%).
2. Dynamic citizen requirement (19.6%).
3. Disconnect between the governing body and the populace (19.5%).
4. Privacy & security threat (16.4%).

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Below refer the Eigenvalue (Lambda), Mean Relative error (MRE) of the weights, Geometric consistency index (GCI), Ordinal inconsistency (Psi), and Consistency ratio (CR).

Result								
	Eigenvalue			Lambda:	8.246	MRE:	26.5%	
	Consistency Ratio	0.37	GCI: 0.09	Psi: 12.5%	CR: 2.5%			

As CR value is at 0.37, there is no requirement to perform any adjustment to the ranking of the barriers. Ensuring consistency is the critical aspect with reference to practical solicitation of AHP. A balanced scale improves consistency, but well-defined, theoretically grounded cut-off limits, independent of scales and priority methods, would be ideal.

Below section the comparison matrix is exhibited:

Matrix	Low educational level and digital skills (1)	Shortage in access to technology (2)	Threats to cultural identity (3)	Urban poverty and inequality in access to (4)	Lack of awareness, engagement (5)	Privacy & security threat (6)	Disconnect between the governing body (7)	Dynamic citizen requirement (8)	0 (9)	0 (10)	normalized principal Eigenvector
Low educational (1)	1	7/9	1/3	2/9	1/9	1/6	1/7	1/7	-	-	2.51%
Shortage in access to (2)	1 2/7	1	1/2	1/2	1/7	1/4	1/3	1/3	-	-	4.29%
Threats to cultural (3)	2 5/6	1 8/9	1	3/5	1/3	3/7	1/4	1/4	-	-	6.17%
Urban poverty and inequality (4)	4 1/2	1 8/9	1 2/3	1	1/5	4/9	1/3	1/3	-	-	7.52%
Lack of awareness, (5)	8 4/5	6 4/5	2 5/6	4 7/9	1	7/8	1 1/3	1 5/9	-	-	24.13%
Privacy & security (6)	6 1/4	4 1/6	2 1/3	2 1/4	1 1/7	1	4/7	3/4	-	-	16.35%
Disconnect between the (7)	7	3 1/8	4 1/8	3 1/9	3/4	1 3/4	1	3/4	-	-	19.48%
Dynamic citizen (8)	7	2 5/6	4 1/8	3 1/9	2/3	1 1/3	1 1/3	1	-	-	19.55%
0 (9)	-	-	-	-	-	-	-	-	1	-	0.00%
0 (10)	-	-	-	-	-	-	-	-	-	1	0.00%

Conclusion

This paper outlines challenges in implementing AHP as a standard MCDM method in a corporate setting. Flexible AHP spreadsheet template was developed and used in multiple projects. The main challenge in AHP implementation is achieving consistent matrices; a strict 0.1 limit for the consistency ratio (CR) proved impractical, with a median CR of 0.37. The balanced judgment scale notably improved consistency.

AHP was well-received for group decisions, especially with larger groups, as it reflects individual inputs. The mathematical basis of AHP also made aggregated group results appear neutral and objective. The AHP method was defined through a review of publications on multi-criteria decision-making and face-to-face interviews. It proved efficient in determining criteria weights and ranking evaluated models. Using weights to classify variables considered all possibilities, enhancing decision reliability. The sensitivity analysis will further improved decision accuracy, which will be ensured during the Structural Equation Modelling methodology in the next level outcome.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used Researcher Life & ChatGPT to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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