Artificial Intelligence-based Technological-Oriented Knowledge Management, Innovation, and E-Service Delivery in Smart Cities: Moderating Role of E-Governance

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Keywords: Technology-oriented Knowledge Management, Innovation, E-Governance, E-Service Delivery, Smart City Performance

1. Introduction

The recognition of "resources" or "capabilities" that permit organizations to identify, generate, convert, and disseminate knowledge is critical to realizing the successes and failures of knowledge management (KM) within corporations. The structural, technical, and cultural elements that enable the intensification of social capital for KM are termed KM infrastructure (Chuang, 2004; Halawi et al., 2005). The innovation facet is related to the technologically enabled affiliations that emerge within organizations (Lee & Van den Steen, 2010), and organizations can ambitiously be organized by a 'smart city' (Van den Bergh & Viaene, 2015). The presence of norm and trust mechanisms, as well as collective learning environments, is signified by the institutional and cultural dimensions. The appraisal of the KM infrastructure that allows the institutions to identify, develop, transform, and disseminate knowledge is crucial to understanding the strengths and weaknesses of KM initiatives.

Numerous scholars have stressed the significance of knowledge systems and applications in knowledge management (Abualoush et al., 2018; Ajanaku, 2018). Previous KM research has been segmented in the sense that it has described a few components of KM performance but has not offered a comprehensive viewpoint of KM impact on other organization attributes such as innovation performance and smart city performance. The majority of the researchers have looked at the association between KM enablers, procedures, or outcomes in exclusion. For instance, (Gold et al., 2001) proposed that the infrastructure of knowledge (culture, technology, structure) and the process of knowledge (attainment, adaptation, submission, and security) have a direct influence on organizational effectiveness, but they ignored the correlation between knowledge management and innovation. While (Lee et al., 2012) demonstrated the unified relationships between knowledge

management enablers, knowledge creation procedures, knowledge management transitional outcomes, and organizational performance, their research did not contemplate the entire knowledge process and its direct and indirect impact on performance.

Currently, the emphasis on innovation and technology-led evolution is on innovation hubs and inventive centers, smart technological localities, and Living Laboratories that test innovative products (Komninos, 2009). KM has taken power from the confines of the corporate world and enlarged into other socio-economic fields such as education, governance, and so on (Angelidou, 2015). Major global institutions, including the UN, the World Bank, the EU, and the Organization for Economic Cooperation and Development (OECD), have incorporated knowledge management frameworks into their domestic and global strategic planning. It has become completely obvious that there is a significant association between knowledge management and urban development, as city activities can be deliberately created to enable knowledge cultivation. Plenty of scholars are looking into 'knowledge cities' (Carrillo, 2006), and knowledge-based smart city development (Sotarauta, 2015). Overall, integrated knowledge and innovation are crucial determinants of the smart city's rhetoric and execution. Recent technology capabilities never had the same impact on smart cities if they had never been entrenched in knowledge and innovation (Komninos, 2011). The extensive knowledge market was essential for the implementation of the paradigm of cities; it is one of two intellectual components that comprise the contemporary concepts about a smart city, its implementation, and enhanced performance.

The term "smart city" is frequently linked with the notion of a digital city, with extensive use of technology, especially its performance in the areas of governance, surveillance, mobility, education, health, and telecom infrastructure (Bernardo, 2019). Nevertheless, the idea of a smart city extends beyond technology to include other predictors of innovation and governance, such as technological innovation, institutional innovation, social innovation, e-governance, e-government, and smart governance issues (Bokhari & Myeong, 2022; Lopes, 2017). Considering the importance of city governance and administration, as well as collaboration between different stakeholders, to meet the optimum city performance, innovation, expansion, sustainable development, and liveability (Silva et al., 2018), we aim to investigate how smart governance affects smart city performance directly and also moderates the association between innovation and city performance.

The main objective of our study is to examine the relationship between technology-oriented knowledge management, innovation, e-governance, and smart city performance with the help of knowledge management based service science theory (D'Aniello et al., 2020) and diffusion of innovation theory (Kaminski, 2011), as service science theory discusses the use of knowledge collected through citizen and artificial intelligence can help to improve and optimize city's service delivery, and diffusion of innovation theory refers to the procedure by which people espouse a new concept, product, practice, and ethos. Further, we will investigate the indirect mediating role of innovation in the relationship between technology-oriented KM and smart city performance and the indirect moderating role of e-governance in the relationship of innovation and smart city performance. Previous scholars examined the direct impact of knowledge management on innovation (Carneiro, 2000; Du Plessis, 2007), the impact of innovation on smart city performance (Anthopoulos, 2017), and the effect of e-governance on smart city performance (Kumar, 2015; Lombardi et al., 2012), but only a few explored the indirect relationship between these constructs (Haider & Kayani, 2020). Our study will contribute to the existing literature by investigating indirect associations to know-how innovation mediates the relationship between integration KM and city

performance, and how e-governance strengthens the relationship between innovation and smart city performance.

The subsequent section provides a brief outline of the literature on KM, innovation, e-governance, and smart city performance. Section 3 describes the research method used to find relevant outcomes for this study. Section 4 describes the research findings, while Section 5 discusses the recommended next steps for smart city research from the perspective of knowledge management. Section 6 concludes with policy implications and a conclusion.

