

Article

How Do Institutional and Technological Innovations Influence the Smart City Governance? Focused on Stakeholder Satisfaction and Crime Rate

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Abstract: Effective institutional and technological development are key to governance in smart cities. This study investigates the fundamental complexities of institutional and technological innovations in smart cities. A city's innovation capabilities depend significantly on its technology and implementation capacity. This study suggests that institutional and technological innovation serve a role that moderates the relationships between smart city governance, stakeholder satisfaction, and crime rate. Multiple regression models were developed by surveying 496 Pakistani citizens with a questionnaire. Using stakeholders and innovation theories, analyzing the relationships between smart governance, stakeholder satisfaction, and city crime rates reveals a moderating role of institutional and technological innovation. The findings showed that institutional and technological innovations have strengthened the stakeholder satisfaction level while weakening the crime rate in a smart city.

Keywords: smart city governance; institutional innovation; technological innovation; stakeholders' satisfaction; crime



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1. Introduction

Over half of the world's population resides in cities, and the proportion will eventually grow to three-quarters by 2050 [1,2]. City governments must accomplish an intensifying number of social, physical, organizational, and technical issues developing from such composite audiences of people in spatially limited areas with the escalation in urban population. Rapid urbanization generates a pressing desire for governments to find better solutions to concomitant concerns, including high crime rates, satisfaction among stakeholders, environmental contamination, traffic jams, inefficient energy usage, and managing waste difficulties [3,4]. Moreover, urban cities are becoming recognized as drivers for economic development and innovation, along with an approach to address challenging issues [5–7]. Municipal governments must develop appropriate and sophisticated strategies for addressing challenges like social integration, steady economic development, combating crimes and conservation, and innovation [8,9].

The expression “smart city” has been disseminated across the developed and developing world, distressing government strategies and urban development programs. Such “future cities” are prefigured for their effective networked technological innovation entrenched within the fabric of urban environments that furnish modern resources of social control for the state [7,10,11]. Such cities are intended as a “solutionism” for the many glitches of modern city life, yet evolving technologies are imperfect and have weaknesses that criminals may manipulate [12]. However, there needs to be a stimulating uproar on security issues among believers in smart cities. Nonetheless, there remains to be more perception of the smart community program's effect from criminologists, particularly concerning previously prioritized fears of systematized crime [13]. The urban government may

be asked a key question: How can it make a city smart enough to produce inclusiveness, sustainability, and safety, generate economic growth, and impact its stakeholders?

Technological innovation has the potential to help city administrations address the issues associated with city governance while simultaneously enhancing sustainability [4,11]. Security surveillance, traffic management, and power generation benefit from emerging technological innovations that strengthen the intelligence aspects of the urban environment, and urban administration should make maximal use of modern technology to address critical problems. Smart city governance applies modern technology to enhance city governance by optimizing information use and communication [14]. Presently, two primary domains of technological innovation have emerged that hyperlink with various methods of smart city governance [3], solutions to be employed to provide concentrating information and technologies that can be utilized for spreading information.

The rapid advancement of technologies can strengthen the concentrated intelligence of city government by providing up-to-date information and better and more comprehensive information about relevant advancements [15]. Monitoring traffic systems, for instance, with the help of sensors and cameras, can assist city governments in obtaining precise information regarding the pros and cons of the system to control traffic violations, and such information can be used for traffic management by city governments [14,16]. In other words, the crime rate of traffic violations is decreased in smart cities where technology is used to monitor traffic systems. Furthermore, communication technologies in communities and policy networks may connect various urban players to develop additional distributed urban intelligence [9]. For example, social media and open data help city government to form a new kind of collaborative governance by combining information about crime patterns from numerous sources, such as theft, robbery, traffic violations, and bribery, and directing protective efforts of housing corporations, citizens, and police to minimize crime rate in their cities. Concentrated and distributed intelligence technologies are combined differently in different patterns to produce hybrid smart city governance. City governance can be strengthened with the hybrid use of these technologies, but previous literature needs to pay more attention to the effectiveness of such new forms of governance [10].

Technological innovation in government organizations is currently attracting significant attention in the academic community. Hartley et al. (2013) explored three significant public innovation methods integrating institutional and organizational analysis [17]. Naphade et al. (2011) explained that implementing system interoperability, maintaining security and privacy, expanding sensors and devices, and introducing an innovative closed-loop paradigm for human–computer interaction will constitute the main technological obstacles [18]. In addressing expectations from stakeholders and appreciation, government institutions should employ technological innovation approaches to address various amalgamated and complicated issues while considering its limitations and available resources [17,19]. City governments may pressure the stakeholders to adopt technological innovations to avoid pollution, minimize resource consumption, reduce climate costs, and decrease energy problems [20], and doing so will positively affect stakeholders' satisfaction.

These technologies and innovations seem impressive and remarkable but are only somewhat effective. Measuring the efficiency of smart city governance is complex due to the absence of simple success indicators in the public sector, as profitability indicates success in private organizations [14]. Innovation dissemination and implementation are practicable, alongside technology assessment [21], smart city, and planning research. All significantly contribute to the overall excellence of a smart city's environment—not exclusively in the context of the outcomes but in their achievement process. Modern technology may not be appropriately used in smart cities. Nonetheless, they remain adept at producing effective and exceptional results [7] in economic development, environmental sustainability, reduced crime rates, safer neighborhoods, and offering a better system through effective decision making, policy execution, and settlement of various disputes. Smart city governance is supposed to use new technologies and contribute to improving the urban environment subjectively and objectively using those new technologies. Smart city governance may

contribute to the smart city environment and be evaluated through many stakeholders, networks, communities, and participant formulae.

Developing an adaptive smart city governance system requires substantial consideration of institutions and the strategies in which institutions may innovate to address new emerging risks and pressures, such as stakeholders' satisfaction and crime rate [22]. Institutions denote the organizations that establish rights, regulations, and procedures for making decisions that shape social activities, assign roles to the individuals who engage in them, and govern relationships between those with these positions. Institutions are the key feature of governance systems and cooperate with other parts, such as values, customs, traditions, culture, and an impression of community [23]. In smart city governance systems, specific issues are typically considered by the institutions, such as health, crimes, water, and spatial planning, at a citywide scale that administers several municipalities that also deal with wider levels of governance such as state, national, or international. Consequently, it is mandatory to consider issue-specific institutions to understand how smart city governance can become more effective and useful for stakeholders [24].

