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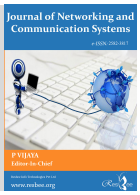

An Empirical Study of Smart Cities Framework Adoption for Sustainable Living in Province Balochistan of Pakistan

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Abstract: Information and Communications Technology (ICTs) are being used to build smart cities capable of reacting to the city's multiple changes and obstacles, such as Smart living, competent governance, Smart climate, intelligent people, smart tractability, and wonderful economics. For a better understanding of smart cities, several academics have sought to define them and highlight the potential and difficulties of creating intelligent urban communities using the Internet of Things. Due to a lack of comprehensive resilience due to respect for the component of a smart city, city leaders and organizers/designers must distinguish between the smart city system and its related activities, which smart city implementation representatives must enthusiastically accept. By enforcing acceptable standards and developing partnerships, smart cities that use Internet of Things (IoT) and cutting-edge innovation-based assets help ordinary citizens. As a result, this research identifies and promotes the development of a smart city framework adoption model based on a Systematic Literature Review (SLR) for the framework's adoption and Behavior Intention, Perceived Privacy, Perceived Security, and Perceived Value, as well as the self-efficacy and effort-expectancy of smart cities (Smart Economy, Smart Environment, Smart Government, Smart Living, Smart Mobility and Smart People). A review survey was also used to obtain input from respondents on their observations and acceptance of the proposed smart city framework adoption model by city professionals (city planners and organizers, engineers and academics, and important stakeholders). These findings, which influenced Balochistan Province policy, demonstrated that two cities in the province made the right option in implementing smart city technology.

Keywords: Adoption, Framework, IoT, Sensors, Smart City, Urbanization.

1. Introduction

"Smart City" is a systematic endeavor. This idea entails a wave of Information Technology (IT) advances to make cities smarter [1]. Smart city societies seek solutions. The ICT planning process has resulted in secure, experienced, and robust solutions for demanding cities' issues [2]. In addition, executive malfeasance is a concern [3].

On the other hand, smart city observations and technological improvements boost the ability of association and potential inside cities, not because they make city links more accessible to residents [4]. Today's advanced city pushes include direction, prosperity, and partner engagement [5]. Introducing new technologies into an organization's activities takes time and consideration of present IT foundations and frameworks [5]. As a result, coordinating digitalized and linked smart city accomplishments and conditions is no easy feat. When professional help is applied, a range of acute city activities often vanishes [5]. The study acknowledges sectoral changes, environmental creation, and collaboration in a city. This research presents a smart city strategy configuration that differs from the Smart City Conceptual Model (SCCM) given by [6] Strategy, advancement, organization, and partners are the four elements that make up the smart city strategy framework. As a result, a smart city structure was designed to enable extraordinary city partners from the business and government sectors to understand the complexities of smart city organization, ownership, association, and dynamic frameworks. Smart municipal organizations must also have mechanical closeness, acceptable limits, and asset mobility. The smart city plan structure [6] and [7] is utilized to deconstruct the smart cities in Pakistan and find a few cures for smart city practices and utilization. The construction of urban areas has evolved, many of which

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developed independently. Compatibility issues lead city utilities and administrations to run sub-optimally, restricting new value-added administrations, increasing transportation costs, and undermining existing coordination chains and commercial models. To make their cities more productive and profitable, municipal leaders and planners work on carbon reduction and redevelopment [8]

Over 180,000 people every year relocate to cities, creating over 60 million additional renters. Realistic, practical, and social urban districts should prepare for a metropolitan turn of events. Smart city design can assist balance social, environmental, and economic freedoms. The smart city should be able to communicate data rapidly and easily, improving operations and citizens' lives. It ensures that the frameworks' functional city communities may tap into a large reservoir of cross-area city data [8]. To successfully deal with metropolitan communities and develop supply chains across Pakistan, governments must promote innovative and current talent. Many cities throughout the world are seeking innovative ways to better serve their inhabitants by utilizing cutting-edge technology. ICT (data, information, and communication technology) are critical components of a smart city, which is developing as a worldwide paradigm for a wide variety of breakthroughs in urban viability and adaptability [9]. Adaptability to both financial and biological risks has allowed for quick progress. It is now possible to discover urban issues such as public assistance shortages, traffic, over-progress, shoreward pressure, regular or sanitization deficits, and other types of divergence using IoT networks [10] Along with illustrations of key motivations and issues, it showcases spectacular city activities from throughout the [11]. Political, monetary, and social settings have a significant influence on Social Cognitive (SC) growth [12]. Thus, this study sought to understand how IoT operates and is recognized in Pakistan's major cities.