2. Background and Hypotheses

2.1 Technological-Oriented KM, Innovation, and Smart City Performance

For numerous eras, the practice of knowledge management (KM) has attracted the attention of researchers and experts alike. Academics and professionals have focused their efforts on the discussion of how to effectively employ KM in contemporary organizations to achieve better outcomes (Ajanaku, 2018; Lee et al., 2012). The fundamental KM approach and its application to accomplish benefits of performance and competitive advantages are critical success factors in this context (Jennex, 2019; Oluikpe, 2012). Considering the significance of specialized innovation and knowledge sharing in our economic system, knowledge management will hold a significant role in the corporate in the future (Davenport & Ronanki, 2018). Consequently, the digital revolution and the increase of new high-tech innovations in various disciplines will absorb various tedious tasks, abandoning only complicated operations for highly competent, primarily white-collar workers (de Grip et al., 2018). Concurrently, new forms of knowledge are developed because of the use of such new technologies, leading to new prerequisites for administering knowledge (Fteimi & Hopf, 2021). Previous literature suggests one of the main approaches of KM which is referred to as technology-oriented KM, and it follows a codified strategy to find explicit knowledge stashed in external databases (Maier & Remus, 2003). Digitization can effectively process enormous amounts of heterogeneous data, knowledge, and information by employing AI and associated technologies. Two aspects distinguish AI applications, which determine our understanding of knowledge and how it is managed in institutions. First, AI algorithms can process data and discover trends in it autonomously, perhaps more effectively than people. As a corollary, these evolutionary computations can instantly develop important types of knowledge from data (Fteimi & Hopf, 2021).

Smart city governments are constantly under pressure to enhance public service delivery in a citizen-friendly approach in the context of digital transformation. Local governments in smart cities are constantly interested in improving citizen-friendly delivery of public services in the age of technology revolution to enhance efficiency. Instead of focusing on a specific range of services for target markets, as is common in the private sector, municipal government services must manage a broad, diverse array of services that must be delivered to all inhabitants (Wang et al., 2005). Even though distinctive clusters of residents will have unique attributes and expectations, access to public services and information must be guaranteed (Gouscos et al., 2002), while cost efficiency of service delivery must be sustained.

Knowledge sharing is critical to the principle of Knowledge Alignment because knowledge integration cannot be easily accomplished without sharing. Consequently, numerous previous researchers found no association between Knowledge Stock and Knowledge Integration (Reich et al., 2012), which is not surprising given that level of expertise does not indicate proclivity to share. This is consistent with prior research, which discovered that knowledge had little or no direct impact on

performance (Faraj & Sproull, 2000). Subject Matter Experts may be reluctant to share their knowledge with non-domain professionals for a variety of reasons, including power, language differences, and time constraints (Maqsood, 2009). On the contrary, most organizations claim that an effective and efficient KM process will benefit organizational performance. As a result, knowledge management (KM) is widely accepted as an important predictor of organizational innovation or performance (Darroch, 2005). However, there are some differences in the outcomes of KM sub-processes or sub-dimensions and organizational performance.

Performance is a common thread in most disciplines such as social science and management, and it is of significance to both academics and practitioners. Although the relevance of the notion of performance is broadly accepted, the intervention of performance in study designs is perhaps one of the most difficult issues encountering academic researchers today. With the quantity of literature on the subject constantly growing, it appears that there is little hope of achieving alliance on basic terminology and interpretations. Some people have expressed their dissatisfaction with this concept. As a consequence, electronic service delivery by smart cities should be included as smart city performance in this study (Saha et al., 2010). From a traditional standpoint, organizational performance is usually associated with economic performance (Richard et al., 2009), and the financial benefits of organizational effectiveness are strongly tied to the company's performance (Ahmed et al., 2015). (Darroch, 2005) her analysis, employs contrasting and individually introspective performance indicators, such as "Our company is more profitable than the industry average," and individual introspective performance indicators, such as "We are more profitable than we were five years ago." These performance indicators include both financial and non-financial indicators. Nevertheless, just like any other organizational resource, effective technology-oriented knowledge management through artificial intelligence should contribute to key attributes of smart city performance such as e-service delivery (Erastus et al., 2021). Furthermore, as smart cities improve their AI-based knowledge management, they can achieve optimal e-services solutions to satisfy the needs of their citizens (Fteimi & Hopf, 2021). Smart cities can acquire and use knowledge more productively with increased AI-based knowledge management capabilities, resulting in above-average performance. Thus, we propose

Hypothesis 1: Higher the AI-based technology-oriented knowledge management, the higher the likelihood that a smart city offers e-service delivery to citizens

When considering the association between Knowledge Management and innovativeness, we first begin with Schumpeter. The procedure of integration of established theoretical and physiological ingredients is known as innovation according to him (Schumpeter, 1935). Specifically, innovation is the process of combining an organization's existing knowledge capital to generate new knowledge. As a consequence, the ultimate focus of an innovative business is to reorganize modern knowledge assets while simultaneously researching new knowledge (Yao-Sheng, 2007). Knowledge exploration and manipulation have both been proven to contribute to the innovativeness of an organization and its performance (Hall & Andriani, 2002). Numerous research on the significance of Knowledge Management in the process of innovation has been undertaken. The outcomes of (Du Plessis, 2007) supported the crucial importance of knowledge management in knowledge processing capability, and hence in the incidence and interactivity of innovation. (Huergo, 2006) presents statistical evidence supporting the positive effect of technology management on organizations' innovation success. (Brockman & Morgan, 2003) argue that KM techniques like "innovative information use," "efficient information gathering," and "shared interpretation" improve the efficiency and

innovativeness of new products. Theoretical approaches provide vague arguments about a particular emphasis on "demand-driven" or "collaborative" knowledge management techniques. Incredibly strong relations in a knowledge-sharing community may constrain the innovation process due to redundancy (Alavi & Leidner, 2001). On the other hand, a shared knowledge base enhances intellectual capital within the society (Nonaka et al., 2000).