Institutional innovations must continue to be adaptive to achieve responsive city governance while balancing stakeholder satisfaction and incidences of crime [25]. In this research, institutional innovation refers to strategic modifications in collaboratively choosing institutions that improve the effectiveness and performance of smart cities to foster the satisfaction of various stakeholders while decreasing criminalities. It may incorporate changes in legal and policy frameworks that constitute changes in organizations to achieve new goals, changes in policy tools to implement, and changes in cooperation arrangements between key players. Scholars have begun studying innovation in different domains quite extensively in recent years, both within and on larger scales. For instance, it contains initiatives defined as urban city experimentation [26] and policy innovation [27] involving business, public, and civil society stakeholders. However, a significant need for more emphasis has been devoted to evaluating the established institutions that shift because of these innovative initiatives. An institutional perspective provides a significant novel understanding of how smart urban governance structures can or cannot influence levels of contentment and criminal activity in urban areas.

Examining the effects of urban governance is challenging because the relationships between smart city governance structures and stakeholders' satisfaction and crime rate are contextual. It is legitimate, although prior research has shown a positive connection between city governance and stakeholders' satisfaction [19] and an adverse effect on criminal activity rate [13,28]. The interaction between smart city governance and the level of crime and the connection between smart city governance and stakeholder satisfaction is examined in this research, along with the moderating effects of technological innovation. This study formed the assumption that contextual variables influenced the correlations between smart city governance and the level of crimes as well as satisfaction among different stakeholders. Specifically, the moderating impact of technological innovation is carefully investigated by analyzing data from 496 bureaucrats and citizens from Pakistan. The main reason for choosing Pakistan is that it is a developing country in South Asia where surveillance cameras were installed in urban cities a few years back by a government project named "Safe City". We analyzed how this technological innovation in urban areas of Pakistan has affected the relationship between smart city governance and stakeholders' satisfaction and crime rate in those cities.

The rest of the research is structured as follows: To formulate hypotheses addressing smart city governance, stakeholder satisfaction, crime rate, and technology innovation, Section 2 presents the literature review from prior research. The research framework equations, evaluation, and data used for assessment are all explained in Section 3. The empirical findings are shown in Section 4, and the discussion, conclusion, and recommendations for further research are explained in Sections 5 and 6, respectively.

2. Literature Review and Hypotheses Development

2.1. Smart City Governance and Stakeholders' Satisfaction

A more in-depth assessment of smart city governance necessitates to be carried out in the field of public administration research. According to some academics, the impact of government performance on the environment, the public, the economy, accessibility, and the quality of life of residents are all factored into account when estimating it [29,30]. Some scholars disagree and contend that governance's primary attributes are the parties' various aims and purposes. Various city stakeholders may prefer an initiative taken from the local government based on their efforts to meet their needs. For example, the public wants to improve their ecological environment, neighborhood, quality of life, and access to essential health, water, and educational resources. Simultaneously, real estate associations would consider an advantageous atmosphere conducive to their corporate ambitions and tenant attraction. At the same time, security services might emphasize the decline in criminal behavior in the city [14]. Good governance necessitates the prompt and sustainable availability of accommodation, transportation, employment opportunities, hygiene, energy, water infrastructure, and other utilities to the extent that it improves life for citizens, who are among the main stakeholders. Access to fundamental human development indicators, such as equal opportunity, health care, schooling, safety, and community engagement, must also receive adequate attention [31].

Existing research suggests that assessing governance success is solely possible regarding stakeholders' satisfaction considering the variety of objectives [32]. Uncertainty is likely to develop when community groups are confronted with societal issues and are dubious about the outcomes of their efforts to address them. Consequently, the city administration actively engages all pertinent stakeholders in the decision-making and policy-implementation processes, particularly residents, institutions, business organizations, and other target groups. They place less emphasis on independent legal mechanisms like regulation and legislation to support instruments that can be more impartial and facilitate collaboration and assistance, such as agreements, incentives, and covenants preferred by stakeholders and the government [33,34]. It indicates that the city government's objective is to meet the requirements of its stakeholders by offering smart services without triggering difficulties as opposed to perpetually having a final decision.

Stakeholders' satisfaction is an intellectual design venture and an institutional and strategic challenge for city government. Creating a collaborative environment by the city government is one of the main differences between smart governance and electronic government concepts [35]. Smart governance is collaboration and interaction between stakeholders in decision and policy-making processes. Hence, the satisfaction of all stakeholders is mandatory. According to Scholl & Scholl (2014), smart collaboration with stakeholders is an extensive field for researchers in smart city governance that stems from traditional e-government. The main objective of e-government is to augment services in city areas, which consequently helps improve the quality of life for the people living in those constituencies [33].

Additionally, to this basic understanding, a strong emphasis is given on the importance of using information technology communication-based approaches to improve the quality of collaboration and relationships between city government and other stakeholders. Furthermore, it emphasizes the utilization of such ICT-based networks to host e-government services as a source of creating contact with city government [35,36]. Nevertheless, stakeholders need to consider various factors to be satisfied, and interaction with the administration is one of them. In addition to interactions, engaging stakeholders in policy enforcement, decision making, and service delivery is vital to the governance of smart cities. Transparency and equality are crucial to engaging and including key stakeholders in policy formulation [37].

Previous city and urban governance researchers have well-explained the stakes for stakeholders' satisfaction. Deng (2018) asserts that to ensure that stakeholders are satisfied with smart cities and urban administration, special focus must be given to their broader

objectives (companies, political, general, and state interests) [38]. Failure to perform consequently may have adverse political, social, and institutional impacts. The most relevant and significant theory that supports the interaction between stakeholders and businesses is stakeholder theory [39]. Regarding stakeholder satisfaction in this scenario, the association between the governance structure of the smart city and its governing bodies deserves consideration as it may result in enhanced performance, for example, in terms of stakeholder satisfaction since government entities that incorporate social actors in their decisions strengthen stakeholder satisfaction. The engagement of stakeholders in policy and decision making by the local government facilitates their availability of basic necessities, including clean air, water, and education [33,40]. Stakeholder satisfaction will eventually be significantly enhanced if we work with them to develop and use ICT-based to host e-government [31] and encourage them to develop and use it [35,36]. Therefore, we presume:

Hypothesis 1. *The smart city governance is positively related to stakeholders' satisfaction.*

2.2. Smart City Governance and Crime Rate

Crime has traditionally been concentrated in urban areas. Smart cities have long been synonymous with security, with the perimeters functioning as a key symbol [41]. Nonetheless, the absence of dangers (as well as the presence of safety measures) is one aspect that distinguishes a safe city; the other is the absence of terror. Therefore, while contemplating security, one must consider not only the possibility of being truly an aggressor of crime but also the perception of a hazardous and criminal environment, which is impacted by several determinants. Economic concerns, societal difficulties, demographic strife, and the prevalence of migrants are all thought to contribute to the risk in cities. Nonetheless, it may also be influenced by bad urban architecture and planning, a lack of municipal upkeep, and how individuals identify with the location where they reside [42]. A smart city is defined as demonstrating the ability to develop and implement approaches to the potential and obstacles of transforming urban centers into more productive and adaptable places for their residents [42] by integrating technological developments and the hyper-consumption of the Internet of Things [43].