2. Problem Statement

Pakistan's urban population is rising at a higher rate than any other South Asian nation. Urbanization is expected to account for more than half of Pakistan's anticipated population of 250 million by the year 2030. As many as one-eighth of urban residents are living below the poverty line. The following are possible links between the need for a smart city and Balochistan Pakistan:

- Several urban challenges arise as a result of rapid urbanization.
- Find out about local, state, and federal programs.
- The digital economy can profit from the most recent expansions in global advancement.
- ensure that cities in Province Balochistan, Pakistan. compete on an equal footing with those around them.

Future Smart towns in Quetta and Gwadar would benefit from this investigation and will serve as a model for those who want to create Smart City Living in any nation. This evaluation research will modify the present metropolitan networks and organization movement in the Balochistan area of Pakistan to be more customer-driven shrewd city application in metropolitan and underdeveloped metropolitan territorial zones. The research study's final findings will offer a plan to modify how brilliant city applications are distributed, enhance the concept of living, and make Smart city organizations accessible continuously at a lower cost and expand impressively. The total value of assessment research is that it may provide effective checking, examination, assistance, and therapy to an indirectly associated resident in an IoT connection.

3. Framework

Technology Acceptance Model (TAM), D-Theory of Planned Behavior (TPB), Digital Object Identifier (DOI), and Unified Theory of Acceptance and Use of Technology (UTAUT) valence framework, smart city framework success model, and lack's dominance theory are some of the most commonly discussed technology adoption theories and models in the literature. It is currently unclear whether a model or theory is best for studying new technology adoption, even though [13], [14], and [15] indicated that most research and constructions focus on the four main theories Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), Innovation Diffusion Theory (IDT), and Unified Theory of Acceptance and Use of Technology (UTAUT). Many studies on smart city acceptance have been undertaken, but none of them fit well enough to fully solve the study difficulties. Emphasized the similarities among these eight models and provided a thorough theory with a 40% variance [16]. Furthermore, the authors suggested that a researcher may utilize an entire model or choose components from a model to evaluate consumer acceptance of new technology, compatible with the other study's scenario [17] [18] presented three new

components for using the UTAUT model to study consumer technology adoption and usage. Before establishing the UTAUT2 model, models such as UTAUT and TAM were developed and used to measure employee technology acceptance and utilization [19] UTAUT2 is a relatively recent theory that is well-established but needs to be validated in various situations. According to [20], TAM has been used in nearly half of the studies on acceptability and use contexts of new technology uptake. Other theories like IDT and UTAUT are next in line, but they lag well behind TAM. Although TAM has a lot of problems and is sometimes seen as an over-studied model, it is the most often used and tested model in a range of scenarios [20] Similarly, according to [22] the diversity of behavioral research makes it hard to depend on a single model; variables and constructs may vary and be pulled from several theories and models. Several researchers start with a single theory or model as a base model and then include many external constructs to improve explanatory power, such as [21]. TAM and IDT models, which are convincing in certain circumstances, have surpassed IS/IT writing [21]. On the other hand, these assumptions are ineffective when examining behavior in non-western environments [23]. In addition, the use of UTAUT2 is limited in recognition and usage research [24]. experts may use UTAUT2 in various scenarios and notice important changes that might increase the hypothesis As a result, other scientists attempted to use UTAUT2 to investigate the purchasing behavior of customers by extending the hypothesis, for example [25]. More than one theoretical viewpoint is necessary for a comprehensive understanding of the problems, and approaches are covered separately for clarity. Various theoretical thorough understandings of the problems at hand, on the other hand, demand techniques. Consequently, a wide understanding of multiple broad adoption models is essential in these adoption theories, and models are presented to give an overview to better understand these models and theories proposed in the given conceptual smart city adoption model shown in Fig.1.