Knowledge management systems, particularly their ICT elements, emerge to enhance efficiency, at least perceived progress (OECD, 2003). This is compatible with outcomes on the function of knowledge management in businesses, which unearth statistical evidence proving enterprises with superior knowledge management employ their resources effectively, hence increasing innovation (Du Plessis, 2007). Findings of previous case studies offer conflicting results too. Darroch et al.'s findings are an excellent illustration. (Darroch, 2005) demonstrates that dissemination of knowledge improves innovation success, although (Darroch & McNaughton, 2002) discovers no substantial advantages. A further component of the KM-innovation connection is how knowledge management influences distinctive forms of innovation. According to Darroch and McNaughton (2002), different kinds of innovation demand different resources and, therefore, a unique knowledge management strategy such as technology-oriented knowledge management. They examined the impact of knowledge management on three different kinds of innovation. As per their observations, diverse KM initiatives are significant for different kinds of innovations. Consequently, we believe that different knowledge management will influence diverse aspects of innovation success differentially, as well as the velocity, reliability, and magnitude of innovation success. Hence, we propose:

Hypothesis 2: Higher the AI-based technology-oriented knowledge management, the higher the likelihood that a smart city will have more innovation success

Innovation is a modern concept, discipline, or artifact that a person or entity perceives to be novel. When an innovation emanates, diffusion occurs, which implies interacting or distributing the reports of the innovation to the intended group (Rogers, 2010). According to the theory of diffusion of innovations, diffusion of innovation emerges when potential consumers become informed of the innovation, analyze its significance, and decide based on their assessment, to incorporate, or reject the innovation, and demand evidence of the deployment or disapproval decision (Rogers, 2010). These mechanisms eventually occur through a platform among citizens (consumers) within a society. Diffusion of innovation considers both individual and societal elements that influence an adoption decision or abandon a particular innovation. Rogers contends that cognitive and social factors, as well as environmental and contextual aspects, may influence the diffusion of innovation.

Service innovation, defined as "new developments in service processes involved in delivering core products and services" (Oke, 2007), can be defined as a group of enhanced efficiency for delivering existing services or products (Chuang & Lin, 2015). E-service innovation focuses on services provided mostly through digitized network connectivity, demonstrating the types of companies that employ internet technologies to optimize service delivery and adapt the services that suit the clients' demands. E-service innovation improves value by facilitating service providers to leverage digital strategies for improving customer–firm relationships and reducing service output uncertainty (Tsou & Chen, 2012). External data can be consolidated with digital knowledge acquired through the internet and other useful information to maximize the effectiveness of service delivery (Kim & Pae, 2007). E-service innovation can be investigated by identifying the qualities that distinguish it from all other innovations for improved service delivery (Xu et al., 2005). Consequently, e-service

innovations can encourage organizations to provide enhanced customer value while also improving e-service delivery.

Another relationship investigated in this study is the link between innovation and smart city performance, which is a city's capacity to provide e-service delivery. Previous research established a significant positive association between innovation and performance (Darroch, 2005; Li & Calantone, 1998; Vázquez et al., 2001). Hence, we proposed the following hypotheses on this basis:

Hypothesis 3: Higher the innovation, the higher the likelihood that a smart city will provide e-service delivery

Hypothesis 4: Innovation mediates the relationship between AI-based technology-oriented knowledge management and e-service delivery

2.2 Moderating Role of E-governance

Smart city governments are constantly looking for modern techniques to provide quality public services. E-Government is one indication of a drastic transformation in service delivery to citizens, in which unique Information and Communication Technologies (ICT), mechanisms, organizational structures, and management systems are launched to promote the public significance and generate positive change in people's lives (Contini & Lanzara, 2008). During this evolution, a significant number of innovations were implemented. In comparison to the corporate sector, where organizations attempt to maximize competitiveness to generate profit, government institutions strive to innovate to generate better performance. Further, public sector services are poised to generate public performance and improve desired public outcomes. The three main principles of public sector innovations are novelty, execution, and implications, which lead to better public outcomes such as reliability, performance, transparency, and user satisfaction (Daglio et al., 2014).

Service delivery innovation is among the best-acclaimed innovations in public sector organizations in Eu countries; according to the 2010 European Union's Yardstick, 66 percent of organizations across the EU-27 report experiencing incorporated innovations in public services (Arundel & Hollanders, 2011; Paskaleva et al., 2018). System and governance strategies for innovation have been identified as the most prevalent, particularly at the domestic level. Environmental challenges, increasing population, and poverty have highlighted the use of creative and innovative approaches to the challenges confronting public services in European cities. As novel approaches to address the most complex urban challenges, modern e-governance frameworks, organizational techniques, and transparency have been proposed (Co-operation & Development, 2011). In recent decades, technology innovation has boosted governments' capability to perform the necessary methodologies and procedures to achieve this (Osborne et al., 2014).