Despite its several sectors, security administration in smart cities holds an important role due to its features and capabilities [44]. It can be observed in the internet of vehicles, people with intelligence, smart governance, architectural digitization, smart economics, and smart society [45]. In the context of the digital economy, financial security issues, such as on-line fraud, can be discovered. Smart people may be characterized as facilities that improve inhabitants' security and comfort (alerts, safety systems, senior social ostracization avoidance, and flood mitigation). Smart governance relates to public security and using data platforms such as open government data. Smart transportation includes identifying driving offenses, the surveillance of traffic patterns, accident information, and the prioritization of emergency vehicles. Demotics', which encompasses, for example, fire and theft prevention, may be found under Smart Environment. Eventually, smart living includes, among other things, risk analysis in housing, urban planning, and metropolitan sensors. Smart city security is broadly defined as addressing malfunctions, collisions, devastating and disastrous events, controlling turbulent urbanizations, and making cities safer using sophisticated integrated sensor networks and safety mechanisms by applying network cybersecurity encryption for large volumes of data or through the orchestration of rescue activities by security agencies, medical professionals, and other relevant stakeholders [44,46].

Smart city security must consider citizen safety in addition to network and data protection, which is the primary objective of cyber security. The citizen's safety in cities is further enhanced by smart and sophisticated devices based on information and communication technologies [47]. Standard infrastructure can also be optimized for better citizen safety, including smart streetlights [48]. A growing number of academics are debating the prospect of a safe city that capitalizes on such innovations to ensure the safety of its citizens. In

addition to effectively protecting citizens from crime and terrorism, a safe city enables quick response to emergencies and diseases [49]. Smart governance, smart transportation approaches, smart economies, smart individuals, cybersecurity, and smart environmental manipulation through design and urban planning may have behavioral implications that lower the frequency and anxiety associated with crime [50,51]. Therefore, considering the existing research, arguments, and theories, we will formulate the following hypothesis:

Hypothesis 2. *Smart city governance is negatively related to the level of crime rate.*

2.3. Contextual Impact of Institutional Innovation

Institutions are human-invented establishments, norms, values, and practices that reinforce and govern social actors' behavior and foster a consistent and conscious social life [52,53]. Institutional players understand organizations and are independent of institutional frameworks; the benefits accrue to the institutional and constitutional bases. Only within the framework of an institutional structure can an entity function as though it is a distinctive entity with unique rights and obligations [54]. An institutional structure can be very simple or complex. Institutions can refer to specific entities (a company's internal guidelines), an industry or population (technology requirements), all citizens of a country (taxes and land privileges), or people in different nations (human rights laws and trading partnerships), even though institutionalists typically define institutions as regulating action in organizational disciplines [55].

Institutional change transforms an institution's shape, performance, or function through time. Transition in an institutional arrangement can be measured by observing the structure at two or more places along several parameters (e.g., contexts, values, or regulations) and then evaluating the variations in these parameters across time. The institution has changed if there is a substantial difference. If the improvement is novel or exceptional compared to the past, it demonstrates institutional innovation [55]. Institutional innovation is a prominent concern for researchers addressing policy and governance at higher levels besides the cities, both in government in general and in terms of stakeholder satisfaction and security prevention to reduce crime rates in particular [22,56].

Institutional innovation is critical for executing dynamic smart city governance frameworks, considering stakeholders, and mitigating security risks [24,57]. In this study, "institutional innovation" refers to systematic enhancements of cooperative decision-making structures that help cities adapt and prepare for uncertain and complex security contexts and stakeholder prospects. This group includes developments in programmatic and legislative frameworks that govern decision making, adaptations to enforcement techniques, organizational changes to achieve goals, and upgrades to mechanisms for cooperation among various stakeholders. Academics have undertaken coordinated attempts in the past few decades to study innovation in public administration governance in cities both nationally and globally [58]. It includes approaches like urban experimentation [59], policy innovation [60], urban security [61], and urban laboratory cities [62], involving an array of stakeholders, notably businesses, governments, and civil society organizations.

Scholars have examined issues like reform, experimental, and urban labs in urban contexts and found that several crucial governance/management factors influence the innovation of economic development strategies [60]. Furthermore, the attitude to and emphasis on experimenting can reside in integrating dynamics at several unique geographical scales and strategic agencies [59]. It entails deliberate initiatives to effectively reinvent smart city governance structures to manage stakeholders and security challenges. These methods focus on creative actions by various governmental, societal, corporate, and academic entities. Institutional innovation is not a purely nonpartisan method. It includes investigating, disrupting, and eventually overturning established patterns of authority and control [63]. Institutional innovation is, therefore, a political endeavor in the wider context. Stakeholder engagement strategies are often criticized for neglecting or devaluing the complexities of control and authority [64]. We require an essential reconsideration

of the concept and objective of achieving stakeholder satisfaction through engagement and minimizing criminal behavior by mitigating security breaches to firmly establish and reinforce institutional innovation and adaptation mechanisms in cities, businesses, and neighborhoods. Institutional innovation necessitates self-reflection, ambiguity negotiation, and innovative growth [54].

The objective of developing a smart city as a comprehensive concept is fast placing smart governance at its core [14], and academics have highlighted the association between smart governance and the requirement for integrated approaches like security and stakeholder engagement [36]. Becoming a smart city requires stakeholder participation and involvement in decision making, which is essential for smart governance [37]. However, stakeholders' narratives reflect different perspectives of the smart city [65]. There are also disparities between the concept of Smart City governance and its performance, such as stakeholders' satisfaction and reduced crime rate in the city [66], as well as between the ambition of Smart City stakeholders and the activities implemented [42]. Furthermore, although policy initiatives such as situational crime prevention and defensible space have been argued to be effective in reducing certain types of crime, such as robbery, cyberattacks, and vehicle theft, critics have pointed out that they also lead to the creation of sterile and corporatized contexts that are governed in such a manner that they design out undesirable people or inappropriate practices by shuttering or limiting access to areas [67]. In other words, smart city governors prefer to engage and involve stakeholders in decision making to deliver upgraded services that increase their satisfaction [36] and take initiatives to deploy surveillance and other crime prevention technology to reduce crime rates in smart cities [68]. Hence, we developed our hypotheses following the previous literature and theories:

Hypothesis 3. *Institutional innovation in a smart city positively influences stakeholders' satisfaction.*

Hypothesis 4. *Institutional innovation in a smart city adversely influences the crime rate.*

Hypothesis 5. *Institutional innovation moderates the association between smart city governance and stakeholders' satisfaction as such that it strengthens this relationship.*

Hypothesis 6. *Institutional innovation moderates the association between smart city governance and crime rate as such that it weakens this relationship.*

2.4. Contextual Impact of Technological Innovation

In smart cities, governance is coordinating stakeholder dissemination of information and collecting, organizing, and arranging data relating to value-added processes obtained using innovative technology [69]. Additionally, generic enablers may validate data accuracy and excellence, work with all stakeholders across value chains, and build interest in smart city initiatives internally and externally. Generic enablers present reclaimable key components for developing applications for potential technologies. Using technological innovation, key responsibilities in the governance of smart cities include project advancement, implementation, structuring finances, warranting, and accreditation [70]. It further emphasizes how crucial these entities are to promoting transparency, accountability, connectedness, and engagement from every stakeholder involved to ensure their satisfaction [71]. Smart city governance's cornerstone is the technologically innovative application of ICT infrastructure to achieve specified objectives, offering all stakeholders a simplified, one-stop competence for service system execution [72].