4. Hypothesis Development

Using this theoretical model, we want to find out how crucial factors relate to one another. We want to find out the relationship between a person's intention to behave in a certain way, their perception of privacy and security, their sense of value, their self-efficacy, and the expectation that they will be successful in achieving it, as well as their belief in their own abilities and their faith in the government. Before constructing a thorough model, hypotheses should always be examined to determine their applicability. [26] As a result, the theories were mostly based on predictions about what would be discovered. The hypotheses have been tested to see whether they can be put into practice in order to help cities become smarter. The relationship between hypotheses and constructs is explored in the following sections.

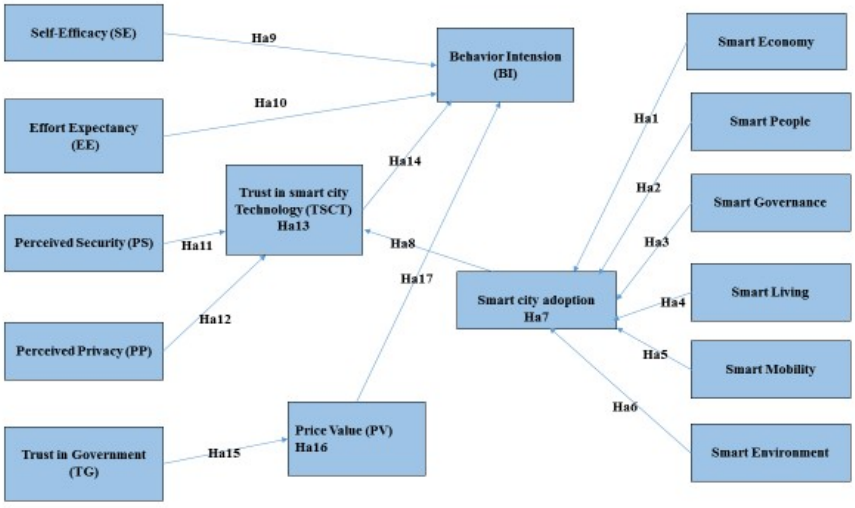

Fig.1. *Conceptual Smart city Adoption Model*

4.1 Perceived Privacy

Consumers, like many others, feel that privacy is an inalienable human right and place a high value on their trust in technology to protect it. So Big Brother imagery may come to mind when governments and companies amass personal data. [28] Smart-city services may be accepted and used by residents if they

are creative, secure, and of good quality according to [29]. Whether or if people in smart cities are ready to give up greater privacy in exchange for the advantages is an interesting question.

H1: Perceived Privacy is positively related to Trust in Smart City Technology

Hypothesis 1 says that people's faith in smart city technologies is linked to their perception of privacy. In Balochistan, Pakistan, faith in smart city technologies is linked to perceived privacy. Research conducted in Pakistan's Balochistan province indicated a positive and statistically significant correlation between felt privacy and the deployment of smart city technologies. This idea has been supported by my findings.

4.2 Perceived Security

Consumers' trust in smart-city services as secure repositories for private information is gauged using the Perceived Security (PS) metric. E-Government, e-banking, and the cloud computing industries have all seen the effect of privacy concerns on user adoption. as important as information and service quality to smart-city service customers [31] A security compromise is unlikely for smart-city service users given previous ransomware assaults in Atlanta in 2018 and Baltimore in 2019, but it's not impossible.

H2: Perceived Security (PS) is correlated with Trust in Technology in the adoption of smart city services

Hypothesis 2 claims that confidence in smart city technologies is linked to perceived security. Trust in smart city technologies is linked to perceived security in Balochistan, Pakistan. Research conducted in Balochistan, Pakistan, indicated a negative correlation between felt security and the deployment of smart city technologies. In my opinion, this idea is not supported by my findings.

4.3 Price Value

The price value is described as "the customers' cognitive trade-off between the perceived benefits of using a specific technology and the financial cost of using it" by [32]. It has subsequently been utilized in several researches on the adoption of new technologies, including UTAUT2. Due to PV's challenges, consumers are less likely to take advantage of or use a service if its benefits don't outweigh its costs. Whether or not smart city services are implemented in a situation where residents are the funders depends on residents' views of the costs (actual or perceived). Trying to place a price on it is almost impossible. People who are in need of a service weigh the benefits against the costs, according to a study. This topic has also been addressed by [33]. According to [34], the adoption of mobile or smart government is hampered by perceived costs.