ICT has been invented to provide an intensifying range of services electronically, to provide people with an access to online platforms and to mitigate service delivery costs. These activities fall under the umbrella of e-government, which aims to "...enable and improve the efficiency with which government services and information are provided to citizens, employees, businesses, and government agencies..." (Carter & Belanger, 2004). In terms of communication channels for the delivery of government services, the online channel is likely to be the top priority for governments, owing to its cost-effectiveness (Ebbers et al., 2008). As a result, governments have an inherent interest in their citizens' adoption of the online service delivery channel. Consequently, the essence of government portals must concentrate on those unique requirements and strive to satisfy

"consumers" (= inhabitants, citizens, and enterprises) (Kubicek & Hagen, 2001). Considering these requirements, governments must choose an online service delivery model that integrates both structure and content to improve performance. Hence, we propose our hypotheses as follows:

Hypothesis 5: Higher the implementation of e-governance in a smart city, the higher the likelihood that a smart city offers e-service delivery to citizens

Hypothesis 6: Relationship between innovation and smart city performance is strengthened with the moderating impact of e-governance

3. Research Methodology

3.1 Sampling

Increasingly researchers are combining mixed-method approaches to establish a deeper level explanation for this phenomenon under investigation, improve the validity of the results, and explain conflicting outcomes (Chuang & Lin, 2013). To collect data for testing the proposed research model and hypotheses, this study used a quantitative survey technique. The quantitative survey was carried out from January 2022 to May 2022. Following that, interviews were performed. We interviewed public officers in target cities in Pakistan in April 2022 to help interpret and understand the statistical results, thereby strengthening the outcomes.

The data was acquired from a sample of South Korea, Pakistan, Bangladesh, and Japan public officials and citizens who were directly or indirectly involved in public service delivery decision-making. This assessment threshold was developed on the assumption that senior officials and citizens would necessitate the presence of some system to ensure knowledge management. The most qualified individuals in each department were identified and requested to respond to the survey, presuming that they would be qualified to comment on the transmission of knowledge throughout the organization instead of one or two departments.

The survey's administration took place in three stages. After identifying the population of public officers, entrepreneurs, and citizens, from metropolitan cities with a population of 600,000 or more in South Korea, Pakistan, Japan, and Bangladesh, a pre-notification mail describing the objective of the study and proclaiming the impending influx of the survey was sent to targeted respondents. A set of questionnaires was forwarded to targeted respondents two weeks later, including shared online on different social media websites. The effective usable sample size was 569. Although there have been very few experimental investigations on knowledge management identified in the existing literature, it is hard to determine how age, education, experience, or nationality may have influenced the findings. To test for quasi bias, a spontaneous cross-section of 90 participants who had not responded was chosen and delivered a short survey questionnaire to fill. The brief questionnaire was completed by 24 (26.7 percent) of this group. ANOVA analyses reported no difference in mean replies from early, late, or non-respondents, and thus no substantial variation between each segment of respondents. Table 1 encapsulates the respondents' characteristics in terms of their age, education, experience, and nationality.

********** Place Table 1 here please **********

3.2 Constructs Measurement

A survey questionnaire was constructed to evaluate the four possible phenomena under study: (a) technology-oriented knowledge management (KM); (b) innovation; (c) e-governance; and (d) smart city performance. All variables were assessed with components that had previously been substantiated in research. The survey questionnaire items were paraphrased to explicitly address the perspective of this study (see Appendix A).

Knowledge Management: Know management was adapted from (Darroch, 2003) who designed three scales to evaluate KM behaviors and practices: acquiring knowledge, disseminating knowledge, and response to knowledge. Those are captured by eight factors: processes for acquiring knowledge about traffic violations through the database; processes for acquiring knowledge about our citizens' behavior through AI; process for acquiring knowledge about new services; process for acquiring knowledge about competitors within our private industry; feedback from projects through the database to improve subsequent projects; processes for exchanging knowledge with our private business partners; process for benchmarking performance through the database; and teams devoted to identifying best practice for services.

Innovation: This paper employs the adapted (Chausset & Mc Namara, 2014) typology of innovation. In this context, innovation is defined as creating groups with different areas of expertise, knowledge sharing within groups, knowledge sharing between groups, encouragement to question and reflect on the decisions, availability of physical resources to acquire new knowledge to develop new ideas, allocate time for idea generation through knowledge sharing, new or significantly improved methods of producing services, acquisition of advanced machinery, equipment, and computer hardware for the development of new or significantly improved services, acquisition of software for the development of new or significantly improved services, and acquisition of existing knowledge, copyrighted works, patented and non-patented inventions and other types of knowledge from other cities.

E-Governance: We adapted the measurement scale (OECD, 2015) to determine e-governance for this study. E-governance is defined in this context as a strategy of local government for e-government, citizen's right to require digital communication, business right to require digital communication, public authority right to require digital communication from other parts of the public sector, utilization of ICT project budget thresholds/ceilings to structure its governance processes, public services or procedures mandatory to use online, government priority to increase the number of mandatory online services aimed at citizens, government priority to increase the number of mandatory online services aimed at businesses, and main national citizen portal for government services.

Smart City Performance: We utilized E-service delivery to measure the construct smart city performance. Measurement scales used by (Wu & Guo, 2015) for e-service delivery were adapted to investigate this variable here. We measured e-service delivery in this perspective as ease of enrolment of voting online for the first time in government elections, ease of lodging personal income tax return online, ease of renewing international passport online, ease of renewing personal driving license online, ease of making an official declaration of theft of personal goods to the relevant police online, ease of obtaining a copy of a birth certificate for self electronically, ease of obtaining a copy of a marriage certificate for self electronically, and ease of renewal of registration for a motor vehicle online.

3.3 Analysis

The survey data was analyzed employing IBM SPSS Statistics 23 and SmartPLS 3, a multi-regression modeling approach that has gained prominence due to its precision and effectiveness. The multi-regression technique includes a regression estimation procedure, which allows for the depiction of both quantitative and qualitative latent constructs while enforcing fundamental criteria on scale items, sample size, and redistributive assumptions We performed an analysis in stages: (1) we evaluated the measurement model by restricting our indicators to a sequence of confirmatory factor analysis (CFA); and (2) we developed a structural model to investigate our hypotheses. SPSS 23 (Santoso, 2016) was used for statistical analysis to substantiate the indicators and investigate the hypotheses.