Several studies underestimate the importance of adopting innovative technologies to decrease crime rates in the security and privacy spheres. Nonetheless, privacy and security are fundamental components of a high-quality existence in every city, as illustrated by Maslow's hierarchy of needs [73]. Therefore, security is a prerequisite for every smart city [74]. The Safer City program, launched in 1996 by UN-Habitat at the suggestion of African mayors, aims to accomplish smart city governance in that region. The Safer

City philosophy originated in various ways, distinguishing this program distinctively. Urban strategies for preventing crime, including institutional crime, violence prevention, and social crime mitigation, were the primary emphasis of the first phase. The second stage witnessed the integration of two new domains from the city security and privacy viewpoint: tenure protection and compelled evictions and catastrophe response. The third phase strongly emphasizes management, strategy formulation, and organization, highlighting the need to maintain the difference between these three elements. Integrating local governments and their innovative approach to security and privacy is an obligation for the two subsequent phases [75].

Among the various uses for innovative technologies are privacy and security, which help create a system that prevents criminal behavior. A smart, safe city is generally described by drawing on the perspective of Vitalij et al. (2012). According to this perspective, a smart city provides a variety of interconnected systems, a single set of information-management devices, multifaceted coverage for intricate and multifunctional operational responsibilities, and backing for the sustainable development of the current and future services [76]. It appears to be identical to the way a smart city is depicted, whereby cutting-edge technology and international ecosystems come together to improve privacy and safety mechanisms' efficacy, lowering the prospect of terrorism and crime, enabling stakeholders to live in a secure atmosphere and facilitating easy accessibility to enhanced facilities [77]. It should be considered although previous research acknowledges that the growing urban population creates difficulties for the safety and security structure of conventional cities [78] and that these are significant concerns for concurrent embedded urban growth [79]. Most research examining the implications of novel ICTs has done so by critiquing government initiatives, largely depending on conclusions drawn from extensive evaluation research and frequently neglecting to examine exceptionally innovative technological developments [13].

One strategy that combines crime prevention issues with recent smart city development developments is the safe city paradigm [76]. Although it was once envisioned to serve as a framework for protecting against natural disasters, it swiftly expanded to include all elements of city security. By incorporating a variety of cutting-edge technological innovations and strategically allocating security resources, the concept attempts to reconcile urbanization with the requirement for safety and security [77]. Furthermore, a safe city can be defined by integrating cutting-edge technology with the natural landscape, which enhances the effectiveness of addressing the threat of crime and terrorism and makes a harmonious environment accessible to all stakeholders [74]. These concerns include whether the technology innovation is benefiting those subjected to assistance and those who have yet to receive assistance, alongside the reaction of stakeholders. It is essential because establishing an environment of security and putting stakeholders at the forefront of any urban security initiative make it crucial. An essential component of smart city governance is evaluating stakeholders' perspectives of urban security since this promises that cities not only prevent or respond to possible threats and security hazards but also continue to be desirable places for stakeholders to consider homes [80]. Therefore, regarding the previous research, the subsequent hypotheses are formulated:

Hypothesis 7. *Technological innovation in a smart city positively influences stakeholders' satisfaction.*

Hypothesis 8. *Technological innovation in a smart city adversely influences crime rate.*

Hypothesis 9. *Technological innovation moderates the association between smart city governance and stakeholders' satisfaction, strengthening this relationship.*

Hypothesis 10. *Technological innovation moderates the association between smart city governance and crime rate, and it weakens this relationship.*

3. Research Methods

The main purpose of this study is to provide a research framework for a thorough understanding of the association between governance in smart cities and its impact on stakeholders' satisfaction and crime rate in cities, with institutional and technological innovation acting as moderators. Longitudinal studies were conducted to investigate the hypothesis derived from this study and to evaluate the test results using SPSS. Survey questionnaires were administered for this research to assess community perceptions, and primary data were acquired. Four hundred ninety-six individuals from the public sector, private sector, and general community completed and returned survey questionnaires distributed through email and social media, allowing us to enhance construct reliability and validity [81]. The flowchart of research methods is presented in Figure 1.