H3: Price Value (PV) is correlated with Behavior Intention BI in the adoption of smart city Service

Hypothesis 3 asserts that behaviour intention adoption of smart city services is linked to perceptions of value. Perceived Value is linked to smart city services in Balochistan, Pakistan. Perceived Value and Behavior Intentions in Balochistan, Pakistan's mart city service consumption were shown to be positively associated in the current study (value 0.575, p-value 0.000). As a result, I believe this idea is correct.

4.4 Self-Efficacy

The environment, personal, and cognitive characteristics all influence human behaviour. "Psychological processes, whatever their form, modify expectations of personal efficacy," is how Albert Bandura puts it in his self-efficacy theory [34]. This relationship between SE and the users' sense of their ability to complete a job was established by [36]. As a result, it has been shown that SEs can accurately anticipate user behaviour. As [37] points out, residents in smart cities must believe they are capable of using new services, even if they are difficult to get for those from lower socioeconomic backgrounds.

H4: Self Efficacy is correlated with BI in the adoption of smart city services.

Hypothesis 4 asserts that the adoption of smart city services is linked to a person's sense of self-efficacy. Self-efficacy is linked to smart city services in Balochistan, Pakistan. Self-Efficacy and Behavior Intentions in smart city service consumption in Balochistan, Pakistan (value 1.715, p-value 0.000) were shown to be positively and significantly linked in this study. As a result, I believe this idea is correct.

4.5 Effort Expectancy

'The degree of system usability' is defined by [38] as the measure of expected effort. Early adopters' judgments of ease of use inform this idea [38]. There was a lot of concern that too much technology (such as a mobile parking app) might prevent certain residents from carrying out formerly easy duties, such as parking.

H5: Self Expectancy is correlated with BI in the adoption of smart city services.

Hypothesis 5 states that the adoption of smart city services is linked to Effort Expectancy. Effort Expectancy in Balochistan, Pakistan, is linked to the intention to use smart city services. There was a strong correlation between behaviour intention and behaviour intention in Pakistan's Balochistan province (value 1.426, p-value 0.000) according to the findings of this study. As a result, I believe this idea is correct.

4.6 Smart Economy

A city's smart economy is based on the use of information and communications technology (ICT) and the addition of new sectors that include ICT in their production and construction processes. [39]

H6: Smart Economy has positively influenced smart city framework adoption.

Smart City Adoption is linked to a Smart Economy, according to Hypothesis 6. Balochistan, Pakistan's Smart City Adoption is linked to the province's Smart Economy. Research conducted in Pakistan's Balochistan province indicated a favorable and substantial correlation between Smart Economy and Smart City Adoption in smart city service utilization. As a result, I believe this idea is correct.

4.7 Smart Environmental

City natural surroundings may be protected and conserved by using cutting-edge technology known as a "smart environment" [40]. [40] The elements of a smart environment include trust and security, the use of information and communication technology to promote municipal safety, and cultural efforts to digitalize cultural assets [41].

H7: The implementation of smart city frameworks is boosted by environmental activities.

Hypothesis 7 asserts that a Smart City Adoption of Smart City Services is linked to a Smart Environment. Pakistan's province of Balochistan has a Smart Environment, a Smart City Adoption, and Smart City Services. Smart Environment and Smart City Adoption in Balochistan, Pakistan (value 0.120, p-value 0.020) were shown to have a positive and significant link with the usage of smart city services. This idea has been supported by my findings.

4.8 Smart Governance

Examples of smart government methods include active and political participation, residency services, and the usage of e-government [42]. The implementation of new technologies, such as e-democracy or e-government [40], is commonly involved.

H8: Smart governance efforts have a favorable impact on the adoption of smart city frameworks.