To ensure that the answers were truly representative, the stimulatory effects of nonrespondent bias were mitigated by distinct participants to a sample of nonrespondents predicated on personal characteristics such as age, education, and experience. At the 5% level of significance, chi-square test results found no significant difference between the three respondent groups for age ($\chi2 = 70.323$, $p < 0.01$), education ($\chi2 = 484.580$, $p < 0.01$), gender ($\chi2 = 4.937$, $p < 0.01$), and experience ($\chi2 = 423.907$, $p < 0.01$). Consequently, we asserted that this study did not have a concern with nonresponse bias.

Another potential source of concern is the presence of common technique bias. By separating predictors and criterion construct objects throughout a lengthy survey question and assuring survey confidentiality, we reduced typical technique bias. The Harman one-factor test was used to look for common approach bias (Podsakoff et al., 2003). An unrotated confirmatory factor analysis of all elements employed in this study reveals five elements with eigenvectors greater than one, which explains about 73% of the variation. The first (largest) component accounted for 18% of the variance. Because multiple factors were collected and no single criterion accounted for more than 52 percent of the variation, common technique bias was not identified as a significant concern.

A convergent validity test was employed to create a measurement model of the entire self-rating scales using confirmatory factor analysis (CFA). Thereafter, the modification index is used to select objects from the factors. The element with the highest modification index score was eliminated first, followed by the next component, and so on until the intended goodness of fits was accomplished. Most of the goodness of fit predictors surpassed the defined cut-off criterion, but a few factor loadings were below the minimum standard of 0.5. Therefore, we excluded them to acquire valid data for our model. The factor loadings of all factors of estimated parameters are validated to be higher than the critical value point of 0.5 (Bokhari & Myeong, 2022). We are now at the crucial stage of determining whether the conceptual framework that we have defined is legitimate after it has been explained and has delivered all the necessary reliability and validity tests. This was achieved by ascertaining the goodness-of-fit benchmark for the model fit. The potential to ascertain how well the model fits into the variation structure of the dataset is regarded as goodness of fit. The CFA evaluation and research framework represent the data well based on quantitative assessment criteria. Cronbach's alpha coefficients were employed to evaluate the reliability of the metrics, and construct correlation was applied to estimate the sample's validity. The items for each variable were created using previous research. These indices have the potential to provide superior evidence about construct reliability and validity above the threshold of 0.50.

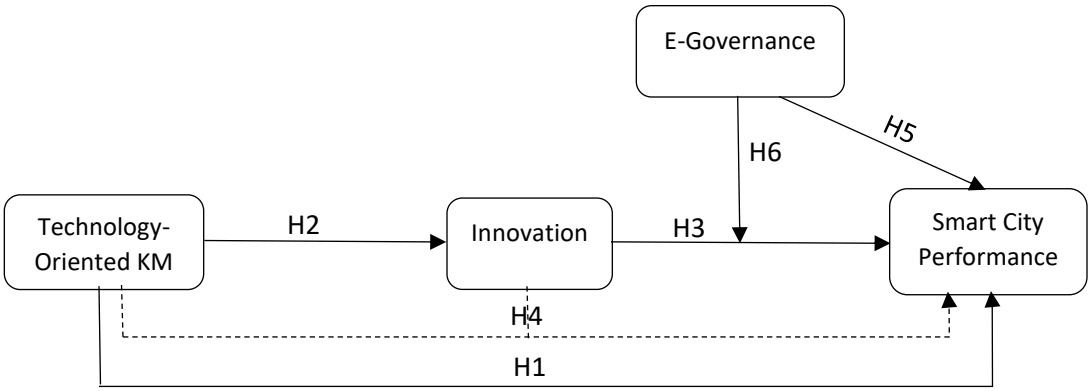

Figure 1: Research Framework

Figure 1 illustrates our research framework, in which technology-oriented KM is depicted as an independent variable, smart city performance dependent, innovation mediating, and e-governance as a moderating variable. Our conceptual framework suggests a direct impact of technologically oriented KM on smart city performance, which is e-service delivery, but with the integration of innovation, the immediate linear relationship was transformed into a mediating relationship. Furthermore, e-governance was introduced as a moderating variable between innovation and smart city performance. Statistical mediation and moderation analysis employ three fundamental techniques: (1) causal stages, (2) coefficient difference, and (3) coefficient product (Hair, 2009).

4. Results

Table 2 displays the item measures' standardized loading outcomes and other benchmarks, as well as the reliability and validity indicators. All components in the reliability analysis had factor loadings varying from 0.637 to 0.895, suggesting that they were suitable for the rest of the assessment. The composite reliability indicators of all first-order components range from 0.903 to 0.953, which is greater than the recommended threshold of 0.70 (Segars, 1997). Furthermore, the average variance extracted was greater than the 0.50 threshold suggested by (Segars, 1997). The descriptive and discriminant validity of the measurements is shown in Table 3. For better discriminant validity, the square root of a construct's average variance extracted must be greater than the square root of the construct's comparisons with the other components (Coleman et al., 2016). The findings also suggested that our components met this threshold, proving discriminant validity. An investigation of cross-loadings revealed appropriate discriminant validity as well.