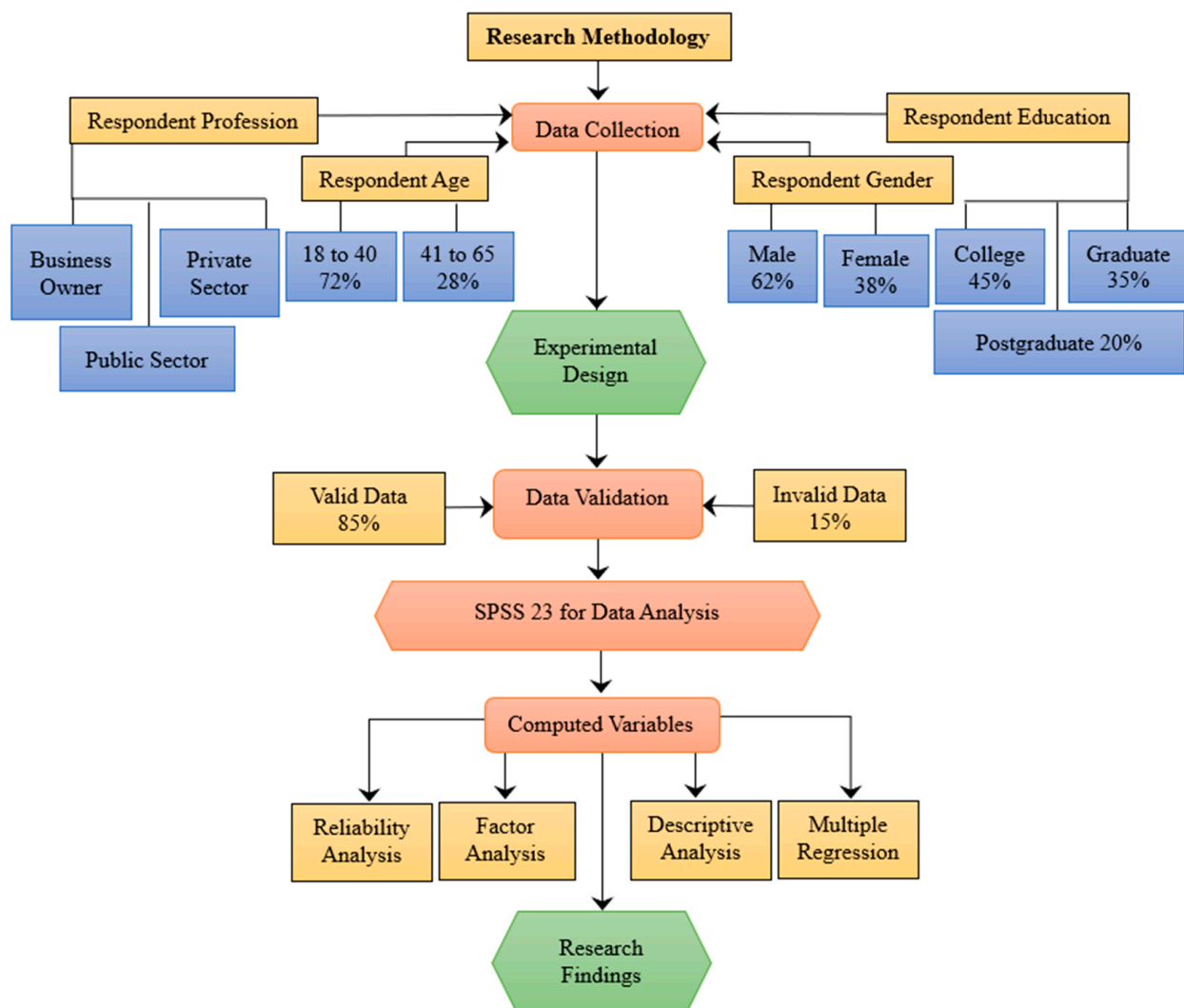


Figure 1. Flowchart of Research Methods.

3.1. Participants and Procedure

Individuals in the public and private sectors, professionals, individuals, graduate students, and other actors in different regions of Pakistan contributed to the data collection. Two bilingual experts first constructed the questionnaire in English, translated it into Urdu, and then translated it back into English to check accuracy and legitimacy [82]. Each participant received an appropriate period to finish and submit the questionnaire when it was distributed. They provided answers to the questions regarding smart city governance, institutional innovation, technological innovation, stakeholder satisfaction, crime rate, and

other demographics. To facilitate comparison, the responses to the questionnaires that were gathered were encoded. Participants were assured that their information would be kept private and applied exclusively for study. With an 85% validity rate, 496 completed survey questionnaires were received. The data were statistically analyzed to satisfy the minimum sample size requirements for multiple regression modeling [83]. 62% of respondents in this study were men, and 72% were in the 18–40 age range. In terms of education, of the 496 respondents, 45% had completed college, 35% had completed graduate school, and 20% had obtained a postgraduate degree.

3.2. Measures

All factors in this study were assessed using a five-point Likert scale ranging from 1 to 5, with 1 being strongly disagree and 5 being strongly agree.

3.2.1. Smart City Governance

We adapted and utilized the collaborative 6 multidimensional scales [84] to evaluate smart city governance. These dimensions and factors were smart living (“education, health, housing, safety, and cultural facilities provided by the city government are excellent”), participation in decision making (“city government always involve the community in decision/policy making”), transparent governance (“performance of city government in different departments is transparent and excellent”), and public and social services (“I am satisfied with city government’s organizational structure to provide better public and social services”).

3.2.2. Stakeholders’ Satisfaction

Elements by Fernandez-Anez (2016) were adapted to measure and investigate stakeholders’ satisfaction with a Cronbach Alpha of 0.727 [85]. The factors in the sample include confidence (“I have full confidence in city government”), personal interests (“my city government takes care of my interests”), provision of information (“I believe that city government provides information true and trustworthy”), and things to do (“I believe that city government does right things for the public”).

3.2.3. Crime Rate

To measure the participants’ perception of the crime rate, we adapted a four-item scale of [86] with a Cronbach Alpha of 0.673. Sample items included traffic violations (“with innovations by city government in institutions and technology resulted in reduction in traffic rules violations”), robbery and theft (“with innovations by city government in institutions and technology resulted in reduction in robbery and theft”), corruption and bribery (“with innovations by city government in institutions and technology resulted in reduction in bribery/corruption”), and smuggling and drugs (“with innovations by city government in institutions and technology resulted in reduction in smuggling/drugs”).

3.2.4. Institutional Innovation

Institutional innovation was rated using an adaptation of [87] four-item measure with a Cronbach Alpha of 0.727. Respondents designated how often they perceive innovations by institutions in cities with factors including usefulness (“innovations made in government institutions are very useful”), legitimate (“innovations made in government institutions are legitimate”), and novel and original (innovations made in government institutions are novel, original, and new).

3.2.5. Technological Innovation

Technological innovation was measured using adapted nine-item factors by [87] with a Cronbach Alpha of 0.778. Survey participants described how often they perceive technological innovation activities, including services improvement (“innovations in technology from city government have improved services”), working conditions on health and safety

(“innovations in technology from city government have Improved working conditions on health and safety”), and environmental impacts (“innovations in technology from city government have reduced environmental impacts”).

3.2.6. Control Variables

Three demographic factors were added to our data sample through a questionnaire. It was further used to evaluate the effect magnitude of the predicted variable. We evaluated and controlled for participants’ age, gender, and education, all of which can influence participants’ perceptions of stakeholder satisfaction and crime rate (sex: female = 0, male = 1; education: high school 1, bachelor’s degree = 1, Master and PhD degree = 3; age: 18 to 35 years = 1, 36 to 50 years = 2, 51 and older = 3).

3.3. Common Method Variance

Because the current study relied on self-reported data, there were reservations about the prevalent technique bias. To avoid the possibility of common method bias, respondents were informed of their confidentiality and the anonymity of their responses [88]. It encouraged people to be truthful in their replies. Furthermore, the questionnaire survey was maintained to be simple and explicit so respondents could easily comprehend it [89]. Finally, Harman’s single-factor test was utilized to investigate the possible impact of common method bias. The test results revealed a poor fit for the single variable solution, with the single factor vector explaining just 28.68 percent of the variance, indicating that common method variance was not a significant threat in the current study [89].