A smart government is linked to the adoption of smart city services, according to Hypothesis 8. In Balochistan, Pakistan, the adoption of smart city services is linked to the implementation of a smart government. In Balochistan, Pakistan, researchers discovered a substantial and positive correlation between Smart Government and Smart City Adoption (value 0.438, p-value 0.000). This idea has been supported by my findings.

4.9 Smart Living

People's well-being, culture, housing, travel, and security are all part of what is meant by the term "smart living," which incorporates a wide range of concepts. As a result, enhancing these characteristics leads to a more harmonious, satisfying, and happy existence [40],[41].

H9: Smart living initiatives positively determine smart city framework adoption.

Hypothesis 9 asserts that smart city adoption of smart city services is linked to smart living. For the people of Balochistan, Pakistan, Smart City Adoption and Smart Living are intertwined. In Balochistan, Pakistan, researchers discovered a substantial and positive correlation between the adoption of smart city services and smart living (value 0.388, p-value 0.000). This idea has been supported by my findings.

4.10 Smart Mobility

Provide citizens with access to new and innovative technology, and incorporate these technologies into ordinary urban life. Access to new and innovative technologies, as well as their integration into daily urban life, are all part of what is meant by "smart mobility" [40]. All citizens should be able to process and share information instantaneously from any location in the city, including their homes and workplaces [41].

H10: A smart city framework adoption is favorably influenced by smart mobility efforts.

Hypothesis 10 argues that Smart Mobility is connected to smart city framework adoption. In Balochistan, Pakistan, Smart Mobility is connected to smart city framework adoption. The present research found a negative and insignificant relationship between Smart Mobility and smart city framework adoption in Balochistan, Pakistan (β value 0.060, p-value 0.336). Thus, my analysis does not support this hypothesis.

4.11 Smart People

People are the main consumers of smart devices and services; therefore, improving their quality of life is a major objective of smart cities. So it's critical to plan and build these services carefully. The literature discusses important issues of smart city life. The elements that influence IoT utilization in smart cities are based on information and systems quality—highlighted contactless card privacy and security issues connected to public facilities and transportation. Smart people are the defining feature of digital cities [43]. Educated and skilled, the residents understand the significance of social collaboration in public life and can interact with other nations [44]

H11: Smart city framework adoption is influenced favorably by the engagement of intelligent citizens.

If you have clever people, you're more likely to make use of smart city services, according to Hypothesis 11. Pakistan's province of Balochistan is a prime example of how Smart People and Smart City Adoption are intertwined. A correlation between Smart People and Smart City Adoption in Balochistan, Pakistan (value -0.219 and p-value of 0.028) was identified in this study. As a result, I believe this idea is correct.

4.12 Smart City Adoption

Study how well Smart Cities are accepted in society. In a smart city, conventional urban regimes are transformed and the socio-technical adoption of Smart Cities is examined. As a result of technological advancements, cities are becoming smarter and more technologically advanced. Smart city programs improve quality of life and tackle key socio-economic concerns. Adopting a Smart City requires a participatory strategy involving people to optimize both systems jointly. The involvement of press connections to enable information transmission between municipal actors and residents was a successful element for smart city adoption. Smart cities are a trend of urban policies aiming at enhancing inhabitants' lives by utilizing modernity and technology to address difficulties produced by dense populations [45].

Specifically, smart cities use ICT to improve the efficiency of essential municipal activities by bringing together disparate stakeholders and actors in a fault-tolerant intelligent system [46]. These traits are linked to larger ideals like social progress, economic viability, and environmental conservation. Additionally, infrastructural components of Smart city programs improve quality of life and tackle key socio-economic concerns. Adopting a Smart City requires a participatory strategy involving people to optimize both systems jointly. The involvement of press connections to enable information transmission between municipal actors and residents was a successful element for smart city adoption.

H12: Smart city adoption technology moderates the positively determined trust in smart city technology.

Hypothesis 12 asserts that the adoption of smart city technology is linked to confidence in smart city services and technology. The adoption of smart city services in Balochistan, Pakistan, is linked to citizens' faith in smart city technology. Smart City Adoption and Trust in Smart City Technology in Balochistan, Pakistan (value -0.201, p-value 0.000) were shown to have a positive and significant association with the utilization of smart city services. This idea has been supported by my findings.