********** Place Table 2 here please **********

To examine the proposed model, we employed IBM SPSS Statistics 23 with the bootstrap technique. An evaluation of the conceptual framework, which included the coefficients of the correlation between constructs, substantiated the hypothesized impacts as well as the R-square values, which suggest the proportion of the variation in dependent constructs expressed by their forebears. The control constructs (Model 1) were joined into the analysis model first, preceded by the main variables (Model 2), two-way interaction effect (Model 3), and moderating effects (Model 4), as suggested by (Bokhari & Aftab, 2022). Consequently, we simulated both the interactive (Model

3, 4) and main effects on innovation (Model 2). The findings of the structural equation model analysis are demonstrated in Table 5. We concentrated on Model 3 and Model 4 because the speculated complex interactions are statistically significant.

********** Place Table 3 here please **********

Figure 2 illustrates the Model 4 and Model 5 paths and their significance. Technology-oriented knowledge management had a significant impact on innovation ($\beta = 0.766$, $p < 0.01$) and e-service delivery ($\beta = 0.370$, $p < 0.01$). This factor accounted for 64.9 percent of the variation in innovation and 65.3 percent of the variation in e-service delivery. Consequently, H1 and H2 are supported. H3 was supported by the fact that innovation had a significant impact on e-service delivery ($\beta = 0.935$, $p < 0.01$). The outcomes for the three control variables in the study exhibit that respondents' gender, education, age, and experience have no impact on innovation, e-governance, or e-service delivery.

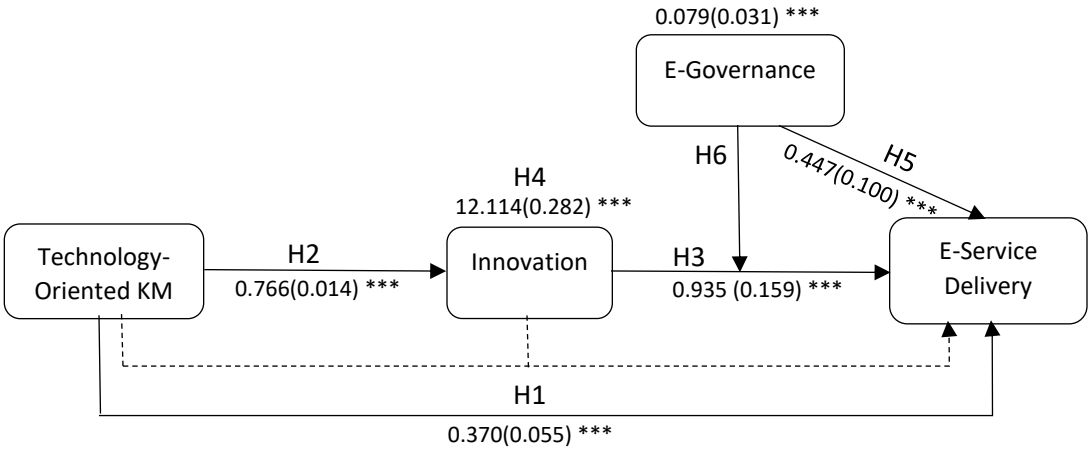

Figure 2: Research outcomes

We investigated the interaction effect of innovation on technology-oriented KM and e-service delivery and discovered a significant interactive effect ($\beta = 12.114$, $p < 0.01$). We further examined the interaction impact of e-governance between innovation and e-service delivery and found a strong significant moderating effect ($\beta = 0.447$, $p < 0.01$). This result corroborates our hypothesis that complementarity is essential in the suggested framework. Although the complementarity of internal and external dynamics may expedite synergic innovation, few investigations have been made to test this correlation. Therefore, we designed to simulate both the interactive and main impacts of innovation. When these interaction terms were included, the R^2 for innovation increased to 0.653. Model 5 explained by applying multiple-regression modeling to explore the mediating role of innovation when knowledge management was a predictor variable and e-service delivery was considered an observed variable. Results in Table 5 revealed ($\beta = 12.114$, $p < 0.01$) a significant positive and indirect relationship between knowledge management and e-service delivery, hence, H4 is strongly supported.

********** Table 4 (Models) here **********

The results of the moderating analysis are shown in Model 4 of Table 4. The findings demonstrate a direct positive relationship between e-governance and e-service delivery ($\beta = 0.447$, $p < 0.01$), strongly supporting our proposed H5. It indicated a significant and positive direct relation between e-governance and e-service delivery. Moreover, we hypothesized that e-governance would play a moderating role in the relationship between innovation and e-service delivery. The findings ($\beta = 0.079$, $p < 0.01$) provided strong support for our hypothesis H6 as an indirect moderating relationship between innovation and e-service delivery. The outcomes showed a substantial and progressive direct and indirect relationship between e-governance and e-service delivery; e-governance plays a critical positive and significant moderating role between innovation and e-service delivery.

5. Discussions

According to the knowledge management-based service science theory by (D'Aniello et al., 2020) and the diffusion of innovation theory of (Kaminski, 2011), a city government should integrate its technological resources and competencies to manage acquired knowledge and enhance e-service delivery through technological innovation. Following the theoretical framework, the findings corroborate our hypothesis that enhancing innovation must be driven by the interaction effects of knowledge management and city performance. (Hess & Rothaermel, 2011) explored the role of innovation on a city's performance to determine when and how technology-oriented sources are substitutive. This paper advances a research gap by examining the interaction effects of technology-oriented knowledge management and e-service delivery on innovation and the contextual role of e-governance between innovation and e-service delivery. City governments must implement diverse approaches regarding e-service offering and e-service delivery protocols by ensuring innovation and e-governance, thereby fostering advantageous e-governance with innovation.