3.4. Data Analysis

Multiple regression methods were applied to support our hypothesis, and SPSS 21 statistical software was used to examine the sample for this study. According to modern social science research, among the best conventional methods for analyzing moderating variables across social scientific disciplines is the bootstrapping method [83]. Furthermore, multiple regression using SPSS is acknowledged as one of the most innovative alternatives to conventional analytical procedures because of several new developments, including confirmatory analysis, nonlinear effects, and mediating and moderating elements [90]. Using primary and secondary datasets, prior studies provided multiple regression statistical techniques to examine interaction effects [91]. We determined that multiple regression using SPSS 21 constituted the optimal approach for this study to analyze our findings. However, several researchers [91] used structural equation modeling (SEM) to examine the impact of the interaction between independent and dependent variables [83].

Convergent validity assessment was employed to develop a confirmatory factor analysis (CFA) measurement model of the full set of self-scales. Items from the parameters are then selected using the modification index. Until the necessary goodness of fit was reached, the element with the biggest modification index value was deleted before proceeding to the next element. Most goodness of fit indicators were higher than the minimal threshold. All the measured variables’ factor loadings are demonstrated to exceed the critical threshold of 0.5 [92]. The goodness-of-fit test, which assessed how well a dataset represented the interconnected path map of a broader context, was used to determine the maximum model fit index.

Our conceptual framework is presented in Figure 2, whereby innovations (institutional and technological) are moderating variables, while stakeholder satisfaction and crime rate are the dependent variables for smart city governance. Our conceptual framework in Figure 2 shows how stakeholder satisfaction and crime rate are both directly affected by smart city governance. Nonetheless, the direct causal connection turns into a moderating relationship when institutional and technical innovation are incorporated into a theoretical framework.

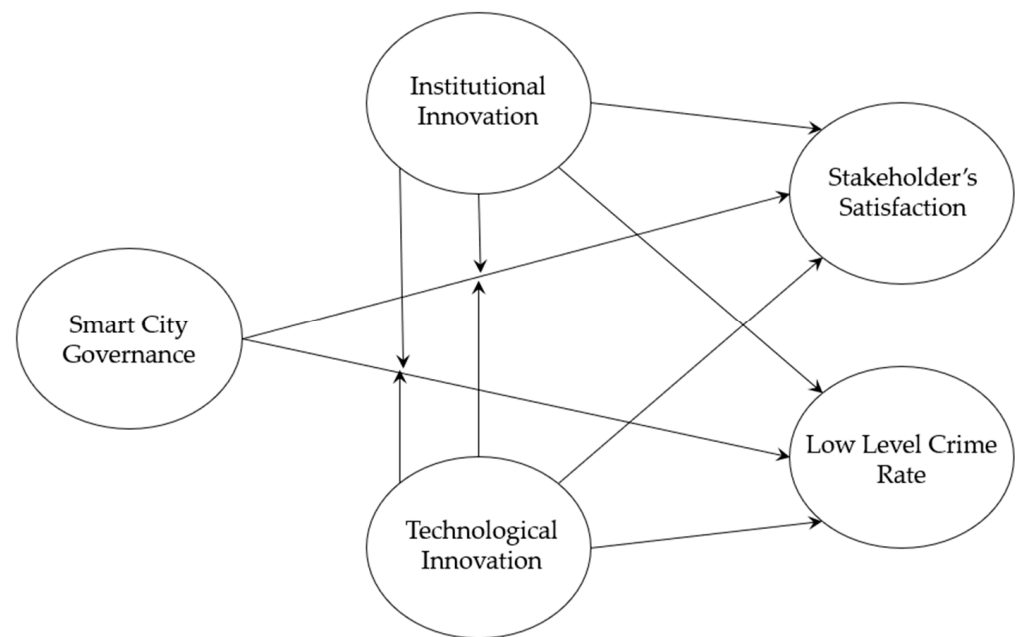


Figure 2. Conceptual Framework.

4. Results

Table 1 demonstrates KMO's findings for each of the five variables—smart city governance as the independent variable, institutional and technological innovation as the moderating variable, stakeholders' satisfaction as the dependent variable, and the crime rate as the dependent variable. A value of 0.561, greater than 0.001, indicates that the data sample size used in this study was acceptable. Furthermore, at a statistically acceptable significance level of 0.000, the Chi-square estimate is 902.463.

Table 1. Bartlett Sphericity Test and KMO of Self-Rating Items.

Factors	No of Items	Component	N	KMO	Bartlett Test Chi-Square	Sig
Smart City Governance	4	0.96	496	0.561	902.463	0.000
Stakeholders' Satisfaction	4	0.821	496			
Crime Rate	4	0.931	496			
Institutional Innovation	4	0.807	496			
Technological Innovation	4	0.877	496			

The reliability and validity assessments are explained in Table 2. The influence of smart city governance as a predictor construct, stakeholders' satisfaction and criminal behavior as outcome parameters, and institutional and technological innovation as moderating variables were all assessed through reliability testing for 20 items. The responses to the twenty questions are as follows: Four elements were attributed to the crime rate, four elements to institutional innovation, four elements to technological innovation, four elements to stakeholder satisfaction, and four elements to smart city governance. Given a sample size 496 and an overall Cronbach Alpha of 0.934, the inquiries used to determine each of the five components proved reliable for this search. Moreover, each element's factor loadings were greater than 0.9. Every component with a factor loading higher than 0.6 suggests that all the responses provided by participants used to assess the variables in this study were valid and reliable.

Table 2. Reliability and Validity Analysis.

Variables	Items	Factor Loadings	KMO @ Bartlett's Test
Smart City Governance	"Education and health facilities in my city provided by the city government are excellent."	0.934	0.737
	"City Government involves the community in decision/policy-making."	0.926	
	"The performance of city government in different departments is excellent."	0.935	
	"I am satisfied with the city government's organizational structure to provide better services."	0.939	
Institutional Innovation	"Innovations made in Government institutions are useful."	0.929	0.727
	"Innovations made in Government institutions are Legitimate."	0.928	
	"Innovations made in Government institutions are novel/new."	0.929	
	"My city government keeps experimenting and taking risks."	0.930	
Technological Innovation	"Innovations in technology from city government have improved services."	0.928	0.778
	"Innovations in technology from the city government have improved working conditions for health and safety."	0.929	
	"Innovations in technology from the city government have reduced environmental impacts."	0.929	
	"My city government invests in R&D and time-to-market."	0.931	
Stakeholder Satisfaction	"I have full confidence in the city government."	0.928	0.727
	"My city Government takes care of my interests."	0.929	
	"I believe that the city government provides true and trustworthy information."	0.928	
	"I believe the city government does the right thing for the public."	0.927	
Crime Rate	"Innovations by the city government in institutions and technology resulted in reduced traffic rule violations."	0.932	0.673
	"Innovations by the city government in institutions and technology resulted in reduced Robbery/theft."	0.939	
	"Innovations by the city government in institutions and technology resulted in reduced bribery/corruption."	0.932	
	"Innovations by the city government in institutions and technology resulted in reduced smuggling/drugs."	0.931	

Table 3 displays the relationships between the variables, internal consistency reliabilities, and descriptive statistics. The additional evaluation of hypotheses on smart city governance's positive relationship ($r = 0.801, p < 0.01$), negative relationship ($r = -0.027, p < 0.01$), and positive relationship ($r = 0.642, p < 0.01$) with institutional innovation, technological innovation, and stakeholder satisfaction is supported by the evidence that all relationships were in the expected directions. As Muller et al. (2005) suggested, multiple regression analysis was performed to assess our moderating framework [93].