4.13 Trust in Government

Trust in government is defined by [34] as the belief that political authorities, agencies, and institutions have the integrity and competence to provide services that meet the expectations of the people. [34] [47] make a similar case that security and privacy are important issues. It is possible that the general people may be wary of the rising use of technology, questioning why and for what purpose their personal data being gathered. A user's decision to use an e-government website or service is heavily influenced by TG and TT. [34] Consumers may be apprehensive of IoT devices in the hands of the government, but the government itself enjoys the advantages IoT provides to service delivery, such as improved public safety and responsiveness to emergencies. In terms of cost, it's all about the implementation and enhancement

of these technologies and the expenses of IT training and skill development, which may be exorbitant. [3]
H13: Perceived Value (PV) is connected with Trust in Government in the adoption of smart city Services.

Hypothesis 13 asserts that in smart cities, perceived value is linked to citizens' faith in government. In Balochistan, Pakistan, Perceived Value is associated with Trust in Government to the adoption of smart city Services. Perceived value and trust in government were shown to be positively correlated with Balochistan, Pakistan's smart city service consumption (value 0.73, p-value 0.000). This idea has been supported by my findings.

4.14 Trust in Technology

Trust in technology evaluates citizens' willingness to embrace smart-city technologies and is heavily influenced by PS and PP. Smart-city services must address security and privacy concerns before changing infrastructure, according to [48]. However, any city attempting to improve its technology would inevitably seem like a nightmare to some citizens. City leaders may also have nightmares, considering how easy outages or cyber-attacks may shut down a city's whole information technology operation. TT has also been demonstrated to impact customer intent to buy, purchase behavior, and utilization of e-government services [49] We found similar results in our pilot test survey and conversations with municipal staff and people concerned about how user data will be gathered and used. [50] discovered a substantial shortage of technological expertise among municipal planners and policy-makers.

4.15 Behavior intension

BMI assesses the degree of one's intention to undertake a given activity. [16] It may be used to predict individual uptake of new technologies. BI can detect user technology use. For example, a person who says they will use a smart-city parking app to locate a location reveals their intention to employ the device.
H14: When it comes to the adoption of smart city services, TT and BI go hand in hand.

Theory 14 proposes a link between smart city technology trust and the intention to engage in certain behaviours inside the city's smart services. In Balochistan, Pakistan, Trust in Smart City Technology is associated with the Behavior Intention to embrace smart city Services. In Balochistan, Pakistan, the current study discovered a substantial and positive correlation between trust in smart city technology and behaviour intention in the usage of smart city services (value -0.16, p-value 0.018). This idea has been supported by my findings.

5. Conclusion and Future Work

In recent years, the rate of urbanization has increased. It is anticipated that over 60 percent of the world's population has been living in cities by 2030. This rural-to-urban demographic transition is predicted to continue for a few years. A huge and diversified human population is prone to turmoil. A thorough understanding of smart cities is required to keep people safe and healthy as the world's urban population expands. Many communities worldwide are researching new techniques to manage sustainable living. This paper presents a strategy for identifying smart city aspects to be adopted. This study provides smart city initiatives to analyze the existing smart city strategy in cities to create sustainable living for inhabitants. The use of smart city services and technology was evaluated based on perceived trustworthiness. It revealed that perceived usefulness, external pressure, and data security impact smart city technology trust. Another research found a correlation between smart city technology adoption and stakeholder trust. As a consequence, government agencies must create policies to assist smart city technology.

This research contributes to the body of knowledge about smart cities and the factors that affect participant trust, such as technology, organization, setting, and security. How to leverage trust and incentives to accept new technology like smart cities is also covered. Researchers strive to boost regional cities' livability, productivity, and sustainability. Data from regional cities in Balochistan was used to evaluate the model's assumptions. Further study towards a trust-based smart city technology adoption paradigm is needed, as shown by these results. An online survey collects data. Stakeholder interviews may be leveraged in future studies to better understand participant intention.

Compliance with Ethical Standards

Conflicts of interest: Authors declared that they have no conflict of interest.

Human participants: The conducted research follows the ethical standards and the authors ensured that they have not conducted any studies with human participants or animals.

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