Table 4 shows a diverse range of results. All the correlations between knowledge management, innovation, e-governance, and smart city performance indicators were positive and statistically significant. Table 4 provides evidence that several independent knowledge management elements do not correlate with different aspects of performance measures. One conceivable interpretation of these findings is that comparative performance metrics may struggle from a halo effect, wherein city governors sensationalize their own cities' effectiveness. Besides that, knowledge management is not the only factor that influences performance. Other factors, such as the city's innovative or e-government environment, may have a substantial impact on performance. The relationship between knowledge management and innovation was theoretically established in the literature, but statistical evidence was inadequate. Consequently, in this study, a city that is proficient in knowledge management attributes is more innovative. According to a common assumption, intangible knowledge is more complicated for contenders to access and replicate, therefore this type of knowledge has a tremendous opportunity to transform competitive advantages (Foss, 1996) hence improving performance. The findings presented in this study are significant because they demonstrate that to be innovative, having knowledge is just as essential as what you do with that knowledge.

Smart cities with well-developed technology-oriented knowledge management behavioural patterns are more likely to generate greater performance (i.e., e-service delivery) and develop incremental innovations supporting our proposed H1 and H2 substantially. Moreover, municipalities

with well-developed innovations and technology are more strongly predictive of e-service delivery, with the fact that technological innovation is critical for providing electronic services in smart cities, supporting our assertion in H3. These conclusions are also supported by an analysis of individual knowledge management factors. Our empirical analysis not only suggests that knowledge management has a significant and positive influence on innovation and innovation had a significant positive effect on smart city performance but the findings also revealed that knowledge management has a significant indirect effect on smart city performance through innovation, supporting our projected H4 substantially, suggesting that cities with more information technology can enhance performance by maximizing the e-services they provide to their citizens.

Furthermore, our statistical analysis recommended that e-governance has a substantial and positive impact on smart city performance therefore our proposed H5 was supported significantly. The findings also supported H6 and proved that the direct relationship between innovation and performance is strengthened by the e-governance factor hence this moderating relationship is also confirmed. In the context of smart cities through innovation, we investigated the role of e-governance in boosting e-service delivery and the implications it has on citizen satisfaction. According to the study findings, e-governance has the potential to strengthen the association between innovation and e-service delivery. There is a significant disparity in the expectations and perceptions of ordinary citizens in the cities regarding service delivery, which has harmed residents' satisfaction over the years. Considering the prevailing adverse effect of the predominant dilemma, there is an imperative need in developing cities that lack innovation to implement e-governance in all public agencies (Naz, 2009).

6. Conclusion

This study demonstrates that direct and indirect driving forces are mutually advantageous. Furthermore, analyzing their interaction can help to model the relationships between knowledge management, innovation, e-governance, and e-service delivery. Smart cities should manage the knowledge acquired through artificial intelligence and develop new information technology-based e-services through innovation. Furthermore, innovation mediates the relationship between knowledge management and e-service delivery, while e-governance moderates the relationship between innovation and smart city performance.

6.1 Theoretical Implications

Decisions are made within organizations about what operations the organization will engage in, how those operations will be carried out, what resources will be necessary, which resources will be disbursed to different functions, and, eventually, which resources will be used (Penrose & Penrose, 2009). In this context, this study contends that knowledge acquired through artificial intelligence serves several functions: first, technological-oriented knowledge can be both an intangible and tangible resource (Hall, 1993) that can be used for better decision-making; second, acquiring knowledge favours any decision-making regarding the utilization of resources to provide electronic services; third, a competency in knowledge management empowers everyone within a city government to capitalize the most assistance from the knowledge and other capabilities (Penrose & Penrose, 2009); fourth, effective, efficient, and constructive knowledge management contribute significantly to innovation, and fifth, innovation through KM has a stronger influence over e-service delivery when there is a high degree of e-governance in a smart city.

Constructive knowledge management was developed as a coordinating mechanism by presenting substantial evidence with a proclivity for establishing innovation capabilities were more probably to have well-developed knowledge management policies and attitudes. It is reasonable to suggest that most smart cities not only have knowledge management capabilities but also ensure effective utilization of other accessible resources. This finding provides early evidential support for (Penrose & Penrose, 2009) concepts by demonstrating the importance of knowledge management as a coordinating mechanism when formulating innovation capabilities. Furthermore, we discovered substantial evidence for the notion that a smart city developing dynamic innovations had well-developed knowledge management policies and behaviours, as well as credible evidence that enhanced smart city performance and knowledge management co-existed.

Technology-oriented knowledge management was found to have a direct impact on e-service delivery and innovation, while innovation had a direct effect on e-service delivery. When e-governance was added as a moderator, it not only had a direct impact on e-service delivery but also strengthened the relationship between innovation and e-service delivery. These findings are significant because empirical support is provided for the existing knowledge management-based service science theory (D'Aniello et al., 2020) and the diffusion of innovation theory of (Kaminski, 2011), and, more importantly, empirically evidenced development of e-governance as a moderator between the innovation and e-service delivery is yet another contribution to the literature of innovation and applied sciences.

6.2 Managerial Implications

Knowledge management has been heralded as a novel discipline. The understanding of the concept of knowledge management is frequently systematic with the advent of information technology as a remedy for knowledge acquisition. This study addresses a broader framework of knowledge management by utilizing previously discovered knowledge management elements that are characteristics of an organization that manages knowledge effectively (Darroch, 2003). The study also demonstrates the significance of effective knowledge management. Consequently, smart city managers should develop initiatives to improve the knowledge management attitudes and behaviours, because a city that manages knowledge effectively will be more innovative. Furthermore, smart city governors should develop and implement an e-governance system to improve e-service delivery to smart city citizens through innovative technologies.