To investigate the moderating hypotheses, we employed SPSS 21.0. After controlling for responders' age, sex, and education, as indicated in Table 4 (Models 1 and 2), we discovered that smart city governance was positively and substantially correlated with stakeholders' satisfaction ($b = 0.026, p < 0.01$), hence confirming Hypothesis 1. According to Hypothesis 2, there is a negative correlation between the crime rate and smart city governance, suggesting that more effective governance will decrease crime rates. The results presented in Model 6 of Table 4 illustrate a negative relationship between the crime rate and smart city governance ($b = -1.064, p < 0.01$). Hypothesis 2 is, therefore, substantially supported as predicted. Hypothesis 3 forecasts that institutional innovation substantially and positively impacts stakeholder satisfaction. However, Hypothesis 4 contends that institutional innovation negatively affects the crime rate. Table 4 presents empirical findings suggesting a positive relationship between institutional innovation and

stakeholder satisfaction ($b = 0.463, p < 0.01$) and a negative interaction between institutional innovation and crime rate ($b = -0.437, p < 0.01$), hence providing significant support for Hypothesis 3 and Hypothesis 4. In addition, Hypothesis 7 predicts that technological innovation would significantly and positively influence stakeholder satisfaction; on the other hand, Hypothesis 8 predicts that technological innovation will negatively correlate with the crime rate. Technological innovation has a negative correlation with the crime rate ($b = -0.831, p < 0.01$) and is substantially correlated with stakeholder satisfaction ($b = 0.646, p < 0.01$), as indicated by the findings displayed in Table 4's Models 3 and 7. These results indicate that Hypothesis 7 and Hypothesis 8 are substantially supported.

Table 3. Mean, Standard Deviations, and Correlations.

Variables	Mean	SD	SCG	InstI	TI	SS	CR	Gen	Age	Edu
SCG	2.887	0.937	1							
InstI	3.499	0.922	0.642 **	1						
TI	3.812	0.829	0.559 **	0.808 **	1					
SS	3.278	1.242	0.801 **	0.574 **	0.687 **	1				
CR	3.623	0.906	−0.027 **	0.560 **	0.636 **	0.345 **	1			
Gen	0.650	0.478	0.060	0.116	0.168 *	0.137 *	0.176 **	1		
Age	1.472	0.500	0.057	0.047	0.003	−0.025	−0.083	−0.071	1	
Edu	1.322	0.469	0.094	0.006	−0.100	0.003	−0.117	−0.185 **	0.369 **	1

Note: * $p < 0.1$, ** $p < 0.05$.

Table 4. Effect of Smart City Governance on Stakeholders' Satisfaction and Crime Rate.

Variables	Dependent Variable: Stakeholders' Satisfaction				Dependent Variable: Crime Rate			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
(Constant)	3.278 ***	3.664 **	1.286 ***	1.408 **	3.007 ***	0.402 **	0.969 ***	3.563 ***
Gender	0.304 **	0.300 **	0.115 *	0.131 *	0.370 **	0.202 **	0.104 **	0.154 **
Age	−0.083	0.084	−0.148 *	0.170 **	0.074	0.126 **	1.410 *	0.161 **
Education	0.136 *	0.141	0.074	0.054 *	0.106	0.106 **	0.060 *	0.083 **
SCG		0.026 **	0.588 ***	0.260 **		−1.064 **	−0.924 ***	−0.885 ***
InstI			0.463 ***	1.092 **			−0.437 ***	−0.564 ***
TI			0.646 ***	2.825 ***			−0.831 ***	−1.269 **
Interaction Effect:								
SCG × InstI				0.521 ***				−0.245 **
SCG × TI				0.710 ***				−0.679 ***

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We projected moderating models, including Model 4 and Model 8, which incorporated the moderation effect of institutional and technological innovation on the relationship between smart city governance and its influence on stakeholder satisfaction and crime rate to test the proposed moderating hypotheses, e.g., Hypothesis 5, Hypothesis 6, Hypothesis 9, and Hypothesis 10. Unstandardized empirical findings for Models 4 and 8 are displayed in Table 4. Both the interacting terms between smart city governance and technical innovation ($b = 0.710, p < 0.01$) and the interacting terms between smart city governance and institutional innovation ($b = 0.521, p < 0.01$) in Table 4, Model 4 had a positive relationship with stakeholder satisfaction, suggesting that Hypotheses 5 and 9 are substantially supported. Moreover, the moderating effect between smart city governance and institutional innovation and the interaction term between smart city governance and technological innovation had a negative correlation with crime rate ($b = -0.245, p < 0.01$). The results indicate that Hypothesis 6 and Hypothesis 10 are strongly supported.

Tables 5 and 6 describe the R, R-square, adjusted R-square, and Standard Error values. Because the R values in all the models displayed in both tables are more than 0.4, we included them in this study. Furthermore, R-square values are greater than 0.5 across the models, showing that the model is successful enough to determine the correlations. In multiple regression, adjusted R-square describes the generalization of outcomes, such as the variance of sample results from the population. Tables 5 and 6 explain the values of

the adjusted R-square that are less than the R-square but close to it, which is excellent for generalizing results.

Table 5. Models 1–4 summary.

Model Summary										
Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R-Square Change	F Change	df1	df2	Sig. F Change	
1	0.501 a	0.540	0.527	0.89424	0.540	2.934	3	221	0.034	2.290
2	0.502 a	0.541	0.523	0.89604	0.541	2.231	4	219	0.051	2.281
3	0.798 a	0.636	0.625	0.55465	0.636	60.292	6	207	0.000	2.195
4	0.811 a	0.658	0.645	0.54003	0.658	49.371	8	205	0.000	2.131

a. Predictors: (Constant), EDU, GEN, AGE, InstI, TI, SCG, SCGxInstI, SCGxTI.

Table 6. Models 5–8 summary.

Model Summary										
Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R-Square Change	F Change	df1	df2	Sig. F Change	
5	0.543 a	0.510	0.506	0.23829	0.520	1.456	3	210	0.228	2.165
6	0.809 a	0.655	0.648	0.73709	0.655	99.003	4	209	0.000	2.215
7	0.872 a	0.760	0.753	0.61696	0.760	109.425	6	207	0.000	1.921
8	0.891 a	0.795	0.787	0.57378	0.795	99.180	8	205	0.000	2.219

a. Predictors: (Constant), EDU, GEN, AGE, InstI, TI, SCG, SCGxInstI, SCGxTI.

5. Discussion

Given the rapid developments of technology and its significance for innovation to flourish in such environmental shifts, we must adopt effective continuous learning on institutional and technological developments. The primary focus of this study was to investigate how smart city governance influences stakeholder satisfaction and crime rate through the moderating impact of institutional and technological innovation, keeping this significant problem in mind and extending it to the backdrop of Pakistan. The outcomes of this research showed that smart city governance considerably decreases the city's crime rate and increases stakeholder satisfaction by applying institutional and technological innovation. Prior studies in the literature on smart cities have discovered that while smart city governance has an adverse effect on the city's crime rate [3], it has a positive effect on stakeholder satisfaction [30]. This research contributes to the body of literature by highlighting the constructive and interesting effects of smart city governance on four important aspects of stakeholder satisfaction, including authentic information about personal interests and self-assurance in acting morally, alongside the detrimental effects of smart city governance on four aspects of crime rate, including traffic infractions, robberies, misconduct, and trafficking. These outcomes suggest that smart city governance and integrating traditional and emerging technological innovations can enhance stakeholder satisfaction and decrease crime rates.

Based on the statistical analysis in Model 2, we discovered a positive relationship between smart city governance and stakeholder satisfaction and a negative relationship between smart city governance and crime in Model 6 in a sample of 496 individuals. These results are consistent with previous studies by [30,41], who found that smart governance positively correlates with stakeholders' satisfaction and negatively impacts the crime rate. Because of the diversity of objectives between stakeholders, governance progress can only be measured in terms of stakeholder satisfaction. Uncertainty arises when stakeholders are confronted with societal issues in their territory and need help understanding the

consequences of their attempts to solve those challenges. Consequently, the local government deeply involves stakeholders such as inhabitants, business groups, organizations, and other target audiences in policy formulation and implementation. It implies that the city government's primary focus is sometimes to influence but to provide smart services without generating complications to satisfy its stakeholders [31].

Similarly, security has long been regarded as the heart of smart cities, with their walls as the foremost symbol. On the other hand, a secure city is differentiated by the absence of hazards and the utter lack of terror. As a result, when considering security, one must recognize not only the actual incidences of crime but also the implications of a violent and harmful environment, which is shaped by several factors [41].

5.1. Practical Implications and Theoretical Contributions

Based on our findings, there are several policy implications. First, smart city governance could balance the involvement of stakeholders in their economic development to promote high-quality growth and ensure their security to avoid crimes, especially in developing countries like Pakistan. For better governance in smart cities, governments should incorporate institutional and technological innovations into their economic development policies to improve life standards, safety, and service delivery to their stakeholders. Second, our findings suggest that technological advancement driven by innovation positively impacts inhabitants in smart cities. Therefore, policymakers should promote pro-innovation policies such as infrastructure, construction projects, information technology, and university funding programs to fully realize urban innovation's potential. Finally, smart city strategy augments the stakeholders' and innovation theories. Finally, smart city strategy adds to the stakeholders' and innovation theories. The smart city mitigates the negative side effects of urban expansion (e.g., pollution) while allowing city governors to allocate resources to innovation to reduce these negative effects efficiently. Local governments should incorporate technology and institutions into their urban development plans to make them more innovative.

5.2. Limitations and Future Research

Although the limitations of the research do not reduce the significance of the results, they nevertheless bring our attention to how broadly the results can be generalized. The first limitation is that we cannot ensure the representativeness of our sample because it was developed by adopting a simple random sampling technique. This study's second limitation is that we employed a particular model section to predict outcomes at a given time. Reconstructing our results at various points in time may assist us in discovering possible variations in crime rate and stakeholder satisfaction because of institutional and technological innovation implemented in smart cities. It will reinforce the significance of our findings. We have more dynamic insight into the effects of different important indicators. This research was performed in Pakistan, which is another limitation. The outcomes obtained by applying an identical framework in a different environment may not be equally significant as the findings presented in this study. Finally, we could have examined how institutional and technological innovations interact with other indicators, like crime rate and service quality [94] for income equality and stakeholder satisfaction [95], to determine how this may affect the social connections that citizens can cultivate with their smart cities.

This study enables us to determine several potential research directions. Examining the relationship between the crime rate and citizen satisfaction in a smart city [94] and its improved service delivery could be a potential focus for future research. To expand the scope of this study, researchers may additionally investigate the factors that influence various kinds of innovation, such as social innovation [96], and how integrating such innovation in smart cities impacts crime rates and stakeholder satisfaction.

6. Conclusions

This mixed-methods study assessed the impact of institutional and technological innovation on the relationships between smart city governance, stakeholder satisfaction, and crime rates. A deductive method was used to validate the research framework, which was theoretically constructed. An internet-based survey questionnaire, including 496 individuals from Pakistan's public and private sectors, was used to collect the sample data. The quasi-moderating role of institutional and technological innovation on the relationship and the influence of smart city governance on stakeholder satisfaction and crime rate were examined.

The study objectives can now be answered after being emphasized. In the first question, we discovered a strong positive association between smart city governance and stakeholder satisfaction; in the second, we discovered a substantial negative association between smart city governance and crime rate. The findings supported Hypotheses 1 and 2 statistically at the 95% confidence level. The third hypothesis is substantiated by the idea that stakeholder satisfaction positively correlates with governments' adoption of institutional innovation in smart cities. Given that there is a relationship between implementing institutional innovation in smart cities and decreasing crime rates, Hypothesis 4 is supported. Moreover, as predicted, the inclusion and use of technological innovation in smart cities decreases crime rates and enhances stakeholder satisfaction; for these reasons, Hypotheses 7 and 8 are adequately supported.

Given that institutional and technological innovations have been promptly related to stakeholders' satisfaction and crime rate, we witnessed both moderating variables serving as a quasi-moderator for Hypotheses 5 and 6, institutional innovation as a moderator, and Hypotheses 9 and 10, technological innovation as a moderator on the relationship between smart city governance and stakeholders' satisfaction and smart city governance and crime rate. The results indicated that while a smaller association exists between smart city governance and crime rate, institutional and technological developments have enhanced the relationship between smart city governance and stakeholder satisfaction. As anticipated, Hypotheses 5 and Hypothesis 6, along with Hypothesis 9 and Hypothesis 10, exhibit substantial support.

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