6.3 Limitations and Future Research

This study, like most empirical research, has certain limitations that must be considered when interpreting, extending, and generalizing the findings. Since this research was performed in Asian countries like South Korea, Pakistan, and Japan, the attributes of the analyzed respondents may not extend to those in other cultures and countries that differ from those mentioned. Consequently, further investigation into cross-continent differences in social mechanisms designed to address innovation in e-service delivery is warranted. Finally, because participation in this survey was discretionary, consciousness variance was unavoidable. The Harman one-factor test was used to rule out any potential issues. According to the results of the test, each major construct describes roughly equal variance, denoting that our data do not have an elevated common method variance.

According to the findings of this study, smart cities that effectively manage knowledge were more innovative and outperformed in delivering e-services. The study also discovered that knowledge management influenced innovation and that innovation influenced performance positively. E-governance had a significant impact on performance and moderated the relationship between

innovation and performance. One of the core themes of this study is that effective knowledge management facilitates the extraction of high-quality e-services from certain resources. Future research is needed to strengthen and expand this assumption by investigating the facilitating importance of knowledge management in greater depth.

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Table 1: Respondent Characteristics

Characteristic	Category	N	%
Age	18 to 30 years	297	52
	31 to 40 years	188	33
	41 to 50 years	58	10
	More than 50 years	26	05
Education	Ph. D degree	55	10
	Master's degree	174	30
	Bachelor's degree	340	60
Experience	1 to 10 years	176	31
	11 to 20 years	326	57
	21 to 30 years	60	11
	More than 30 years	7	01
Nationality	South Korea	380	67
	Japan	31	05
	Pakistan	109	19
	Bangladesh	49	09

Table 2: Construct Reliability and Validity

Item	Standardized Factor Loadings	Composite Reliability	Average Variance Extracted (AVE)	Cronbach Alpha	KMO and Bartlett's Test
Cronbach Alpha = 0.971			KMO & Bartlett's Test = 0.815		
KM1	0.742	0.953	0.717	0.943	0.934
KM2	0.807				
KM3	0.895				
KM4	0.870				
KM5	0.852				
KM6	0.872				
KM7	0.875				
KM8	0.850				
INN1	0.717	0.929	0.569	0.910	0.928
INN2	0.678				
INN3	0.819				
INN4	0.823				
INN5	0.817				
INN6	0.656				
INN7	0.792				
INN8	0.637				
INN9	0.809				
INN10	0.764				
EG1	0.720	0.917	0.553	0.897	0.906
EG2	0.759				
EG3	0.805				
EG4	0.743				
EG5	0.650				
EG6	0.732				
EG7	0.784				
EG8	0.735				
EG9	0.753				
ESD1	0.735	0.903	0.540	0.840	0.798

ESD2	0.761
ESD4	0.813
ESD4	0.686
ESD5	0.672
ESD6	0.665
ESD7	0.776
ESD8	0.757

Table3: Descriptive Statistics, Mean, Standard Deviation, and Correlations

	N	Mean	Std. D	Edu	Gen	Exp	KM	Inn	EGov	ESD
Edu	569	2.293	1.477	1						
Gen	569	1.453	0.498	0.073	1					
Exp	569	2.489	0.695	0.037	0.157**	1				
KM	569	3.522	0.819	0.109**	0.049	0.305**	1			
Inn	569	3.592	0.683	0.108**	0.095*	0.313**	0.929**	1		
EGov	569	3.851	0.602	0.102*	0.081	0.210**	0.715**	0.841**	1	
ESD	569	3.797	0.625	0.095*	0.034	0.318**	0.668**	0.771**	0.614**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4: Multiple Regression

Variables	Dependent Variable: E-Service Delivery				DV: Innovation
	Model 1	Model 2	Model 3	Model 4	Model 5
Independent Variables					
(Constant)	4.500(0.1118) ***	1.207(0.139) ***	1.398(0.144) ***	2.309(0.379) ***	1.066(0.080) ***
Education	0.043(0.017) ***	0.005(0.011)	0.006(0.011)	0.004(0.011)	0.006(0.007)
Gender	0.099(0.050) **	0.172(0.033) ***	0175 (0.032) ***	0.177(0.032) ***	0.064(0.021) ***
Exp	0.300(0.036) ***	0.100(0.024) ***	0.091(0.024) ***	0.086(0.024) ***	0.026(0.016) ***
Knowledge Mgt.		0.309(0.053) ***	0.388(0.055) ***	0.370(0.055) ***	0.766(0.014) ***
Innovation		1.027(0.063) ***	1.283(0.086) ***	0.935 (0.159) ***	
E-Governance			0.223(0.051) ***	0.447(0.100) ***	
Moderating effect					
Innovation x E-Governance				0.079(0.031) ***	
Mediating effect					
Knowledge Mgt. -→ Innovation -→ E-Service Delivery				***(Sobel Test)***	12.114(0.282) ***
N	569	569	569	569	569
R	0.344[a]	0.798[a]	0.805[a]	0.808[a]	0.931[a]
R^2	0.118	0.637	0.649	0.653	0.866
Std. Error	0.588	0.378	0.372	0.370	0.250
F Models	25.316***	197.424***	172.968***	150.738***	912.608***
Durbin-Watson	1.704	1.993	2.032	2.045	1.882

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).